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127



COLONIAL OFFICE

# COLONIAL RESEARCH

## 1957-1958

### REPORTS OF THE

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

Research Matters not covered by the above Reports  
of the Specialist Advisory Bodies

*Presented to Parliament by the Secretary of State for the Colonies  
by Command of Her Majesty  
November 1958*

LONDON

HER MAJESTY'S STATIONERY OFFICE

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Cmnd. 591

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Colonial Research Council  
Annual Report  
on Colonial Research  
(1957-1958)

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Colonial Office,  
The Church House,  
Great Smith Street,  
Westminster,  
S.W.1.  
13th October, 1958.

SIR,

As Chairman of the Colonial Research Council, I have the honour to submit to you the Council's Annual Report on Colonial Research for the year 1957-1958.

I have the honour to be,

Sir,

Your obedient servant,

PERTH,  
*Chairman.*

The Rt. Hon. Alan Lennox-Boyd, M.P.,  
Secretary of State for the Colonies.

## COLONIAL RESEARCH COUNCIL

### Membership

- THE MINISTER OF STATE FOR COLONIAL AFFAIRS (*Chairman*).
- THE DEPUTY UNDER-SECRETARY OF STATE IN CHARGE OF ECONOMIC AFFAIRS (*Vice-Chairman*).
- SIR CHARLES DODDS, M.V.O., D.Sc., M.D., F.R.C.P., F.R.I.C., F.R.S. (Chairman, Colonial Products Council).
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- SIR HARRY MELVILLE, K.C.B., F.R.S. (Department of Scientific and Industrial Research).
- PROFESSOR SIR ARNOLD PLANT (Chairman, Colonial Economic Research Committee and Chairman, Colonial Social Science Research Council).
- SIR WILLIAM SLATER, K.B.E., D.Sc., F.R.I.C., F.R.S. (Chairman, Committee for Colonial Agricultural, Animal Health and Forestry Research).
- PROFESSOR SIR ALEXANDER TODD, M.A., D.Sc., F.R.I.C., F.R.S. (Professor of Organic Chemistry, University of Cambridge).
- MR. C. E. LAMBERT, C.M.G. (*Secretary*).

### Terms of Reference

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

**COLONIAL RESEARCH COUNCIL**  
**ANNUAL REPORT ON COLONIAL RESEARCH FOR 1957-1958**

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Table I: List of schemes approved for Research grants under the Colonial Development and Welfare Acts during the period 1st April, 1957, to 31st March, 1958.

Table II: Allocations for Research under the Colonial Development and Welfare Acts, 1940, 1945, 1950 and 1955 to 31st March, 1958.

Table III: Actual issues in respect of Research Schemes, 1940-1958.

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

Agricultural, Animal Health and Forestry.

Economic.

Fisheries.

Medical.

Pesticides.

Colonial Products and Colonial Products Laboratory.

Road Research.

Social Science.

Tsetse and Trypanosomiasis.

Locust Research and Control.

Research matters not covered by the reports of the Specialist Advisory Bodies.

## COLONIAL RESEARCH COUNCIL (1957-1958)

### INTRODUCTORY

The report of the Council deals with certain research matters not covered by the reports of the specialist advisory research committees. The subjects comprised in the latter are Agriculture, Animal Health and Forestry; Economic; Fisheries; Pesticides; Anti-Locust Research and Locust Control; Medical; Colonial Products; Road Research; Social Science, and Tsetse and Trypanosomiasis Research. Other research matters, also not covered by the reports of these Committees, are discussed in report number XII in this volume.

2. During the year the Earl of Perth visited Singapore, Sarawak, Brunei and North Borneo, and visits to various territories were made by members of the Secretary of State's advisory staff. Attendance at meetings of the Regional Research Advisory bodies for East Africa, West Africa and the West Indies by members of the Council and Committees was again combined with visits to the various territories. These and other visits by Committee members and by other specialists from the United Kingdom, are referred to in more detail in the accompanying reports of the individual committees.

3. With the attainment of self government, Ghana and the Federation of Malaya ceased to be eligible for assistance from Colonial Development and Welfare funds. The Government of Ghana will continue to participate in regional research schemes operating in West Africa on an inter-territorial basis.

4. Expenditure during the year under review was £1,330,641 as compared with £1,534,746 during 1956-57.

### GENERAL

#### *Colonial Development and Welfare Research Schemes made in 1957-58 and their Cost*

5. A list of the schemes made during the year and the grant allotted to each from Colonial Development and Welfare funds is given in Table I of the Appendix. 85 new schemes and 54 supplementary schemes were made, involving grants totalling £1,123,850. These compare with 101 new schemes and 59 supplementary schemes made during the previous year entailing grants totalling £2,202,880, but it will be appreciated that many of the schemes shown as new schemes are in fact in continuation of earlier schemes. As will be seen from Table II, these grants bring the total sum allotted to Colonial Development and Welfare Research schemes since 1940 to £18,694,958. The net commitment, after allowing for revision of schemes and unspent balances, was on the 31st March, 1958, about £17·35m. of which some £17·2m. is chargeable against the funds provided under the 1945, 1950 and 1955 Colonial Development and Welfare Acts. The financing of many of these schemes is assisted by Colonial Governments from their own resources. Table III shows the actual disbursements made each year since 1940-41 which now total nearly £13·5m.

6. About 35 per cent. of the gross allocation of Colonial Development and Welfare Research funds has been for agricultural, animal health and forestry schemes, 16 per cent. for medical research, 10 per cent. for fisheries research, 9 per cent. for tsetse and trypanosomiasis research, 8 per cent. for social science and economic research, 8 per cent. for pesticides research, 5 per cent. for research sponsored by the Colonial Products Council, 3 per cent. for anti-locust research, and 6 per cent. for miscellaneous schemes including building and road research. Approximately 38 per cent. of the gross allocation has been for schemes to benefit the East African territories, 17 per cent. for the West African

group, 8 per cent. for the South-East Asian territories and Hong Kong, 12 per cent. for the West Indian colonies, British Guiana and British Honduras, 5 per cent. for the Central African territories (Northern Rhodesia and Nyasaland) and 20 per cent. for other territories and for schemes of general interest.

7. New projects during the year include: in the United Kingdom, provision for the appointment of a soil sample analyst at Rothamsted Experimental Station, a Colonial Rodent Liaison Officer at the Infestation Control Division of the Ministry of Agriculture, Fisheries and Food, and the preparation of a Regional History of East Africa; in Zanzibar, an investigation into the Withertip disease of limes; in Nigeria, the establishment of a Nigerian Institute of Social and Economic Research, expansion of vaccine production and associated research and a study of soil fertility maintenance in high rainfall areas; in Sierra Leone, the establishment of a Fisheries Development and Research Station; in Bechuanaland, the establishment of a Veterinary Investigational Laboratory; the establishment of an Agricultural Research Station in Swaziland; a survey of antiquities in the Aden Protectorate; an economic survey of the New Hebrides and, in Barbados, research on flying fish at the Bellairs Institute.

*Research Branch of Her Majesty's Overseas Civil Service*

8. Recruitment to the Research Branch continued steadily and 26 new appointments were made during the year bringing the total complement in the Branch, in March, 1958, to 202 officers compared with 189 officers in March, 1957. Two Research Fellows continued their investigations, one working on human trypanosomiasis at the West African Institute for Trypanosomiasis Research, and the other studying nematode damage on East African crops. A further eight research studentships were awarded to train candidates in veterinary subjects (2), agronomy (3), entomology (2) and medicine (1) for overseas research appointments.

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

9. The Ninth meeting of the C.S.A. was held in Accra and several other specialists meetings and symposia dealing with Quelea Birds, Oceanography and Sea Fisheries on the West Coast of Africa, Eichhornia crassipes and Radio Isotopes were held during the year. The Social Sciences Committee also held its Fifth meeting in Brussels.

*Co-operation between the Colonial Office, Colonial Governments and the United Kingdom Research Councils*

10. The United Kingdom Research Councils continued to provide valuable assistance for the territories from their various laboratories. Notes on building and water pollution research will be found in the accompanying report No. XII, while information on other fields of research covered by the Research Councils is contained in the reports of the individual committees. Advice has also been given by the Hydraulics Research Station to Overseas Service officers visiting the Station.

*Colonial Research Publications*

11. The following reports have been published by Her Majesty's Stationery Office:—

Colonial Research Publications Series.

No. 19 Money in British East Asia, by F. H. King (13s. 6d.).

No. 20. A Study of the Aphididae of East Africa, by V. F. Eastop (27s. 6d.).

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COLONIAL RESEARCH 1957-58

- No. 21. A Report on Grain Storage Problems in Nyasaland Protectorate with special reference to Maize by Dr. K. F. Salmond (4s. 6d.)
- No. 22. Colonial Agricultural Statistics, by K. E. Hunt (14s.)
- No. 23. Grasses of Barbados, by J. A. Allan (7s. 6d.).

Colonial Research Studies Series.

- No. 22. Land Tenure and Land Administration in Nigeria and the Cameroons, by C. K. Meek (55s.).
- No. 23. A Fiscal Survey of the British Caribbean, by A. R. Prest (10s.).
- No. 24. The Measurement of Levels of Living with special reference to Jamaica, by C. A. Moser (10s.).
- No. 25. The Exploitation of Sea Birds in Seychelles, by The Hon. M. W. Ridley and Lord Richard Percy (12s. 6d.).
- No. 26. The National Income of Tanganyika, 1952-1954, by Alan T. Peacock and Douglas G. M. Dosser (7s. 6d.).

## COLONIAL RESEARCH COUNCIL

## APPENDIX

TABLE I

LIST OF SCHEMES APPROVED FOR RESEARCH GRANTS UNDER THE COLONIAL DEVELOPMENT AND WELFARE ACTS DURING THE PERIOD 1ST APRIL, 1957 TO 31ST MARCH, 1958

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
624A	General ... ..	Provision to meet the cost of sending blood samples to the United Kingdom for sickle-cell investigations. (Supplementary provision.)	£ 100
628A	do. ... ..	Trypanosomiasis research at the London School of Hygiene and Tropical Medicine. (Supplementary provision.)	535
640A	do. ... ..	Appointment of Assistant on sickle-cell research work at Cambridge. (Supplementary provision.)	92
656A 656B	do. ... ..	Research on animal physiology under tropical conditions at the Hannah Dairy Research Institute. (Supplementary provision.)	2,650 1,800
696	do. ... ..	Colonial contribution towards the cost of maintaining the Common Services Section of the British Commonwealth Scientific Office (London). Scheme No. R. 696 (1958-59).	868
704A	do. ... ..	Fundamental research on insecticides at Rothamsted Experimental Station. (Supplementary provision.)	1,031
709A	do. ... ..	Colonial Pesticides Research Unit, Porton, 1956-60. (Supplementary provision.)	4,723
735A	do. ... ..	Expansion of the Tropical Products Institute. (Supplementary provision.)	49,300
737B	do. ... ..	Augmentation of the staff at Long Ashton Research Station, Bristol (1956-60). (Supplementary provision.)	2,406
756A 756B	do. ... ..	Provision for sickle-cell research at the Post-Graduate Medical School of London. (Supplementary provision.)	30 125
818A	do. ... ..	Electoral studies in Sierra Leone. (Supplementary provision.)	145
838	do. ... ..	Maintenance of Colonial Road Research Section at the D.S.I.R. Road Research Laboratory, Harmondsworth.	66,858
847 847A	do. ... ..	Physiological study of pond-fish breeding. (Supplementary provision.)	750 250
855	do. ... ..	Visit to Northern Nigeria for further research studies on leprosy.	571.

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
860	General—cont. ...	Visit of member of Medical Research Council to Nigeria.	£ 325
863	do. ...	Employment of an Assistant on tuberculosis and leprosy research at Guy's Hospital Medical School.	663
865	do. ...	Provision for filariasis and schistosomiasis research at London School of Hygiene and Tropical Medicine.	1,200
869	do. ...	Visit of a member of Bristol University to Ibadan to initiate therapeutic trials on children with kwashiorkor and oedema.	300
874 874A 874B 874C	do. ...	Fish Culture Research Institute, Malacca. (Supplementary provision.)	7,265 1,171 2,491 9,119
887	do. ...	Visit to Nigeria in connection with investigations on abnormal haemoglobins.	300
890	do. ...	Appointment of Soil Sample Analyst at Rothamsted Experimental Station.	2,125
895	do. ...	Visit to East Africa in connection with helminthic diseases.	250
897	do. ...	Appointment of Colonial Rodent Liaison Officer at Infestation Control Division, M.A.F.F.	5,683
899	do. ...	Visits abroad by members of the Colonial Fisheries Advisory Committee.	2,000
902	do. ...	Visits abroad by members of the Agricultural Research Council Unit of Experimental Agronomy.	250
903	do. ...	Visits abroad by members of the Colonial Pesticides Research Committee and Sub-Committees.	1,500
911	do. ...	Visit of a Pathologist to the East African Leprosy Research Centre.	207
912	do. ...	Visit to the Gambia to study the influence of sickle-cell trait in malaria.	300
917	do. ...	Visits abroad by members of the Tsetse Fly and Trypanosomiasis Committee.	2,000
920	do. ...	Employment of an Assistant on malaria research at Liverpool School of Tropical Medicine.	1,300
921	do. ...	Colonial contribution towards the cost of maintaining the Agricultural Research Council's Unit of Experimental Agronomy, Oxford (1958-59).	6,800



Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
678A	<b>Africa</b> General ... ..	Studies connected with the control of grain-eating birds in Africa. (Supplementary provision.)	£ 100
820A	do. ... ..	Study of the economics of African farming systems. (Supplementary provision.)	5,270
871	do. ... ..	Fact finding survey of literature on African fauna.	3,000
906	do. ... ..	Visit of a member of the Medical Research Council to Africa for bilharzia research.	600
482A	<b>East Africa</b> General ... ..	Research into Relapsing Fever in East Africa. (Supplementary provision.)	185
642c	do. ... ..	Employment of an Assistant to the Professor of Pathology at Makerere College, Uganda (1958-59). (Supplementary provision.)	800
666B 666C	do. ... ..	Investigation of snail vectors of schistosomiasis at Mwanza, Tanganyika. (Supplementary provision.)	92 1,528
676B	do. ... ..	Investigation of <i>Aedes Aegypti</i> at the East African Virus Research Institute, Entebbe. (Supplementary provision.)	1,055
688B	do. ... ..	Survey of the incidence of insect pests of cereal crops. (Supplementary provision.)	226
693B	do. ... ..	East African Institute of Social Research. (Supplementary provision.)	3,029
745A	do. ... ..	Study of plant steroids at Makerere College, Uganda. (Supplementary provision.)	40
757A	do. ... ..	East African Trypanosomiasis Research Organisation (1957-60). (Supplementary provision.)	135,730
840	do. ... ..	East African Council for Medical Research	5,000
843	do. ... ..	East African Scientific and Industrial Research Organisation (1957-60).	49,064
844	do. ... ..	Research Section of the East African Meteorological Department.	9,852
845	do. ... ..	Study of Hydrological techniques in the United States.	360
850	do. ... ..	Tuberculosis therapy investigation in East Africa.	5,000
856	do. ... ..	Control of malaria in a hyper-endemic area of East Africa.	19,370
857	do. ... ..	Desert Locust Survey (1957-58) ... ..	23,546.

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
864	East Africa General—cont. ...	Colonial Pesticides Research Unit, Arusha (1957-58).	£ 70,156
868	do. ...	Joint capital housing programme for the East African Agriculture and Forestry Research and Veterinary Research Organisations.	30,938
876 876A	do. ...	Preparation of a Regional History of East Africa. (Supplementary provision.)	10,400 1,000
878	do. ...	Transfer of F.R.V. "Manihine" from Singapore to the Zanzibar Fisheries Research Station.	8,500
885	do. ...	Visit of member of the Imperial College of Science and Technology to the East African Trypanosomiasis Research Organisation.	150
886	do. ...	Visit of member of Rothamsted Experimental Station to East Africa.	100
909	do. ...	Weather forecasting research in East Africa.	3,889
915	do. ...	Provision of aircraft hangar at the Colonial Pesticides Research Unit, Arusha.	1,700
916	do. ...	Field experiment on drug fastness by the East African Trypanosomiasis Research Organisation.	1,000
894	Kenya ...	Sociological research on the Samburu tribe in Kenya.	600
351C	Uganda ...	Sociological research. (Supplementary provision.)	11
824A	do. ...	Land use studies in Uganda. (Supplementary provision.)	200
842 842A	do. ...	Study of economics of road development in Uganda. (Supplementary provision.)	1,785 285
858	Zanzibar ...	Control of <i>pseudotheraptus wayi</i> on coconuts.	3,910
889	do. ...	Study of land tenure in Pemba and Zanzibar	600
908	do. ...	Investigations into withertip disease of limes	3,784
698A 698B	Central Africa General ...	Rhodes-Livingstone Institute. (Supplementary provision.)	18,731 1,084
772A	Nyasaland ...	Agricultural Research and Experimental Station, Lilongwe. (Supplementary provision.)	18,395
273B	West Africa General ...	West African Fisheries Research Institute. (Supplementary provision.)	3,653

## COLONIAL RESEARCH COUNCIL

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Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
311E	<b>West Africa General</b> —contd.	West African Building Research Institute. (Supplementary provision.)	£ 7,731
424F	do. ...	West African Institute for Trypanosomiasis Research. (Supplementary provision.)	20,100
841	do. ...	West African Council for Medical Research	5,000
851	do. ...	Revision of Flora of Tropical West Africa...	3,168
867	do. ...	Expedition to Nigeria and the Cameroons for collections of Flora.	275
644B	<b>Gambia</b> ...	Appointment of an Entomologist to the Medical Research Council Laboratories, Fajara, Gambia. (Supplementary provision.)	424
645A	do. ...	Sociological research in the Gambia. (Supplementary provision.)	425
861	do. ...	Visit to the Gambia for survey of the breeding of mosquitoes.	370
900	do. ...	Appointment of an Entomologist to the Medical Research Council Field Station at Fajara.	3,523
410D	<b>Nigeria</b> ...	Investigation into transport economies. (Supplementary provision.)	30
854	do. ...	Study of the Bamenda Chiefdom in British Cameroons.	350
859	do. ...	Study of soil fertility maintenance in high rainfall areas.	23,022
866	do. ...	Maintenance of Fisheries Research sub-station at Bernin Kebbi.	183
883	do. ...	Nigerian Institute of Social and Economic Research.	32,992
884	do. ...	Study of the ophthalmological aspects of onchocerciasis in Nigeria.	557
888	do. ...	Expansion of vaccine production and associated research.	65,000
910	do. ...	Nigerian Leprosy Service Research Unit ...	2,895
919	do. ...	Research on guinea worm, at University College, Ibadan.	1,400
585B	<b>Sierra Leone</b> ...	Investigation into the control of infestation of stored rice. (Supplementary provision.)	1,150
877	do. ...	Collation of information on the Porro Society of Sierra Leone.	90
880 880A	do. ...	Fisheries Development and Research Station, Sierra Leone. (Supplementary provision.)	20,608 1,476

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
			£
	<b>South Africa High Commission Territories</b>		
907	Bechuanaland ...	Establishment of Veterinary Investigational Laboratory.	34,185
834A	Swaziland ...	Soil survey. (Supplementary provision) ...	9,285
873	do. ...	Agricultural research ...	51,675
	<b>Atlantic St. Helena</b>		
846	... ..	Appointment of an Entomologist to study agricultural pests.	8,300
	<b>Indian Ocean Mauritius</b>		
227c	... ..	Malaria eradication experiment (Supplementary provision.)	120
839	Seychelles ...	Economic study of the Seychelles ...	1,220
	<b>Middle East Aden</b>		
853	... ..	Preparation of a history of Aden ...	3,200
901	do. ...	Survey of antiquities in the Aden Protectorate.	6,966
	<b>South East Asia North Borneo</b>		
837	... ..	Appointment of an Entomologist for research on Manila Hemp.	5,885
904	do. ...	Appointment of a Forest Botanist...	4,941
618c	Sarawak ...	Investigation into the control of pepper disease. (Supplementary provision.)	2,475
848 848A	do. ...	Establishment of a Soils Laboratory. (Supplementary provision.)	28,000 2,800
	<b>Western Pacific British Solomon Islands Protectorate</b>		
533c	... ..	Investigation into means of controlling coconut pests. (Supplementary provision.)	60
849	Fiji ...	Appointment of a Parasitologist for filariasis research.	4,515
914	New Hebrides ...	Economic survey of the New Hebrides ...	5,750
	<b>West Indies General</b>		
654A	... ..	Nutrition research. (Supplementary provision.)	2,840
742c 742D	do. ...	Colonial Microbiological Research Institute, Trinidad. (Supplementary provision.)	24,046 19,010
852	do. ...	Standing Advisory Committee for Medical Research in the British Caribbean.	5,000
862	do. ...	Visits to Trinidad to attend Caribbean Commission Conference on demographic problems.	855

Scheme No. (Prefix "R")	Benefiting Territory	Description of Scheme	Amount
870	<b>West Indies</b> General—cont. ...	Provision for two research studentships for work on natural products of medical interest.	£ 2,900
872	do. ...	Livestock and grassland research mission to the West Indies.	1,800
875	do. ...	Expenses of members at the First meeting of the Technical Co-ordinating Committee on Agricultural and Allied Research.	120
879 879A	do. ...	Appointment of member of Medical Research Council to Tropical Metabolism Research Unit, Jamaica. (Supplementary provision.)	4,753 35
891	do. ...	Seismic Research Unit, Imperial College of Tropical Agriculture, Trinidad.	6,630
893	do. ...	Investigation into incidence and distribution of abnormal haemoglobins.	1,815
913	do. ...	Visit of member of Manchester University to the Tropical Metabolism Research Unit.	410
882	<b>Barbados...</b>	Research on flying fish ...	3,924
892	<b>British Guiana</b> ...	Soil and land-use surveys ...	37,785
898	do. ...	Visit of Botanist to British Guiana ...	1,800
896	<b>British Honduras</b>	Investigation of cutaneous leishmaniasis among forest workers.	657
881	<b>Dominica</b> ...	Research into control of insect pests ...	1,260
905	<b>St. Vincent</b> ...	Arrowroot research ...	9,405
743A	<b>Trinidad</b> ...	Participation in a hurricane research project of the United States Weather Bureau. (Supplementary provision.)	515
802A	do. ...	Sugar technology research at the Imperial College of Tropical Agriculture, Trinidad. (Supplementary provision.)	15,833
918	do. ...	Survey of bromeliad malaria by a member of Princeton University, U.S.A.	110

TABLE II

## ALLOCATION FOR RESEARCH UNDER THE COLONIAL DEVELOPMENT AND WELFARE ACTS, 1940, 1945, 1950 AND 1955

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	606,776*	1,074,904*
31st March, 1947	1,099,382*	2,174,286*
31st March, 1948	2,073,340*	4,247,626*
31st March, 1949	1,666,229*	5,913,855*
31st March, 1950	1,814,124*	7,727,979*
31st March, 1951	2,514,536*	10,242,515*
31st March, 1952	879,902*	11,122,417*
31st March, 1953	1,096,904*	12,218,821*
31st March, 1954	738,065*	12,945,194*
31st March, 1955	533,548*	13,478,742*
31st March, 1956	1,889,486*	15,368,228*
31st March, 1957	2,202,880*	17,571,108*
31st March, 1958	1,123,850*	18,694,958*

\* These figures include expenditure (totalling £137,376 up to the 31st March, 1957) incurred on Scheme R.7 (work of the Colonial Products Research Council: see Appendix II to Progress Report of the Colonial Research Committee for 1942-43, Cmd. 6486).

TABLE III

## ACTUAL ISSUES IN RESPECT OF RESEARCH SCHEMES, 1940-1958

Financial Year	Issues
	£
1940-41	Nil
1941-42	6,670
1942-43	13,793
1943-44	30,450
1944-45	58,345
1945-46	93,307
1946-47	169,388
1947-48	428,301
1948-49	764,211
1949-50	1,285,348
1950-51	1,411,352
1951-52	1,233,262
1952-53	1,268,562
1953-54	1,289,840
1954-55	1,176,317
1955-56	1,374,323
1956-57	1,534,746
1957-58	1,330,641
	£ 13,468,856

Committee for Colonial Agricultural,  
Animal Health and Forestry Research  
1957-1958

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Agricultural Research Council,  
Cunard Building,  
15, Regent Street,  
London, S.W.1.  
12th August, 1958.

SIR,

I have the honour, on behalf of the Committee for Colonial Agricultural, Animal Health and Forestry Research, to transmit to you the Thirteenth Annual Report of the Committee covering the period 1st April, 1957 to 31st March, 1958.

I have the honour to be,

Sir,

Your most obedient servant,

W. K. SLATER,  
*Chairman.*

The Rt. Hon. Alan Lennox-Boyd, M.P.,  
Secretary of State for the Colonies.

COMMITTEE FOR COLONIAL AGRICULTURAL, ANIMAL HEALTH  
AND FORESTRY RESEARCH

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- DR. J. C. F. HOPKINS, D.Sc., A.I.C.T.A., Director, Commonwealth Mycological Institute.
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- MR. D. RHIND, O.B.E., Secretary for Colonial Agricultural Research
- MR. C. A. KIRKMAN (*Secretary*).

COMMITTEE FOR COLONIAL AGRICULTURAL, ANIMAL HEALTH  
AND FORESTRY RESEARCH

THIRTEENTH ANNUAL REPORT

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**COMMITTEE FOR COLONIAL AGRICULTURAL,  
ANIMAL HEALTH AND FORESTRY RESEARCH**

**THIRTEENTH ANNUAL REPORT**

**I. GENERAL**

Changes in membership included the addition of Professor J. E. Nichols and the replacement of Mr. F. S. Collier by his successor in the post of Forestry Adviser to the Secretary of State, Mr. C. Swabey. The Committee met five times.

2. Collaboration between research in the United Kingdom and in overseas territories was strengthened by numerous visits by members of the Committee and by other scientists. Professor Beveridge and Dr. Bell represented the Secretary of State at the first meeting of the Technical Co-ordinating Committee for Agricultural and Allied Research in the West Indies and Mr. Bawden and Mr. Rhind attended the second meeting. At the same time these members visited several territories in the Caribbean. Mr. Nye visited Nigeria and the Cameroons and attended the Inter-African Bureau of Soils and Inter-African Pedological Service meetings in the Belgian Congo. Mr. Swabey attended the Seventh Commonwealth Forestry Conference in Australia and New Zealand and also visited Malaya, Papua, New Guinea, New Britain and Cyprus. Sir Frank Engledow visited the Central African Federation and Uganda. Mr. Herford visited Nigeria. Dr. Hopkins attended the Eighth and Ninth Meetings of the East African Research Council and visited Uganda, Kenya, Tanganyika and Zanzibar. Mr. Marshall visited Nigeria, Sierra Leone, the Gambia, Bahamas, Jamaica, British Honduras, Kenya, Uganda and Tanganyika. He also attended the meeting of the Office Internationale des Epizootics in Paris and the Inter-African Advisory Committee on Epizootic Diseases in Dakar. The Secretary attended the Ninth Meeting of the East Africa Research Council, the Second Meeting of the West Indies Technical Co-ordinating Committee for Agricultural and Allied Research and the West African Standing Committee for Agricultural Research. He also visited Kenya, Southern Rhodesia, Swaziland, Basutoland, Bechuanaland, Jamaica and Barbados. He served on several international committees concerned with biological research.

3. The Committee has kept under review the recruitment of scientists to overseas posts. There has been a small improvement in the staffing position except for moderately senior research posts for which recruitment continues to be difficult. Candidates for junior posts have been coming forward well and vacancies have been fewer than for some years.

4. Political developments in the Colonial territories have necessitated some review of research activities so as to maintain them and to continue collaborative work. In West Africa interterritorial research is expected to continue undisturbed thanks to the very co-operative action of the new Government of Ghana which is no longer eligible for C. D. & W. assistance. As changes occur the maintenance of research activities is kept carefully under review.

5. The Committee recommended grants to a total amount of £359,755 during the year.

## II. SUMMARY OF PRINCIPAL RESEARCH DEVELOPMENTS

### *Agriculture*

6. From the growing bulk of research results which are now coming in it is difficult to make any summary which avoids important omissions without ceasing to be a summary. Inevitably the effort which has been put into research in the last ten years is producing results, and there is good and growing evidence that much of practical use is being taken up by farmers in many parts of the colonial territories. Indeed, the clamour to adopt new ideas not fully tested has on occasion been an embarrassment. The commonest improvements which have been received by farmers are new varieties resulting from plant breeding research, fertilisers and control of pests and fungus diseases by sprays.

7. A most fruitful character of the organisation of research in colonial territories is the close link which has developed with research institutes and organisations in the United Kingdom. Through a series of committees and by tours overseas by the members, contacts are made and maintained with outstanding research workers in many fields. This helps to relieve the isolation which hampers research in remote places, brings to the fore problems which call for special work, and tends to minimise duplication. A particular development has been provision in a number of instances for prolonged visits by specialist research workers to centres overseas where their presence serves to stimulate and encourage.

8. In the field of soil physics a notable advance has been the development of a satisfactory but simple instrument to measure the total solar energy falling on soil. This instrument provides data for an estimate of the amount of water actually used by a crop and greatly facilitates work on soil moisture relationships.

9. The behaviour of organic matter in soils under tropical conditions has not been well understood. Recent work has shown that soil humus occurs in two forms, one which is held in the soil solution and which is easily and rapidly oxidised, and the other which is held by the soil and is resistant to decomposition. The latter and larger fraction only comes into solution when the soil is dried and re-wetted. The effect on soil nitrate production is to limit it to periods shortly following dry spells. This again influences farming practices.

10. A great deal of work continues on the use of fertilisers on tropical crops. Broadly tropical soils respond to nitrogen and phosphorus but the effect of potash is usually slight though occasionally large. Deficiencies of trace elements continue to come to light. Some long-sustained residual responses to phosphates have been found and may well be more general than the limited data from tropical soils has hitherto shown.

11. Plant selection and breeding has continued to produce good results, too many for separate mention. Outstanding have been high yielding rust-resistant maize in West Africa, hybrid cocoas in West Africa and Trinidad, disease resistant and high yielding cassava in East and West Africa, hybrid oil palms, a series of improved sugarcanes from Barbados and new rices from several stations. More attention has been given to minor food crops, hitherto somewhat neglected because they are more garden crops than agriculture.

12. While much work was maintained on plant diseases the serious loss of condition and yield which can be caused by eelworms parasitic on crops has lately become widely recognised. The survey of plant nematodes in

East Africa revealed a number causing serious damage to crops, including coffee, and in the West Indies similar pests have been shown to affect bananas and possibly sugarcane.

#### *Forestry*

13. A large part of forestry research is necessarily slow, giving results over extended periods which obscure any striking character they may have. In several territories trials with a number of species of tropical pines are giving notable results. In a number of areas where pines are not indigenous, species have been found which promise to be very successful for softwood production. In other areas eucalypts are proving hopeful though termite damage can be serious. This, however, may be found economically controllable with some of the new chlorinated hydrocarbon insecticides. The termite studies which are in progress may have particular bearing on forest plantations.

14. Forest enumeration, a tedious and expensive task, may become easier and cheaper by the use of improved statistical sampling methods now under trial.

#### *Veterinary*

15. Studies in rinderpest in East Africa have shown that calves from immune dams have passive resistance which may last for seven months. In outbreaks of this scourge such calves cannot be artificially immunised until past the age when their passive immunity disappears. The development of an agar double diffusion precipitation test for rinderpest now provides a rapid test for the virus which can be used on wild game and for detection of rinderpest-like diseases which are becoming important as the disease is brought under control.

16. Improved supplies of vaccines and their more general use has speeded up control of animal diseases. This work occupies a large part of the time of veterinary departments whose efforts are shown by steadily decreasing losses from disease. Safer vaccines more easily stored and administered continue to be produced.

### III. LIAISON WITH RESEARCH INSTITUTIONS

17. The valuable assistance rendered by many research organisations and universities in the United Kingdom has been of great help to research in colonial territories. The Committee wishes to record its appreciation of this co-operation without which research overseas would be severely handicapped. As in previous years, the help of the Agricultural Research Council and the laboratories of the Department of Scientific and Industrial Research have been outstandingly valuable.

#### *Commonwealth Institute of Entomology*

18. Much of the work of the Commonwealth Institute of Entomology continues to be directly or indirectly concerned with colonial problems. In 1957-58, some 20,000 specimens were received for identification, from 20 colonial territories, and over 2,300 identifications sent out, which, together with the appreciable numbers made for the now independent territories of Ghana and Malaya, amounted to 45 per cent. of the work of the identification service.

19. In 1957, the *Bulletin of Entomological Research* (Vol. 48), which is published by the Institute, contained 26 papers, representing 40 per cent. of



the contents, dealing with the results of entomological research carried out in colonial territories or financed from Colonial Development and Welfare funds.

20. Mr. E. A. J. Duffy, of the staff of the Institute, completed a visit to Trinidad and British Guiana in connection with the forthcoming volume, dealing with the Neotropical region, in his series of monographs of the immature stages of timber beetles, of which that dealing with Africa appeared during the year.

#### *Commonwealth Mycological Institute*

21. The work of the Institute has proceeded normally, a number of mycologists and plant pathologists from the Colonial Dependencies having made use of the herbarium and library. The facilities now available, particularly in the herbarium, do not appear to be sufficiently well known. The Culture Collection also provides a service of which more advantage could be taken. Nearly 2,500 fungi covering a very wide range from pathogens to industrial ferments are maintained, and a catalogue is published at regular intervals.

22. Material for identification was received from 18 Colonial Dependencies including large collections from Northern Rhodesia, Malta, Cyprus, Nigeria, Sarawak and Sierra Leone. New and interesting records were *Cercospora oryzae*, newly recorded on rice in Nigeria, and *Leptosphaeria salvinii*, also on rice from Nigeria, as a new record for Africa. There were further reports of banana leaf spot (*Mycosphaerella musicola*) from Sierra Leone, whilst the first record of a rust (*Melampsora* sp.) of poplar from tropical Africa came from Kenya. The smut *Tolysporium globuliferum* was recorded from Kenya on *Leersia hexandra*, *Hyalodendron album* on bean came from Malaya, and *Sclerotinia ricini* on castor from Southern Rhodesia. Assistance was given in Nigeria in the identification of *Phytophthora* sp. causing a seedling disease of cacao in the nursery. It is not the common *P. palmivora* which causes black pod.

23. Miss Waterhouse spent considerable time in the study of Phycomycetes from different colonies, including a large collection made during the disease survey of Malta carried out by the "Pool", the *Phytophthora* sp. causing foot-rot of pepper in Sarawak, species of *Pythium* from root rots of palms in the Caroline Islands, and fungi from the Abyan root rot of cotton in the Aden Protectorate.

24. Dr. Hopkins visited East Africa in October 1957 and February 1958 as representative of the Secretary of State for the Colonies on the East African Agricultural Research Council. He devoted particular attention to *Armillaria mellea* root rot of trees and tea, and coffee stem diseases. He also visited Zanzibar to assess the importance of wither tip disease (*Gloeosporium limeticola*) of limes as a research project for the Pool of Plant Pathologists.

#### *Adviser on Tropical Soils, Rothamsted Experimental Station*

25. Dr. H. Greene visited Swaziland, the Central African Federation, Kenya, Tanganyika, Uganda and Malta. He also visited the Belgian Congo for discussions on the Inter-African Bureau of Soils and the Inter-African Pedological Service, and attended the U.N.E.S.C.O. Advisory Committee meeting on Arid Zone Research in Pakistan.

26. In addition to the soil surveys by members of the Pool of Soil Surveyors (para. 250), soil surveys are also in progress or recently completed in Nyasaland, Uganda, Western and Northern Nigeria and Fiji. Besides

considerable progress in fertiliser use with major nutrients, it is becoming clear that minor elements are deficient in many areas. Responses to zinc in Basutoland and Swaziland have occurred, to boron by wattle in Tanganyika, to sulphur by legumes in Kenya, and indications of responses to magnesium in several places. In East Africa rainfall and soil moisture studies continued to give valuable information on cropping practices and on the control of stream flow. Work at E.A.A.F.R.O. on soil organic matter in relation to nitrate formation and changes in soil moisture have given results which may lead to a better understanding of soil fertility under moderate rainfalls. At W.A.C.R.I. responses to fertilisers by cocoa under different degrees of shade have given valuable results.

*Department of Statistics, Rothamsted Experimental Station*

27. Most of the enquiries received this year from Colonial territories concerned the design and analysis of experiments. Seventeen such enquiries were dealt with and two officers spent short periods at Rothamsted on their problems. Many designs relating to fertilizer trials were discussed with the Colonial Adviser on Tropical Soils (Dr. H. Greene), in particular a large programme for work in the Gambia. Work was resumed on the analysis of the large experiments on oil palms at the West African Institute for Oil Palm Research which need the aid of the electronic computer.

28. A theoretical investigation into the effect of introducing sterilized males into a natural population of tsetse flies was completed with the aid of the electronic computer and the results will shortly be published in *Biometrika*.

29. In the analysis of a large set of  $3 \times 3 \times 3$  fertilizer trials on cultivators' fields in Bihar, India, electronic methods have been developed which are likely to be of considerable value for the analysis of similar trials in Colonial territories.

#### IV. REGIONAL RESEARCH

(a) *EAST AFRICA*

*East African Agriculture and Forestry Research Organisation*

30. At the outset it is appropriate to emphasise that since E.A.A.F.R.O. is an inter-territorial station, a great deal of the work described here could only have been done with the very ready and active co-operation of many research and administrative officers in the Territories, and this help and co-operation is gratefully acknowledged.

31. The main work of the Physics Division and the Plant Physiologist continues on the studying of the water relationships of plants and soils, and in particular on problems concerned with making the best use of the water available, particularly in areas where water is limited. Four ambitious catchment area experiments are being carried out in East Africa jointly by the Physics Division and various Government Departments in the Territories, in which the Forestry Departments will be taking a major share. Three of these have now been properly set up, and the fourth is in its initial stages of preparation. Dr. Pereira visited the United States of America this year to discuss with their catchment research workers, hydrologists, physicists and others, some of the problems of running experiments of this type, and of extracting in the most economical way the information required from the great mass of data which has accumulated.

32. Another important aspect of their work is concerned with the calculation of the amount of water crops are actually using week by week

from simple meteorological and basic soil data, and comparing this with the amount determined by direct soil sampling. A trial of a method now proposed over a six year period with Arabica coffee on a deep soil has shown that throughout this period the calculated moisture content in the soil agreed with that found by periodic direct determinations within the limits of accuracy of the sampling. The most important meteorological measurement for this calculation is the amount of solar energy reaching the earth's surface day by day. A simple instrument for measuring this has been under test for several years, and it appears to be so satisfactory that it has now gone into commercial production. Several of the first batch have been tested here, and it is hoped that a considerable number will soon be in use in East Africa.

33. The Plant Physiologist has been particularly concerned with the effect of drought on maize and sorghum leaves, and he has found that if a maize leaf becomes badly wilted it will regain turgor after the soil is re-wetted, but the stomata have been permanently injured so that the photosynthetic ability of the leaf drops to a low level. On the other hand, when a badly wilted sorghum leaf regains turgor the stomata continue to function fairly normally. Thus maize yields can be severely depressed by late drought, although a plant may look quite healthy, whilst sorghum yields are much less sensitive to such drought.

34. The two important aspects of the work of the Chemistry Division concern the prediction of crop responses to phosphate fertilisers from the chemical analysis of the soil, and the build up of nitrates in the soil due to the decomposition of soil humus. The Department of Agriculture, Kenya, has been running a number of phosphate trials in the field with various crops and on different soils, and this Division has been given the opportunity of carrying out chemical analyses on the soil and plant samples. None of the standard chemical methods of soil analysis has been found to be of any value for predicting the responsiveness of crops to phosphate fertilisers on these soils. However, an incidental result of great interest which has come out of this work is that adding a phosphorus fertiliser to a soil has increased the plant available P in that soil for a number of years, and no soil has yet been found which locks up the phosphate of the phosphate fertiliser in an unavailable form.

35. The work on the factors responsible for the oxidation of soil organic matter or soil humus, and the production of soil nitrates therefrom, has now shown quite definitely that the soil humus can be divided into two parts. One part of it is held by the soil and is resistant to decomposition, even if the soil is kept moist, warm and well aerated; and the other much smaller part is in the soil solution and oxidises rapidly under these conditions. Humus only comes into solution when a dry soil is wetted, and the drier the soil before wetting the greater the amount of organic matter coming into solution. Thus nitrates are only produced in the soil in appreciable amounts during the first rains after the dry season, and during the rains these nitrates are liable to be washed out without any appreciable production of new nitrates later on. This explains a common finding in East Africa that late sown crops never give the yield of early crops, even if water and diseases are not limiting, and it emphasises the need to get these crops established as early as possible so that the roots have the maximum chance of picking up as much as possible of the nitrates produced in this early flush of decomposition.

36. The Soil Survey Division have been completing the compilation of the Kenya and Tanganyika sections of the new soil map of East Africa on the scale of 1:2 million which they are preparing. During the year they

have made a number of reconnaissance surveys of areas which had not been adequately described. It was hoped to have published the new map, together with the memoir, almost immediately, but it has been decided to wait for about two years until the new Uganda soil survey, which it being made on a scale of 1:¼ million is complete, for this will allow a much more accurate representation of the Uganda soils on the map than is possible at the moment.

37. The Soil Microbiologist has been completing the work on the biochemistry of the nitrifying organisms in the local Muguga soil. Their behaviour seems to be almost identical with those of temperate soils, indicating that they are the same organisms; but they are present in very much smaller numbers in the Muguga soil; at least they take much longer to build up to their full oxidising capacity on this soil when an ammonium salt is perfused through the soil than do those in temperate soils. Typically the nitrite producers (*Nitrosomonas*) build up more quickly than do the nitrate producers (*Nitrobacter*) so nitrites accumulate for a time before nitrate production begins. Work has been started on the behaviour of exotic nodule bacteria (*Rhizobia*) which form nodules on exotic legumes in the local soil.

38. The Spectrochemistry Division has recently recruited a second spectrochemical assistant to help with the analyses of samples of soils and plants suspected of trace element deficiencies or excesses which are submitted by the Territorial Departments. In addition a routine analysis is being carried out on soil samples from well recognised soil types; and, as time permits, new methods for speeding up the analyses, or making them more accurate, are being examined or developed.

39. The Plant Pathology Division has brought to a completion a very successful piece of work on breeding maizes resistant to Tropical American Maize Rust, *Puccinia polysora*, which reached West Africa in 1949 and East Africa in 1952. Maizes resistant to it were looked for and were found amongst a number of Central American maize varieties. It was shown that these carried one of two genes for resistance, which later work showed to be linked and hence to occur on the same chromosome. Methods for testing resistance of seedlings to the rust were developed, and breeding material containing one or other of these genes was sent out to the Departmental plant breeders so that they could transfer this gene to their local varieties. Seedlings from their progenies were grown by the plant breeders at Muguga, and lines homozygous for resistance were identified. These were grown by the plant breeders and back-crossed to the local material. In this way it was possible from Central American seed imported into Muguga in 1953, to be able to plant in 1957 a considerable acreage in the Southern Province of Tanganyika of high yielding local varieties having this resistance incorporated in them. A study has now begun on genetics of the resistance some Peruvian maizes possess to Streak, a virus disease of maize carried by the leaf hopper *Cicadulina mbila*, and which depresses the yield of maize seriously in several districts of East Africa.

40. A study of the viruses of sweet potatoes has also been concluded. Two types of virus were recognised, one, carried by aphids, which does not cause severe symptoms and which only has a localised distribution in East Africa, and the other, carried by a White Fly, which is very widespread and which exists in several strains, some of which cause severe symptoms. The second virus was found in a number of wild hosts in East Africa. A study of the virology of Ratoon Stunting of sugar cane has now been started, as well as a preliminary study of a new or previously unrecognised trouble in

young coffee, which is known locally as stem pitting or bottling, to test how far it may be due to a virus.

41. The Ecologist has been helping the Kenya Department of Agriculture in the ecological surveys in Southern Kenya, and these have shown that evergreen scrub formations occur over a much wider area and in greater variety than had previously been recognised. But they have also shown the seriousness of encroachment of useless tussock grasses, weeds and bush into the grazing areas due to wrong land use. He has also completed a co-operative study with the Northern Rhodesian Forest Department on the effects of repeated hot or cool burns on the vegetation in miombo (*Brachystygia-Isobertia*) woodlands.

42. The work of the East African Herbarium falls into three main parts: naming collections of plants which are submitted to it and giving other help to the public and to Government Departments; increasing the number of specimens in the Herbarium, which is done by exchanges with other Herbaria, by gifts, and by staff travelling in the field to make collections; and giving the Herbarium at Kew all the help possible with the production of the East African Flora and preparing accounts of some families themselves. Owing to the increasing demands being made on the staff, it is becoming difficult for them to spend the time collecting in the field which they ought, and to prepare critical descriptions of new species and critical discussions of families for the new Flora.

43. The Animal Nutrition Division is concerned both with the feeding quality of pastures and with the nutrition of the animal. On the pasture side, chemical analyses of tropical grasses grown at Muguga and sampled at regular intervals throughout the year have shown that though these grasses have a higher crude fibre content than temperate grasses at a corresponding stage of growth, the lignin content of this crude fibre is lower. This offers a possible explanation of the observed fact that the crude fibre of tropical grasses is more digestible by stock than is that of temperate grasses.

44. Work with pigs has been concentrated on the effect of replacing the carbohydrate of barley or maize by cassava in the production of the bacon pig. It was found that a ration containing 46 per cent. of cassava for the young pig, and 35 per cent. for finishing did not affect either the conversion ratio of feed to liveweight gain or the quality of the bacon. Work has also started on the weight and distribution of meat, fat and bone in indigenous Zebu (Boran type) steers at different ages and of different conformations. This work has been made possible because a small abattoir with a cold room is now available on the farm.

45. The Silvicultural work is largely devoted to forest problems in the drier areas of East Africa. It is concerned on the one hand with nursery management and the care of young seedlings when planted out in the forest, and on the other with the testing of a large number of mainly exotic trees in the Muguga Arboretum for their economic value in East Africa, that is for such purposes as the production of firewood, housing material or timber. The general principles of nursery and transplanting management have now probably been found, the principal experimental results have been written up, and courses of instruction to foresters and African nursery headmen held both at Muguga and at the actual forest nurseries themselves. The Forest Entomologist, Mr. Gardner, retired in March, 1957, but before he left he prepared a list of East African forest insects which was based on a survey of forest insects carried out during the last seven years under his supervision. Over 30 per cent. of the species found are not in the British Museum,

and most of these have not yet been properly named or described by taxonomic specialists. This increasing number of new species which cannot be named by the Commonwealth Institute of Entomology will become increasingly embarrassing as more detailed work on the control of forest pests becomes possible.

46. Two Colonial Development and Welfare Schemes have been attached to E.A.A.F.R.O. during the year. The first is a two-year Scheme for a survey of East African cereal pests which Dr. I. W. B. Nye, a Colonial Pool Entomologist, has almost completed. The three main problems being worked on are : to determine the distribution of the various species of insect pests which attack maize, sorghum, millet, rice and sugar cane ; to find out whether wild and cultivated grasses which may be used for contour banking or pasture are important in carrying these pests from crop to crop during the dry season ; and to find methods for identifying the larvae of the various species of insect so that they can be named at the actual time they are damaging the crop, for the larvae of many of these species are so similar that they can still only be named after the adult insects have been bred out from them in the laboratory.

47. The survey has been concerned with shoot flies which mainly attack sorghum and rice ; stalk borers, which have been found to be distributed according to altitude, attacking maize, sorghum and rice ; and insect grain feeders principally in sorghum and maize. Of the latter, *Heliothis armigera* Hbn. which is also a severe pest of cotton has been previously known in Africa as the American Bollworm. It has recently been established that the American Bollworm in the New World is not *H. armigera*, so a new common name must be adopted for the one here. An important finding is that in the drier areas of East Africa wild grasses do not appear to play an important part in carrying these pests from one crop to the succeeding one, but in the wetter areas of Uganda, where climate encourages lush grass growth, the principal pests have been commonly found on the wild grasses.

48. The second Scheme is a survey of nematode damage on East African crops. This again is a two-year Scheme and Mr. A. G. Whitehead, the Colonial Research Fellow doing this work, has already been able to visit considerable areas of East Africa and as a result of his studies has found 22 genera of known or suspected parasitic nematodes associated with crops in East Africa, and nearly every crop grown is seriously attacked by nematodes in one or more of the areas in which it is grown. The attacks of main economic importance have been found on bananas, coffee, most legumes including beans and clovers, pineapple, pyrethrum, nursery tea and tobacco. It is not yet possible to estimate the proportion of the area under these crops which are seriously attacked, or the loss of yield these pests cause, but there is no question of their importance in several regions. This scheme ends in September, 1958, but it is hoped to appoint Mr. Whitehead on to the E.A.A.F.R.O. staff, so that systematic work on plant parasitic nematodes can be continued.

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#### *East African Veterinary Research Organisation*

49. The Rt. Hon. A. T. Lennox-Boyd, M.P., Secretary of State for the Colonies, visited Muguga on the 17th October, 1957. The functions and policy of E.A.V.R.O. were described to him by the Director, Mr. H. R. Binns, and he was shown the work being carried out by the several Divisions of the Organisation. His keen interest in these demonstrations and exhibits, and in the various activities which he saw, was a great encouragement to all members of the staff.

50. The year 1957-58 saw further good progress in the establishment of E.A.V.R.O. as a major research institution, and the Organisation is rapidly acquiring an international reputation as an attractive well-equipped centre in which to do research or hold scientific meetings on African livestock problems.

51. The rate of recruitment of scientific staff has inevitably slowed down as the filling of the establishment neared completion. Mr. G. H. Lampkin, B.Sc., N.D.A., Dip. Animal Genetics, was transferred from E.A.A.F.R.O. to the post of Animal Geneticist and Mrs. K. Lampkin, B.Sc., Ph.D., who worked as Scientific Assistant to the Director of the Animal Breeding Research Organization at Edinburgh before coming out to East Africa, was also appointed to the Genetics Section of the newly created Animal Production Division of E.A.V.R.O. Dr. D. Horrocks, B.Sc., Ph.D., who has worked during the past four years in the University of Liverpool Veterinary School, was appointed as Biochemist towards the end of the year. Two important E.A.V.R.O. posts remained unfilled, namely Senior Bacteriologist and Senior Biochemist.

52. A number of important results of considerable practical significance have been achieved by the work of the Divisions of E.A.V.R.O. Research, whether basic or applied to the solution of problems, all too often ends in



failure and this has always been recognised by scientists as inherent in any research. Nevertheless, the value of a research organization is judged by its successes, and it is therefore gratifying to be able to record several material contributions to progress in the solution of some of East Africa's major livestock problems.

53. The Division of Virus Diseases made substantial progress in research on rinderpest and other diseases. G. R. Scott carried out a series of experiments comparing different inactivated adjuvant rinderpest vaccines, and showed that the most promising is an aluminium hydroxide adsorbed vaccine; results of value to countries whose policy precludes the use of living attenuated vaccines. He continued his research on the strains of rinderpest virus which he had adapted to the hamster and the mouse, and on the use of avianized virus in serum neutralization and vaccine production. R. D. Brown completed his long-term studies on the duration of passive immunity in calves born of dams immune to rinderpest, showing that it lasts for up to seven months, and that such calves cannot be successfully protected with living vaccines before eight months of age. This information is of much importance and has long been wanted in planning mass immunization campaigns, especially in areas where vaccination is confined to the annual calf crop. G. White has successfully applied the agar double diffusion precipitation test to rinderpest, and thus developed a most useful rapid diagnostic method; this is the first simple laboratory technique to be produced for the detection of rinderpest. This test has been satisfactorily applied to the investigation of rinderpest in game, such as buffalo, wildebeeste and eland in Tanganyika, and to research on rinderpest-like diseases in cattle which are assuming increasing importance as rinderpest is progressively brought under control.

54. In the Tissue Culture Section of the Division, W. Plowright and R. D. Ferris have made further significant advances in the growth in cell culture of the viruses of several important diseases, and in studies on the pathological changes produced by these viruses in culture. They have established a very satisfactory serum neutralization test for rinderpest using culture viruses, and, in collaboration with Dr. J. Nakamura, have shown that their culture virus is the best antigen hitherto used in the complement fixation test. Passage of the rinderpest virus in culture results in attenuation with retention of immunising capacity. The viruses of Rift Valley fever and sheep pox have also been successfully propagated in various cell cultures, and this work is being extended to other diseases, especially the pox group of viruses. At the end of the year a start was made on research on the growth and cytopathogenicity in tissue culture of the virus of lumpy skin disease, which was detected for the first time in Kenya late in 1957.

55. The requirements for E.A.V.R.O. rinderpest vaccines have been progressively diminished as the disease has been satisfactorily controlled. During the year, 398,600 doses of K.A.G. (caprinized) rinderpest virus vaccine and 665,775 doses of lapinized rinderpest virus vaccine have been produced by S. A. Evans and C. S. Rampton, and sold in the East African and adjacent territories. They carried out various experiments on improvements in these products.

56. The Division of Bacterial Diseases has continued research on contagious bovine pleuropneumonia, and has issued 793,200 doses of avianized pleuropneumonia vaccine. S. E. Piercy and G. J. Knight have expanded their work on this vaccine, especially studies on the value of various strains of the organism for vaccine preparation, methods of testing

vaccines, and the causes of post-vaccination reactions. C. R. Newing and A. K. McLeod are participating in this research, and are continuing investigations on the rapid slide agglutination and complement fixation tests; the latter work concentrates on improved methods of antigen production.

57. G. White has applied the agar double diffusion precipitation test to pleuropneumonia for the first time and has shown that it is very satisfactory for post-mortem laboratory confirmation of the disease. The test is effective using preserved or contaminated specimens, and thus furnishes a laboratory diagnostic method suitable for material from remote outbreaks. These are important findings, for pleuropneumonia now occurs mainly in the more primitive and isolated regions of Africa.

58. The long-term studies of S. P. Barnett and K. P. Bailey, in the Division of Protozoal and Arthropod-borne Diseases, on the nature of East Coast fever in Zebu cattle under experimental conditions have been largely completed, and the great mass of data are being prepared for publication. Their research on immunization against E.C.F. by the use of Aurofac, which was described last year, has continued satisfactorily, and Zebu and grade cattle varying in age from three to 18 months, have been very effectively immunized at the laboratory. The method is being applied in practice by field trials, and the territorial Veterinary Departments in East Africa are planning to establish immunization centres at which this method will be used for protection of valuable cattle, especially bulls used in livestock improvement schemes.

59. D. W. Brocklesby has done much research, partly in collaboration with Dr. F. Hawking of the Medical Research Council whose visit of three months duration to E.A.V.R.O. was mentioned last year, on the growth of *Theileria parva* in tissue culture. Hopes that this might provide an inexpensive method for preliminary screening of chemotherapeutic compounds for the treatment of E.C.F. have unfortunately not been realized, as the parasite could only be grown with great difficulty.

60. Barnett and Brocklesby have started research on a theilerial disease of wild buffaloes, which is transmissible to cattle near forest areas and which closely resembles and may easily be confused with E.C.F. Barnett and Miss B. O. Vidler continued their studies on various aspects of the transmission of E.C.F. by ticks, including the development of the parasite in the tick host.

61. Miss J. B. Walker's long-term researches on East African ticks, especially the vectors of disease, have progressed steadily and her work has established Muguga as a widely recognised reference centre on the ticks of this region. While on leave in 1957 she travelled in Central, South and West Africa studying various tick problems.

62. The work of the Division of Helminth Diseases on important East African diseases of livestock caused by parasitic worms has expanded considerably with the appointment of G. M. Urquhart. He is doing research on various aspects of the pathology, immunology and epizootiology of the following diseases: fascioliasis, or liver fluke disease; paramphistomiasis, which is caused by stomach flukes; and cysticercosis, or infection with beef measles. Research on cysticercosis is being done in collaboration with the University of Glasgow.

63. J. A. Dinnik and Mrs. N. N. Dinnik have continued their research on the systematics and life-cycles of parasites of ruminants, and have determined the snail intermediate hosts of two more stomach flukes. They have now established snail hosts for eight of the twelve species of paramphistomes of domestic ruminants which they themselves have identified in

East Africa. Their studies on the African liver fluke have included important new observations on the larval stages of this parasite. A relationship between temperature fluctuations and development in the snail has been established; findings of significance in ascertaining the seasonal incidence of liver fluke disease. Their work on a method of diagnosis of stomach and liver flukes by egg identification in the faeces has been completed and is being published.

64. In the Pathology Division, W. Plowright and W. G. McLeod have continued their research on the morbid anatomy and histopathology of the major East African diseases of livestock. They have investigated the pathogenesis and haematology of rinderpest and the pathogenesis of bovine pleuropneumonia. Plowright is studying the correlation between changes produced by viruses in animal tissues and cell cultures.

65. The new Animal Production Division was established on the 1st July, 1957, to replace the E.A.V.R.O. section of the joint Animal Industry Division of E.A.V.R.O. and E.A.A.F.R.O. which has been abolished. The programme comprises research on animal physiology and metabolism, and on animal breeding.

66. G. D. Phillips and A. MacGregor have carried out research on the physiology of digestion of Zebu and grade cattle, using three experimental methods. These are, manometric estimation of microbial activity in the rumen, done in collaboration with Professor R. E. Hungate of California; determination of the retention of food in the alimentary tract; and total digestibility. A. Rogerson has started studies on animal metabolism and is establishing a respiration calorimeter for work on the energy requirements of indigenous and exotic stock.

67. G. H. Lampkin and Mrs. K. Lampkin have continued their long-term research on the growth and production of beef-type indigenous Zebu cattle. They are investigating the relative importance of breeding and management in the improvement of beef quality in a large Boran herd derived from foundation stock obtained in the Northern Frontier Province of Kenya, and are determining heritabilities by the use of sire progeny groups. Deliberate selection is not being practised in this herd, but by better management it is hoped to obtain steers weighing 1,000 lb. and ready for slaughter at three years old, and heifers which have reached a minimum weight of 550 lb.—and can then be served—at 90 weeks of age. At the end of the year the Boran herd included 165 animals bred at Muguga, and, although the experiment has only been in progress for about three years, present indications are that these objectives are not unduly optimistic. It is beyond the scope of this report to give liveweight data for various age groups, which indicate the success already achieved. However, it must be emphasised that it is already evident that the doubts and apprehension, expressed in various quarters when this breeding research was proposed, regarding the suitability of the Muguga climate and environment for long-term studies on Boran cattle, have proved to be quite unfounded.

68. The scientific work of E.A.V.R.O. has received considerable assistance from visits by a number of research workers from overseas, who have spent varying periods at Muguga working on problems falling within the broad research programme of the Organization. It is one of the basic principles of the policy of E.A.V.R.O. to attract and encourage such visiting scientists by all possible means.

69. Professor R. E. Hungate, Chairman of the Department of Bacteriology in the University of California, and a world authority on ruminant digestion and rumen microbiology, spent about three months on a Rockefeller Foundation Grant during June to September. He studied the

food utilization of Zebu and exotic breeds and compared microbial activity in the rumen of these two types of cattle.

70. Among those who paid shorter visits to E.A.V.R.O. were the following scientists: Dr. J. Nakamura, Director of the Nippon Institute of Biological Science in Tokyo, who is primarily known in Africa as the research worker who developed lapinized rinderpest virus vaccine, worked at Muguga on the complement fixation test using E.A.V.R.O. rinderpest culture virus as his antigen. Dr. D. H. K. Lee, Chief of Research in the United States Office of the Quartermaster General, and formerly Professor of Physiological Climatology at John Hopkins University, spent about ten days with E.A.V.R.O. during a tour of Africa to investigate potential developments in, and facilities for, research on environmental physiology of man and animals. Mr. I. Beattie, Head of the Pathology Department of the Royal (Dick) School of Veterinary Studies at Edinburgh University, studied animal diseases with the Pathology Division of E.A.V.R.O. and collected pathological teaching material for the Diploma of Tropical Veterinary Medicine; the course for this Edinburgh Diploma is supported financially by the Colonial Office.

71. The most important work by visiting scientists is the research on virus diseases of animals which is being carried out under a scheme for co-operative research between E.A.V.R.O. and the United States Department of Agriculture, which was initiated on the 1st January, 1957, and is planned to last for several years. Dr. D. E. DeTray and Dr. W. A. Almquist, two experienced virus research workers, have been at Muguga since the beginning of the year, and a third is expected shortly. The three American scientists will change periodically and be replaced by others, each spending about two years with E.A.V.R.O. The United States Department meets the cost of the salaries and certain expenses of these officers, and also pays an annual sum, now fixed at \$20,000, in respect of technical and other services rendered by E.A.V.R.O. The co-operative project is concentrating primarily on African swine fever, which is the exotic disease of pigs causing most concern in North America, and which involves a number of complex and hitherto intractable research problems. Research will be undertaken in future on other virus diseases, as shall be mutually agreed. At the end of the year DeTray and Almquist started certain lines of research on rinderpest applicable to the development of a system for the rapid detection of the disease should it ever be introduced into the United States of America. White is collaborating in this work.

72. The Wellcome Research Foundation is establishing a laboratory near Nairobi whose main function will be research on chemotherapy of protozoal and other African diseases. Until the construction of the new station was completed early in 1958, Mr. J. K. H. Wilde and Mr. J. Ford of the staff of the Foundation worked in E.A.V.R.O. for about a year on the chemotherapy of East Coast fever.

73. In the Laboratory Animals Section, Mrs. J. Palmer and her staff have continued very satisfactorily the large-scale production of the small animals required for research and vaccine production, including some 7,000 rabbits, most of which are used for lapinized rinderpest virus vaccine. It is gratifying to conclude this report on a more earthly note and to record that E. S. Palmer, in addition to operating his most efficient internal system for the supply of the experimental animals needed for the multifarious activities of the Organization, has taken full advantage of this year's exceptional rains and produced 50,000 bales of hay at Muguga North. It would cost some £9,000 to purchase this quantity of hay, which represents about two years' requirements of fodder for all the large animals used by E.A.V.R.O.

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*The University College of East Africa, Makerere College, Faculty of Agriculture*

74. Dr. P. N. Wilson completed his work in the study of planes of nutrition of the Teso goat. Mr. W. H. Boshoff has continued his studies of the

anaerobic fermentation of Elephant Grass (*Pennisetum purpureum*) and has designed and is developing apparatus both for laboratory tests and a pilot-scale plant. He has also been working upon the modification of certain implements to suit them to special purposes under local conditions. This work includes the development of a tie-ridger and a stabiliser for the South African Wonder Planter. A comparative study in the relative efficiency of mouldboard and disc ploughing for the initial opening of land was commenced. Dr. M. A. Key made some progress in the detailed study of the morphology of East African crop plants, many of which are poorly described in botanical literature. Dr. E. Pawson spent some time in the design and development of apparatus for more rapid and accurate determination of organic matter in soils and soil extracts. Mr. J. L. Joy made a study on the marketing of maize and completed studies on the introduction of mechanisation to African farming in parts of Uganda.

#### Publications

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WILSON, P. N.—Two Surveys of Kasilang Erony, Teso, 1937 and 1953. *Uganda J.* **20** (1957) 182.

WILSON, P. N.—Studies of the Browsing and Reproductive Behaviour of the East African Dwarf Goat. *E. Afr. Agric. J.*

#### Flora of Tropical East Africa

75. The amount of publication during the year (*Gymnospermae*, *Alangiaceae*, *Orobanchaceae* and *Polygonaceae*) does not reflect the amount of work done. It is expected that 1958 will see more pages published than have appeared hitherto. The following accounts of families and subfamilies are in the hands of the editors: *Celastraceae*, *Loganiaceae*, *Mimosoideae* and *Rosaceae*, together with several more small families. The accounts of many other families (including most of the *Leguminosae*) are in various states of preparation.

76. The work has not, however, progressed as fast as had been expected owing to the loss of trained staff through resignation, and the difficulty in replacing them with experienced taxonomic botanists.

77. Members of the Kew staff have contributed considerably, whilst Dr. B. Verdcourt of the East African Herbarium, Nairobi, has written the large and difficult family of *Convolvulaceae*. Help from specialists outside Kew is greatly appreciated, among whom are Mr. B. L. Burtt, Professor G. Cufodontis, Mr. J. R. Laundon, Mr. R. Ross and Dr. B. Schubert. Thanks are also due to the Directors of many of the great European Herbaria for so generously lending type and other valuable specimens for examination by those working on the flora.

78. The collections made by the three Colonial Office Expeditions have proved to be most useful and have helped to fill in many gaps in our knowledge of the flora, but there is a need for further well prepared and annotated collections from the south-eastern corner of Tanganyika.

(b) *CENTRAL AFRICA**Flora Zambesiaca*

79. Good progress was made with the work on this Flora and Volume I is nearly ready for printing. Thirteen families have been completed involving over 400 species, many of them new to science.

*Publications*

WILD, H.—New and little known species from the Flora Zambesiaca Area. I. Proteaceae. *Bol. Soc. Brot.* **30**, 2nd ser. (1956) 5.

EXELL, H. W.—*ibid*, II. Polygalae novae: *Bol. Soc. Brot.* **31**, 2nd Ser. (1957) 5.

WILD, H.—*ibid*, III. Tiliaceae et Elatinaceae. *Bol. Soc. Brot.* **31**, 2nd Ser. (1957).

(c) *MEDITERRANEAN**Flora of Cyprus*

80. Work on the family *Cruciferae* has been completed, and accounts of the families *Capparidaceae*, *Resodaceae* and *Violaceae* are in course of preparation. Descriptions of new species and commentaries on existing taxa are, in future, to be published in the "Kew Bulletin" under the title "Notes on the Flora of Cyprus". Part I of this series, comprising notes on the families *Ranunculaceae* to *Papaveraceae* (together with a note on *Convolvulus*) has already appeared.

(d) *WEST AFRICA**West African Standing Advisory Committee for Agricultural Research*

81. Consequent on the independence of Ghana, an inter-governmental meeting in Lagos on the 20th and 21st January, 1958, was convened to consider, on the basis of proposals formulated by the Government of Ghana, how West African research should be organised in future. It has been agreed that the West African Inter-Territorial Secretariat should be replaced by a West African Research Office concerned exclusively with research, and that the West African Standing Advisory Committee for Agricultural Research should be discontinued with effect from the 31st March, 1958, its administrative functions in relation to research being taken over by the new West African Research Office.

*West African Cocoa Research Institute*

82. The testing of cocoa plants for resistance or tolerance to virus infection has been continued on an increased scale. There are indications that highly tolerant plants contain very little available virus, and if confirmed, this may have important practical implications in the use of tolerance as a control measure. Neither thiouracil nor 8-azaguanine appear to be effective against cocoa virus infections. Preliminary experiments have shown that dieldrin effectively controls ants attending mealybugs, and that following such control mealybug populations are reduced to negligible proportions. The effect on the spread of cocoa viruses is being investigated.

83. Evidence of resistance to Black-Pod disease has been found in some cocoa selections. A study of the distribution of Black-Pod infections has indicated that diseased cherelles are more numerous than was previously realised. Comparative tests of isolates from various areas in Ghana and Nigeria are in progress.



84. A number of chlorinated hydrocarbon insecticides have been tested in the field against capsids. Endrin, *gamma*-BHC, aldrin and dieldrin gave satisfactory control, while heptachlor was ineffective. No appreciable difference in pollination rates have been found between plots treated with *gamma*-BHC or dieldrin, and untreated plots.

85. Further variety trials have been planted in Ghana and Nigeria to compare Upper Amazon cocoas, local types, and crosses between Upper Amazons and local types. Varietal differences under different climatic and edaphic conditions are being studied.

86. In the first year of a shade and manurial trial at W.A.C.R.I. significant responses have been found to the removal of shade and to the application of a complete major nutrient fertilizer mixture. Water culture methods are being used in a detailed study of the nutritional requirements of cocoa.

87. A new technique has been developed for the fermentation of Amelonado cocoa on slatted trays, without mixing, in two to three days. Experiments on the chemistry of fermentation have shown that the anthocyanin concentration is inversely related to quality.

#### *Publications*

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CORNWELL, P. B.—An investigation into the effect of cultural conditions on populations of the vector of virus diseases of cacao in Ghana, with an evaluation of seasonal population trends. *Bull. int. Res.*, **48** (1957) 375–396.

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#### *West African Institute for Oil Palm Research*

##### *Agronomy Division*

88. Great progress has been made in the raising of seedlings in pre-nurseries. Experiments have shown that wider spacing in pre-nurseries (in the form of raised trays) produces a more robust plant for transplanting into the nurseries, and that both mulching and the application of fertilizers in the pre-nursery is advantageous. In the nurseries themselves deep cultivation by ploughing has had a remarkable effect on growth, while further improvement has been obtained by mulching throughout the season or by ploughing-in organic matter in the form of bunch refuse. In an attempt to avoid Blast disease seedlings are being raised for off-season planting. Very robust tray seedlings have been set out in nurseries in September and attempts are being made to force them forward to plantable size by May. This method of raising seedlings shows promise and, if successful, will have the added advantage of making it possible to issue seed twice, instead of once, a year, thus increasing the overall germination percentage of seed issued by the Institute. With regard to transplanting to the field, only the problem of nitrogen manuring around planting time remains to be solved.

89. Field experiments on pruning, manuring, seedling selection, spacing, and intercropping continue. A large experiment has been laid down at the

Main Station to deal with problems of combining the planting of oil palms with farmers' annual crop rotation. A small experiment of this type has been laid down at Abak and similar trials have been or will be planted in Ghana and Sierra Leone.

#### *Plant Breeding Division*

90. The programmes have been maintained in spite of lack of staff; but now new breeding programmes will be put in hand and preparations are being made to produce Extension Work Seed by line breeding. Particular attention is being paid to the crossing of Deli *dura* palms with *pisifera* pollen.

#### *Engineering Division*

91. A study of the economics of the Pioneer mill is being made and, when the results of this study are known, attempts will be made to increase the efficiency of the mill by chemical engineering research. Some laboratory work has already been carried out and improvements in methods of sterilisation, extraction and clarification are envisaged.

#### *Plant Nutrition Division*

92. The installation of equipment has taken up a great deal of time, but it has been possible to carry out sand culture studies with the major elements. A preliminary indication of the deficiency symptoms of nitrogen, magnesium, phosphorus and sulphur has been obtained, but it has become clear that the symptoms of potassium and calcium deficiency require further study.

#### *Plant Pathology Division*

93. Work was confined almost entirely to nursery diseases and considerable progress has been made during the year in the elucidation of the factors giving rise to Blast disease. The technique for isolating the *Pythium* species associated with this disease has been mastered and inoculation experiments have shown that this fungus is capable of reproducing the typical symptoms of the disease. An interesting study has revealed a method by which *Rhizoctonia lamellifera* may gain entry into nursery seedlings, and recent laboratory work has shown that under artificial conditions of growth on media, *Pythium* may be parasited by *Rhizoctonia lamellifera*. Although the 1956-57 nursery at the Institute's Main Station was severely affected by Blast disease the nursery of 1957-58 has shown a very low incidence of the disease. Examination of the total August and September rainfall since 1950 has indicated that an inverse correlation may exist between the total rainfall during these months and the incidence of Blast disease. This discovery indicates the possibility of controlling Blast by irrigation during the months of August and September, and trials along these lines are being planned for 1958.

94. Trials of various fungicides in the control of Freckle (*Cercospora elaeidis*) were completed and the results published in the 7th number of the Institute's Journal. The organic fungicide Ziram proved most efficient and the use of a sticker with the fungicide has been shown to be desirable.

#### *Plant Physiology Division*

95. Work on the determination of optimum temperatures and humidities for the germination of *dura* and *tenera* seed was completed by an experiment on the optimum humidity requirements of *dura* nuts. This was shown to be between 17 and 19 per cent. An electric germinator has been erected and tests

have shown that temperature control is within  $\pm 1^{\circ}\text{C}$ . and humidity within  $\pm 3$  per cent. The germinator is to be used first for a long-term experiment on methods of seed storage, but trials of germinating seed without media will also be carried out.

96. Studies of stomatal movement and of photosynthesis form part of the Division's programme. Under the environmental conditions of the Main Station, stomata show partial closure during the dry season in the middle of the day. From the onset of the wet season, however, they remain fully open from the initial opening period in the early morning until the beginning of closure about an hour before darkness. Apparatus constructed for the study of photosynthesis has proved to be slow and tedious for the estimation of assimilation under natural conditions, and it has been decided that future work shall be carried out with the aid of an infra-red gas analyser.

#### *Soil Chemistry Division*

97. Great progress in the determination of the minimum amount of exchangeable magnesium required in the sandy soils of Nigeria has been made. Magnesium deficiency gives rise to Orange Frond disease and the soil studies have suggested that the limiting level at which deficiency may be expected is about 0.15 m.eq./100 g. (18 p.p.m.) of exchangeable magnesium. A relation has also been found between the mole fraction of exchangeable potassium and yield responses to potassium fertilizers and leaf symptoms of potassium deficiency. As a general guide it appears that areas showing a mole fraction of less than 0.01 are definitely deficient. In Sierra Leone a soil laboratory has been constructed and work has started on a study of soil nitrogen fluctuations and their relationship to the production of palm products.

#### *Statistics Division*

98. Studies of uniformity trial data continue and a great deal of work which was to be carried out at Rothamsted is now to be undertaken at the Institute. Assistance continues to be given to all other divisions in the designing and interpretation of experiments.

#### *Publications*

ANON.—Notes on the Botany of the Oil Palm: 2. The Seedling. *J. W. Afr. Inst. Oil Palm Res.* 2 (1956) 92.

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PURVIS, C.—The Colour of Oil Palm Fruits. *J. W. Afr. Inst. Oil Palm Res. 2 (1957) 142.*

ROBERTSON, J. S.—Leaf Diseases of Oil Palm Seedlings. *J. W. Afr. Inst. Oil Palm Res. 1 (1956) 110.*

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SPARNAAIJ, L. D.—Mixed Cropping in Oil Palm Cultivation. *J. W. Afr. Inst. Oil Palm Res. 2 (1957) 244.*

TOOVEY, F. W., and PURVIS, C.—Segregation from the *Dura* × *Pisifera* Cross. *J. W. Afr. Inst. Oil Palm Res. 1 (1956) 106.*

#### *West African Research Station*

99. The Officer in Charge visited Ghana and Northern Nigeria to study rice growing conditions and advise, and a visit was made by one of the botanists to the French Rice Research Centre at Kankan in French Guinea. The Soil Microbiologist visited Nigeria, mainly the Niger delta area, at the beginning of the year. The Station was represented at the F.A.O. Rice meeting in Italy in September. Visits have been made to Rokupr by officers from all the other West African territories.

100. Botanical work has included the growing of 491 rice varieties of which 52 were new varieties. Yield trials of the most promising of the varieties introduced in recent years have been continued, and a station extension area on riverain grassland has been opened for trials with floating rices and other varieties suitable for this type of land.

101. Routine work has been carried out on hybrids and selections, particular attention being paid to the progeny of the *indica* × *japonica* hybrids made in 1951. Further hybridization has been carried out.

102. The investigations on seed dormancy and viability have continued. Viability has now been maintained for two years under conditions of low humidity and temperature. Other storage conditions are being investigated.

103. The preliminary experiments on the factors influencing life period have been completed. Light intensity is found to affect not only duration but tillering, and the importance of sowing each variety on an optimum date for uniformity of growth and flowering has become evident.

104. The seasonal fluctuations which occur in the acidity of cultivated tidal mangrove soils have been studied throughout the year. The increase in acidity which takes place in these soils during the early part of the dry season can be correlated with a decrease in their moisture contents and a large increase in the numbers of sulphur-oxidising bacteria which they contain. It has not been possible to show a simple correlation between the numbers of these organisms present in the soil and the soil moisture content throughout the year. An interesting feature of the results has been the presence of large numbers of organisms in the surface soil during the growing season, when the soil moisture content was high. They may be responsible for the slow rate at which the soil acidity drifts upwards during this period—a surface soil pH value of 5 units was not established until the middle of November, when rice had been growing satisfactorily for over three months. The bacteria may be of importance in preventing the rapid accumulation of high concentrations of sulphides toxic to rice.

105. Information has been obtained on the movement of salt water in the Great Scarcies River throughout the year. A study of the ratio of chloride concentration to sulphate concentration in the river water has revealed that sulphate is removed from the water in the middle of the dry season. This may be a reflection of sulphate accumulation in tidal soils. The effect is to be confirmed and studied as part of a programme of investigation of general sulphur cycle relationships in these soils. Pure cultures of bacteria involved in acid-production in tidal mangrove soils have been isolated and are being studied.

106. Observations on the arboricide trials have shown that 2,4-D ester in diesel oil is the most effective of the substances used on both *Avicennia* and *Rhizophora* mangrove. Without frilling of the trees, 4 per cent strength gives a good kill, but if the trees are frilled the strength can be reduced to 2 or even 1 per cent.

107. A further experiment on *Paspalum vaginatum* has shown that burning immediately prior to spraying reduced the strength of the effective dose of Dalapon to 10 per cent. Cutting before spraying leads to an increased strength being needed to kill the grass.

#### Publications

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TOMLINSON, T. E.—A Seasonal Variation of the Surface pH value of some Rice Soils of Sierra Leone. *Trop. Agric., Trinidad*. **34** (1957) 287.

*West African Maize Research Unit*

108. The analysis of maize survey data has continued slowly due to lack of staff. Northern flint types have shown similarities to early Caribbean types. Selected survey lines have been put in trials and the varieties Chariga and Bongo from Northern Ghana show field evidence of stem borer resistance. The elucidation of the races of West African Maize will be of value in the future production of hybrids.

109. *Maize Pottery*. In West Africa it has been a common practice since the introduction of maize to roll ears or cobs on the surface of unbaked pottery to form a raised or sunken pattern. Antique specimens of such pottery thus provide evidence of the type of maize grain in the area in former times. Analysis of these markings has shown that early maize types were less variable than later ones and probably confined to the early Caribbean introductions. Later introductions are not found at the city of Old Oyo, abandoned in 1837. A wider range of types is found in the archaeological remains of the town of Ife which is still inhabited.

110. The selection of existing varieties has reached the stage where attention is being directed towards the environmental suitability of these selections in the various climatic zones of West Africa. A collection of 130 Caribbean varieties was tested in the rain forest areas of Nigeria and Ghana during the year and a group of varieties from Martinique has proved very promising in this environment. The evaluation of the Mexican group is nearly completed and a programme of varietal selection and improvement has commenced.

111. A series of 29 trials was laid down throughout Nigeria and the Cameroons in order to determine the response of current selections to environment. Varieties differing in maturity time and seed type were incorporated in these trials and the results will give information on the interaction of such factors as variety, locality and disease incidence.

112. The main breeding work has been the production of inbred lines by individual plant selection. Recurrent selection cycles were started with the first inbred stages and their general combining ability is being tested by crossing out to parental varieties. Inbreeding is continuing with the aim of obtaining synthetic varieties derived from a number of inbreds of good combining ability, in order to prevent a disadvantageous narrowing of the gene populations within varieties.

113. A trial has been carried out with lines derived from the Minnesota group, carrying resistance to the European corn borer. A comparison was made of highly susceptible West African varieties, susceptible but high yielding Mexican  $\times$  Minnesota crosses and the first and second back-crosses to the Mexican varieties.

114. A new virus disease of maize, provisionally termed Pellucid Ring Spot, is now widespread and must be considered a major maize pathogen. Caribbean varieties, possessing resistance to *Puccinia polysora*, were severely attacked during 1957, and to a lesser extent several West African locals. From field observations an aphid vector is suspected. All attempts to transmit the disease mechanically have failed.

115. An analysis of measurements of uredospores of *P. polysora*, made with the co-operation of the Commonwealth Mycological Institute and the Arthur Herbarium, from samples of uredospores from all existing world collections showed a highly significant difference between the dimensions of spores from the African Continent and those from South East Asia and adjacent islands. The results suggest that distinct and geographically isolated forms of *P. polysora* exist, with different spore sizes.

116. Studies on the life cycle of *P. polysora* have been concluded. Repeated attempts have failed to induce germination in the teleutospore and the aecidal and pycnidial host is unknown. Until such time as further evidence becomes available the rust should be considered to be an autoecious hemi-form.

117. Analysis of several years' records of the uredospore content of the atmosphere obtained by an automatic volumetric spore trap has shown that the time of outbreak of the rust can be forecast each year. Onset of rust in the field can be expected when the atmospheric uredospore content rises above 5/cu.m. This value has been termed the "primary epidemic threshold".

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CAMMACK, R. H.—Factors affecting infection gradients from a point source of *Puccinia polysora* in a plot of *Zea mays*. *Ann. appl. Biol.*—In press.

WILLET, F., and STANTON, W. R.—Maize Pottery in Nigeria. *Man.*—In press.

#### West African Timber Borer Research Unit—Investigations in West Africa

118. In the early part of 1957 the Senior Staff of the Unit was increased with the arrival of Dr. H. Roberts, entomologist. Shortage of staff during the year again limited the programme of work that was carried out, since for half the year only one officer remained in West Africa.

119. The work of 1956-57 had shown that of the many insecticides tried gamma BHC as a water emulsion was the most efficacious for the protection of logs in the forest. Work in the current year therefore commenced with attempts to obtain (a) the optimal concentration of gamma BHC and (b) to see if the residual insecticidal effect could be improved by the addition of dieldrin. Results indicated that 0.75 per cent. gamma BHC was the optimal concentration this giving 99 per cent. protection for four weeks in the forest and falling only to 95 per cent. protection after ten weeks. Addition of dieldrin (conc. of 5 per cent.) to the gamma BHC did not significantly improve protection over a period of 12 weeks.

120. Attention has also been given to the use of resin insecticide formulations for log protection. Aroclor 5460, coumarone indene 460 and 469, and epok emulsion V750 were used at two levels, 1 per cent. and 5 per cent., with 0.75 per cent. gamma BHC as the active ingredient on logs in the forest. Results showed no significant differences in protection between the resin + B.H.C. treatment and a 0.75 per cent. gamma BHC water emulsion used as a control. Of the resins C.I.460 (5 per cent. level) was significantly better as a mechanical protection than the remainder.

121. On the basis of these results investigation into the protection of water-transported logs using resins was commenced in Nigeria. The efficacy of C.I.460 was compared with that of a log grease and a water-miscible log paint. Gamma BHC, aldrin and dieldrin (all at 0.75 per cent. or 0.5 per cent. active ingredient) were incorporated into resin, grease and paint as insecticides. Results, as yet incomplete, indicate that after six weeks the resin formulation appeared more efficacious and gave more persistent protection than either grease or log paint.

122. The study of susceptibility of different timbers to ambrosia beetle attack was extended to include a number of tree species not used in the previous examination (see Webb and Jones, British Wood Preservers Association Annual Convention, 1956). Susceptibility tests were carried out in many parts of Ghana giving additional information on the distribution of different beetle species and their hosts.

123. Studies on the biology of ambrosia beetles have been extended. In August, 1957, an examination of the seasonal variation of beetle species as determined by aerial trapping, was commenced. Other work on the ecology of these pests included studies of the relationship of the flight of beetles to weather conditions, and also study of the preferred flight levels of beetles in the forest. All this work is now at an interim stage and will not be completed until the end of 1958.

124. The Forestry Department of Ghana has sought the co-operation of the Unit over the attack of living mahogany trees (*Khaya senegalensis*) in the Northern Territories of Ghana by a lepidopterous shoot borer believed to be *Hypsypla* sp. Larvae of the moth attack the leading shoot of young mahoganies causing die-back. The main attack probably occurs at the end of the long dry-season (April-May) and after some months within the tree the larvae emerge to pupate on the ground. There may also be a second generation attack in September-October. It is hoped to carry out some insecticide trials during 1958 with a view to limiting the damage done by this pest.

#### *Publications*

WEBB, W. E. and JONES, T.—A study of the Biology and Control of Ambrosia beetles (Scolytoidea) attacking timber in West Africa. *10th Int. Cong. Ent.*, Montreal, August, 1956.

WEBB, W. E. and JONES, T.—Report of the West Africa Timber Borer Research Unit. (1953-55.) Crown Agents Publication, September, 1957.

#### *Investigations at Princes Risborough*

125. Mr. J. M. Baker continued his investigations at the Forest Products Research Laboratory on the biology and fungal relationships of the oak pinhole borer *Platypus cylindrus*. Further observations have been made on the progress of attack in oak logs of which the felling date and time of infestation were known. Emergence of a new generation of beetles from logs attacked during the summer of 1956 began in the middle of July, 1957. The insects emerged mostly on warm days when they could immediately take to flight, but also on days when it was too cold (below 15°C.) for them to fly and so suffered the hazards of a period in the open before weather conditions became suitable for flight. A few beetles emerged sporadically throughout the autumn and even the winter, and were capable of flight if brought into the warm laboratory. The population of the galleries was investigated after the first year's emergence had taken place. Many individuals, mostly last instar larvae, remained in the tunnels, reaching a density of 800-900 per cubic foot of log. Some immature adults, in equal ratio of males to females, were found in the galleries at all times during the autumn and winter; after overwintering, these insects would be the first to emerge in summer 1958. Some immature adults had fed on the ambrosial lining of the galleries; others had eaten nothing since completing larval development. They do not appear to do any boring, but lead an inactive life in the galleries. Considerable boring was carried out by last instar larvae and in well established galleries these larvae are responsible for much of the extension, although they bore only slowly. A study of the variation in the state of the reproductive organs



throughout the life of the beetle has been completed. Mating takes place once only, when the female arrives at the new tunnel started by the male. Live sperm can be found in the spermatheca of the female over two years later, and the egg laying potential increases as the gallery system becomes more extensive. The male reproductive system remains fully active throughout the life of the beetle.

#### *Fungal Relationships*

126. In a study of the carriage of fungi by the insects, the species recovered from emerged beetles were the same as those consistently isolated from the tunnels, and work on their morphology and physiology has been continued. The normal tunnel flora appears to comprise four species of fungi, but others such as *Graphium*, *Ceratocystis*, and *Caryne sarcoides* are often found in parts of the tunnel where browsing is not taking place. One of the four species seems to be the main ambrosia fungus, producing the chlamydo-spores referred to in an earlier report as an "A-spore" (*Colonial Research* 1955-56, p. 47). This fungus has been induced to form chlamydo-spores in artificial culture, and also produces small apiculate spores in a manner resembling *Sporotrichum*. Cultures of this and of the three other fungi have been grown on sterile oak blocks. The *Sporotrichum*-like fungus, and the fungus which in certain stages of its growth resembles *Cephalosporium* both grew well on these blocks and produced staining of the type associated with the tunnels. The other two fungi, both yeasts, grew on the wood blocks without causing staining. This accords with the observation that in very new tunnels, where no discoloration is seen, the main constituent of the fungal lining is one of these yeasts, *Endomycopsis* sp. All attempts to rear larvae through to maturity by artificial feeding have proved unsuccessful.

#### *Flora of West Tropical Africa*

127. Part 2 of Volume I is expected to be published early in 1958. Staff changes have resulted in a temporary slowing down of the revisional work. Mr. Hepper made a collecting expedition to the highlands of the northern part of the British Cameroons, an area poorly known botanically. The Supplement on Ferns and Fern Allies was completed at the British Museum (Natural History) in the early part of 1957.

#### *University College of Nigeria*

##### *Entomology and Grain Storage*

128. Regular collections of insects were made from 73 different crops and 87 species new to the collection were identified by the British Museum and four by the Department. Work on the biology of *Papilio demodocus* and *Callosobruchus maculatus* continues. A study of the biology of *Prodenia litura* has commenced. The relative merits of different types of grain storage bin and grain dryer are being examined in conjunction with W.A.S.P.R.U.

##### *Soil Science*

129. Mineralogical and chemical studies of the movement of iron, aluminium and silicon in a soil of the Ibadan series under five different covers are being continued; also the effect of soil cover on temperature and moisture distribution on the same site. The application of thermal analyses to the fractionation of soil organic matter (in collaboration with the Government Soils Chemist at Moor Plantation) continues.

*Animal Husbandry and Health*

130. Observations on the dairy herd of White Fulani (Bunaji) zebu cattle under conditions of moderate exposure to infection with trypanosomes continue. In view of the satisfactory gains in weight made at Ibadan by Bunaji bulls and steers protected with antrycide pro-salt and managed intensively on mixed grass/legume pastures, more attention will be given to research on the zebu as a potential beef producer. The chief obstacle will be to find suitable grass fallows and systems of management that could be integrated with local cropping practices or in land reclamation schemes.

131. Studies continue on the performance of layers under extensive, semi-intensive and intensive methods. A pen of mixed, exotic hens managed on cow dung compost and sawdust litter gave a hen-housed average of 191 eggs in 12 months (approx. 5.5 lb. feed per dozen eggs laid). Local hens in batteries averaged 124 eggs—about 40 eggs more than their sisters' average production on free range. Mortality was highest in hen-yards and on free-range although better hatchability of all eggs set (65 per cent.) appeared to be obtained with eggs from hens on free range. A "Nucleus" system of poultry breeding has been commenced, also work on broiler production.

132. Tri-hybrid pigs made significantly greater average daily live-weight gains than either the di-hybrid, or pure, non-inbred and inbred lines. Sample figures were prepared on carcass grading and efficiency of food conversion in pure breeds, and on a small number of local pigs managed intensively. Fold rearing on grass/legume pastures is being tested. Data on reproduction and live-weight gains and carcass measurements of local Dwarf sheep are being summarised.

*Nutritional Chemistry*

133. Laboratory analyses are in progress on samples obtained from the extensive field investigations on the influence of time and frequency of cutting on the nutritive value and yield of *Pennisetum purpureum*, *Andropogon tectorum*, *Panicum maximum*, and *Tripsacium laxum*, four of the most important fodder grasses grown in Nigeria.

134. Grazing trials with White Fulani cattle on *Cynodon plectostachyum* Pilger alone and mixed with legumes and herbs have been in progress for one year. The object of the trials is to study the effect of grass-legume swards as compared with grass alone, on the live-weight gain of heifers, bullocks, and cows; to note any possible seasonal effect on grazing and liveweight increase and to ascertain the carrying capacity of such pastures.

*Agricultural Economics*

135. The work of this division included a comprehensive study of the rural economy of the country, land tenure changes and land tenure policy, commodity marketing, and the relationship of agricultural improvement to general economic development.

*Publications*

OYENUGA, V. A.—The composition and agricultural value of some grass species in Nigeria. *Emp. J. Exp. Agric.*, **25** (1957) 237.

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OYENUGA, V. A. (with AMAZIGO, E. O.).—A note on the hydrocyanic acid content of cassava (*Manihot utilissima* Pohl). *W. Afr. J. Biol. Chem.* **1** (1957) 39.

HILL, D. H.—Environmental physiology of domestic animals with particular reference to livestock breeding problems in the tropics. *University College Ibadan Press*, 1957.

McILROY, R. J.—*Combretum verticillatum* Gum. *J. Chem. Soc.* 1957, 4147.

McILROY, R. J.—Agriculture at the University of Khartoum. *Nature*, 179 (1957) 304.

OLUWASANMI, H. A.—Land tenure and agricultural improvement in tropical Africa. *J. Farm Economics*, 39 (1957) 731.

(e) *WEST INDIES*

*The Imperial College of Tropical Agriculture, Trinidad  
Agriculture*

136. *Crop Husbandry: Yams (Dioscorea alata var. Lisbon)*. With the aim of extending the season of availability of yams, experiments are being made on the use of chemicals to break dormancy in the tubers, the hastening of maturity by spraying the foliage with a herbicide, and the prevention of growth of the stored tubers with chemical treatment. Dormancy can be broken by the use of ethylene chlorhydrin by a dipping method, preferably using cut yams; maturity is hastened by spraying foliage with 2,4-D, and germination can be inhibited by application of Mena (the methyl ester of alpha-naphthelene acetic acid). Yams treated with Mena stored satisfactorily for eight months but lost about thirty to forty per cent. in weight. If such yams were stored in boxes or covered heaps, the Mena caused wartiness, which affected their appearance but not their eating quality, but warts were not produced in uncovered yams.

137. *Tomato*. Experiments on the production and transplanting of seedlings conducted over four seasons, showed that seedlings raised within an open greenhouse in three inch clay pots containing good compost, or in open seed beds of good, fertilised soil at a spacing of three inches square, gave appreciably higher early and total yields, and reduced numbers of vacancies after transplanting, as compared with seedlings raised in open seed beds and not properly spaced, which is the common peasant method. Seedlings raised in pots were the best in all respects. Application of a small amount of soluble fertiliser in the water at transplanting also increased early and total yields. An experiment on staking and pruning with an indeterminate variety showed that neither practice was beneficial as regards yield or quality.

*Herbicides*

138. A Colonial Development and Welfare grant, supplemented by increased funds from the College, became available in September, 1956. This money has been used primarily to improve the facilities for undertaking accurate investigational work, but some extension of the programme has also proved possible, owing to the appointment of a full-time technical assistant. A building has been erected in which to house seed-boxes after spraying and various items of laboratory equipment have been purchased. Work with both rice and maize has now reached the stage where results previously obtained in the greenhouse are being tested in the field.

*Regional Research Centre, Trinidad*

*Banana Research*

139. In the course of breeding operations designed to produce new male parents, families raised from crosses between strains of *Musa acuminata* subsp. *banksii* recently collected in the Pacific, and edible diploid bananas

have been planted in Trinidad and Jamaica. As noted in the previous report (1956-57, para. 165), many of the wild strains collected on the banana collecting expedition (1954-55) turned out to be susceptible to disease: nevertheless some apparently resistant types appeared and these have been the basis of the crosses just mentioned. At the Banana Breeding Station at Bodles, Jamaica, the principal male parent in use is a triple hybrid between wild strains of bananas from Burma and Samoa and an edible diploid ("Sikuzani") from Zanzibar; bunches of this selection are heavy, compact and generally symmetrical and they undoubtedly represent the best synthetic male parent yet used.

140. Another promising line of male parents is being developed from crosses of the clone "Tongat", an edible diploid from Borneo. "Tongat" is notable for its vigour, its disease resistance and its excellent grade but short fingers. Some hundreds of hybrids of it with seeded bananas have been raised in recent years but all have proved to be useless for banana breeding; however, there are now signs that crosses with certain other edible diploids may yield useful male parents: two excellent seedlings of parentage "Tongat" × "Pisang lili" and "Tongat" × "Paka" have already been sent to Jamaica and large families are being raised. More generally it begins to look as though diploid edible × edible crosses offer the best current hope of male parent improvement. Such crosses are often difficult and always tedious to make because of the inevitable sterility of the parents so that development of the programme cannot be rapid; but the first selections are very promising indeed. If the programme develops satisfactorily, then the main value of the two banana collecting expeditions will ultimately lie in the edible diploids collected rather than in the wild bananas.

141. The edible diploid "Paka" from Zanzibar (mentioned in the preceding paragraph of this report and in the previous report, 1956-57, para. 164) has proved to be slightly susceptible to Panama disease. It is best used therefore in hybrid combinations and for this purpose the cross "Tongat" × "Paka" seems to be especially promising.

142. Importation of edible diploids from Asia to Kew for quarantine and transmission to Trinidad continues satisfactorily—though shipments from places as distant as New Guinea have inevitably sustained losses. One of the most promising clones ("Pisang jari buaya", from Malaya) is already established in Trinidad and a big shipment of other clones is expected early in the summer. While this work is going on, the opportunity is being taken to introduce to Trinidad certain African and Indian banana clones which are primarily of taxonomic interest and a number of West Indian bananas are being distributed in Africa.

143. K. Shepherd has continued his studies of female sterility in edible bananas and has found that bud pollination results in increased seed yields in some clones, though, unfortunately, not in "Gros Michel"; the technique is therefore likely to be useful in banana breeding only in the pollination of certain edible diploids such as are used in male parent improvement. A post-graduate student, T. Menendez, has begun investigations of the relative importance of pre- and post-fertilization failures in causing seed sterility in the edible bananas.

144. Cytological investigations by K. Shepherd of interchange behaviour in *Musa acuminata* and of interspecific hybrids have been continued. Examination of the chromosomes of two new species recently introduced to the collection has revealed the existence of two chromosome numbers hitherto unreported in the genus *Musa*: one species, a dwarf banana with scarlet bracts from North Borneo, has 18 somatic chromosomes; the other, a gigantic

plant that comes from the mountains of New Guinea and was earlier thought to be an *Ensete*, has  $2n=14$ . The classification of the family will certainly need some revision to accommodate these two interesting discoveries.

145. Dr. C. W. Hagen of the Botany Department of the University of Indiana arrived in Trinidad in late August, 1957, to spend nine months working on the biogenesis of the anthocyanin pigments in banana bracts. Previous work had suggested that the comparatively large size and seriation of the bracts would make the male bud of *Musa* unusually favourable material for biogenetic studies.

#### *Cocoa Research*

##### *Plant Breeding*

146. Hybrids amongst certain ICS clones and SCA 6 and SCA 12 have engaged a considerable amount of attention during the year. The yields from these hybrids for the 1956-57 crop were considerably above those for the preceding year and are given below.

Parents	lb. dry cocoa per acre
ICS. 1 × SCA 6	1,706
ICS. 1 × SCA 12	1,931
ICS. 6 × SCA 6	2,323
ICS. 6 × SCA 12	2,455
ICS. 60 × SCA 6	1,354
ICS. 60 × SCA 12	1,930

147. So far, in the years 1954-57, the best crosses ICS. 6 × SCA 6 and ICS. 6 × SCA 12 have given 4,818 and 4,774 lbs/acre respectively, which are equivalent to 5.4 lbs. per tree. Seed sizes remain on the small side but are in excess of the one-gram dry weight given as a minimum limit by British manufacturers. Individual tree records of Witches' broom infection are being kept. Infection has not yet been uniformly distributed through the field so that no conclusive evidence as to the Witches' broom resistance of the hybrids is available. The SCA 12 progenies continue to be more heavily infected than the SCA 6 progenies.

148. The excellent results obtained from these hybrids have prompted the extension of research in two lines:

- To increase the range of hybrids with SCA 6 which appears to hold more promise for Witches' broom resistance. These crosses are now in process of being produced. Some of them will be planted in an experiment at Las Hermanas estate during 1958.
- The progenies under observation at River Estate offer possibilities for the isolation of resistant individuals which combine other favourable agronomic characters. A small number of trees have been sib-crossed and their progeny are being tested for resistance in the seedling stage. The surviving progeny have been planted in the field to observe their agronomic qualities. This work has just been started and it is not possible to indicate the directions it will take.

149. In addition, a wide range of crosses has been tested for their reaction to seedling inoculation by *Marasmius perniciosus* in order to provide further information as to the relative resistance of various types of cocoa. Considerable data have been collected to aid in the assessment of the reaction of individual inoculated seedlings in future tests.

##### *Incompatibility*

150. It seems now clearly established that three types of self-incompatible tree exist. The first group, which show a twenty-five per cent. incidence of

ovules wherein gametic fusion fails, are heterozygous for the incompatibility s-alleles, a dominant allele being associated with one recessive to it. The second group, giving fifty per cent. non-fusion ovules in selfed ovaries, are also heterozygous at the s-locus, but the two alleles are of equal dominance. The third group, giving one hundred per cent. non-fusion ovules in selfed ovaries, are homozygous for an s-allele. Except where a homozygous type is involved as a parent, its allele being dominant to those of the other parent, or where two homozygous genotypes are hybridized, all compatible crosses between self-incompatible trees will produce progeny within which there will be cross-compatible groups, even though all the progeny are self-incompatible. The practical implication of this is that progeny trials usually need not have pollinators planted amongst the seedlings.

151. The self-compatible cocoa tree may or may not contain s-alleles. The Trinidad clone, ICS. 1, is thought to be homozygous for an amorph of the S-series. To explain, however, the emergence of self-incompatible progeny from the cross, ICS. 1  $\times$  ICS. 45 (both parents are true breeding self-compatible clones), it is necessary to postulate the existence of at least one other locus which has complementary relationships with the S-locus. Investigations on the inheritance of compatibility/incompatibility in various progenies raised under the cocoa-breeding scheme have indicated that probable three loci are involved, designated A, B and S. The A and B loci must simultaneously be at least heterozygous before the S-locus shows an incompatibility reaction. If either A or B loci, or both, are homozygous for the recessive alleles, the tree will be self-compatible, even though active S-alleles are also present.

152. Self-compatible cocoa trees may have genotypes as follows:—  
 $aabBS_{x,y}$ ,  $AAbbs_{x,y}$ ,  $Aabbs_{x,y}$ ,  $aabbs_{x,y}$ , and any combination of A, a, B, b, with  $s_{f,f}$  where  $s_f$  is an amorph of the s-series.

153. Self-incompatible trees may have genotypes as follows:—  
 $AABBS_{x,y}$ ,  $AABBS_{x,y}$ ,  $AABbs_{x,y}$ ,  $AAbbs_{x,y}$ ,  $AABBS_{x,f}$ , etc. One practical point of interest to cocoa plant breeders is that all progeny from a cross which involves a self-compatible parent will be back-compatible with that parent.

#### *Growth regulators*

154. A qualitative examination of the auxins of cocoa has been completed and these studies are being extended on a quantitative basis to the fruit. Work on flushing behaviour will be resumed when apparatus for the more sensitive Avena curvature test arrives. Preliminary investigations of the auxins of banana fruits have shown that auxins of the cell elongation type are present in the seeded varieties but not in the parthenocarpic varieties. One of the auxins present in the banana is almost certainly indolyl acetic acid, which has not been found in cocoa.

155. Gibberellic acid, a new plant growth regulator of the non-auxin type, has been shown to accelerate the growth rate of seedling cocoa, doubling the height of treated plants three weeks after application. The interesting physiological feature is that gibberellic acid has no effect on the growth rate of flushes on cuttings. Some of the subsidiary morphological effects of the gibberellic acid led to the suggestion that *Marasmius perniciosus*, the causal fungus of Witches' broom disease of cocoa, might be producing metabolic by-products of the gibberellin type at the green-broom stage and, in co-operation with W. Dudman of the Colonial Microbiological Research Institute, culture filtrates of *Marasmius perniciosus* are being tested on rice and cocoa seedlings.

156. Phloem inversion, the removal of a ring of bark and its replacement upside down, has been found to result in dwarfing and early flowering of many trees. The effect is being investigated with cuttings and seedlings of cocoa and may prove of value in the breeding programme.

#### *Fermentation*

157. The optimal conditions for cocoa fermentation are being reinvestigated in view of the conflicting evidence obtained by previous workers in the field. From the observations made it is evident that a full development of the latent chocolate flavour of the Trinidad bean cannot be induced by a purely thermal treatment of a sterile bean preparation. Moderate to strong chocolate flavour was observed in material prepared by two types of microfermentative technique: (a) where the conditions are such as to allow the normal sequence of micro-organisms to develop; (b) where the sterile bean preparation is treated with substances which induce, under appropriate temperature conditions, a lysis of the tissues of the cotyledon.

158. Experiments are also proceeding on a field method of micro-fermentation employing a plastic container, which on incorporation in a fermenting bean mass permits free diffusion of the metabolically important gases, whilst preventing the entry of pulp liquors from the surrounding cocoa into the sample. The method thus permits the assessment of small samples of cocoa under commercial conditions.

159. An investigation is being carried out on the optimum conditions for the artificial drying of cocoa. The relationship between bean temperature and the flavour character of the product has been explored and the results assessed by the tasting panel. The maximum temperature for optimum flavour development has been shown to be directly related to the degree of post-fermentative oxidation of the bean substrate.

160. The metabolic chemistry of the microflora of the cocoa fermentary is under investigation and the role of microbial metabolites in determining the auxiliary flavours of the bean is being studied. Particular attention is being given to the aetiology of the characteristic auxiliary flavour principles of Trinidad cocoa. It has been shown that bean material, which in normal fermentation is potentially capable of giving some degree of Trinidad flavour, gives rise to a product completely lacking this auxiliary character when the fermentation is conducted under sterile conditions. Attention is therefore being given to microbial metabolic products showing relevant organoleptic properties.

161. Experiments with pure cultures of yeasts isolated from cocoa fermentaries have shown that certain of them are able under optimal conditions to form appreciable quantities of organic esters.

162. The darkening of the pod wall following infection by *Marasmius perniciosus* and *Phytophthora palmivora* has been shown to be largely due to the action of polyphenol oxidase on a single fluorescent hydroxy-aromatic compound, which has been isolated and upon which chemical studies are now proceeding. Epicatechin is present in high concentration in the surface tissue.

#### *Plant Pathology*

##### *Witches' broom disease of Cocoa*

163. Studies on the physiology of *Marasmius perniciosus* have been commenced in collaboration with R. Nichols. It has been shown that the growth of the mycelium of *M. perniciosus* isolated from green brooms and grown on artificial media is greatly stimulated by an aqueous extract of cocoa beans or dry brooms. Also mycelium produced from monospore cultures

is similarly stimulated. By a technique of paper chromatography and subsequent bio-assay an investigation into the active principle involved has been started.

#### *Soils Research and Survey*

164. A method for the measurement of soil pH proposed by Schofield and Taylor has been investigated. So far three Trinidad soils have been examined by this method; River Estate Soil (sandy loam), Montserrat Clay, and San Pablo Soil (calcareous clay). It has been shown that the relationship  $\text{pH} - \frac{1}{2}\text{P} (\text{Ca} + \text{Mg})$ , the "lime potential" of a soil (in terms of activities and not concentrations), is constant for varying weights of soil when equilibrated with 100 ml. of  $\text{CaCl}_2$  solutions of varying strengths. M/100 was selected as the final concentration of  $\text{CaCl}_2$  to be used in the determinations. Shaking time required to reach equilibrium at room temperature ( $28^\circ \text{C}$ ) was as short as five minutes, and little change in pH occurred when the equilibrated suspensions were allowed to stand for periods up to two hours. After further testing on a wider range of soils (with widely differing cationic distribution on the colloids) the method will be considered for routine use.

165. Spectrographic work and combined pot tests on the soils of the Rupununi Savannahs mentioned in last year's report were continued. Preliminary evidence was obtained that plant growth was limited by deficiencies of nitrogen, phosphate, potash, calcium, magnesium, molybdenum, copper and boron. The soils of the area had been previously found to be very sandy with their fine fractions devoid of weathering feldspathic and ferromagnesium minerals. Results of this work are incorporated in a report in the press. It is hoped to apply the same combined spectrographic analysis and pot test technique to the soils of St. Vincent and Grenada now that the field work of the soil survey in these islands is complete.

166. The comprehensive logging procedure of the River Estate cocoa experiments described in last year's report was continued until August, 1957. At this point field operations were stopped and the staff re-deployed in the handling of the data collected. During the period of field work 2,560 leaf and bark samples were taken which have provided 20,480 analytical results. In addition 6,000 dendrometric measurements were taken, 9,000 soil moisture determinations, 147,000 flower and cherelle observations and 8,000 root observations were made. This provides a grand total exceeding 190,000 facts and figures collected in a fourteen month period. To facilitate the handling of this data extensive use has been made of clip cards. The wisdom of adopting this procedure has already become apparent in the preliminary attempts at assessing results.

167. During the year a system of pot tests was initiated with the intention of investigating the differential fertiliser needs of the soils established by the field survey teams in the various islands. A routine testing procedure was visualised using a minimum of soil per pot, in view of the large distances the soil samples have to be carried. Clay pots of  $\frac{1}{2}$  lb. capacity were used, mounted on "Dexion" benches. All pots were watered from beneath from constant level reservoirs supplying water to over two hundred pots for a specified time each day. An arrangement was incorporated in the apparatus which allowed the pots to drain freely. Preliminary tests were carried out using three soils and a variety of crops including lettuce, tomatoes, sorghum, ginger and arrowroot.



*Soil and Land-use Survey*

168. Jamaica: soil survey work continued during the year. The Government of Jamaica has now received twenty-six transparent overlays at 1:12,500 scale of the soil survey of the parish of St. Catherine. Maps at 1:25,000 scale are also available and a report on the soils survey with accompanying 1:50,000 maps is at present being printed. Thirty transparent overlays at 1:12,500 scale of the soil survey of the parish of Clarendon have been completed and will be handed over shortly to the Government of Jamaica. The final report and maps will be ready soon for printing. Field work on the parishes of St. Andrew and St. James is complete and maps and reports on these surveys are presently being prepared.

169. St. Vincent: the soil map of St. Vincent has now been printed in two colours at 1:20,000 scale and the accompanying report will be sent shortly to the printer.

170. Grenada: the field work on the soil survey of Grenada has been completed and the map and report are being prepared.

171. British Guiana: work was continued at first in the northern part of the Rupununi Savannahs. The field party then moved to the Mahdia Valley where another soil survey was made. Later a survey was made of the Ebini Livestock Research Station. Maps and reports of these surveys are in preparation. The final report of work in the southern part of the Rupununi Savannahs is being printed. The accompanying black and white maps have been published at 1:50,000 scale although soil maps (thirteen sheets) of the whole survey area have been made available to British Guiana Government at 1:30,000 scale.

*Statistics*

172. Under the Colonial Development and Welfare Scheme D. 2878 for the improvement of agricultural statistics in British Caribbean territories, investigations have been carried out in preparation for a full agricultural census in 1961, while the necessary procedures for both regular and special sample surveys are being developed and demonstrated to Departments of Agriculture. This work is being carried out in collaboration with Mr. W. R. E. Nanton, the Agricultural Survey Officer, who is in charge of the field operations. The investigations have included the testing of definitions with particular reference to those of a farm and a farmer, and the clarification of associated problems so that future work can be on a comparable basis. In connection with this scheme visits were made with the Agricultural Survey Officer to Dominica and St. Vincent where preliminary arrangements were made for surveys. As usual, the opportunity was taken during these visits to discuss problems of experimental work with members of the Agricultural Department.

173. Sample surveys have been completed in Grenada, Nevis and Montserrat, in the course of which basic statistics on farms, land utilisation, crops and livestock have been collected. The field procedures, which were developed in Grenada and subsequently modified, have worked well in the Leeward Islands. The analysis of the data collected is now being carried out in Barbados under the supervision of the Agricultural Survey Officer.

174. A full report has been prepared for the Central Statistical Office, Trinidad, on the 1956 Sample Survey of Agriculture on farms of less than one hundred acres in Trinidad and Tobago, following the computation of the estimates and the sampling errors. Assistance was also given with a sample survey of food crops in North-east and Central Trinidad which was carried out by a group of post-graduate students. In the design and analysis

of experiments, close co-operation has been maintained with the members of the Trinidad Department of Agriculture. These have included irrigation and cultivation trials and a co-ordinated series of fertiliser experiments on grape-fruit on commercial plantings.

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#### *British West Indies Central Sugar Cane Breeding Station*

175. Conditions for flowering were good, and a full breeding programme was carried out. In addition to the standard crossing method with the Barbados-type lanterns, further experiments were made with cut arrows in preservative solutions of dilute sulphurous-phosphatic acid. Difficulties previously encountered with this technique were overcome, and several thousand seedlings from various crosses were raised. The method has evident advantages, not the least of which is the fact that pollination continues unaided, and without the necessity for daily hand-pollination. In future it is proposed to carry out a considerable proportion of the breeding programme by the solution method, with consequent savings in labour and expense.

176. The successful use of cut arrows in breeding made possible the beginning of a series of experiments to work out a method of emasculation of sugar cane flowers by means of a hot-water technique. On account of the very small and numerous flowers, emasculation by hand is slow and difficult, and is out of the question where large numbers of seedlings are required from emasculated arrows, as in the case of the more refined biometrical methods of parent evaluation, which call for reciprocal crosses as well as selfs. Further experiments are required before a suitable time-temperature relationship can be worked out to ensure male-sterility without loss of female fertility in a hermaphrodite variety.

177. Several varieties were used for the first time in breeding. These included some locally bred and others imported from various countries. New

importations of parent material included commercial varieties, naturally-occurring *officinarums* from the New Guinea collection and a promising *robustum* form. The object is to increase the variability of seedlings subjected to selection by widening the range of parent varieties.

178. Seedling losses in the boxes and after potting out were greatly reduced by the use of a 4:1 soil:filter-press mud medium, which ensures healthy growth and minimises the lime-induced chlorosis often seen at certain stages of growth in previous years. Where, as in certain cases, chlorosis still appeared, treatment with chelated iron compounds proved effective. The maximum numbers of seedlings were taken to field trials in all crosses. In the First Year Trial, cuttings of a standard variety were interplanted among the experimental seedlings. This allowed not only a better assessment of seedling characters, but also a statistical estimate of environmental variation over the area.

179. Good progress was made in the inbreeding work, including the starting of several new lines from parent varieties of proven value. At the time of nursery selection it was found that populations from inter-line crosses and top-crosses on to established parent varieties—and indeed in some cases those from second and third generation selfs—showed good promise in comparison with those from the general breeding programme. This corroborated previous findings and the deductions from theoretical considerations, namely that in interspecific material of sugar cane, selfing results in useful segregation, and the derivatives may be of considerable value not only for subsequent crossing, but also as direct producers of potential commercial varieties. The loss of vigour which usually characterises selfing in simple diploid plants is by no means of general occurrence in the early stages of pure line production in the hybrid sugar cane varieties. These observations tend to support the views of sugar cane geneticists in India, who claim that some commercial varieties once thought to be hybrids might have resulted in fact from a post-meiotic parthenogenesis—a system which does not differ essentially from selfing, in that it involves a re-arrangement of genes without addition of any new ones.

180. In the laboratory, attention was given to the development of a root-tip squash technique, and some progress was made in overcoming previous difficulties met in effecting adequate hydrolysis and critical staining. Further experimentation is necessary, however, before a squash method can be used regularly to replace the embedding technique for chromosome counting.

181. Somatic chromosome counts were made for numerous breeding and commercial varieties, and for individuals in the inbred lines. A comprehensive examination of the Barbados noble cane varieties (*S. officinarum*) to find whether any had resulted from fertilisation of unreduced female gametes, which function in crosses with *S. spontaneum*, showed that all those examined had the 80 chromosomes characteristic of *S. officinarum*, and were derived therefore from reduced parental gametes in the normal way. In an investigation to ascertain the cause of male-sterility in B.37161, pollen mother-cell smears showed that meiosis is very regular for a hybrid of this nature, with 50-54 bivalents and 0-8 univalents. There is usually a single chiasma. Tetrad formation was apparently normal, and it was concluded that sterility is due to breakdown in the maturing pollen grains.

182. The Station's contributing members now include all the British West Indies sugar-growing territories, British Guiana, British Honduras, Guadeloupe, Martinique, St. Croix, Dutch Guiana, Panama, Costa Rica, and a United States Corporation in the Dominican Republic. Cuttings of selected varieties were sent to all contributors, and in addition true seed from a range of crosses

was sent to Jamaica and British Guiana where seedlings produced are screened for resistance to mosaic and leaf scald diseases, respectively, and selections are carried through all stages of a testing scheme in consultation with the Station's officers.

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### V. OTHER RESEARCH PROJECTS UNDERTAKEN WITH ASSISTANCE FROM COLONIAL DEVELOPMENT AND WELFARE RESEARCH FUNDS

#### *ADEN*

##### *Abyan Research Scheme*

##### *Plant Breeding*

183. Two cotton seed bulking schemes have been established, one for Lahej, the other for Abyan and the small outside areas. BAR × L1 will replace AB selections throughout the area in 1960. A bulking plot of K1 (first bulked selections from BAR × L1) at the station will provide the following wave of seed. Work continues on the attempted transference of resistance to Abyan Root Rot of cotton from Wilds Early to Sudan-Egyptian L types. A number of promising lines have been bulked for further testing. An estimate of the degree of natural outcrossing to be expected between L types, at the station's farm in the centre of Abyan, showed that outcrossing between adjacent ridges was of the order of five per cent. No cross pollination was recorded between ridges more than 20 metres apart.

##### *Agronomy*

184. A preliminary field trial on the control of Abyan Root Rot indicated that a degree of control can be achieved by the application of formalin during field flooding. Sulphate of ammonia, applied at sowing time, significantly reduced plant mortality due to root rot. The plant pathology section of the Cotton Research Station, Nāmulongē, are undertaking investigations on the causative organism.

185. Fertiliser trials confirm the results of the previous two years, which showed that a low level of soil nitrogen is a major limiting factor to crop production in Abyan. Very considerable responses were obtained with dressings of 200 lbs. per acre of sulphate of ammonia applied by placement at sowing time. Doubling the rate gave very little additional response. The type of nitrogenous fertiliser is under consideration from the point of view of relative costs and crop responses.

186. A field trial to assess the nutrient value of flood-deposited silt was unfortunately destroyed by Root Rot and no comparative crop data are available. Deposits of silt and flood-borne top soil, resulting from one flooding, averaged approximately 300 tons per acre.

187. Investigations on sowing the cotton crop prior to flooding have so far indicated that this system may have considerable merits because of the initial boost it gives to the crop. Its practicability under normal field practice depends on a greater degree of control of field watering being achieved.

*Soil Science*

188. The work is concerned with the relationship between soil moisture, salinity and alkalinity in relation to fertility. Irrigation experiments have indicated that much of the commercial crop is consistently overwatered. Water control methods based on infiltration rate measurements have therefore been developed for use by farmers. The movement of the water-table is being analysed regularly and the changes in its chemical composition recorded. One field survey of a devastated area was completed but any major development of reclamation will have to wait until the correct watering practices are adopted throughout the area.

189. The changes occurring during saline-alkaline deterioration have now been fairly fully described. A typical saline profile may have as much as a 1000 m.eq./l. of salts in the saturation percentage extract of the upper foot of soil profile, while at 3 ft. depth this may be as little as 20 m.eq./l, which is as saline as the saturation extract of the "normal" (not visibly saline) profile. The chemical composition is, however, different, the more saline profile being invariably more highly saturated with sodium. The fine sandy loams which are typical of the best Abyan land do not suffer unduly in their physical properties, and appear to regain their fertility when the water-table is lowered.

190. The water-table depth below soil-surface is undoubtedly very critical, a change of as little as 10 cms. in the micro-relief determining whether a worthwhile crop can be grown or whether complete failure occurs. The tracing of impermeable layers and the plotting of seepage channels has not been possible this season owing to the disturbed conditions at Abyan. The importance of the presence of layers of coarse sand, which allow rapid lateral seepage, has been emphasised by earlier work.

*Entomology*

191. Entomological work has been confined mainly to Abyan with monthly visits to Lahej—the other large cotton-growing area of the Protectorate. The primary object has been to obtain some idea of the importance of the various pests, and much data has been obtained through regular surveys were interrupted owing to the disturbed conditions at Abyan. The Sudan, or red bollworm, occurs everywhere but has not so far been serious this season in any area sampled. American bollworm caused some loss of buds in a few areas early in the season but this loss would doubtless have been made good by the plants. Spiny, or Egyptian bollworm has been negligible and pink bollworm has not yet been found. Jassids multiplied only late in the season and will probably not affect the yield. Whiteflies and flea-beetles have never become abundant on cotton, and thrips are found only occasionally.

*ANTIGUA**Cotton Research*

192. Work continued on the Sea Island Cotton crop involving the breeding and testing of three major cotton types, agronomic studies on yields, fertilizer trials and on pest control, the latter mainly concerned with Pink Bollworm.

*BASUTOLAND**Soil and Crop Research*

193. Research into soil and crop problems was continued on the Maseru Experiment Station, on six small district sub-stations, and on farmers'

holdings. More information was collected on the dominating phosphate deficiency in lowland and foothill soils. Phosphate fertilizers bring about 100 per cent. and greater yield increases in all crops on most sites in these regions. The conclusion is drawn that the general use of phosphate fertilizers will make the territory more than self sufficient in food production. Co-operative statistically analysed experiments on Basuto farms demonstrated that the use of fertilizers is highly economic and that first year residual effects are large. No benefit is obtained from applications of potash, irrespective of soil type. The Mountain Black Clays are extremely fertile and do not respond to manuring.

194. Important results were obtained on the use of nitrogenous fertilizers for maize. Response to N is related to plant population. An application of 60 lb. N per acre to a stand of 15,000 plants per acre, with basal phosphate, increased grain yields by 1,750 lbs. per acre. In another trial a considerable response was obtained from an application of limestone ammonium nitrate (40 lb. N per acre) ploughed in with the stover in winter. Where no stover was incorporated the nitrogenous fertilizer was less effective. No responses to N were recorded in sorghum, while for winter wheat the effect of N is found to depend on spring rainfall conditions.

195. The liming of acid red ferruginous soils has been proved highly beneficial, and on the lateritic foothills red loams on basalt (pH 5.4), maize responses to liming of 1,300 lb. per acre have been recorded. On the lightly buffered grey-brown sandy loams of the lowlands liming is dangerous and severe minor element deficiencies are readily induced.

196. Field experiments with minor elements have given indications of a widespread molybdenum deficiency in the lowlands and foothills. Applications of molybdenum trioxide at the rate of 4 ozs. per acre produced significant responses in field beans and maize (which had received adequate basal fertilizer) on sites representative of the three main soil types in these regions. Considerable significance is attached to the results, which may have implications for large areas of Southern Africa. The relationship between the results and those from lime trials requires investigation. In greenhouse pot experiments a deficiency of sulphur in a lowland grey-brown (solonetzic) sandy loam has been demonstrated. In one field trial an application of gypsum increased maize yields by 440 lbs. per acre.

## BRITISH GUIANA

### *Ebini Livestock Station*

197. Beef-type Brahman cattle were imported from Jamaica to form a pure-bred herd for the production of half-bred bulls for distribution and to be used for crossing. Santa Gertrudis and Sahiwal bulls were also used for crossing with promising results. The herd now totals 818 animals and the majority of these are grazed on the infertile mineral deficient savannahs. The carrying capacity of the fenced savannahs has been raised to about 20 animals to the square mile. Improved fertilized pastures using Pangola grass (*Digitaria decumbens*) and Bahia grass (*Paspalum notatum*) were extended with the object of studying the economics of raising cattle on improved savannah. Studies on the growth rate of calves show a daily liveweight increase from 1 to 1.5 lb. The average liveweight gain of steers was 0.5 lb. per day. Mineral consumption was 1.16 oz. of trace element bone flour per head per day together with half this quantity of salt. Carcase quality was studied and killing percentage averaged 45.4 per cent. Other work included preliminary heat tolerance studies, force feeding of copper and cobalt, chemical weed control and citrus culture.

*St. Ignatius Livestock Station*

198. Seven beef-type Brahman bulls were introduced from Jamaica to improve the herd which was increased further by the purchase of 150 locally bred heifers. The herd now totals 403 head. The Santa Gertrudis bulls have produced promising cross-bred calves. Four Border Leicester ram lambs and ten ewe lambs have been imported. The fencing programme is well advanced with the completion of 35 miles of fence; about 15 miles of fencing remain to be erected. Better types of grasses, including Molasses grass (*Melinis minutiflora*) and Bahia grass (*Paspalum notatum*), show promise for fertilized pastures. Jaragua grass (*Hyparrhenia rufa*) and Nadi Blue grass (*Dichanthium caricosum*) may also prove useful. Growth of maize on the open savannahs was unsatisfactory despite the use of fertilizers.

*Cotton Investigations*

199. Conclusions so far drawn from these trials are that the unreliability of the seasons for land preparation and harvesting makes the crop hazardous. The sand reef soils, which are limited in occurrence, are the only really suitable soils, but the crop requires heavy fertilizing on all soil types. Blackarm disease-resistant varieties must be used, and BLR 14/25 and BAR × L1 are the most suitable. Stainer and jassid control as routine measures are essential for good yields of clean cotton. Under present conditions, the crop is not adaptable to estate management and can best be considered for organised groups of small farmers. The practice of cutting back the cotton plants to allow a second picking from new growth in the following season shows considerable promise and is being investigated further. Good yields of high quality cotton can be grown under favourable weather conditions which are generally infrequent.

*Soil Surveys*

200. Surveys were carried out on the coast and in the interior. Soils of the Mahdia valley were of poor fertility, but much more promising soils were discovered in the Kamarang and Kuki valleys of the upper Mazaruni basin. The area is large enough to be considered for settlement but is most inaccessible. Survey of the Mara Land Settlement and adjoining areas indicates that the majority of soils are quite suitable for agriculture with no problems of aluminium or sulphate toxicity. The survey of Hog Island in the Essequibo River indicated that the area was suitable for agricultural development provided it was empoldered and drained. A fair proportion of the area was overlaid with pegasse (tropical peat) and toxic concentrations of aluminium were found in this soil type.

*BRITISH SOLOMON ISLANDS PROTECTORATE**Premature Nutfall of Coconuts*

201. This trouble is caused by the Coreid bug *Amblypelta cocophaga* which is controlled by two, but unaffected by the other two, of the four ant species commonly occurring on coconut palms. No method has yet been found of modifying the ant populations in favour of the beneficial species, although long-term ground cover experiments are being carried out. During 1957 attention has been concentrated on developing a direct method of controlling *Amblypelta* with insecticides, although trunk spraying is still being carried out in a limited area in an attempt to prevent the spread of harmful ants.

202. Laboratory work with insecticides has comprised biological and chemical tests to determine the lethal dose, for contact and residual effect against the adult and young stages of *Amblypelta*, and also the effect of

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varying the droplet size of the spray. The persistence of different insecticidal formulations on coconut tissue is also being compared. This work has been almost exclusively with DDT so far, and was incomplete at the end of 1957.

203. In connection with future field mist spraying trials it is most desirable to have a rapid method of assessing the degree of control of *Amblypelta* being achieved, rather than waiting a year and measuring crop increase. The amount of damage on young fallen nuts may provide a means of doing this, and observations were commenced in 1957 on plots in several areas having different degrees of *Amblypelta* attack, in an attempt to correlate degree of damage on young nutfalls with final yield. It will be necessary to continue these observations for at least a year before any definite conclusions can be drawn. It is hoped that it will be possible to decide on a figure for the percentage of young nutfalls bearing *Amblypelta* feeding scars, which will indicate that adequate control of *Amblypelta* and a full crop are being obtained. The target in spraying trials will then be to reduce the damage rate to this figure.

#### *Pests of Cocoa*

204. Cocoa is a new crop in the Protectorate, and several indigenous insects have shown themselves capable of causing damage. A limited amount of investigational work is being carried out on them. The two most important at present are *Amblypelta cocophaga*, the same insect which causes early nutfall of coconuts, and the weevil *Pantorhytes biplagiatus*. *Amblypelta* damages the fruit and the young shoots. The damage from *Pantorhytes* is caused by the larvae which bore beneath the bark of trees from about two years old onwards. The bark beetle *Xyleborus fornicatus*, in association with the fungus *Corticium salmonicolor*, has proved capable of killing young trees, but its occurrence so far is not widespread.

### DOMINICA

#### *Crop Pests*

205. Studies on the biological control of certain pests have led to considerable success especially for the Sugar Cane Borer (*Diatraea saccharalis*) which has been controlled to a great extent by introductions and liberations of *Lixophaga diatraeae* and *Paratheresia claripalpis*. Introductions of *Metagonastylum minense* have proved less successful, but further attempts have been made to establish this parasite. Other pests included in the investigations are the Citrus weevil (*Diaprepes* sp.), Coffee Leaf Miner (*Leucoptera coffeella*), the Banana Borer (*Cosmopolites sordidus*), various species of fruit-piercing moths attacking citrus and miscellaneous pests of food crops. Adults of *Plaesus javanus* and of *Leionota quadridentata* have been introduced and released to control the banana borer.

### FIJI

#### *Animal Husbandry*

206. Facilities have now been completed on the Principal Agricultural Station for investigations into the economics of indoor, i.e. permanently housed, dairying.

207. After considerable difficulties ten Santa Gertrudis females were secured from the United States. These will not be fit for breeding for possibly 12 months, and meantime the previously imported bulls will be used to upgrade local beef stock. Eventually the Fiji Department of Agriculture will be able to supply purebred Santa Gertrudis bulls to local beef breeders.



208. The emphasis on pasture improvement work is now moving from flat and undulating country where management problems still, however, remain, to the improvement of hill country, particularly in the intermediate and drier climatic zones of the Colony.

## GAMBIA

### Groundnuts

209. With experiments using Agrosan seed dressing, dressed seed gave significantly higher yields of unshelled nuts over the controls; the distribution of Agrosan to farmers is being made on a limited scale in 1958.

210. Experiments on the use of groundnut shells, which are a by-product of the Decorticating Mills, have produced intriguing results. In 1956 mulched and unmulched Pennisetum gave a mean grain yield of 1,236 lbs. per acre, and differences were not significant. The same plot in 1957 was disc-harrowed and sown with groundnuts, and the former shell-mulched sub-plots gave a mean yield of 2,700 lbs. of unshelled nuts per acre, and the unmulched 2,006 lbs., an increase of 694 lbs. or 34.6 per cent., which was very highly significant at the 0.1 per cent. level. Further trials have shown that a groundnut shell mulch on fallow land increased the yield of groundnuts in the following year by 63 per cent. (884 lbs. per acre) as compared with the yield following a weedy fallow. Since the Decorticating Mills occur at only three scattered sites in the Gambia, the problem of transporting shell mulch arises. Trials at three sites using a grass mulch have demonstrated that six inches of grass applied to the inter rows of six weeks old groundnuts increased the unshelled groundnut yield by 26.3 per cent., 73.9 per cent. and 77.8 per cent. respectively. Burning the same quantity of grass *in situ* increased the yield by 20.3 per cent., 38.6 per cent. and 26.7 per cent., and applying ash (the grass being burned elsewhere) gave increases of 21.2 per cent., 55.6 per cent. and 40 per cent. respectively.

211. Trials on different methods of planting groundnuts, of pre-planting cultivation and perimeter bunding were continued both at Yundum and at other sites. Variety trials and selection work on groundnuts, sorghum, maize, millets and castor were also intensified at Yundum, and data on the performance of varieties continues to be accumulated. The variety of sorghum, Dwarf Hegari from the Sudan, has appeared most promising and seed of this early maturing variety is being distributed to farmers. Seed of the South African Top Cross (Potch Pearl  $\times$  K.64) is also reserved for trial distribution to farmers during 1958.

212. Efforts to produce an economic cash crop as an alternative to the groundnuts have continued to centre on cotton. Despite the incidence of attacks by cut worms, hairy caterpillars, leaf roller, cotton stainers, boll worms and late Blackarm disease, a promising yield of 1,347 lbs. seed cotton per acre was obtained from the Nigerian variety Samaru 26C. Plants have been selected for earliness and yield for progeny observation in 1958. The perennial Marie Galante variety (*G. hirsutum* var. *africanum* ex Carriacou, B.W.I.) withstood over seven months dry season (October to May) to produce a promising crop which is being analysed.

213. The use of fertilizers forms an essential part of the research work and efforts to assess experimentally the limiting factors to plant growth have been continued. A 3  $\times$  3  $\times$  3 NPK trial obtained a notable response to potassium sulphate applied before sowing, a small response to superphosphate applied before sowing, and a negligible response to ammonium sulphate applied six weeks after sowing. Ground limestone applied with and without NPK had no effect on pH nor on yield of groundnuts.

214. Following the successful use of the subtractive method of detecting mineral deficiencies of soils in pot tests, the method was extended to field trials. On groundnut and grain crops in 1955 and 1956 these trials were inconclusive for some elements, but it was believed that deficiencies of N S P K and Ca existed—elements which are generally applied in a normal NPK fertiliser; B and Cu were possibly deficient. These trials probably suffered from an excess of trace elements. No trace element deficiency appeared in the 1957 trial on groundnuts, and on this occasion treatments may well have contained insufficient trace elements. The problem of finding a suitable subtractive trial which contains adequate, but not toxic, quantities of all essential elements has not yet been solved. It is worthy of note that at the seven scattered sites for the 1957 subtractive trial, the responses to treatments at the different sites were remarkably similar, despite the fact that the control plots yields varied from as little as 581 lb. of unshelled groundnuts per acre to as high as 1,716 lb. per acre. The lowest control yields came from Gambian farmers' land typical of the area in which the site was chosen; the remaining sites were on departmental stations and sub-stations. Nevertheless the results of field trials, particularly of 1957, have shown that a fertiliser capable of giving increases in yield of groundnuts of economic importance can reasonably be expected.

215. A study of the possibilities and limitations of the Homes Method of Systematic Variations in fertiliser investigations is being made. Preliminary results in pots are very satisfactory, and the methods used have brought to light valuable information on the nutrition of the groundnut.

### *NORTH BORNEO*

#### *Abaca Bunchy Top Disease*

216. There was improvement in the control of Bunchy Top on abaca estates except in one place. The removal of the infected plants followed by insecticide spraying of three squares of adjacent mats appears effective provided no new foci arise from outside the controlled area.

217. Experiments on the development of the disease from planting material from diseased mats showed very few cases of virus symptom expression. It appears that the incubation period is very variable and can be very long, or the rate of multiplication and translocation of the virus is very slow, so that it had not moved into the planting material (corms of various sizes) when they were separated from the original diseased mats.

218. Edible bananas showed more severe symptoms than abaca, and these persisted till fruiting. Abaca showed milder symptoms which were often evanescent and which might or might not recur.

219. Studies were begun on aphid movement which was found to be faster in old plantings with a dense leaf canopy than amongst young plants. Re-infestation of plants freed from aphids with insecticides generally occurred in three days (range 2 to 14 days) over distances of three rows of plants.

220. Comparison was made of the spraying equipment in current use with the Long Ashton Research Station power spraying originally designed for spraying bananas, and incorporating a centrifugal pump. Spray distribution was studied by incorporating a fluorescent material in the spray with subsequent examination of foliage in ultra-violet light and also by chemical analyses of spray deposits. Using two hoses on the Long Ashton machine, with one long and one short lance, considerably better cover can be obtained. While it is not possible at this stage to give detailed conclusions it is thought that adequate wetting, longer residual effect and better spray-cover will lead to better control at less cost.

*Forest Research*

221. Due to the most unfortunate death of G. H. S. Wood in May, 1957, relatively little work has been possible. One month was spent in intensive botanical collecting in the Territory of Brunei when about 330 new collections were made. Since then work has been brought up to date in the herbarium. 399 numbers were distributed to each of the seven herbaria which receive our collections, and 1,036 determinations were received from Kepong (52) Leyden (697) and Singapore (287). All "additional notes" for every collection made by Mr. Wood were distributed to each receiving herbarium. The preliminary manuscript copy of Mr. Wood's book "Common Dipterocarp Trees of North Borneo" will shortly be published in the Malayan Research Pamphlets series. Demand for wood samples remained strong. All told, 762 hand samples were distributed and about 240 smaller trade samples sold to outside buyers. Few wood collections were made as these can only be made when collecting botanical material.

*Silvicultural Research*

222. Trials with 2, 4-D and 2, 4, 5-F showed that when used in a frill girdle these materials are only a little more expensive than sodium arsenite and just as effective. They are now being employed on the West Coast where it is not possible to use sodium arsenite. About 1,000 acres in the Kimanis Forest Reserve is being treated as a large scale experiment.

223. A major experiment has been designed to give accurate information on the timing of the regeneration tending operations after logging. It may be found that for silvicultural reasons, i.e. growth and particularly specific composition of the regeneration, a delay in girdling may be desirable. This will take many years to finalise, but in the meantime useful information on logging damage, survival of seedlings, etc., has been accumulated. Because so few undamaged advance growth of good form remain after logging, it is thought that the present policy of relying on the seedlings to form the next crop is a sound one. In conjunction with this experiment an endeavour is being made to determine the optimum light requirements of seedlings of various species. This will enable a greater control to be exercised over the composition of regenerated crops by altering the amount of opening up after logging.

*Mensuration*

224. Summaries of all measurements of sample plots were made. The results obtained have to be used with caution, since many of the measured trees were not dominant. However, when these are discarded it is found that all of our important trees will be of good millable size in 80 years at least. Some, such as Majau and Urat mats, are very fast growing and will reach a size of 8 ft. girth in 54 and 60 years respectively.

*Timber Research*

225. The graveyard test laid down in 1956 was inspected after one year. Good control was given by the two preservatives used, namely Nux-bora 8x and Nux-bora 15x. It was shown that though untreated red seraya and keruing both show similar average amounts of degrade after one year, red seraya is more susceptible to complete failure.

226. During the year the Department undertook to carry out investigations into a number of common defects particularly in Urat mats. A number of these such as "brown stain" and "Dote" became troublesome; the latter, which occurs in converted timber, was controlled by dipping in borax and boric acid. The former is still under investigation.

## NYASALAND

227. Work on the new buildings of the Silvicultural Research Station in Chongoni Forest, near Dedza, has proceeded very satisfactorily during the year, and it is expected that they will be ready for occupation before the middle of 1958. Until then, work continues in temporary accommodation at Dedza.

228. The Silviculturist's programme of field studies during the year included the following: Soil moisture studies in *Brachystegia* woodland and grassland; Soil survey in relation to natural regeneration of *Widdringtonia whytei* in planted stands in Zomba Plateau Forest, and a series of measurements of all age classes in all species of pine in the trial plots established by the Nyika Syndicate on the Nyika Plateau. Field trials included the following: A comparison of three different thinning intensities in *Widdringtonia whytei* in Zomba Plateau Forest; a spacing trial of *Widdringtonia whytei*, and a trial mixture of this species and *Cupressus lindleyi*; a replicated trial of N P and K fertilizers in pine plantations; an underplanting trial with *Pinus patula* under *Brachystegia* cover, and a trial to test the effects of planting *Pinus patula* in cultivated contour trenches. These trials were laid out in Nchisi Forest in the Central Province, where establishment of pines has proved difficult. In Mua-Livulezi Forest the trial plantation of *Pterocarpus angolensis* batons was extended.

229. In Lusangadzi Forest a series of trial plots was laid out, using *Eucalyptus saligna*, *Eucalyptus microcorys*, *Eucalyptus maidenii* and *Eucalyptus maculata*, planting being done under a moist woodland type of canopy of *Brachystegia*, *Uapaca* and *Parinari* spp. in order to test the possibilities of establishment of eucalypts under an undisturbed canopy, and one with all trees less than 6 inches D.B.H. removed, and in order to compare the results with establishment on cleared ground.

*Botanical Collection*

230. The Forest Herbarium was transferred to Dedza from the Headquarters Office at Limbe, and a considerable amount of further collection was done on field trips by the Silviculturist. In addition to these, 160 specimens of trees and shrubs were collected by Mr. J. D. Chapman, Assistant Conservator of Forests, on Mlanje Mountain, many of which were obtained in the mixed *Widdringtonia* and evergreen forest in the Upper Lukulezi Valley. An event of great interest and importance was the publication early in the year of the "Trees of Central Africa," by Olive Coates Palgrave, in which 110 indigenous trees are described and illustrated with coloured paintings and photographs, published by the National Publications Trust, Salisbury.

*Forest Utilization*

231. During the year an experiment to investigate sawing and air seasoning of Mlanje Cedar was initiated. Internal tests were carried out on conversion rates for *Cupressus lindleyi* of various size classes. The Forest Products Institute, Pretoria, has now reported on tests carried out on representative samples of *Eucalyptus saligna*. The report indicates that the density and strength properties of Nyasaland-grown material are very similar to those of mature *Eucalyptus saligna* grown in South Africa.

## ST. LUCIA

232. Trials with American hybrid maize showed one strain to be superior in yield to local maize under good growing conditions, but local maize showed greater resistance to insect attacks. Leaf scald disease of sugarcane was

identified, and certain varieties were highly susceptible. Banana nematode disease ("Toppling Disease") has been found in the northwest of the Island. For the control of Banana Leaf Spot, applications of copper sprays at 21-day intervals were found inadequate even in the drier months. Zineb was superior to copper, and alternate applications of zineb and copper oxychloride on a 10-day cycle was superior to copper alone.

233. Applications of CMU at 2 lb./acre to pineapples six weeks after planting effectively controlled broad leaved weeds and most grasses except *Sorghum halipense*.

### ST. VINCENT

#### Arrowroot

234. Much variation has been discovered in the arrowroot selections made the previous year, and the five best clones of each of the Banana and Creole varieties have been selected for multiplication and testing in replicated plots against a range of clones showing poorer performance. Additional material is being selected in the field for further testing. A time of harvesting versus time of planting trial with arrowroot has been started but results are incomplete.

235. Encouraging results have been obtained with the pre-emergent application of 2,4-D and MCPA herbicides to arrowroot, and extensive trials on a field scale are in progress. Post-emergence applications of a range of herbicides to control weeds in arrowroot have been disappointing.

236. A trial to determine the best time for the application of fertilizer to arrowroot has indicated that there is no benefit derived from the early application of phosphate and potash, nor from splitting the nitrogen application. The trial has confirmed earlier work which showed that maximum results were obtained when the NPK mixture was all applied to arrowroot at the flowering stage at 3½-4 months after planting. This trial is being repeated under a range of conditions.

### SARAWAK

#### Pepper Disease

237. Foot-rot disease is now confirmed in the first, second, third and fourth Divisions where the main pepper producing areas are found.

238. Oospores which resemble those of *Phytophthora hibernalis* Carne have resulted from culture work by the Commonwealth Mycological Institute. If this identification is confirmed *Piper nigrum* L. will become a new host record. Most commonly the fungus attacks the youngest roots first. From there it spreads into older roots and so into the underground stem at which stage death of the vine occurs. The field identification of the disease is facilitated by a characteristic juncture between healthy and necrotic parts of the cortex of stem and roots. Root infection may already be widespread in a garden when the first vines begin to die. On only two occasions has leaf infection been found: in both cases in cuttings rooting in beds.

239. In an attempt to find a resistant stock, cuttings of four Indian and three Indonesian varieties have been introduced. One of the Indonesian varieties obtained was reported, over twenty years ago, to show resistance to foot-rot. However, in the areas of Indonesia where the variety is grown, foot-rot disease does occur.

240. Methods are being devised to study (a) the survival of the fungus in infected host material, (b) the behaviour of the fungus in the soil when

introduced free of host material. A study on the course of infection from single point root inoculations is also in progress.

#### Publication

HOLLIDAY, P., and MOWAT, W. R.—A Root Disease of *Piper nigrum* L. in Sarawak caused by a species of *Phytophthora*. *Nature, Lond.*, 179 (1957) 543.

#### Colonial Pool of Entomologists at the Commonwealth Institute of Entomology

241. Mr. E. S. Brown was working at the Institute for the greater part of 1957, following his return from the British Solomon Islands. During this time he prepared seven papers for publication concerning the results of his investigations of the Coreid bug, *Amblypelta cocophaga*, that causes premature nutfall of coconuts, and other insects of economic importance to the Protectorate. In December, 1957, he left for the Middle East, on temporary secondment to the Foreign Office for work, under the Economic Aid Agreement clause of the Baghdad Pact, on the sunn pest, *Eurygaster integriceps*, which causes serious damage to cereal crops in that region. Mr. C. R. Wallace was posted to the island of St. Helena in August, 1957, after a short preparatory period at the Institute. He is making a general study of the insects of economic importance in the island, the first that has ever been made there; his work has already shown the need to control the eucalyptus weevil, *Gonipterus scutellatus*, and parasites are accordingly being sent to him through the collaboration of the Department of Agriculture, Union of South Africa.

242. Dr. I. W. B. Nye has completed his two-year assignment to East Africa for the survey of the pests of tropical cereal crops, and he will require to spend some months at the Institute on his return in the further study of the material he has collected and in the preparation of reports and papers.

#### Colonial Pool of Plant Pathologists

243. The progress made in the investigation of pepper foot-rot (*Phytophthora* sp.) in Sarawak by Mr. Holliday has not yet reached the stage when satisfactory control can be achieved.

244. Dr. Wheeler's report on his investigations into *Alternaria longpipes* leaf spot of tobacco in Nyasaland has been prepared. The Colonial Development Corporation report that no serious outbreak of the disease has occurred on their estates in Nyasaland since the recommendations made as a result of this work were put into practice.

245. Dr. Wheeler spent six months in Malta making a preliminary survey of economic crop diseases. A total of over 120 major fungal, bacterial, and virus diseases has been confirmed by the herbarium and Drs. Dowson and Kenneth Smith respectively.

246. On the recommendation of Dr. Hopkins, after his visit to the Island, Dr. Wheeler has commenced an investigation of wither tip disease of limes (*Gloeosporium limeticola*) in Zanzibar.

#### Colonial Termite Research Unit

247. Taxonomic work was continued at the British Museum (Nat. Hist.) by Mr. W. V. Harris and Mr. R. M. C. Williams. Identifications numbering 122 were made, covering a diversity of sources from living termites arriving in England in imported timber, to pests of cotton in Aden, jute in Bengal and a Royal Naval vessel in Singapore. Two large collections worked out in detail and the results submitted for publication were from the British Solomon Islands Protectorate and the Parc National de l'Upemba, Congo Belge.

Registered accessions to the termite collection of the Museum during the year were 27,850, of which 27,614 were donated by or passed through the Unit. Living termites for class and research purposes have been supplied to a number of University Zoology Departments.

248. Information on termites has been supplied to: Ecuador, Ghana, Iraq, Jamaica, Madeira, Nigeria, Philippine Islands and Queensland. Recommendations were made on mound destruction, site poisoning, and proofing of hardboards, plasterboards and cables.

249. Field work has been continued in Nigeria. Mr. W. A. Sands has covered a wide area in the course of his termite survey, and is co-operating with the Forestry Department, Northern Nigeria, in the control of termites in forest nurseries and in young plantations in semi-arid conditions. Mr. W. Wilkinson has recently returned to this country on the conclusion of his work on dry-wood termites of the genus *Cryptotermes*, with special reference to laboratory methods of testing for resistance in materials at the Ministry of Supply's Tropical Testing Establishment, Port Harcourt, Nigeria.

#### *Publications*

HARRIS, W. V.—Introduction to Malayan Termites. *Malay Nat. J.* 12 (1957) 20–32.

HARRIS, W. V.—More about Dry-wood Termites. *East Afr. agric. J.* 23 (1958) 161–167.

#### *Colonial Pool of Soil Scientists (formerly Colonial Pool of Soil Surveyors)*

250. All members of the pool (6) were engaged overseas in territories including Hong Kong, Northern Rhodesia, Swaziland, Sierra Leone, Malta and British Guiana. A soil map of the Copperbelt in Northern Rhodesia has been published together with analyses and field observations on land use and farming efficiency. Selected areas in British Guiana have been surveyed with the co-operation of the Regional Research Centre, British West Indies. To meet the need for agronomic work to follow soil surveys in territories with limited resources, the Pool has been increased to include three Agronomists. The Pool has been re-named the Colonial Pool of Soil Scientists to conform with its widened scope.

#### *Colonial Liaison Officer at the Pest Infestation Laboratory, D.S.I.R.*

251. The Colonial Pest Infestation Liaison Officer (Mr. D. W. Hall) was on tour in the Colonies on three occasions. He visited Nigeria and the Gold Coast accompanied by Mr. A. E. H. Higgins of the Colonial Spraying Machinery Pool to study the methods which had been adopted for controlling the insect pests of stored cocoa. He later revisited Nigeria with the Chairman of the Stored Products Research Sub-Committee, Mr. G. V. B. Herford, to attend the West African Stored Products Research Unit Reviewing Committee, and then visited Sierra Leone and the Gambia. Mr. Hall also spent three weeks in Jamaica discussing local storage problems and the programme of work to be carried out by a stored products entomologist newly appointed to the Ministry of Trade and Industry. Mr. H. K. Heseltine of the Pest Infestation Laboratory (D.S.I.R.) visited Kenya to assist with experiments to determine the distribution of methyl bromide gas throughout stacks of bagged maize covered by gas proof sheets.

252. The seriousness of insects being spread throughout the world by trade is slowly being realised by a wider circle of organizations. The East African territories have introduced legislation to minimise the possibility of the insect *Trogoderma granarium* being imported on produce and sacks. This insect, which is not easy to control, has gained entry into territories such as Sierra Leone, the Gambia and Zanzibar.



253. In certain territories stacks of bagged produce fumigated under gasproof sheets with methyl bromide have been found a few weeks later to be infested, particularly with *Tribolium castaneum* and *Oryzaephilus surinamensis*. The problem appears to be one of reinfestation after fumigation rather than survival of insects from fumigation. Several new types of material for gasproof sheeting are being tested at the Pest Infestation Laboratory for their permeability to methyl bromide vapour and in a number of African territories for their efficiency under tropical conditions.

254. Encouraging results on the control of certain stored products pests, particularly *Oryzaephilus* sp., with Malathion have been obtained in Southern Rhodesia and Northern Nigeria. These results were encouraging both from the effective kill of insect pests, and from the lack of appreciable contamination of the produce.

255. In the 1956-57 report (253) reference was made to experiments to determine the taint and toxicity hazards to cocoa when the insecticides DDT and lindane are used in certain prescribed ways. Cocoa beans were mixed with lindane dust to concentrations of 1.0, 2.5, 10 and 20 p.p.m. Untreated beans were packed in standard type sacks of which the surfaces were dusted with 0.5 per cent. lindane dust and sprayed with 50 per cent. lindane dispersible powder and with 50 per cent. DDT paste to give 40 mg. per sq. ft. of gamma BHC and 100 and 400 mg. per sq. ft. of DDT. In the case of the beans mixed with lindane dust, chemical analyses indicated that there was no detectable gamma BHC in the kernel but only in the husk and even then at an extremely low level. In the case of the surface treatment of sacks the insecticidal content of the beans was very low except in the case of the 400 mg. per sq. ft. of DDT treatment, in which an average sample of beans from these sacks contained 3.2 to 4.6 p.p.m. of DDT. Tasting tests carried out by the Cocoa Scientific Advisory Committee of the Cocoa, Chocolate and Confectionary Alliance did not detect any significant off flavours which could be attributed to the insecticidal treatment.

256. In British Guiana a rice storage research group has surveyed the practical post harvest problems, advised on the use of insecticides, has set up laboratory experiments to determine the damage and loss caused to paddy and rice by certain pests, and is experimenting to determine the efficiency of a small drier and small wooden bins for rice storage.

257. The experimental work on rice storage problems being carried out by Mr. P. Prevett in Sierra Leone are indicating the suitability of bulk storage for rice and the efficiency of certain insecticides when applied to this commodity stored in bags.

258. In the Gambia experiments have been carried out on the varietal differences in groundnuts in susceptibility to attack by *Caryedon fuscus*. The applied work being carried out on groundnut storage to minimise the losses from insect pests is progressing satisfactorily.

259. In 1957 a stored products specialist (Mr. J. A. McFarlane) was seconded to the Ministry of Trade and Industry in Jamaica. This officer has carried out experiments to elucidate local problems with pimento, ginger, cocoa, copra, coffee, kola nuts, maize and pulses. Valuable scientific data have been obtained. Legislation providing for the storage of food, for the prevention of loss of food by infestation, and for purposes connected therewith, has been gazetted. The formation of a new storage and infestation division has been approved by the House of Representatives and by the Executive Council.



**Publications**

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HASWELL, G. A. and OXLEY, T. A.—A thermocouple spear for temperature measurement in stacks of bagged produce. *Trop. Agric., Trin.* 34 (1957) 55.

HOWE, R. W. and LEFKOVITCH, L. P.—The distribution of the storage species of *Cryptolestes* (Col., Cucujidae). *Bull. ent. Res.* 48 (1957) 795.

LEFKOVITCH, L. P.—The Biology of *Cryptolestes ugandae* Steel and Howe (Coleoptera, Cucujidae), a pest of stored products in Africa. *Proc. zool. Soc. Lond.* 128 (1957) 419-429.

LEFKOVITCH, L. P.—Further records of *Laemophloeinae* (Col., Cucujidae) in stored products. *Ent. mon. Mag.* 93 (1957) 1121.

LEFKOVITCH, L. P.—A new genus and species of *Laemophloeinae* (Col., Cucujidae) from Africa. *Ent. mon. Mag.* 93 (1957) 271.

SOUTHGATE, B. J. and POPE, R. D.—The groundnut seed beetle, a study of its identity and Taxonomic Position. *Ann. Mag. nat Hist.* 10 (1957) 669.

**Research Studentships**

260. Seven Research Studentships were awarded covering training in Veterinary subjects (2), Agronomy (3) and Entomology (2). There remained seven in training from the previous year, a total of 14 research students.

## VI. RESEARCH UNDERTAKEN BY COLONIAL DEPARTMENTS OF AGRICULTURE, FORESTRY AND VETERINARY SERVICES

**ANTIGUA****Livestock**

261. Work continued at the Central Experimental Station in the further development of the Nelthorp breed for beef production. Favourable results were obtained in the selection of animals for early maturity. The establishment of new pastures with Pangola (*Digitaria decumbens*) and Coastal Bermuda (*Cynodon* sp.) continued with better results as improved methods of establishment were developed. The analysis of pasture grasses was started with a view to applying the results for the improvement of the management of respective types of pastures.

**BARBADOS****Agronomy and Agricultural Chemistry**

262. The 1957 results of sugarcane ratoon cultivation trials showed a reduction in yield from subsoil cultivation of ratoons. Food crops again had no effect on the subsequent cane crop. Mulching had no effect on plant cane yields at Waterford.

263. Drilling operations have been continued and the position of underground streams and the boundaries of the sheet water area in certain districts have been precisely determined. Experimental work on sugarcane irrigation was continued at The Pine, Sandy Hill and The Hope. Several more years' work are required on the problems under investigation, but some preliminary results are available:—

- (a) Yield increases of 20-25 per cent. may be expected from irrigation under the conditions of above average rainfall which have pertained

in Barbados during the past nine years. It is considered that the proportion of increase would be greater in drought years and that irrigation should be considered also as a form of insurance against loss of yield through drought.

- (b) In order to obtain the best yields with irrigation early applications of ammonia must be made.
- (c) Considerable improvement of drainage and cultivation must be effected on most cane lands.
- (d) Applications of water should be such as to supplement the natural rainfall to the total of 1.5 inches every ten days. Smaller volumes of water would be required before the canes have closed in.
- (e) Spacing of 5 ft. by 4 ft. gives best results under irrigation.
- (f) Costings under the conditions at the three stations indicate that the capital outlay on large irrigation units is at present \$283.78 (B.W.I.) per acre and that recurrent costs are \$69.80 per acre for 1957 under the conditions of Government operated investigational schemes.

#### *Sugar Cane Pests*

264. Cane root borer (*Diaprepes abbreviatus* L.) occurred mainly in the coastal areas of the south and west, causing much damage especially to ratoon canes. A week by week population study of the beetles in one area has given useful results, and the method evolved will enable the effects of insecticides on the adult beetles to be accurately assessed. Preliminary trials with the newer chlorinated hydrocarbon soil insecticides gave promising results.

265. A prototype soil washer constructed to separate root borer larvae from the soil has proved very successful on a small scale, and the large model which has been planned will make possible the estimation of the larval population in the field. The effects of insecticides on the larvae can therefore be assessed in two ways—in terms of the reduction in population and the increase in cane yield.

266. In attempts to control the moth borer (*Diatraea saccharalis* Fabr.) mass liberations of the egg parasite *Trichogramma* were continued. The joint infestation of plant canes was 12.3 per cent. which continued the slight upward trend that has been apparent since 1951. A start has been made on the reassessment of the status of *Trichogramma* in the control of moth borer. The oviposition preferences of moth borer for different cane varieties were noted in experimental plots.

### BECHUANALAND PROTECTORATE

#### *Fertilizer and Manurial Trials*

267. In trials now continued for three years, to test the residual effects of applications of superphosphate and kraal manure both separately and in combination at different levels, significant yield increases were still obtained for treated plots over control plots. The results of these trials are being actively extended to African farmers by demonstration plots, the greatest emphasis being on the use of kraal manure which is readily obtainable in all areas.

#### *Agronomic Investigations*

268. Investigations into the effect of simple crop rotations and grass leys continue and the beneficial effect of cowpeas on the following grain crop is already apparent. A search has been instituted for local varieties

of sorghum showing resistance to *Striga* infestation which is becoming widespread. Local veld grasses have also been observed to be attacked by this parasite. Sixty homozygous lines of *Pennisetum typhoideum* have now been bred and seed of these is being multiplied for yield trials.

269. A bulk trial planting of A7215 (Muka) cotton was grown at Mogobane Irrigation Scheme. Only one irrigation was possible but a yield of over 900 lb. of marketable seed cotton per acre was harvested. This cotton was graded as "good middling to strict middling" with a staple length of  $1\frac{5}{8}$  inches. Further plantings have been made during the current season.

#### *Pasture Research*

270. Grazing trials on natural pastures were continued to determine the optimum carrying capacity and to compare different systems of grazing. As far as animal liveweights are concerned, there does not appear to be any significant difference between the different grazing systems with the exception of those carried out on debushed pasture where the liveweight increases have been significantly higher, even at an increased rate of stocking.

271. In order to test the differences between the commonly used ranching breed of cattle, each experimental group now consists of one third Afrikaner, one third indigenous Tswana and one third Afrikaner-Hereford crossbred animals. Preliminary results seem to indicate that the seasonal liveweight increase in the case of the latter two breeds is higher than that of the Afrikaner cattle. Trials to determine the value of goats in controlling bush encroachment were initiated. Botanical analysis of the natural pastures to determine vegetation changes show that the average basal cover of the sward is of the low order of 3.4 per cent.

#### **BERMUDA**

##### *Mediterranean Fruit Fly Control*

272. The Mediterranean Fruit Fly (*Ceratitis capitata* Wied.), has been a pest of importance in Bermuda for over eighty years. Soft fruits, particularly peaches, are severely damaged by the fly, and in recent years citrus has been heavily attacked. Control measures attempted in the past were ineffective. In 1957, a vigorous campaign of spraying was carried out in all citrus orchards in which the Mediterranean fruit fly had been recorded during the previous two years. Malathion 25 per cent. wettable powder was used as the toxicant and Staley's No. 2 sauce bait included in the spray as an attractant. Plastic traps, baited with angelica seed oil, were set up in the orchards to check on the presence of the flies and to measure the effectiveness of the sprays. Spraying was carried out on a regular ten-day schedule, from the middle of May, until the end of August.

273. Excellent control of fruit fly was achieved in the treated orchards, with virtually no damage to citrus fruit recorded. Furthermore, through the use of the traps, valuable information was obtained on the seasonal trends and infestation centres of the fruit fly. This information will be of great assistance in future control work.

##### *Biological Control of Insect Pests*

274. Investigations of two scales attacking local oleanders were continued, with particular emphasis on introduction of new parasites and predators to control these scales. Large numbers of *Prospaltella berleseii* (How) (strains from both Japan and the South of France), were liberated against the oleander scale, *Pseudaulacaspis pentagona* (Targ.), but establishment was not achieved. The *Coccinellids*, *Azya luteipes* (Muls.), and

*Cryptolaemus montrouzieri* (Muls.), were effective in controlling green shield scale, *Pulvinaria psidii* (Mask.) in localized areas, and both of these beetles now seem to be well established. The successful introduction of beneficial insects has been handicapped by the presence of the Argentine ant, *Iridomermex humilis* (Mayr.), which is becoming increasingly widespread in Bermuda.

275. Efforts were also made to exert some control on the tree lizards (*Anolis* spp.), which abound in the Colony. The lizards hamper biological control work by preying upon beneficial insects, particularly predacious beetles. Two hundred flycatchers, *Pitangus sulphuatus* (L), were introduced from Trinidad in the hope that they would feed on the lizards. Whether or not the birds will successfully breed on the island and reduce the number of lizards remains to be seen.

276. Small numbers of the predacious snail *Euglandina rosea*, were obtained from Hawaii for release against *Dtala lactea*, an edible snail which causes serious damage to vegetable and flower crops in Bermuda. *Euglandina* was successfully tested in the laboratory and liberations have yet to be determined.

#### *Plant Growth Stimulant*

277. Tests were carried out with gibberellic acid in an effort to evaluate the usefulness of this material in breaking dormancy in potato tubers. At the present time Canadian seed potatoes, arriving in the Colony in late summer, are dipped in ethylene chlorhydrin to hasten sprouting and thus permit a fall planting. Ethylene chlorhydrin gives very satisfactory results, but because of its extreme toxicity, a suitable substitute has been sought. Initial tests conducted with gibberellic acid have given interesting results. When used at strengths of 10 p.p.m., and greater, gibberellic acid causes treated potato seed pieces to produce excessively etiolated sprouts. Strengths between 1 and 5 p.p.m. show a great deal of promise and are being investigated further.

### BRITISH GUIANA

#### *Central Experiment Station*

278. The main crops grown on the station were rice, jute, grasses, cow-peas, maize and cotton. The grasses, Pangola (*Digitaria decumbens*), Locuntu (*Ischaemum timorense*), Para (*Brachiaria mutica*), Nadi Blue (*Dichanthium caricosum*) and Coastal Bermuda (*Cynodon* sp.) showed promise and are to be used in rotational grazing trials.

#### *Hasororo Station*

279. The development plans for the station were revised and involve the planting of increased areas with cocoa, citrus, avocado pears and robusta coffee on the lateritic hills. Para grass (*Brachiaria mutica*) and Locuntu grass (*Ischaemum timorense*) have done well on the peaty riverain soils and it is proposed to use these soils for livestock. The problems of fertility maintenance on the peaty riverain soils were studied, and it is considered that a solution will be found by growing suitable crops and attending to the fertiliser requirements of phosphate and lime. Ginger has shown some promise.

#### *Cocoa*

280. The propagation of clonal cocoa continued and plans for the planting of the crop on the riverain settlements and lateritic hills in the North West District were made. The main clone being proposed is I.C.S. 95.

### Jute

281. Jute research was continued at the Central Agricultural Station and 46½ acres were grown for the spring crop and 215 acres for the autumn crop.

282. The species *Corchorus olitorius* (varieties E.C.R. 576 and BZ/5) and *C. capsularis* (varieties BZ/1, 2, 3, 4) have been proven suitable. Certain *C. capsularis* strains have been found suitable for spring cropping. Jute can be grown and will yield suitable fibre. The economics of production remain to be proven. During the year crop production was most disappointing on account of toxic soil conditions and abnormally dry weather. The Ferguson kale cutrake was tested and resulted in reducing the cost of harvesting by a half. One ton and half ton fibre retting tanks have been developed, tested and proved satisfactory for retting. The handling of ribbon and fibre in and out of the retting tanks has been partially mechanised, resulting in reduced labour costs.

### Sugar Cane

283. Variety testing of seedlings forwarded from Barbados and from "fuzz" from variety crosses made in Barbados and British Guiana continued. The variety B.47258 is being extended as it has shown itself equal to the main commercial canes B.41227 and B.37161. B.49119 appears likely to outyield these three canes but is unfortunately susceptible to Leaf Scald disease. Two Demerara seedlings D.49/46 and D.141/46 are recommended for limited extension.

284. Foliar analysis for the determination of fertilizer requirements has become established practice, and fertilizer trials concerned with the technique were concluded. New experiments were laid down to determine the nitrogen requirements of different varieties and the relative value of different nitrogenous and phosphatic fertilizers. Liming experiments showed only small responses in the plant cycle.

285. Routine testing and classification of new canes for resistance to Leaf Scald disease continued. Sporadic outbreaks occurred in the notably susceptible variety B.34104 and also on B.49119. It is clear that the disease is kept in check by growing varieties which are not readily susceptible to the disease.

### Rice

286. Fifteen locally bred varieties have shown considerable promise in small plot trials, yielding more than the standard variety No. 79 and having stiff straw and resistance to shattering as well as different maturation dates. These characteristics are required for mechanical harvesting and the promising lines are being bulked for large scale field observations under full mechanised conditions. Numerous other selections have become homozygous and show promise in small plot trials. Resistance to blast (*Piricularia oryzae*) has been noted in one selection.

287. At the Mahaicony Abary Rice Development Scheme, a series of small plot experiments were carried out and general observations were continued on the 3,000 acres of mechanically cultivated rice. On the experimental station, long term fertilizer trials continued. Newly bred varieties were planted for the first time for testing and showed considerable promise for mechanised harvesting. On the commercial fields, complete costs of all operations and field histories were continued. The incidence of red rice was again recorded and low volume spraying with 2,4-D, for the control of broad leaved weeds in flooded rice fields, was carried out. The spraying technique proved practical and economic.

### *Rice Storage Investigations*

288. The first two year phase of the investigations was completed, but will be continued for a further two years as from January, 1958. The extent of insect damage to paddy and rice, the causative agents and an estimate of loss from pests under commercial conditions has been determined. Methods of insect control have been worked out. Effective methods of water-vapour proofing the floors of storage bonds have been developed. Investigations into in-bin storage and drying are continuing together with a survey of mills.

### *Control of Insect Pests*

289. An outbreak of locusts (*Tropidacris laterillei*) occurred on coconuts. Control was effective by the aerial spraying of dieldrin. Stainers (*Dysdercus ruficollis*) and jassids were effectively controlled by low volume spraying of dieldrin, the residual effects being particularly useful. A serious outbreak of Army worm (*Laphygma frugiperda*) on maize in the North West District was controlled by BHC dusting. Outbreaks of the defoliating coconut caterpillar (*Brassolis sophorae*) and moth borer (*Castania daedalus*) occurred. Hand clearing of the caterpillar and spraying with 1 per cent. dieldrin effectively controlled these pests.

### *Animal Health and Diseases*

290. Owing to its economic importance, special attention was paid to paralytic rabies in cattle and horses. Animals on both the inland and intermediate savannahs and on the coast were affected and about 55,000 cattle were inoculated. Preventive inoculation has proved effective. Mineral deficiencies and infertility problems in cattle have been investigated as well as poultry diseases and trypanosomiasis in equines. Ethidium bromide continues to prove effective in controlling the latter disease.

## BRITISH HONDURAS

### *Pastures*

291. Production of dry matter per annum has been measured for regular six week clippings on several sites. Yields have varied from 8,000 lb./D.M./acre for Guinea grass (*Panicum maximum*) and Jaragua grass (*Hyparrhemia rufa*) up to 14,000 lb./D.M./acre for Sweet grass (*Ixophorus unisetus*) and Pangola (*Digitaria decumbens*). The latter had the highest D.M. of 34 per cent. Sweet grass shows highest yield (2 cows per acre) between September and January, but appears to rest from March to August with comparatively small response to the onset of the rains in June. It is extremely palatable. Pangola grass production is proportional to rainfall in the drier (50") northern half of the territory. In the south (100") the highest yield (3 cows per acre) occurs between April and September, after which yields fall off despite continuing rain. Pangola grass suffers badly from rust and froghopper. Jaragua grass is favoured by farmers because of its persistence. Guinea grass, also popular, appears to be the species most resistant to drought.

### *Maize*

292. British Honduras participated in the Central American Corn Breeding Programme by testing 32 types. Ten of these were found to yield more than 80 bushels (local corn yields 20-40 bushels). By ear-to-row breeding, one local type reached a yield of 78 bushels per acre.

### *Fertilizers*

293. Various trials indicate responses to phosphate by coconuts, rice, sugar, maize, pasture and beans; and to nitrogen by pasture, sugar and forage sorghum. No responses have been obtained from potash.

*Forestry*

294. Having established that *Pinus caribaea* (Morelet) will grow on poor savannahs of the coastal plain (rainfall 80"-100" annually) by ridging and applying 2 oz. of triple superphosphate per plant, experiments were laid out to determine whether less fertilizer can be used and the best time to apply it. Indications so far are that 1 oz. gives nearly the same response as 2 oz. per plant, and the earlier the application the better.

295. Further direct sowing trials were carried out standardising the most successful technique known, namely patch sowing on ridges but using three provenances (Mountain Pine Ridge seed, Stann Creek seed and Mango Creek seed) and three different methods of fertilizer application (by hand to each patch, in drills by a hopper attached to a tractor, and broadcast by machine) before germination took place. A trial sowing by machine was also made after preparing the ground by rotivating and then ridging.

296. Pine is usually put out with a ball of soil and this method prohibits machine planting. Preliminary investigations have been started to see whether this species has a regular resting period during which it could be planted with bare roots. A number of young trees are being measured at weekly intervals. Similar investigations are being carried out in a *P. elliottii* plantation at Augustine, and this species appears to have a definite winter resting period in British Honduras although the temperature is seldom below 60° F.

297. It has been established that *Cedrela mexicana* lays down one ring per year. *Pinus caribaea* sometimes lays down several rings per year but the age can be estimated within five years or so. Investigations are proceeding on Mahogany but rings are difficult to see.

**BRITISH SOLOMON ISLANDS PROTECTORATE***Agriculture*

298. Pasture establishment experiments include the use of *Digitaria melangiana*, *Dichanthium caricosum*, *Ischaemum aristatum* and *Panicum maximum*. The latter is most promising in drier conditions and can be satisfactorily established from seed. *Centrosema pubescens* is very satisfactory as the leguminous factor.

299. A collection of breadfruit varieties is being established in co-operation with the South Pacific Commission in order to investigate varietal characteristics of fruiting time, etc.; it is hoped that using local and introduced Polynesian varieties a long fruiting season may be obtainable.

300. Copra investigations have shown that copra dried to below 4 per cent. moisture content attains an equilibrium moisture content of about 5 per cent. in storage; and that storage of copra at 8 per cent. results in a very considerable decrease in dust production.

*Forestry*

301. A series of sample plots was established to obtain information on the growth rate of different size classes of kauri in both undisturbed and exploited forests.

*Agathis macrophylla*

302. Experiments were laid out to test the efficiency of both post-exploitation and pre-exploitation treatments in securing kauri regeneration. Since kauri seedlings are plentiful in unfelled forest, and a good proportion of these can survive for some years after exploitation, the former technique would seem to be the more appropriate. Experiments aim at determining the optimum rate of release of the young kauri crop by elimination of

unwanted stems. The pre-exploitation experiments are now being conducted in case it proves desirable for the new crop to be further advanced before felling and are to test the response of kauri seedlings to different degrees of canopy opening. For tree poisoning a water-borne solution of sodium arsenite is applied in a frill girdle, but hormonal contact arboricides are to be tried.

303. Experimental planting, mainly of exotic timber species, in small trial plots on a range of sites was intensified, and twenty-five different species were planted out during the year. Balsa and teak both show promise. Apart from these, mainly high grade softwoods (e.g. *Arāucaria spp.*, *Agathis spp.* and cabinet class hardwoods such as Honduras and African mahoganies "Cedars" (*Cedrella spp.*), Queensland "maple" (*Flindersia brayleana*), "silky oak" (*Cardwellia sublimis*) and "black bean" (*Castanospermum australe*) are being tried.

## CYPRUS

### Agronomy

304. Research continued to be concentrated on cereals (wheat and barley) including disease problems and particularly wheat rust resistance studies. Some very promising types of barley have now been bred and tested for a sufficient time to warrant their multiplication for distribution.

305. It has been shown that Safflower (*Carthamus tinctorius*) has a definite place as an oil crop in Cyprus agriculture. A number of farmers are already growing the crop and it is expected that the area will increase rapidly.

### Pasture and Forage

306. The pasture survey, designed to map and classify the areas of uncultivated land suitable for development as sown pastures, was completed. Maps of the island, showing these areas, are in preparation and they will also indicate present land use outside the Main State Forest areas.

307. Sowing of pastures on 500 acres was completed in December, 1957, at eight sites. These sites can be regarded as pilot plot projects and they are being used to discover the reaction of shepherds and others to sown pastures. Very valuable experience was gained on scrub clearance and rock ripping in these areas. The species sown were mainly *Lolium rigidum* (Wimmera) and *Medicago tribuloides*, but a small area of *Phalaris tuberosa* was also sown. Selected species and types of pasture and forage plants are now being multiplied at a new Experimental Seed Farm of forty acres established in Kyrenia. Species selection work continued; the most outstanding type has been a selection of *Trifolium subterraneum* which grows well in the highly calcareous soils of Cyprus. This is also being multiplied. Various fodder bushes, including a number of species of *Atriplex* and *Kochea*, are being grown under field conditions following successful nursery tests.

### Crop-Livestock Integration

308. Mixed farming methods, with different classes of animals maintained under various methods of management and levels of nutrition, were studied at six centres. These projects, which have now been in operation for some years, are beginning to show that pasture and forage will be of great value in future agricultural development, the first because it represents a cheap source of high quality food when utilised *in situ*, the second because when conserved it can be used at a period of scarcity of forage. Future development will probably be directed towards better feed for better quality livestock. Studies on the effect of goat grazing on scrub, at various intensities, were continued.



### *Plant Nutrition*

309. The yield of carobs was significantly raised by the addition of sulphate of ammonia in the second year of a long-term experiment; superphosphate had no effect. The carob tree is leguminous but it carries no nodules on its roots.

310. The effect of excessive irrigation and heavy dressings of animal manure in inducing iron deficiency in apple seedlings was confirmed.

### *Horticulture*

311. A new experimental Citrus Grove is being established at the Government Farm, Morphou. The programme of research includes studies of nutrition and irrigation problems, the performance of different varieties and rootstock/scion compatibility.

312. The Lassen variety of strawberry was found most suitable for local conditions; Huxley was also good but Talisman was disappointing.

313. Varietal collections of carobs, pistachio (*Pistacia vera*) and vines are being built up so that classification of local and imported varieties can be made. Establishment of "mother" plants for propagation purposes continued. Variety trials with potatoes, melons, asparagus and onions were also made.

### *Plant Pests and Diseases*

314. Experiments were carried out by a resident F.A.O. Specialist, Dr. Poláček, on the use of ethylene dibromide for the control of Mediterranean Fruit Fly (*Ceratitis capitata*) in citrus fruit. These were very successful and a technique for treating large quantities of fruit has been developed and is now in operation. Studies on control in the field with Dieldrin, Malathion and Diptorex were also made. Observations on the biology of the Cereal Leaf Miner (*Syringopais temperatella*) were continued.

### *Animal Husbandry*

315. A survey of the dairy cattle industry of Cyprus is in progress and is likely to be completed by the end of March, 1958. The survey has been designed to cover the whole field of management, with supplementary detailed work on the chemical and bacteriological quality of milk at different seasons of the year. Work on early weaning of pigs, at about 14 days of age, gave promising results, but the economics of this method have still to be worked out.

### *Animal Diseases*

316. An epidemic of Foot-and-Mouth disease, identified as Type A by the Ministry of Agriculture's Laboratory at Pirbright, broke out early in 1957. The condition was mild, of relatively low morbidity, and in the earlier stages the disease was observed only in cattle and sheep. All bovines were immediately inoculated with a tissue vaccine of Italian origin and the results were satisfactory, but the disease continued to maintain itself in semi-nomadic flocks of sheep and goats and there were a few outbreaks among pigs.

317. As a possible answer to this situation, research work was initiated, in collaboration with Dr. Komarov, Director of the Tel Aviv Veterinary Institute, Israel, to determine the effect of inoculating sheep with an egg-attenuated strain of the virus (Type A) isolated by Dr. Komarov in Israel. This work is still in progress.

318. An epidemic of Sheep Pox also broke out early in the year. All sheep in the island were vaccinated with a locally produced vaccine and effective control was obtained, but a number of abortions were reported from

certain districts, six to eight weeks after vaccination. In no case was sheep pox virus isolated from the foetuses, but in the absence of other causes it appeared probable that there was an association. An Algerian strain of the virus, reported to produce much milder reactions in vaccinated sheep and lambs, is being obtained from Greece for experimental purposes.

## DOMINICA

### Agriculture

319. Fertilizer trials with N P and K have shown marked response to P on yellow earth type of soils by maize, sweet potato and cassava. Bananas have responded to nitrogen applied at planting time. Pangola grass showed increased fodder yield of about a third from nitrogen dressings.

## FIJI

### Agriculture

320. *Rice*. Observations on both wet and dry land varieties continue at the Principal Agricultural Station, Koronovia. Particular attention is being devoted to straw strength and it is, therefore, somewhat disappointing that Serandah Kuning, which is attractive in this respect, is relatively slow in maturing.

321. *Bananas*. Control of Banana Leaf Spot is possible with a high volume of zinc-based spray—100 to 150 gallons of liquid per acre—but this is expensive and as good, if not better, control is now being achieved with an application of two gallons per acre of Shell Silver Oil diluted with one in six diesel oil.

322. *Cocoa*. Approximately 1,500 acres of cocoa have now been planted, principally by Fijians, and for the most part with seedling material from the best of local selections. Records of performance and flavour characteristics of local varieties continue to be accumulated, while experimental plantings of imported clonal material are also being made.

323. *Entomology*. The campaign against *Oryctes rhinoceros* L., the Coconut Rhinoceros Beetle, continues, the main control measure being the treatment of the crowns of palms with a BHC sawdust mixture. The annual rate is about 700,000 crown-treatments. Laboratory trials have indicated that Diazion is more effective than BHC, but would cost three times as much at the dosage rate required.

324. Work on parasites of *Graeffea crouani* Le Guill., the Coconut Stick Insect, has produced no useful result. It is not known whether the introduced Tachinid parasite of armyworms *Achaetoneura archippivora* Will., has become established. The stem-borer of Lantana, *Aerenicopsis championi* Bates, is not likely to be effective in controlling the weed.

325. In New Guinea, Mr. R. W. Paine found a complex of parasites attacking *Nacoleia octasema* Meyr., the Banana Scab Moth, and *Agonoxena pyrogramma* Meyr., a close relative of the local coconut pest, *A. argaula* Meyr. The Scab Moth parasite which appeared to be of primary importance was an Encyrtid of the genus *Litomastix*. This has been introduced to Fiji, and great numbers have been bred and liberated in the field. However, it appears doubtful whether it will bring about successful control of the Scab Moth.

326. Breeding of parasites of *Agonoxema* which were introduced to Fiji was unsatisfactory. Some small liberations were made in the field, but the fate of these is not known.

327. A *Trypetid* fly, *Tetraeuaresta* sp. was introduced from Trinidad, in co-operation with Dr. F. J. Simmonds, of the Commonwealth Institute of Biological Control, with a view to control of Tobacco Weed, *Elephantopus mollis*. Several thousand adults of this species, which breeds in the seedheads, were liberated, and it is now established in the field.

### GAMBIA

#### *Veterinary Research*

328. Work was concluded on the incidence of tuberculosis and brucellosis in cattle, in collaboration with the Medical Research Council Unit, and on the hæmotology of the local cattle.

### GRENADA

#### *Cocoa Industry Improvement Scheme*

329. As expected, the yields of the varietal trials designed to test the performance of the seventy-nine local Grenada selected strains showed an increase over the previous year. It is, however, anticipated that in the coming year yields would have at least attained the pre-hurricane level. Although these experiments are planted on representatives of the three major soil types at different elevations in the colony, the ranking of superior clones has been fairly constant with few exceptions irrespective of soil differences. The response to fertilizers and other cultural treatments has been so far negligible. They were all established under temporary shade, and current opinion is that this shade might be preventing any response to fertilizers, but the damage done to these experiments by the 1955 hurricane made it imperative that shade be maintained until the clonal trees recovered to the stage where this could be eliminated. This will be done in 1958.

#### *Nutmegs*

330. The destruction of nearly 80 per cent. of the nutmeg cultivation in Grenada by the 1955 hurricane made it imperative that investigations should be carried out to propagate this crop vegetatively. The traditional method of establishing nutmegs in Grenada was by seedlings, resulting from the fortuitous germination of fallen pods or, in rare instances, imported seeds from the East Indies. The dioecious habit of the tree makes determination of the sex difficult before the onset of flowering, which, under Grenada conditions takes about five to seven years.

331. A fair measure of success has recently been achieved locally by "marcotting" or air layering proven female trees. Plants produced by this method have been established in demonstration plots in typical nutmeg producing areas. Promising results have also been obtained with the propagation of nutmegs by rooting young stem cuttings.

### HONG KONG

#### *Animal Industries*

332. Work on the selection and upgrading of the local Chinese pig breed continues and fine herds have been established at Castle Peak Agricultural Station and at Pak Ngau Shek. The first feeding trials using the local pig have been concluded and valuable basic data have been obtained. The experimental cross breeding of local sows with Mid-White and Berkshire boars has progressed and the quality of the first batch of cross bred animals has been assessed. The females of these first crosses have been bred back to Middle White, Berkshire and local boars respectively to assess the value of the first cross sow as a mother and also to produce second-cross pigs for

further experimental study. The first batches of locally bred Mid-Whites and Berkshire pigs have been released to selected farms for field trials under commercial conditions. These animals are under careful observation, regular reports on their progress are being compiled and they are serologically tested every two months for *Brucella suis*.

333. Foot and Mouth disease continues to occur in both the quarantine stations and on farms in the New Territories. All outbreaks have been typed at Pirbright; Type "O" has been identified in the New Territories, but Type "O" and "Asia I" occur in quarantine stations.

#### *Agriculture*

334. Work on the selection and improvement of local paddy continues and improved seed grown on departmental stations has been distributed to selected farmers for trial under farm conditions. There is now a large demand for improved seed following successful demonstrations with farmer co-operators and the stage has been reached for the organization of contract seed farmers.

335. Pot experiments were conducted with soils taken from typical paddy growing areas to investigate the effect on the growth of paddy of NP, NK, PK, NPK. It was observed that nitrogen greatly increases the yield and no appreciable difference was found between NP, NK and NPK treatments. These results of pot tests on soils taken from farmers' fields are in close agreement with the results of field trials conducted over the last five years on agricultural stations.

336. Work has continued under field trial conditions on the study of the effect of compost, compost with nightsoil, compost with inorganic balanced fertilizer, compost with organic balanced fertilizer, compost with ammonium sulphate, and compost with peanut cake, on the growth of leafy vegetables. The results obtained during three years of work are in line with what are to be expected and do not indicate that nightsoil has any special merit. These tests were conducted on a soil type characteristic of the vegetable growing region and were designed to demonstrate to Asiatic farmers that nightsoil is not the only fertilizer for growing vegetables.

#### *Soil Survey*

337. The Soil Surveyor, seconded from the Pool of Soil Scientists, has almost completed his study of the agricultural soils of the Colony. There are apparently some very rich paddy soils in the Colony, but also a comparatively large group of structureless types which require careful treatment or even a different form of utilization. Work is continuing on the hill soils.

### *JAMAICA*

#### *Agriculture*

338. *Bananas*. The programme of breeding of seedling varieties and their testing against Panama Disease continued. In this connection, 3,515 stems were pollinated, 2,746 seeds were planted, 321 seedlings were transferred from the greenhouse to the nurseries and 38 promising seedlings were subjected to Panama Disease testing.

339. *Cocoa*. There were indications that for the commercial planting of clonal cocoa the new method of establishing "scionlings" in the field would be successful only if conditions were ideal and intensive supervision could be applied. Investigation of more efficient methods of producing rooted cuttings continued. Very promising results were obtained from a modification of the La Reunion method, where the cuttings are rooted directly in the pots and production by this method is being increased. The possibilities of producing "budlings", where seedlings are established in pots and budded in

the nursery, were investigated. Production of clonal planting material by this method would be cheaper than rooted cuttings whilst their field establishment would require less supervision than scionlings.

340. *Coffee*. A trial to ascertain the response of the local variety *C. arabica* var. *typica* to NPK fertilisers was maintained. However, seed of variety *C. arabica* var. *bourbon*, which has largely replaced var. *typica* in most of the coffee producing countries of Central and South America was recently introduced, and another fertiliser trial was laid down with both varieties. A plot was established to observe the behaviour of both var. *typica* and var. *bourbon* under the local system of planting and establishment as compared with some of those under which the latter variety is normally grown in Central America.

341. *Citrus*. Investigations were continued on the post-harvest physiological disorder of oranges, known locally as "Brown Stem", where an area of the stem end collapses and disfigures the fruit. Various lines of investigation have not produced conclusive results with regard to either the cause or the control of the condition, but there are firm indications that water relations of both the tree and the fruit may play an important part in this disorder. Consequently efforts are being made to evolve better methods of handling and processing fruit with a view to reducing any water loss during these operations.

342. Due to a blistering of the fruit, serious losses of mature oranges occurred in a number of isolated groves and investigations to ascertain the causal agent were begun. Affected fruits exhibit one or more round bruised areas with a tiny puncture or punctures in the centre. The bruised spots are often surrounded by a halo of brighter yellow colouration on the rind of the fruit. Similar blisters have been observed on oranges throughout the island from time to time, but this is the first occasion on which their occurrence has become so concentrated as to reach economic significance. Superficial examination of the injury led to the belief that it could be caused by the mouthparts of flies of the genus *Anastrepha* but this theory has now been proved to be erroneous, and investigations are continuing to establish whether a fruit-piercing moth may not be causing the damage.

343. *Coconuts*. Work on "Unknown" or "Lethal Yellowing" disease continued. The seven field trials, which were laid down to compare the resistance of three dwarf and one tall variety of coconut to the disease, were maintained, but it is yet too early to make any assessment of the results.

344. Aetiological investigations of the disease were given special attention with particular emphasis being placed on the possibility that it might be a virus or that nematodes might be the causal agents. Severe drought conditions in the field hampered the work on the virus theory. The nematode studies were not completed and are therefore inconclusive, but there were indications that nematodes may be involved, even if they are not the primary agents.

345. In continuation of the work on the "FronD Drop" conditions of coconuts, leaf analyses of both healthy and affected trees indicated a significant difference in the content of both phosphorus and iron. This theory is being tested on a field scale by the application of Phosphorus and injected Iron Sequestrene (11% Fe) to trees in a statistically designed experiment. Leaf samples are taken twice per year and yields are recorded monthly. In addition a visual assessment of the thriftiness of trees will be taken at regular intervals.

346. *Field Crops*. Investigations were continued on the growth and production of Virginia Tobacco. Seven plots totalling 19 acres were laid down in various tobacco growing areas where two varieties imported from America

were under test. Both these varieties are reported to be highly resistant to "Black Shank" and possess good curing, smoking and burning qualities.

347. A series of trials to explore the possibilities of economic production of cotton was completed. It is apparent that the greatest problems will be the control of insect pests, mainly the Cotton Stainer (*Dysdercus* sp.) and the Green Stink Bug (*Nezara viridula*).

348. A long term programme for work on improvement of food crops is being implemented. Fertiliser trials in combination with planting methods have been laid down for yams. Work on the taxonomic classification of cassava has continued and similar work with sweet potato has commenced. A breeding programme for maize has been initiated and selection work to produce a variety superior to the local J.S.Y. has been put in hand.

#### *Livestock*

349. *Development of Tropical Breeds.* The Ministry's herd at Bodles remained the centre of the Jamaica Hope breeding work. Bulls out of dams whose 305-day lactations are not less than 800 gallons, are loaned to Jamaica Hope cattle breeders. During the year farmers have had purebred Jamaica Hope available to them for the first time, and it is hoped that the number available will reach 10,000 in the next six to eight years.

350. The Jamaica Black Cattle Breeders' Society in which three types of Jamaica Black were previously accepted has now ruled in favour of the continued development of a single type. The three types formerly produced were those with little Zebu blood, those with a fair percentage, and those that fell between these two extremes. The middle group, the so called "Y", is the one now accepted.

351. *Animal Nutrition.* The recent establishment of a Division of Animal Nutrition at Bodles represented a major advance in the programme to increase and intensify livestock production. Efforts have so far been directed at the completion of the capital works and organisation of the laboratory and field work of the Division. Collaborative work has been undertaken with the Pasture Research Section, primarily in the laying down of animal production trials.

352. *Veterinary.* Trials on the efficiency and practicability of immunising all imported day-old chicks against Newcastle Disease were completed. Thirty day-old chicks from the Ministry's hatchery at Hope were sprayed with Connaught-prepared Newcastle Disease Live Virus Vaccine under conditions prescribed by the manufacturers. On challenge with the local virus 73 per cent. died showing symptoms and post mortem lesions of Newcastle Disease. Trials with the Connaught-prepared intro-nasal vaccine gave more promising results.

353. Two new special of helminths were identified for the first time in Jamaica, viz. *Harborenema megastoma* from the stomach of a horse, and *Ascuria spp.* from the gizzard of a parrot. Equine Piroplasm organisms have been identified in blood smears from three imported thoroughbred horses.

#### *Forestry*

354. It has become increasingly apparent that because of gradual deterioration over a period of years, local soil conditions are now much more favourable to the introduction of exotics such as species of *Eucalyptus* and *Pinus* than to the growing of Jamaican species. During 1957 research on soils was primarily directed at the investigation of factors militating against

the satisfactory introduction of indigenous species in the afforestation programme. Research on Pines has continued, showing that *Pinus caribaea* seems most adaptable to local conditions. Excellent results were obtained with four plots of *Pinus occidentalis*, but unfortunately there are difficulties in obtaining seed.

355. It has now been established that *Pinus caribaea* will grow well in Jamaica. Unfortunately trials of it six years ago met with misfortune and were discontinued, but planting recommenced in 1954 and has continued annually showing great promise in various types of soils and at different altitudes. No special treatment has been carried out either in connection with mycorrhizal association or fertilizers. Spectacular results have been obtained with *Pinus occidentalis*, also on various types of soils and at various altitudes. This species is confined naturally to Haiti, the Dominican Republic and Cuba. Satisfactory results have also been obtained with *Pinus radiata* and *Pinus taeda*. *Pinus merkuzii* from Indonesia introduced on a small scale in 1953 remained backward, but during the last twelve months has grown vigorously. Investigations regarding all species of pine in Jamaica and their possible mycorrhizal associations are being started with the help of the Botanical Department at the University College of the West Indies.

356. *Eucalyptus spp.* and *Tristania conferta* have proved to be the fastest growing and most tolerant species of hardwoods for general afforestation. The indiscriminate planting of *Mahoe* has been reduced.

357. *Improvement fellings.* These were carried out in ruinate forests and natural regeneration of economic species responded. In areas where economic species were absent cedar was planted. There is enormous scope for this type of work, but it could only be carried out adequately with a special allotment of funds and further research into techniques.

## KENYA

### Agriculture

358. *Grassland.* Grassland investigations in African areas were continued with the object of finding suitable grasses and legumes for the various ecological zones, and the best methods of establishment and management of leys. The 1957 results generally confirmed previous findings. In Nyanza, good ley establishment was obtained under maize. The grasses represented in the leys were *Panicum maximum*, Nzoia Rhodes, Nandi *Setaria*, and Molasses grass. The legumes were Kenya White clover and Louisiana White clover, Hunter River Lucerne at Kakamega, and Rueppell's clover and Booberowrie lucerne at Sotik. At both stations the Nzoia type Rhodes grass showed more early promise than the others. In the high rainfall areas Nzoia Rhodes is the easiest seeded grass to establish. Field trials of *Setaria sphacelata* at Shimba Hills and Matuga in Coast Province have been promising. Where fertility is good, establishment is easy and the grass productive. Top-dressing with a light dressing of sulphate of ammonia increased productivity very successfully. At Embu in Central Province, the beneficial effect of double superphosphate, applied to a previous maize crop, was very evident in the undersown Rongai Rhodes grass.

359. The 1956 fertilizer trials in African areas were analysed statistically and it became part of Departmental policy in 1957 to advocate the use of fertilizers on soils which the results had shown to be economically responsive. Applications of farmyard manure, phosphate on highly coloured soils, and nitrogen, particularly on pallid soils, but seldom potash, were found

economically beneficial. On certain very acid soils liming was found essential if any crop was to be obtained. Where fertilisers and manures are worth using, potatoes and cereals were found better crops to treat than legumes. Good residual effects from phosphate fertiliser were obtained, extending even into the ninth and tenth seasons in two cases in Southern Province. Much of the work is now concerned with assessing the best rates and times of application of fertilisers and manures and in what form phosphate or nitrogen is best applied.

360. The plant introductions of special interest mentioned last year, namely Sainfoin, Giant *Setaria*, Ronpha grass and *Phalaris daviessii*, continue to show promise. New plantings this year include many varieties of Rhodes grass, Star grass, Guinea grass, and Elephant grass. In particular it is hoped that some good seeding varieties of Star grass will be found among these introductions.

361. The beneficial influence of gypsum, presumably by supplying additional sulphur, continues to show clearly in mixed grass-legume swards at Kitale and other places nearby. In an experiment to compare the effects of calcium alone, sulphur alone, calcium plus sulphur, and gypsum, the two latter have given the best results to date. The object was to see if anything better than sulphur in the gypsum is influencing the growth of legumes. Investigations to find out what fertilisers, other than triple superphosphate, and what trace elements, if any, might be required by legumes to increase their ability to fix nitrogen were generally inconclusive, as were those to test the effect of magnesium, boron and zinc on legumes.

362. The co-operative experiments programme has revealed legume response to gypsum on central Cherangani farms and on farms in a line from there through to Hoey's Bridge, to the Lugari district, and in one instance on Mt. Elgon near the Suam River. No responses have been obtained from the soils of Endebess, Soy, Eldoret or Ainabkoi.

363. The animal agronomy work, designed to compare species and strains, management and manuring, by means of meat and milk production, has now started. Kitale station now possesses over 30 pairs of monozygous and dizygous cattle twins, mainly females. These will help very considerably in future experiments where animals are used.

364. Seed production investigations have as yet found no control for Bunt and Ergot on *Setaria* and *Panicum*. Rhodes Grass strains, Nandi *Setaria*, Guinea grass, Molasses grass, Kenya white clover and Lucerne are being bulked by a local seed growers' organisation.

### Coffee

365. Research on the control of Antestia, *Antestiopsis lineaticollis* Stal, demonstrated the value of Malathion against this insect. Two pints of the 50 per cent. emulsion concentrate applied per acre with the machines commonly used in coffee gave satisfactory control.

366. Outbreaks of leafminers, *Leucoptera* spp., occurred towards the end of the year. Experiments on control of leafminer demonstrated the value of Malathion against the moths and Diazion against both moths and larvae in the leaves. Two sprays, with 8-10 days' interval between them, against either moths or larvae were found adequate to control an outbreak. The choice of insecticide could be varied according to whether moths or larvae were predominant in the field.

367. Field experimentation, using Dieldrin bands against White Stem Borer, *Anthores leuconotus* Pasc., confirmed the value of this method of



control. Three applications of  $\frac{1}{2}$  per cent. Dieldrin bands were found adequate to eliminate the borer population from the block used for the experiment. The bands were applied prior to the onset of three consecutive rains.

368. Growth data in the presence and absence of added nitrogen can be related to actual nitrate nitrogen trends in the soil during the rains, particularly with the low values found towards the end of the rains. Laboratory incubation, under standard conditions, of wet soil samples, taken at the end of the rains period, suggest that low nitrate values are not only related to rapid leaching from the upper soil profile and to uptake by the coffee crop, but also to an inability of the soil to produce large quantities. Apparently the nitrogen mineralisation process slows down considerably following a sustained period of adequate soil moisture. Easily assimilable organic matter might be less readily available towards the end of a long rains period and may account for this condition.

369. Further laboratory studies to investigate the influence of pre-drying the soil sample, in preparation for incubation, upon its performance under standard conditions, have pointed to a second mechanism which results, directly or indirectly, in large increases of ammonia nitrogen. This, in turn, is rapidly nitrified when the soil is re-moistened.

370. Topsoil temperatures of 45°-55° C. are often recorded in the field during the hot dry months of January and February; pre-drying soil samples overnight at an air oven temperature of 50°-55° C. has consistently resulted in very high ammonia nitrogen values eight days after re-wetting the samples.

371. Under field conditions, the first mechanism of ammonia accumulation comes into operation as soon as the soil moisture level falls much below the permanent wilting percentage (Robinson, J. agric. Sci. 1957, 49, 100). This effect has been found to a depth of 24 inches under field conditions. Subsequently, following the Short Rains Season and particularly when the topsoil has dried out, soil temperatures are high and this partial sterilisation effect, which in some manner results in release of readily assimilable organic nitrogen, is operative. Both these mechanisms would appear to be related to the large nitrate nitrogen flush that occurs when sufficient rainfall is received to wet the soil adequately, usually in the following Grass Rains or early Long Rains after such a dry, hot period.

372. The investigation of magnesium nutrition of coffee has been continued following the identification of a magnesium deficiency condition in coffee during 1956, and preliminary study of the relationship with grass mulches. There is no doubt that the incidence of this condition is related to the use of mulch grasses in coffee, and more specifically to the increases in soil potassium which results from mulch grass decomposition. The imbalance of high potassium: low magnesium in the leaf is closely related to the high potassium and normal magnesium values in the soil.

373. *Pathology and Physiology.* Work this year has largely been devoted to problems of coffee leaf rust (*Hemileia vastatrix*) control. The studies on physiologic races, commenced last year, have been continued. The main problem has been the determination of the causes of rust attacks on K.7. In one group of cases, segregation of susceptible types was the cause, whilst another group was attacked by D'Oliveira's Rust Race I. Field observations suggest that although this latter is likely to be a serious menace to coffee growing in the lower areas of Nyanza and probably eventually elsewhere, K.7 still remains less affected by rust attacks than other varieties and may continue to be of value until satisfactory varieties resistant to Races I, II, and III are available. Further, apparently the susceptibility of K.7. to Race I

varies with climate. This may be the reason it has remained free of attacks in certain areas.

374. Studies of the factors influencing germination and penetration of rust spores have been carried out. In confirmation of the findings of earlier workers it was found that spore germination is strongly inhibited by light and that a water film is essential. Germination takes about 3 hours at 23° C. and penetration commences after 7 hours. In the field, it is thus apparent that the leaves must be wet from not later than 10 p.m. for penetration to occur.

375. An experiment has confirmed that spores are only likely to land on the upper surface of leaves and that they reach the under-surface by rain washing and splashing. It was found that during this process, sufficient copper may be picked up from copper fungicide deposits on the upper surface of leaves to inhibit spore germination when these droplets are splashed on to the upper surface.

376. A field trial was carried out with various fungicide sprays applied just prior to the Long Rains. Magadi Ash Burgundy was used at  $\frac{1}{4}$ ,  $\frac{1}{2}$ , 1 and 2 per cent., and Perenox at the same copper contents, each being contrasted for application to upper surface as against lower surface of the leaf. Tests of Captan, Fermate and Oleocuvrè were included at the  $\frac{1}{2}$  per cent. concentration only. The results indicate that considerably enhanced control is obtainable by the higher concentrations of Perenox and Burgundy and that these are effective also on the upper surface of the leaf. Captan, Fermate and Oleocuvrè produced about the same control as  $\frac{1}{2}$  per cent. Burgundy.

377. *Coffee Berry Disease*. Results from the time and frequency of spraying trials, using phenyl mercuric acetate were worked out during the year. In Upper Kiambu, flowering is the most critical period, 20-30 per cent. increases being obtained from one well-timed blossom application. No subsequent treatments gave any new significant results. In the Nyeri district, July and August sprays increased yield by 20 per cent. (2 cwts. parchment per acre). In the West Rift conditions again seem different as there appear to be two periods when spraying is required in that locality. At Kapsabet, valuable responses were given by a variety trial varying from 64 per cent. increase in SL. 28 to 260 per cent. in SL. 30.

378. Based on these results, a more critical programme was laid down for 1957-58 and the results are now coming in. These confirm the indications given above, the responses this year being considerably higher. Those from the Kapsabet trials, for example, have doubled or, in some cases, trebled. It is now clear that the Blue Mountain variety, though its fruit is resistant, is subject to severe flower loss from Coffee Berry Disease.

379. Towards the end of the year, the first signs of a phyto-toxic effect of mercury sprays were observed, first as a delayed scorch, but later developing into growth abnormalities, associated with low values of zinc in the new shoots. Work is now in progress on this, but it is already evident that these effects are not so marked when insoluble compounds of mercury are used.

380. *Vegetative Propagation*. The best results were obtained from wedge-shaped nodal cuttings of two nodes length, prepared from semi-mature wood. On the average, rooting exceeded 90 per cent. after three months. Many other types of cuttings were tested but the results were inferior.

381. A Vinyl Resin (VL 600) was sprayed on to the leaves of coffee cuttings at the time of insertion so as to restrict losses due to transpiration.

Although the rooting percentage of cuttings treated with vinyl resin was not greater than the control, the time taken for rooting was reduced by approximately two to three weeks.

#### *Sugar Cane*

382. A variety trial sited on the upper red soil at Miwani has been completed after its second ratoon crop. In yield of cane and sucrose per acre, CO. 331 was superior to the other varieties tried. A large trial of 25 varieties grown under irrigation at Miwani showed that yields can be raised very considerably by this technique. CO. 419 yielded 77 tons of cane and 9.98 tons of sucrose per acre in its plant crop. Some of the high sucrose Barbados varieties showed equal promise under irrigation.

#### *Plant Pathology*

383. The following plant diseases were recorded for the first time:—*Colletotrichum lagenarium* on melon; *Mycosphaerella brassicicola* on cauliflower; *Cereospora carotae* on carrot; *Pseudomonas delphini* on Delphinium and *Phleospora herbarum* causing leaf spot on Russian Comfrey. The Chrysanthemum leaf eelworm, *Aphelenchoides ritzema-bosi*, was seen for the first time on chrysanthemums, pyrethrum, and Shasta daisy.

384. *Blight-Resistant Potatoes*. The testing and distribution of the blight-resistant potatoes has continued. Three are now well established in commercial production. Six more hybrids from Dr. Black were received. Four of these were resistant to blight and two susceptible. Seed of three varieties from Ireland, Ulster Torch, Ulster Tarn and Ulster Beacon, were received through the courtesy of Mr. John Clarke of Northern Ireland, together with two un-named seedlings for trial. During the year heavy attacks of blight occurred in all districts in both Long and Short Rains seasons, and somewhat unusually during the month of February. The race of blight responsible for the main attack throughout the Colony was identified as Race 4.

385. *Wheat Stem Rust*. The re-establishment of the rust work after its transfer from the Plant Breeding Station has continued with a pathologist for cereal diseases having been appointed during the year. From the 74 collections of rust received from the field, races K.11, K.12, K.13 and K.16 have been re-isolated and maintained. In the course of race identification, three probable new races have been revealed. One hundred and twenty-five selections from the Plant Breeding Station have been screened for their reactions to five of the rust races.

386. The increasing complexity of the rust problem and the dependence on new sources of resistance from other parts of the world has made the adoption of the international collection of differentials essential for comparative race determination while retaining the local differentials hitherto used for the differentiation of the sub-races.

#### *Entomology*

387. A reduction in infestation of the rice stem borer, *Rhinaphe vectiferella*, followed spraying with endrin, but further work is required before adequate control measures can be recommended.

388. A technique for rearing the Coconut Coreid bug in the laboratory has been worked out and bio-assay work on this species is being undertaken. Small scale field spraying trials have shown that dieldrin at high concentration exerts a fair control of this species.

389. Work in Nyanza was largely confined to cotton pests. For the third year in succession, a BHC/DDT dust has given good yield increases in the

Lake shore area. The dust will be in use in African areas on a limited scale next season. In Elgon Nyanza experiments gave considerable promise of economic control of *Lygus* with DDT sprays.

390. Experiments against Barley Fly with Aldrin, Dieldrin and Endrin dry seed dressings gave good control. Sprays of Dieldrin and Endrin gave reasonable but not such good control. Kikuyu grass was recorded as an alternative host.

391. Cob maize dusted with 0.06 per cent. BHC in diatomite at about 8 ozs. to 9 cubic feet remained virtually without insect damage for over a year inside crib walls lined with hessian sprayed with a persistent formulation of lindane. Bagged maize was protected for 33 months after admixture with 0.3 per cent. pyrethrins and  $3\frac{1}{2}$  piperonyl butoxide. Two infestations of *Trogoderma* from abroad were intercepted and dealt with by methyl bromide fumigation.

#### *Veterinary Research*

392. *Virus Diseases.* A tissue culture unit was established. Cultures of bovine kidney, bovine testis and chick fibroblasts were grown regularly. HeLa cells were maintained by serial transfer. Preliminary studies were undertaken with the viruses of Newcastle disease and Rift Valley fever in these cultures.

393. Numerous outbreaks of Newcastle disease were confirmed in the Nairobi district. These outbreaks were confined to small backyard flocks and no large farms were affected. The policy of avoidance of live vaccines was continued and research was carried out towards production of an efficient dead vaccine. Formalin inactivation of infected fowl and oviculture virus material gave no protection, but preliminary trials with a beta-propiolactone inactivated allantoic fluid of high virus titre were promising.

394. Five outbreaks of rinderpest-like disease in Masai were investigated. Cattle between three months and three years of age were mainly affected. Mortality was less than 5 per cent., but morbidity up to 100 per cent. One outbreak was confirmed as due to rinderpest, but the others gave negative results on animal inoculation. Other virus diseases simulating the clinical syndrome of rinderpest are suspected.

395. African swine fever was confirmed in African owned pigs in a village near Nairobi. Pigs experimentally infected at the laboratory showed pyrexia 24 hours after inoculation and particularly severe lesions at autopsy after seven days.

396. Successive needle transmissions of bovine infectious pectechial fever were continued to the 21st passage in cattle after which the strain was lost when control cattle failed to react and were subsequently proven immune. A fresh strain was obtained from the field and successfully passed. Evidence for the infective agent being a virus was strengthened by proof of its resistance to *in vitro* incubation with antibodies, but attempted transmissions with filtered material failed consistently. The infective agent was shown to be in the leucocytes of infective blood and remained viable during nine days storage at 4°C or 48 hours at 37°C. Infectivity was lost at -20°C or by lyophilization. The agent could not be propagated in egg embryo or tissue culture. Vaccines produced from formalin or crystal violet inactivated materials gave no protection and sera from animals immune after experiencing the disease had no neutralizing ability when incubated *in vitro* or injected simultaneously with infective blood. Various drugs used against trypanosomes and babesia and others with vasoconstrictor or adrenocortical activity were ineffective for prophylaxis or therapy. Following field observations that occurrence of the disease was constantly associated with thickly wooded parts

of farms a survey of biting insects was instituted. Insects collected from infected farms emulsified and inoculated parenterally into susceptible cattle did not set up disease and preliminary insect transmission experiments were not successful.

397. Lumpy skin disease was confirmed for the first time in Kenya in a small dairy herd in the Dunderi district near Nakuru. Within a few weeks the disease was diagnosed in small numbers of stock on nine other farms all in the Nakuru area. Spraying against possible biting insect vectors was instituted, strict quarantine imposed and active cases of disease slaughtered. Laboratory confirmation of all outbreaks was by histological examination of skin biopsy material. Intensive efforts were made to isolate virus in tissue culture and sera were sent to Onderstepoort for neutralization tests against South African strains of virus.

398. Epizootiological studies on foot-and-mouth disease with typing of strains was carried out by Pirbright. Of 257 outbreaks sampled, 82 (40.6 per cent.) were type "O", 25 (12.4 per cent.) type "S.A.T.11", 8 (4 per cent.) type "A" and 1 (0.5 per cent.) type "C". Strategic inoculations with appropriate monovalent aluminium adsorbed vaccines continued to give good protection to herds. A capital grant was obtained from the Wellcome Trust and plans for the erection of a departmental institute for research into foot-and-mouth disease were completed.

399. *Bacterial Diseases.* A coccal septicaemia of chicks caused heavy losses in some flocks. Organisms isolated regularly from clinical cases showed most of the cultural and other characteristics of the enterococcus group and pure cultures were shown to be capable of reproducing the disease in chicks at the laboratory. Sulphathiazole was effective in treatment and aureomycin in the drinking water for the first eight days of life an effective prophylactic.

400. Survey of the incidence of Johne's disease continued by cultural methods applied to abattoir materials and by the complement fixation testing of sera on a herd basis. In thirteen herds tested for the first time an average of four per cent. of animals were serologically positive and the incidence in Kenya was seldom found to exceed ten per cent. even on the worst affected farms. In every case where a relatively high proportion of animals were infected circumstantial evidence suggested that the disease had been disseminated by the medium of contaminated dams or similar water supply. Encouraging results from testing and eliminating reactors as a method of control. Experiments were started with sulphone therapy and vaccine prophylaxis.

401. Survey of infectious infertility disease was undertaken on an extensive scale from the Kabete and Naivasha laboratories. The mucus agglutination tests for diagnosis of genital vibriosis and culture of vaginal mucus for detection of trichomoniasis proved reliable in our hands. Much work was done on the development and improvement of these and other diagnostic techniques.

402. Leptospirae isolated from cattle, sheep and goats were identified as *L. grippityphosa*. Serological surveys by the agglutination test showed that only this species was involved in the outbreaks of disease in our last report. Laboratory confirmation of leptospirosis was made on sixteen farms in the Nanyuki area. Abattoir inspection and examination revealed an incidence of 7-60 per cent. *L. grippityphosa* infection in native slaughter stock from the Northern Frontier Province and Kitui districts. A high proportion of kidneys showed varying degrees of kidney disease. A study of the renal histopathology of chronic bovine leptospirosis was made.

403. Bacteriological examinations were carried out on pneumonic lungs from cattle, sheep, goats and camels with particular reference to the role of *C. pyogenes* and *F. necrophorus* in these conditions and in bovine pyaemia.

404. *Biochemistry*. The mineral survey continued and 269 pasture clippings and 5,627 blood samples were analysed. The first stage of the phosphate feeding trials undertaken in conjunction with the E.A.V.R.O. was completed.

405. Work in connection with milk taint investigations showed that cattle grazing on the Naivasha Experimental Station had very low copper status with blood copper averaging less than 0.6 p.p.m. and liver copper less than 25 p.p.m. (dry matter). Controlled feeding trials in which steers, or heifers from two years of age and dairy cows were supplemented with copper or copper and cobalt showed that while copper reserves of all animals could be raised to normal there was no effect on liveweight gains of young stock. The degree of taint in the milk of supplemented cows was not influenced. Early observations on similar trials commencing during gestation or at weaning showed more striking beneficial effects of copper feeding. Experiments were also started on farms in the Naivasha and Nakuru areas where trace element deficiency was indicated by survey analyses.

406. *Hides and Skins Research*. A survey of the diseases affecting a series of 1,059 hides was published and a similar review of the skin diseases of sheep nearly completed.

407. Insecticidal treatment of skins with BHC gamma isomer at 0.05 per cent. was shown to provide superior protection against experimental hide beetle attack when compared with the standard arsenication treatment with 0.25 per cent. sodium arsenite.

408. Artificial smoking of skins under experimental conditions showed that the effect, which is often seen in skins dried in African huts, was not as detrimental to the finished leather as was previously considered.

#### *Animal Husbandry*

409. The long term programme of improvement of indigenous Zebu cattle for milk production was continued by progeny testing and selection within the pure indigenous, and by grading up to pure Sahiwal. The work of grading up to Sahiwals was being accelerated by artificial insemination using semen collected at the Department's Central Artificial Insemination Centre from progeny tested bulls. A small stud of Red Sindhi is maintained on one of the Livestock Improvement Centres located in the Coast Province to provide a comparison in production with the Sahiwal under the hot humid conditions prevailing in the lower altitude regions.

410. Plans were made to conduct a nucleus breeding experiment in Borans. The object is to produce breeding stocks of known economic performance and to compare production in the Boran with other beef breeds. Feeding trials continued in dairy and pig herds using industrial waste products. Feeding experiments are in progress to investigate the effects of feeding different levels of protein on growth and production in pigs.

#### *Forestry*

411. *Silviculture. Pruning*. The experiment to determine losses of volume production caused by various degrees of pruning of *Cupressus sp.* reached the end of its first phase when thinning became due for the first time. The severest treatment was completed during the year. Volume and taper data were analysed. Significant volume losses occur but are in part offset by the superior timber quality and smaller taper of successively severer degrees of pruning. Occlusion rate appears to be faster in the severer treatments.

412. *Planting.* Use of the technique devised by the East African Agriculture and Forestry Research Organisation's Soil Physics Division to calculate soil moisture and thus aid the determination of suitable planting time was used successfully everywhere, but needs further verification in a year of poor rainfall.

413. *Tree breeding.* The first batch of progeny of 40 selected plus trees of *Pinus patula* were planted out in April and arrangements were made to increase the scale of pine progeny trials. Examination of juvenile characters showed some marked difference between progenies.

414. *Mycology.* Progress in the extended research into *Armillaria* Root Rot in pine plantations has been slow. Comparison of variation between isolates on the laboratory scale has been nearly completed. A survey of Dead Top in pine plantations has been completed with an extensive examination of affected tissues for presence of *Diplodia pinea* and other secondary pathogens. No pathogens were detected and it is concluded that the condition in Kenya is due to physiological causes.

415. *Entomology.* Research was concentrated mainly on the habits and control of the important Cermbytid borer, *Oemida gahani* Dist., the most serious pests of cypress plantations. Oviposition has been found to occur during the rains almost entirely and there is evidence that a considerable proportion of eggs laid do not hatch. There was no particular preference for any type of wound on trees, oviposition sites occurring on pruning scars, game damage and rat damage. Though long term trials of insecticides to treat pruning scars as a prevention of attacks are in progress, such methods are likely to prove uneconomic. As it is unlikely that young trees, before the formation of heartwood, are attacked, early and frequent pruning with resultant rapid occlusion, may well be the answer to this problem.

416. A short survey of the importance of *Ambrosia* beetles showed that they are of importance only in the warmer and more humid forest areas, causing negligible damage in the high altitude forest over 7,000 feet. Exotic softwoods are rarely found to be attacked. The application of oil sprays of 1 per cent. and 2 per cent. gamma BHC proved the most effective insecticidal control of attack of freshly felled logs.

#### MALTA G.C.

##### *Animal Health*

417. An experiment has been done to test the value of the attenuated vaccine of Elberg as a means of immunising the Maltese goats against *Brucella melitensis* infection. Immunity is being tested by exposing vaccinated and control goats to natural infection. Results should be available by June 1958. Investigation of the relative reliability of the various diagnostic tests available for detecting brucellosis in goats has been carried out on specimens of blood, milk, tissues and lymph nodes. The extent of brucellosis in Maltese sheep has been investigated by the bacteriological examination of tissues and glands.

#### MAURITIUS

##### *Agriculture*

418. *Tobacco.* Further improvement in the technique of raising tobacco seedlings has been achieved by the fumigation of seed-beds with ethylene dibromide 14 days prior to sowing. Seedlings have considerably improved vigour on the fumigated beds. The use of "soil blocks" to eliminate transplanting check has shown that root development at the time of transplanting



is incomparably greater with the soil block material in contrast with the normal transplants. An earlier and more uniform crop is obtained.

419. *Citrus*. An orchard of *Tristeza*-resistant stock-scion combinations has been established and growth has been satisfactory. Acute zinc deficiency has been overcome to a large extent by spraying with neutralized zinc-sulphate. Much higher rates of application than those normally used have been found to be necessary if symptoms are not to reappear towards the end of the growing season in April-July. Mandarin appears to be the most likely stock for general use in Mauritius. Other *Tristeza*-resistant stocks such as Rough Lemon and Sweet Orange suffer from Canker (*Phytophthora citri* Haase) and lack of vigour respectively.

420. *Maize*. Trials have continued on the breeding of Rust (*Puccinia polysora*) resistant maize. Imported strains from East and West Africa have shown no greater degree of resistance than the selected local strains. The virulence of the attack appears to have lessened very considerably since it was first reported five years ago.

421. *Beans*. Attempts are being made to develop Dwarf Beans (*Phaseolus vulgaris*) as a field crop. This has been found possible by the control of *Melanoagromyza phaseoli* Coq. by a spraying of Aldrin at the two leaf stage.

422. *Fibres*. *Urena lobata* has given yields of up to 2,500 lbs. of dry fibre per acre when grown under suitable conditions. The most important factors are an adequate supply of water throughout the growing season and the correct time of planting which should be in November. When planted after November yields are seriously reduced due to early flowering. *Urena* has also been found to be an excellent cover-crop requiring no cultivation after sowing.

423. *Fodders*. Elephant grass planted at a six-foot spacing has been shown to be considerably more productive in the second and third years than the normal narrow planting of three feet. In the heavily leached upland areas the production of *Setaria sphacelata* has shown good responses to the application of up to 1,000 lbs. of sulphate of ammonia per acre. Investigations on the utilization of *Leucaena glauca* have shown that a high quality protein meal can be readily prepared. This has been used to supplement the protein rations for livestock. Little success has been obtained from any other legume.

424. *Irrigation*. The use of overhead irrigation has been increased on the experimental stations and results have been very encouraging. A system of contour strip cultivation has been devised using sugar-cane as a rotation crop on alternate terraces. This is designed to fit in with sugar-cane cultivation, to give the maximum water conservation and to give protection from wind to more delicate crops, such as tobacco, potatoes, beans and vegetables.

425. *Animal Husbandry*. The cattle breeding policy of fostering and preserving the "Creole" Milch breed has been firmly established. The proportion of pure "Creoles" is on the increase, and the artificial insemination centres are providing only "Creole" semen. A Veterinary laboratory has been established at Reduit to undertake the preparation of biological products. The production of a vaccine against Newcastle disease of poultry has already started.

426. *Pests*. Work continued on the biological control of pests of Pigeon Pea (*Cajanus cajan*), both the parasites of *Bracon Cajanus* and *Eiphosoma* (? *annulatum* Cress) have been recovered during the year. The former appears to be well established. An egg predator, *Cyrtorhinus mundulus* Bred., of *Perkinsiella saccharicida* Kirk., the vector of Fiji Disease of sugar-cane was



liberated in quantity. In September, 1957, both nymphs and adults were recovered. The insect now appears to be well established. Predators of the Giant Snail, *Achatina fulica* Bowditch, have been introduced from Ceylon. Four consignments of *Lamprophorus tenebrosus* Walker, were multiplied and liberated. None have yet been recovered. Parasites of the fruit flies *Dacus* spp., *Ceratitis capita* Wied. and *Pterandus rosa* Karsch have been received from Hawaii. These included eight species of *Opius*, *Dirhinus giffardi* Silv., and *Syntomosphyrum indicum* Silv. This last species is the only one so far to be recovered. Parasites of *Maruca testulalis* and the Scolid Wasp, *Scolia oryctophaga* Coq were despatched to Hawaii and India respectively.

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#### NIGERIA—Federal Research

##### Agriculture

427. *Cassava Collection.* The collection of Nigerian varieties, and the importation of seed and related species of *Manihot* was continued. Consignments of *M. dulcis*, *M. heptaphylla*, *M. carthaginensis* and *M. melanobasis* were received from abroad. Hybridisation within the species *M. utilissima* was continued with a view to produce high yielding mosaic tolerant varieties and to provide information on the mechanism of inheritance of varietal characters particularly on starch and hydrogen cyanide content of the tubers, plant habit, anthocyanin pigmentation, tuber development and sexual sterility. All clones produced in the 1956 series of intraspecies crosses were found to be susceptible to cassava mosaic virus, although the severity of symptoms varied markedly both between and within families. Families derived from variety 42074, one of the least susceptible parent varieties, showed a high level of resistance. The susceptibility of families tended to increase with that of the male parent. Hybrid clone No. 37065.12.41 in its first stage multiplication plots yielded an average of 18.75 lbs. per stand at one year old, equivalent to 29.5 tons per acre. This clone showed very slight symptoms of mosaic in 1957, but it is to be expected that the yield will fall if the mosaic infection becomes more severe (as was the case in its parent variety 37065).

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*Hybridization with other species of Manihot*

428. Many of the interspecific hybrids obtained from Amani flowered during 1957 and were selfed, inter-crossed, and back-crossed to high yielding cassava varieties. The fertility of most of these clones was comparable with that of cassava. F<sub>1</sub> interspecies hybrids between *M. utilissima* and *M. glaziovii* have been obtained with great difficulty as the interspecific compatibility is very low. There are seedlings among the *M. utilissima* x *glaziovii* hybrids and the Amani population which have so far not shown any mosaic symptoms.

*Citrus*

429. The trials of suitable rootstocks for Sweet Orange and Grapefruit planted in 1931 at Ibadan have continued to show a decline in yield. It now appears under local soil conditions, where no fertilizers are used and where grass is allowed to replace the original leguminous cover crop, that budded trees reach their peak around 11-15 years of age with a profitable life of 25 years. Further investigations are under way to determine whether the economic life of the tree can be extended by the continued use of fertilizers (including the addition of Mg, Mn, Cu and Zn to the standard NPK mixture) and by the use of leguminous cover crops.

430. The most promising rootstock for Ruby Blood Sweet Orange based on the annual mean number of fruit produced over a period of 6-25 years was Mandarin. The order of merit compared with sweet orange was Mandarin (1238), Tangerine (950) Sour Orange (908) Acid Lime (820) and Sweet Orange (723). Records of weight of fruit harvested over the last 10 years gave the following order of merit based on the annual mean number of boxes (73.5 lb.) per tree: Mandarin (6.0), Tangerine (5.5), Sour Orange (3.6), Acid Lime (2.9), Grapefruit (2.1) and Sweet Orange (2.1). The most promising rootstock for grapefruit (an un-named seedy variety) based on the annual mean number of fruits produced in the trial was Sour Orange. The order of merit was Sour Orange (724), Mandarin (671), Tangerine (642), Grapefruit (575), Acid Lime (495) and Sweet Orange (465). Records of weight of fruit harvested over the last 10 years gave the following order of merit based on the annual mean number of boxes (60.0 lb.) per tree: Tangerine (10.3), Grapefruit (5.9), Sour Orange (5.8), Mandarin (5.3) and Sweet Orange (2.8).

431. The results of the citrus work to date suggest that it may be possible to find a suitable substitute for sour orange root-stock in the Mandarin-Tangerine groups or their hybrids. In the past, Sour Orange has proved a satisfactory root-stock for Sweet Orange, but its general use is no longer recommended in view of its susceptibility to tristeza, a virus disease which has been shown to occur in other parts of West Africa, though not yet reported in Nigeria.

*Yam Beetle studies*

432. This year's experiments had a low rate of attack in the controls. Despite this, increases in yield were obtained following the use of 0.45 per cent. Gammalin BHC dust applied to seed yams before planting. Aldrin, Dieldrin and Chlordane dust gave promising results, usually better than BHC.

433. The biology of the yam beetle is very poorly understood and studies are being made at Benin with the co-operation of the West African Institute for Oil Palm Research, to improve our knowledge of this pest. The ecology of breeding areas, the movements between them and the yam fields and the methods of attack are being studied.

*Whitefly studies*

434. Recently studies have been confined to determining whether the whiteflies upon various host plants belong to the same species. So far transference has taken place from each of cassava, tobacco and cotton (separately) to cassava, *Calopogonium*, sweet potato, cotton, tomato, *Euphorbia* and tobacco; and from sweet potato to cassava, tomato and *Euphorbia*. It seems likely that whiteflies on these hosts belong to the same species.

*Sorghum Midge*

435. A considerable amount of information has now been obtained on the life-history of *Contarinia sorghicola*, the chief species of importance in Northern Nigeria. Observations at Samaru, Kano, Daura and Kefinsoli have revealed that *C. sorghicola* in these areas carries over from one growing season to the next as diapausing larvae which can be found in heads left in the field after harvest and in the trash remaining in and around villages and threshing places after harvest.

436. Estimation of crop losses have shown that sorghum midge attack is always most severe on departmental farms especially where a wide range of different varieties is cultivated. Native farms show less damage. A visual estimate made in Ketsina Province in 1956, gave an overall loss of 5-10 per cent. of guinea-corn grain. A general survey of midge infestation based on dissection of samples of spikelets is being conducted at the present time.

*Cereal Stem Borers*

437. Detailed studies of the main genera of cereal stem borers have been made and over 1,000 larvae have been reared to maturity in the laboratory to provide information on length of developmental stages in the life-history and on the nature of the dry-season populations. For convenience, progress is detailed below under different crops, but it should be noted that these form an inter-related milieu for a complex of stem borers.

- (a) *Maize*. The use of insecticides such as Endrin, Aldrin and Dieldrin has given promising results in controlling stem borer and increasing yield, but further work is required to determine the most suitable method of application.
- (b) *Guinea-corn*. Estimation of crop losses in Guinea-corn resulting from stem borer attack have so far shown that the crop is liable to recover from all but the most severe attacks and that the highest yields are produced from crops which show a high percentage of stems bored. Further work on the estimation of crop losses is necessary to assess the economic importance of the stem borers and until this data is available it will not be possible to determine whether control methods would produce a worth while increase in yield.
- (c) *Millet*. Results at Kano have shown that Endrin reduces the percentage of stems bored by *Coniesta* at harvest and that there is a significant correlation between incidence of stem borer and yield of threshed grain. A 50 per cent. incidence of stems bored showed a reduction in yield of 40 per cent., but insecticides failed to give control, probably due to the different egg-laying and larval habits of *Coniesta* compared with *Busseola* and *Sesamia*.

*Plant Pathology*

438. Investigations during the year have been concentrated on cassava mosaic, a suspected virus disease of yams, cowpea mosaic virus and pepper

viruses. Studies on a cocoa seedling wilt were completed and a spraying trial for its control was designed for the Western Region Department of Agriculture.

#### *Cassava mosaic*

439. Investigation of cassava infected with mosaic disease has shown that not only is the photosynthetic capacity of diseased leaves reduced, but that there is a reduction in the rate of translocation of carbohydrates from the leaf. One result of the infection is an increase in total nitrogen and crude protein in the leaf. Further improvements were obtained in the technique of curing cassava plants infected with mosaic by heat therapy. A greater measure of control has been achieved by excising the young green shoots for the parent cutting immediately after heat treatment and rooting them separately.

#### *Cowpea Mosaic Virus*

440. This virus of which one strain at least is known to be a form of tobacco mosaic virus (Lister and Thresh, 1955) was found widespread on cowpea throughout the Western Region in September, 1957.

441. Preliminary observations suggest that introduced varieties (e.g., New Era, Dr. Saunder's Upright, etc.), are much more severely affected by the virus than the local varieties and that there is more than one strain of the virus. The virus from cowpea has been successfully transmitted to French beans, but no other alternative host has been found.

#### *Rice Research*

442. During 1957 the research work carried out at the Rice Research Station, Badeggi, was limited to field experimentation due to lack of laboratory facilities and essential services.

443. The aims of the selection programme are to produce higher-yielding, good quality varieties, of as far as possible one grain type, within an ecological zone in order to maintain and improve milling quality. Six such zones are based on the requirements of the following features:

- A. Riverain areas subject to rapidly rising seasonal deep floods of more than four feet ;
- B. Riverain areas subject to slowly rising seasonal deep floods of more than four feet ;
- C. Riverain areas and inland swamps subject to floods not exceeding 2½ feet in depth with flood control and supplementary irrigation ;
- D. Upland rice growing areas ;
- E. Swamp forest ;
- F. Mangrove swamp (fresh water and saline).

#### *Zone A*

444. *Agrobotanical classification of the cultivated varieties of Oryza glaberrima in the Northern Region.* A collection of types has been made and is being added to. A trial to compare the growth rates of varieties of *O. glaberrima* and *O. sativa*, indicates that *O. glaberrima* does not have a markedly faster growth than *O. sativa* under the conditions of controlled irrigation in this trial.

445. In attempts to cross pollinate, seed was obtained from five crosses, but all failed to germinate. In a number of trials superior yields have been

given by varieties from different parts of the world. As would be expected, many of the best varieties have been derived from Asia, particularly the Burma-Siam region and Southern India. Full use has been made of the variety collection at the West African Rice Research Station in Sierra Leone from where a number of promising varieties have been obtained. An extensive collection of local Nigerian rices has been made and these are being tested and selected for yield and other characters. A system of purity maintenance for seed stocks has been set up and a scheme for pure seed multiplication arranged with Regional Departments of Agriculture.

#### *Stored Products Research*

446. In all three Regions visible practical results have been brought about as a result of changes introduced on the basis of results of research and investigations by W.A.S.P.R.U.

447. *Groundnuts*. In the Northern Region a search for a more suitable insecticide than BHC for spraying bagged groundnuts has been in progress for several years. A proprietary colloidal silica showed considerable promise in laboratory trials, but in the field it became rapidly de-activated by a layer of dust. Work has been conducted on storage in paper bags and an interim report has been written on the use of Ctesiphon buildings for groundnut storage. Further work has been carried out on the mechanism of f.f.a. formation and a field trial showed that boric acid could be used as an inhibitor for f.f.a. formation.

448. *Cocoa*. Extensive investigations on the effect of routine misting of stored cocoa with synergised pyrethrins have led to the abandonment of this form of treatment as a routine. The main reason for the failure of the misting programme seems to have been the lack of persistence of the insecticide at the dose used and the presence of insect pests in the cocoa beans before they come into licensed warehouses. Fumigation with methyl bromide is now the only treatment used on a large scale, but misting is still used occasionally to reduce the dusk flight of insects in port warehouses. It has been found that after fumigation of cocoa beans with methyl bromide the insect which reinfests the cocoa most rapidly is *Tribolium castaneum* and misting with synergised pyrethrins did not prevent this. Currently the use of synergised pyrethrin dust for admixture with cocoa beans is being tested, and also the use of various types of hessian bag including a type with polythene lining.

449. *Palm Produce*. A number of field trials have been completed in which palm oil has been stored under trade condition. The increase in free fatty acid was shown to be much less than was anticipated. The nature of the factors involved in f.f.a. development are now being investigated in the laboratory and in some cases of unusual fatty acid rise, moulds are suspected as being responsible.

450. *Grain and Cowpeas*. In Northern Nigeria the Unit has been concerned with planning and supervising the construction of an underground grain storage tank at Kano for the Northern Region Department of Agriculture. There has also been general liaison between the Unit and the Department of Agriculture. In the west the Unit has financed a joint experimental silo project with the Faculty of Agriculture, University College, Ibadan. Silos of concrete, aluminium, steel and plywood have been built and the aluminium silo has

been filled with maize. Studies will be made of changes in temperature, moisture content and insect infestation. Experiments are being carried out on the storage of maize and cowpeas under airtight conditions in 44 gallon oil drums. Admixture of BHC powder with cowpeas together with surface dusting was found to control Bruchids and was recommended as being a satisfactory practical treatment.

#### *Forestry Research*

451. Slow progress has been made in the development of this Department. At the end of the year the Research Staff consisted of a Director, two Principal Research Officers, four Research Officers on silviculture and three on botany.

452. Silvicultural Research has been continued in the Northern, Eastern and Western Regions. In the north the main work is directed towards a comparison of species for plantations, methods of densifying natural savannah woodlands and prevention of termite damage to Eucalypts. Growth and regeneration figures are also being obtained for high forest outliers. In the Western Region the main efforts are directed towards studying methods of obtaining natural regeneration of high forests. There are five investigations into various aspects of this. In the Eastern Region research is being carried out into many problems. Line planting in high forest, regeneration of *Borassus*, reclamation of degraded grass lands and regeneration of *Mitragyna* and *Oxystigma* are among the more important problems being studied. It is hoped soon to start silvicultural research in the Cameroons on a large scale, but at present the activities of this Department are limited to maintaining a few permanent sample plots.

453. Ecological research has been directed towards the problem of re-establishing forest conditions in savannah; the fire-protection experiment started by W. D. MacGregor in 1929 has been re-assessed; the peripheral spread of forest outliers in the savannahs of Jemaa Division has also been studied. The herbarium continues to expand and is providing an efficient identification service for workers in many Government departments and other institutions.

#### *Publications*

KEAY, R. W. J.—Notes on Rubiaceae for the "Flora of West Tropical Africa"—I. *Bull. Jard. Bot. Brux.* 27 (1957) 95.

KEAY, R. W. J.—The Typification of *Haynes ovafolia* Schum. and Thonn. *Kew Bull.* (1957) 175.

KEAY, R. W. J.—Wind-dispersed Species in a Nigerian Forest. *J. Ecol.* 45 (1957) 471.

#### *Veterinary Research*

454. *Rinderpest*. Investigations into the residual moisture content of Dried Goat Virus showed that when this was below 1 per cent. following secondary desiccation at a vacuum below 0.03 mm. Hg it required 4 hours to dry 0.1 gm to 0.25 gm, 6 hours to dry 0.5 gm and eight hours to dry 1 gm.

455. Work has been undertaken with the assistance of an F.A.O. fellow, on the techniques of a complement fixation test for rinderpest. A specific reaction was demonstrated and provided satisfactory results not only as a diagnostic

method in cattle, but as a reliable means of judging virus propagation in the rabbit, embryonic egg and tissue culture. So far variable results have been obtained with the avianised strain of rinderpest from Damascus.

456. *Newcastle Disease*. Demands for this vaccine continue to increase. Attention is being paid to vaccine losses during desiccation. It was shown that the losses were confined to the first fifteen minutes of primary desiccation during the freezing process, and these were in the order of one log (i.e. 90 per cent.). After desiccation no detectable losses were noted when the vaccine, in vacuo, was stored at  $-20^{\circ}$  and  $+4^{\circ}$ C. over a period of six months. Exposure to ambient temperature of  $27^{\circ}$ C. showed that the original titre was maintained for periods up to three weeks but after this the loss of viability was rapid.

457. *Pleuro-pneumonia*. The Rapid Whole Blood Slide Agglutination Test was given a field trial the results of which were most satisfactory. Of 3,000 animals tested, 90 per cent. of the animals giving positive reactions showed macroscopic lung lesions. Work continues in order to find a suitable adjuvant.

458. *Parasitology*. The work on the life cycle of *Neoscaris vitulorum* was continued and it would appear that calves become infested by a prenatal infection. Piperazine adipate administered when the calves were 21 days old was successful in eliminating the worms. A survey of coccidia coccysts in cattle has been completed and a further species, *Eimeria wyomingensis*, identified.

459. *Biochemistry*. Now that the normal blood picture for zebu cattle has been established, findings have been applied to the field. Where worm burdens increase, chiefly due to *Haemonchus* infestation, the packed cell volume decreased from  $24.69 \pm 1.65$  per cent. to 17.0 per cent. When minerals were given the P.C.V. was 22.6 per cent., after minerals plus Phenothiazine the P.C.V. was 24.3 per cent., and after minerals + phenothiazine + protein supplement, the P.C.V. was 26.5 per cent.

#### *Livestock Research*

460. In studying the management practices of White Fulani cattle it was found that the average grazing period in November (end of rains) on good and poor pastures was 7.94 hours and 9.12 hours respectively. At the end of the dry season on the good pastures it was extended to 8.50 hours.

### *NIGERIA—Northern Region*

#### *Agriculture*

461. The recruitment of Senior Service staff continued even more rapidly than was expected. In consequence it has been possible to increase research work in outstations, particularly at Mokwa for the Middle Belt. Consequent on constitutional changes the research branch has been reconstituted as the Research and Specialist Services Division responsible to the Minister through the Permanent Secretary, Ministry of Agriculture. It now includes Fisheries and Agriculture.

462. The majority of the soil surveys of experimental farms were completed and the reconnaissance surveys are in full swing. Three sheets, covering some 3,500 square miles are in process of completion. A rough geomorphological survey of Kabba Province was carried out and an ecological survey of some 1,200 square miles of potential rice growing areas in Shendam. Considerable effort also went into the search for areas suitable to commercial production

of sugar. A series of thirteen fertiliser trials on yams, sorghum and groundnuts was brought to a conclusion and the area in which recommendations for economic applications of fertilisers can be made, thereby extended.

463. A preliminary sorghum midge survey indicates that in most areas the pest is not serious. In some, notably west Sokoto Province, this is not so. In the samples from some villages there, from 50 per cent. to 70 per cent. of spikelets were infected, which must cause a reduction in yield of the same order. This agrees with reports from the area of sorghum failing to set seed due to allegedly climatic reasons. A clear correlation has been established between reduction of yield of bulrush millet and degree of infection with stemborers: no such correlation has been found as yet with sorghum.

464. Experiments in representative areas on the inoculation of soya beans with imported strains of nodule forming bacteria have failed to show any beneficial effect. A new strain of sesamum, Yandev 55, was issued to farmers in the Yandev area and has proved successful. Sugar canes resistant to red rot and of much higher yield than the local soft chewing cane have been imported, but juice extraction is secondary in importance to chewing cane.

465. The replacement of the 26 C strain of cotton by the 26 J selection progresses satisfactorily. Owing to the excellent growing season the second-wave produced twice the amount of seed allowed for in the original plan.

466. At Shika stock farm the emphasis on milk production as a selection factor has been reduced in favour of milk and conformation and thriftiness under conditions which we can reasonably expect the better farmer to attain. Dry season feeding trials indicate that if sufficient roughage is available the main additional food requirement of cattle is protein. The feeding of supplementary carbohydrates has little or no beneficial effect.

467. In the chemistry section new methods were advanced for the rapid determination of available soil nitrogen. Two methods for nitrate were developed and published. One of these is entirely new and based upon the quantitative reduction of nitrate to nitrite. It has been used in a study of soil nitrate changes at Samaru and seven other stations. A method for determination of exchangeable ammonia has also been developed and used in the above study; this is based on a procedure for direct nesslerization of ammonia without distillation.

#### *Publications*

MIDDLETON, K. R.—Colorimetric Determination of Nitrate in water as Orange I. *Chem. and Ind.* 1957, 1147.

MIDDLETON, K. R.—A new procedure for rapid determination of nitrate and its use to study the phenosulphuric acid reagent. *J. appl. Chem.* (1958) (in the press).

MIDDLETON, K. R.—The Orange I method for determination of soil nitrates and a comparison with the phenosulphuric acid method for certain soils of Northern Nigeria. *J. Sci. Food Agric.* (1958) (in press).

#### *NIGERIA—Western Region*

##### *Soil Survey and Crop Nutrition*

468. Owing to shortage of staff and incidence of leave, it was found desirable to curtail field activities on the Cocoa Soil Survey and to concentrate on the marshalling of accrued data. Nevertheless some 1,200 sq. miles of country were covered by the reconnaissance survey unit, mainly in the Southern part of Ondo Province. The present position is that of the 16,000



sq. miles of the cocoa growing area in the Western Region, a total of 10,500 sq. miles has now been surveyed. A number of semi-detailed soil surveys have been carried out towards the end of the year, and a start was made on a survey in the Savannah zone of the Northern part of Oyo province, in connection with an investigation of the possibilities for an irrigation project. Some 40 sq. miles have been surveyed. A provisional key to the cocoa soils of the Western Region has been devised for use in identifying soil types in the field.

### Maize

469. Trials of 12 varieties at six different centres conducted in co-operation with W.A.M.R.U. yielded little information of direct practical interest. In one trial in the wet Forest zone, a Trinidad selection (No. 149) showed considerable tolerance of the very wet conditions that prevailed in 1957. Extended trials of the three best Mexico selections (Nos. 1, 5 and 7) were carried out at twelve different sites. Over the three years that these trials have been conducted, Mexico 5 has out yielded local maize by about 60 per cent., and is approximately 15 per cent. better yielding than Mexico 1. Mexico 5 is now being multiplied for distribution.

470. Preliminary trials on drying and storage have been started. Though storage in cribs is possible without artificial drying, a satisfactory control of insect damage has not been achieved. The use of two types of mechanical dryers and storage in silos, with fumigation where necessary, has given very promising results that may be applicable to group farming or co-operative projects. Early maize this year had a moisture content of 25 per cent. to 30 per cent., and it is impossible to reduce it quickly to the required level for large scale storage in silos without recourse to artificial methods of drying.

471. Trials at four centres on the use of a proprietary formulation confirmed its efficiency in controlling weeds in maize. Pre-emergence spraying is as effective as, and cheaper than, one weeding by hand. A subsequent post-emergence application will, if the initial weed infestation is large, practically eliminate the need for further hand weeding. Experience here has shown that it is important to apply the post-emergence spray at the right stage of growth of the maize in order to avoid crop damage and lodging.

### Yams

472. The use of 0.45 per cent. BHC dust on the control of yam beetles (*Heteroligus claudius*) on farmers' plots was tested at 28 sites in the wetter areas of the region. Though the incidence of beetle attack on the experimental sites was not so severe this year as in the past, a considerable measure of control was achieved. The increase in yield was small, but usually sufficient to cover the cost of treatment. Farmers were more impressed, however, by the reduction of beetle damage by over 50 per cent.; a greater proportion of the treated yams were saleable than was the case with the ones that had not been treated.

473. Trials involving the use of fertilizer on yams planted by farmers in their own small-holdings at the rate of 1 cwt. per acre of sulphate of ammonia, were continued. A review of the results obtained over the past five years showed an average response amounting to an increase in yield of 850 lb. of yams per acre, but considerable differences in response have been noticed between different areas and between sites. In view of this it has only been possible to make recommendations for the use of nitrogenous fertilizer in specific areas. Responses to superphosphate in experiments have generally not yet justified its use on an extensive scale. It has frequently given a lower response when applied in conjunction with sulphate of ammonia than either

fertilizer has given when used alone. No reason for this has yet been found. On long term experiments, there is an indication that potash may be of value as a fertilizer for yams on sedimentary soils.

#### *Legumes*

474. A survey of the edible legumes in the Western Region is being conducted by an officer provided by the International Development Services of New York. He has made a collection of varieties of the species grown in the region, and made observations on the local methods of cultivation. Virus diseases and eelworms appear to be major factors affecting yield, which in the case of cowpeas is very low—of the order of 150 lb. per acre.

#### *Pineapples*

475. An experiment was laid down to test the effect of grading the suckers before planting, and also of time of planting on fruit production and quality. The pineapple crop tends to ripen over a comparatively short period, and some means of spreading the harvest is needed.

476. In experiments with artificial fertilisers, nitrogenous fertilisers have produced the greatest response. Increases were due both to an increase in the number of plants bearing fruit and an increase in the size of the fruit. A trial involving the use of pre-planting treatment of the soil with different herbicides, showed that a worthwhile control of weeds could be achieved by the use of a proprietary dimethyl urea compound.

#### *Grasses*

477. Five fertilizer trials on established pastures of different grass species were laid down at the end of the rains. The response to nitrogen was very striking; up to 300 per cent. increase in yield of dry matter was recorded at the first cutting. Phosphate, potash and lime have not yet shown any marked effects.

#### *Cocoa*

478. Observations on the incidence of premature germination in cocoa pods indicate that it is associated with the onset of the dry season, and may be due to poor root development which may be a feature of certain types of trees or be due to the site. It is also associated with insect damage to the pods at the beginning of the rainy season.

479. Capsid control experiments have confirmed that three applications of 4 oz./acre of BHC at 28-day intervals, starting in August when capsid populations build up, will reduce capsid damage to negligible proportions. No insecticide suitable for use by farmers has been found that is more suitable for the purpose than BHC. Trials of different fungicides for the control of Black Pod Disease of Cocoa have not so far revealed any that are superior to those in current use. Carbide bordeaux mixture still gives the best control.

480. Very successful results have been obtained using polythene sheet for the construction of temporary bins used in the production of rooted cuttings. Seventy-five per cent. of the cuttings taken were rooted successfully, and of these 87 per cent. were hardened off. Vigorous Amazon varieties, such as T12, gave nearly 100 per cent. successful rooting and hardening on many occasions.

481. Multiplication plots of Amazon selections are beginning to produce pods at two years from planting the seedlings. Seedlings on dry sites, however, appear to be very susceptible to shot hole borers.

*Coffee*

482. The Coffee Agronomist provided by the International Development Services of New York is engaged on a survey of the coffee crop in the Western Region. Though the acreage is low (some 4,000 acres recorded to date) possibilities for its expansion exist. The main problem appears to be proper care of plantations, and control of berry borer.

*Economics*

483. The economic aspects of replacing a large area of forest reserve by an oil palm plantation were examined, involving an estimated expenditure of £5½ millions. It showed that modification of the forestry rotation might bring increased returns and that an oil palm plantation would be more profitable than a forest reserve of equal size.

*NIGERIA—Eastern Region**Agriculture*

484. *Rice*. A range of varieties was tested against BG79 at Abakaliki and Calabar. Only two varieties stood out as being superior in yield; at Abakaliki (inland swamp) Mas 2401 and at Calabar (mangrove swamp) G.E.B.24. There is still, however, some doubt as to the true yielding potential of G.E.B.24 as it may have been spaced too widely.

485. A series of herbicide trials has provided preliminary information on which more precise trials can be laid down in future. The beneficial effect of weed control on the inland swamps has been demonstrated but not on the tidal mangrove swamps.

486. *Maize Variety Trials*. Three trials were held in the Region (Nkwelle, Umudike and Abak) in association with W.A.M.R.U. The majority of the introduced material employed in the trials out-yielded the local control with the "Trinidad Bulk" being outstanding.

487. *Yam Trials*. The outstanding feature of the variety trials at Umudike is that for the first time, Chinese Yam (*D. esculenta*) gave the highest yield. This yam has always compared well with other yams on a nett yield basis and there are now indications that high rainfall does not have the same depressing effect on yield as is typically experienced with the local varieties. It would further appear that the extended wet season this year was advantageous to the Chinese Yam with its longer growth period. Size and quality of the tuber was excellent. Absence of stakes again had a depressing effect on yield (50 per cent.). If the crop is to be mechanised, the economics will have to be carefully considered to determine whether saving in cropping costs will compensate for the drop in yield. It has again been confirmed that early planting is a major factor influencing the yield of the yam crop. Early to mid-March is best.

488. Experiments on Yam Beetle Control have been continued in conjunction with the Federal Department of Agricultural Research. A 2½ per cent. BHC dust and a 2½ per cent. aldrin dust have shown a measure of control. Trials have been extended to farmers' plots with satisfactory results.

489. *Variety Collections and Surveys*. A Regional Survey of Yam and Cassava varieties has progressed well and planting material has been collected of what must be practically every variety grown in the Region. A collection of Bambara Groundnuts exhibits a wide range of seed-testa colours and investigations are in hand to determine whether the types breed true.

## NIGERIA—Southern Cameroons

*Agriculture*

490. During 1957, the shortage of staff and, to a less extent, the shortage of money, made it necessary to curtail agricultural activities at the Bambui Experimental farm. The herd of cattle was transferred to the Veterinary Livestock Investigation centre at Jakiri, where it not only increased the numbers, but enabled rigorous culling to be carried out as the first step in the formation of a fixed type of animal of the Adamawa breed.

491. Further work was carried out on cocoa. Psyllids and jassids can be controlled by spraying, but this method of control has given rise to other problems. Observations on the regeneration of abandoned cocoa confirm that the early coppiced plots have made the best progress and some of the chupons are now bearing. Artificial shade trials on Amazon and local Trinitario cocoa confirms the extra vigour of the Amazon variety and its ability to thrive well where shade is poor. Arising out of this experiment has been the fact that the local Trinitario cocoa responds to the application of fertilizer far more than does the Amazon variety. Time of planting trials with potted seedlings have shown that such seedlings can be successfully planted any time between the middle of March and the middle of September.

492. Increasing the frequency of spraying against blackpod of cocoa showed no advantage over the standard practice of spraying at three-weekly intervals between April and November, but the addition of a sticker (Albolinum) to the fungicide (Perenox) had a useful effect.

## NORTH BORNEO

*Animal Health*

493. *Buffaloes*. Investigations into the high death rate of calves continued. A theory that it was largely caused by wild pig was disproved and it seems certain that the main cause is *Ascaris vitulorum*. At Sorob Cattle Farm a calf drop and survival rate of over 70 per cent., a great improvement over previous years, was obtained by the use of piperazine compounds or chenopodium oil. An attempt was made to find the method of "carry over" of the helminths from one season to another. It was observed that calves from areas with running water showed lower counts of *Ascaris* eggs than those from areas with wallows. Samples of the water on being centrifuged showed that no eggs were present. Samples of the soil from certain villages showed that approximately half the samples contained *Ascaris* and hookworm eggs, although they might have been of porcine or canine origin. This indicates a high degree of possible infestation in the ground and also on the udders of the cow buffaloes.

494. *Cattle*. A problem that has been causing considerable concern is the possible effect of latent piroplasmiasis in native cattle and buffaloes. Examinations of the blood of all ill or debilitated animals, however, gave a negative result and recourse was had to splenectomy. Slides were obtained which were considered to show piroplasms, but specialists in Australia regarded the proof as inconclusive. Piroplasms would account for the slow development of calves due to mild attacks while getting "salted" and for the death of calves which sometimes occurs under adverse environmental conditions.

*Pastures*

495. Investigations into open grassland at sea level and in the Interior at 1,200 ft. continued. In the former, one area of 100 acres carried between 70 and 80 head of stock for three months and one paddock of 11 acres

carried 17 head of stock for six months, with considerable improvement in the grazing and without signs of erosion. Illness of the personnel in charge unfortunately caused these trials to be discontinued. In the Interior at 1,200 ft. the predominant grass is lalang (*Imperata cylindrica*) and the danger of invasion by trash is greater; after heavy grazing, love-grass (*Chrysopogon aciculatus*) appears, but there is as yet little evidence of better species. The grazing rate here has been heavy, some 50 beasts on 40 acres, the stock remaining in fair condition.

## NORTHERN RHODESIA

### Agriculture

496. *Soil Surveys.* Preliminary work has commenced to collect and collate the information necessary for the production of a general soils map of Northern Rhodesia, designed to indicate the distribution of the main soil classes with reference to their agricultural usage. Two major soil surveys covering some 600 square miles were undertaken in the Eastern Province during the 1957 dry season in preparation for land-use planning.

497. Extensive reconnaissance soil surveys were also undertaken in selected areas of the Northern Province. Detailed surveys were done in a number of small areas considered suitable for settlement and agricultural development. A detailed survey of conservation works was carried out in the Southern Province during the 1957-58 wet season in order to assess their effectiveness. Shortcomings showed up well in what proved to be an exceptionally wet season and remedial measures and necessary modifications to current techniques were clearly demonstrable.

498. *Ecology and Grassland Research.* The results from yield data and chemical analyses of veld species showed clearly the need to relate composition with production and to give due consideration to the total crude protein per acre rather than to percentage crude protein. Critical examination of eight of the main veld species revealed that *Hyparrhenia dissoluta* and *H. filipendula*, which constitute the bulk of the natural veld communities, were very low in protein content, even in the early leafy stages of growth. Other species such as *Cynodon dactylon* and *Urochloa pullulans* had by contrast usefully high protein content.

499. The popular local conception that the burning of veld in the late dry season stimulates the production of useful quantities of green growth was shown to be fallacious and the practice of late burning to be probably injurious to the more valuable species. The evaluation of pasture species continued. *Cenchrus ciliaris* (Sobangwe strain) and certain strains of *Glycine javanica* were selected for further testing. *Eragrostis curvula* (Ermelo strain) if permitted uninterrupted growth until late August when the dry season was five months old, yielded at the remarkable rate of approximately 400 lb. crude protein per acre at 6 per cent. crude protein content. This and a number of other species including Giant Rhodes Grass (*Chloris gayana*), *Urochloa pullulans* and *Cenchrus ciliaris* require intensive investigation.

500. Seed studies have shown that the seed of *Chloris gayana* shows enhanced germination capacity with storage increasing from 7 per cent. after 3 months to 44.5 per cent. after eighteen months. Molasses grass (*Melinis minutiflora*) was shown to be sensitive to superphosphate, the germination capacity of the seed being reduced to zero after 24 hours direct contact with this fertilizer.

501. *Plant Breeding.* Encouraging progress was made with groundnuts and while the outstanding performance of a recent introduction from Australia (var. Mani Pintar) overshadowed all else, those of other selections made at Mount Makulu Research Station were nevertheless very satisfactory and offered considerable promise for the future.

502. With summer sown wheat the most significant development has been the unprecedented epidemic outbreak of *Helminthosporium sativum* which caused drastic reduction in yields in all varieties and seriously affected the quality of the grain produced. Little or no resistance to this disease was apparent in any of the varieties under test.

503. Tests with various insecticidal treatments for the control of termite damage in young wheat showed that virtually complete control was possible by the use of Dieldrex A, a combined Dieldrin/Mercurial seed dressing at 3 ozs. per 100 lb. seed.

504. *Agronomy.* A spacing fertilizer trial with maize indicated that in the higher and more reliable rainfall areas a much higher plant population than the normally accepted maximum of 15,000-17,000 plants per acre might be possible without unduly depressing the yield of individual plants. No significant differences were apparent between the yield responses of maize to top dressings of sulphate of ammonia, nitrate of soda, nitrolime and urea when applied in quantities of equivalent nitrogen content. The results of nitrogen supported previous findings at Mount Makulu, viz., that for all practical purposes nitrogen may be omitted from the fertiliser dressings applied at planting.

505. Experiments with selective herbicides in the control of weeds in maize supported previous findings. The effects of cultivation other than weed control such as aerating effects, the breaking of soil crust, etc., were of much greater significance than weed control alone in their effects on growth of the crop on the heavy soils of Mount Makulu. Herbicides may be a more effective substitute for cultivation on lighter, sandier soils.

506. *Agricultural Chemistry.* Using a modified version of the Kawanda pot test, a series of experiments were carried out on soils from the Kafue Flats, Balovale and Fort Rosebery. The Kafue soils were shown to be seriously deficient in available forms of nitrogen, phosphorus and boron. The Balovale soils were deficient in potassium and molybdenum in addition to the main deficiencies of nitrogen and phosphorus. The Fort Rosebery soils were markedly deficient in phosphorus, calcium and sulphur as well as somewhat deficient in nitrogen, magnesium, and boron.

507. *Irrigation.* During the course of the winter dry season of 1957 crops of wheat and oats were successfully grown on the Chiansi Experimental Station on the Kafue Flats. Growth was dependent upon substantial applications of nitrogenous and phosphatic fertilizers while the water distribution pattern with sprinkler systems of irrigation under the wind conditions prevailing radically affected germination and subsequent uniformity of growth. It was apparent, however, that such problems could be resolved and that cereals could be grown on this heavy clay.

508. During the summer season of 1957-58, when persistent and heavy rainfall made soil conditions particularly difficult and cultivation impossible, most of the crops under investigation either failed to survive or were swamped by indigenous weeds. Rice again proved difficult, the best stand being obtained with the variety Blue Bonnet, dry planted on raised beds. Dry land rice on the flat and swampy paddy was singularly unthrifty. Jute on raised

beds, however, was particularly promising and with nitrogenous fertilizer dressings was standing eight feet high when on the 7th March, 1958, record floods on the Kafue River overtopped the embankment, flooded the polder and brought investigations to an abrupt close.

#### *Veterinary Research*

509. In an attempt to elucidate difficulties experienced in field control of trypanosomiasis, studies were made of susceptibilities of different strains of *T. congolense* to a variety of trypanocides at graduated dosage levels. The Sesheke strain proved resistant to Dimidium, Novidium and Ethidium Bromide up to 7.5 mg/kilo, and to Antrycide at up to 4 mg/kilo. A strain of *T. simiaë* from pigs in Chisamba also showed a high degree of Antrycide resistance.

510. Research on tick biology in relation to microclimate has been limited to the use of *Rhipicephalus evertsi* engorged females, eggs and unfed larvae, under three differing conditions of herbage cover. Results so far indicate that high temperatures, i.e. 50°C. is the most important factor adversely affecting the ticks—far more so than different ranges of humidity. Both ovipositing and eclosion were similarly affected. Two species of ant predators of the ticks and one species of mite predator of the tick eggs were observed and identified.

511. Comprehensive records of tick distribution for all provinces except the North Western Province have been compiled. Neither *R. evertsi* nor *H. rufipes* have yet been recorded in the Northern Province.

512. Grazing trials to compare different veld management systems and rates of stocking, using cattle in self-contained blocks, continued. Winter supplementation trials aimed at measuring, under controlled experimental conditions, the value of different feeds as dry season supplements to veld grazing were made. The supplements were groundnut meal, urea and a Vitamin A.D. mixture. Preliminary work suggests that the maximum benefit of salt and bone meal supplementation is only obtained where a final finishing period is given to the cattle. Investigations are in progress to explain the apparent lack of response to dry season protein feeding, by the addition of varying amounts of maize meal, representing a freely available carbohydrate.

513. Work was completed on the changes in the haemoglobin index, showing that there was a high correlation between the changes in this index and the development of heat toleration. Confirmatory work was completed upon the level of protein feeding of pigs. From weaning to 100 lb. a ration containing 15 per cent. total protein in which 7 per cent. of the ration was animal protein, gave the greatest efficiency and economy of gain. From 100 lb. to bacon weight, the protein value should be reduced to 11 per cent. with no animal protein. Antibiotic supplementation at accepted levels gave no worthwhile effects, but work is in progress on feeding at higher levels.

514. A detailed survey of the internal parasites of cattle and sheep on the Research Station at Mbesuma Ranch revealed the presence of hyatid cysts in the lungs of one cow on the Research Station, indicating the possibility of the presence of dogs infested with *Echinococcus granulosus*.

515. An experimental proprietary preparation containing butynorate showed, 10 days after treatment, that its addition to the poultry food for one day at two levels of concentration gave the following results:—

at 1.75 concentration effected complete elimination of *Raillietenia tetragona* and of *Anoplocephala sphenoides*.

at 1:100 concentration effected complete elimination of *R. tetragona* but only partial elimination of *A. sphenoides*.

516. Investigations on *Neoscaris vitulorum* showed that ante-natal infestation of calves was not established. Investigations into the duration of viability of the worm eggs under natural conditions in open kraals showed that up to 11 months after vacation of the kraals viable eggs were still being recovered from the kraal manure. Observations also revealed that vultures which often eat mature ascaris worms voided by calves, have passed large numbers of *Neoscaris* worms in their droppings that have proved six weeks later to be fully viable when left on the ground under natural conditions.

517. Piperazine has proved very efficient in controlling mature worms in calves, but the effect of the drug on the immature worms has still to be established.

#### Publications

WALKER, C. A.—The Skin Thickness of Cattle in Northern Rhodesia. *J. agric. Sci.* **49** (1957).

WALKER, C. A.—The Apocrine Gland Population of the Skin of Cattle in Northern Rhodesia. *J. agric. Sci.* **49** (1957).

WALKER, C. A.—The Growth of Northern Rhodesian Indigenous cattle under normal veld grazing and supplemented with salt and protein. *J. agric. Sci.* **49** (1957).

#### NYASALAND PROTECTORATE

##### Agriculture

518. *Maize*. One locally produced variety equalled or excelled the Southern Rhodesian Hybrid in yield. It is not likely that strains of wholly local origin will have the highest yield and genetic material from Southern Rhodesia, Mexico and elsewhere is being incorporated in the new strain and a combination of high yield and good storage quality is being sought. Rust disease (*Puccinia polysora*) continues to be a threat at the lowest elevations and a combination of a local type with E.A.A.F.R.O. resistant material is being bulked up for distribution.

519. *Groundnuts*. Variety selection continues for types which have a proportion of large nuts suitable for the confectionery trade and a high oil content for the conversion of the remainder of the crop.

520. *Tobacco*. The main work on dark fired tobacco continues to be seed selection with special emphasis on types with broad leaves. Fertiliser experiments show the major nutrient deficiency is nitrogen with phosphate giving response on certain soils. Variety selection of Burley tobacco continues with emphasis on production of light coloured leaves which are demanded by the trade at present.

521. *Rotation experiments*. A series of experiments have shown the undesirability of two crops following each other though there is less reduction in yield if maize follows maize than if other crops follow each other. The beneficial effect of a preceding groundnut crop is shown up markedly in this experiment, and tobacco also gives a good effect on the succeeding crop. Green manures ploughed in while the soil is still moist increase the yield of a subsequent maize crop. There is some difficulty in bringing grass leys back into production owing to the immobilisation of nitrogen by undecomposed organic matter in the soil.



522. *Pastures.* The most successful grasses so far are Rhodes grass (*Choloris gayana*) for leys in most areas, Makarikari (*Panicum maximum* var. *coloratum*) which does well in the drier and less fertile soils and Star Grass (*Cynodon plectostachyium*). Applications of sulphate of ammonia give very large responses and in the case of Rhodes grass yields are poor in the third and fourth years unless additional nitrogen is applied. Among legumes *Desmodium intortum* has done well in those areas with well distributed rainfall and in other areas *Indigofera subulata* is showing promise.

523. *Tung.* New clones have been shown to have higher yields and these can be distributed if there should be a revival of interest in the crop. Fertiliser experiments have shown that nitrogen is the only major element which gives much response, but not more than 3 lbs. of sulphate of ammonia per tree can be used economically.

524. *Coffee.* There is renewed interest in this crop which was the principal export of the country at the beginning of the century. Extensive new plantings are being made each year, mainly African in the north of the country and European in the southern half. Variety trials are being conducted in all areas to find the best variety to suit each climatic condition using seeds obtained from Kenya, Tanganyika and Brazil. Experiments are also being conducted on the use of shade trees and fertilisers on various cultivation practices. Two *Fusarium* diseases have caused trouble but may possibly be eliminated by providing optimum growing conditions.

525. *Tea.* Fertiliser experiments are now sufficiently advanced to enable a booklet giving advice to planters on applications of fertilisers to be published. Preliminary experiments with weedicides showed that 15 lbs. of TOA per acre used as a post emergent spray gives good control of grass weeds for 8-10 weeks and the addition of 1 lb. of 2,4-D gives some control over the broad leaved weeds. Dowpon gave good control of grass weeds but may cause damage to the tea. Preliminary work on vegetative propagation has defined the best conditions for striking cuttings and is being used in the breeding work.

526. *Soil Science.* Work has been done on the land survey of the Shire Valley project and the land classified into soil classes and numerous profiles analysed, and the salinity of the soil estimated. An investigation into shattering of tobacco leaf showed that this was associated with a high percentage of nitrogen in the leaf, but other nutrients were normal.

527. *Soil Moisture.* Investigations down to a depth of 10 feet have shown that in general, during the rains, all annual crops have sufficient moisture and this does not become a limiting factor. The position is quite different with perennial crops. It has been demonstrated that pruning of tea materially slows down the drying out of the soil after the rains are finished and a correlation has been established between rainfall at different times of the year and the yield of the tea crop.

#### *Veterinary Research*

528. During the year lumpy skin disease was diagnosed for the first time in Nyasaland, and the country had its first outbreak of foot and mouth disease. A survey of the helminthological parasites of domestic and common wild animals is proceeding and assistance was given to the health authorities in the identification of rat fleas obtained from a number of localities.

529. Work still proceeds on the development of the Livestock Improvement Centres and on the building up of herds and flocks. Investigations in connection with the following main items are, however, being carried out:—

- (a) A comparison of the productivity of the Friesian and Jersey dairy breeds under similar conditions of environment together with an assessment of the adaptability of these two breeds to the local climatic variations.
- (b) A comparison and study of the two local types of Zebu cattle, the Nyasa Zebu and the Angoni Zebu, under similar environmental conditions.
- (c) A study of the sheep and goats indigenous to Nyasaland.
- (d) A study of the adaptability of a number of different breeds of poultry to the local environment, and of the different systems of management under which they may be maintained in Nyasaland.

#### Forestry

530. A further 17 acres of *Pinus patula* in Chambe forest were underplanted with Mlanje Cedar. In the underplanting trial at Chikangawa where Mlanje Cedar was planted in cleared rows under *Pinus patula*, the pine overwood was thinned to 290 stems per acre and pruned to 15 ft. to encourage the growth of the cedar which was showing signs of suppression. Some of the cedar which has died as a result of rodent damage was replanted, but a good proportion of the original planting has survived. The similar interplanting trial carried out in *Pinus elliottii* of the same age is also showing good growth, and thinning here has not been necessary owing to the slower growth of this pine.

531. The trial plots in Champila Forest at the extreme southern end of the Vipya grasslands were extended by the planting of small plots of Mlanje Cedar, *Pinus patula*, *Pinus taeda*, *Cupressus lindleyi* and *Cupressus torulosa*. This area appears to have better soil conditions than most of the Vipya, though the annual rainfall is rather lower. The softwood trials at Lwafwa and Luwawa Dam on the Vipya are all showing promising growth and indicate that these areas are both very suitable for softwood afforestation. No additional trials were planted here during the year. At Likabula, Mlanje Mountain, small trial areas of *Pinus massoniana*, *Eucalyptus citriodora*, *Gmelina arborea*, *Khaya grandifoliola* and *Khaya nyasica* were planted.

532. In the Dzalanyama Forest (Lilongwe section) half-acre trials of *Eucalyptus camaldulensis*, *E. sideroxylon*, *E. paniculata*, *Cupressus torulosa* and *Populus deltoides* were planted. It is unfortunate that 15 acres of previous plantings were damaged by fire. In the small plot of *Chlorophora excelsa* planted in 1956 in Mirale Forest adjacent to two older trees on whose leaves galls were seen in 1955 by Dr. E. W. Jones of the Imperial Forest Institute, Oxford, the trees made normal growth and remained completely free from galls. It is extremely doubtful whether these galls are caused by *Phytolyma lata*, and in this connection it is worth mentioning that *Phytolyma* has not been recorded elsewhere in Nyasaland either on natural or on planted trees.

533. In Cholomwani and Massenjere Forests, additional trial plots were planted. Species planted included *Pinus massoniana*, *Pinus khasya*, *Pinus caribaea*, *Eucalyptus deglupta*, *Gmelina arborea*, *Chlorophora excelsa*, *Khaya grandifoliola* and *Broussonetia papyrifera*. In Kalwe Forest, Nkata Bay, further planting trials of tropical hardwoods were done under the canopy of the natural woodland. Species planted included *Entandrophragma angolense*, *E. utile*, *Khaya anthotheca*, *Khaya grandifoliola*, *K. senegalensis*, *Azelia quanzensis*, *Pterocarpus stolzii*, *Erythroploeum guineense* and *Rauwolfia caffra*.

534. Among the new species introduced during the year, were *Pinus michoacana* and *Abies religiosa*, of which small quantities of seed were received from Mexico. The *Pinus michoacana* has shown very promising growth in the nursery stage, and in view of favourable reports on its growth on the Copperbelt of Northern Rhodesia, it is hoped that the tree may be useful for afforestation in some of the more marginal forests.

#### ST. HELENA

535. The investigations on the cultivation of *Lilium longiflorum* tended to show that if bulbs are given hot-water treatment against eelworm and are then planted on land the humus content of which has been improved by a grass ley, satisfactory results can be obtained.

#### ST. VINCENT

##### *Sugar Cane*

536. A time of application trial on Recent Volcanic Ash soils has confirmed that there is no benefit to be derived from split application of sulphate of ammonia to plant canes. The result of two NPK trials on ratoon canes showed increasing yields up to the maximum application of 120 lbs. nitrogen per acre. Increases from potash were not significant, and the tendency of phosphate in both trials was to depress yields. In much of the fresh volcanic soils covering the north of the Island there is a layer of fine compact sand at a depth of from 8"-18" below the soil surface. In an experiment, sub-soiling to a depth of 18" increased the yield of plant canes by 2.4 tons per acre.

##### *Bananas*

537. The fertilizer trials started with bananas were inconclusive, but have established that bunches of suitable size for shipment cannot be produced unless the plant has been adequately supplied with nitrogen.

538. Successful general control of weeds in banana fields has been obtained by the use of sodium arsenite, but on account of the danger to operators, it is being successfully replaced by a combination of penta-chlorophenol in oil and contact herbicides.

#### SARAWAK

##### *Forestry*

539. A five year research programme was under preparation during 1957. The programme is arranged by sections on a project basis and research will be largely concentrated on silvicultural and mensuration in peat-swamp forest. During 1957 the most important research work undertaken was as follows:—

- (i) Ecological survey of the peat-swamp forests. This work was continued and it is expected that it will be completed in 1959. A draft list of the flora was prepared.
- (ii) Studies of management of peat-swamp forest. Data was collected for the preparation of volume tables for jongkong (*Dactylocladus stenostachys*). A check was also made on the accuracy of the volume tables for ramin (*Gonystylus bancanus*) and the applicability of the tables to virgin forest.

- (iii) Experimental planting on podsolised soils was continued. A modified technique of planting was tried whereby plants of *Shorea albida*, *Dryobalanops fusca* and *Shorea* sp. were planted in cleared lines instead of the normal clear felled and burnt areas. The preliminary results are promising and the survival rate is higher.

### SIERRA LEONE

540. The *Raphia* palm collections sent to Kew in 1955 have indicated that some of the scientific names used formerly for the palms are incorrect. These palms, which are the source of the piassava exported from the country are of importance. The local "Nduvui" palm is *Raphia hookeri* Mann and Wendl. (not *R. vinifera*) and "Keli" is *R. gracilis* Becc. The only other *Raphia* palm occurring in any quantity and which is found in the North of the country, is *R. sudanica*, A. Chev.

541. A member of the Colonial Pool of Soil Scientists started studying and mapping the "boli" lands or inundation grassland areas of the North of Sierra Leone in connection with the location of the most suitable areas for mechanical cultivation and obtaining information on the fertility variation of these areas.

542. Fertiliser experiments have continued on groundnuts and previous years' results on the beneficial effect of lime and superphosphate have been confirmed. At low levels of application the value of superphosphate rests in its calcium content, but the phosphate radical is essential to obtain the full benefit from large dressings of lime.

543. A new series of fertiliser experiments on swamp rice have confirmed the necessity of superphosphate on the "bolis" or inundation grassland areas of the north, sulphate of ammonia having no effect. Yields are poor, even with fertilisers, and further investigations are necessary to solve the production problems in these areas.

544. Further trials were carried out with Perepod, Kopapod and Carbide Bordeaux on the control of Black Pod disease of cocoa. These were very encouraging and indicated that whilst all sprays were effective, 1 per cent. Carbide Bordeaux was rather better than the others when all were applied at two-weekly intervals. Generally applications of Carbide Bordeaux every four weeks appeared to be as satisfactory as at shorter intervals. Other information from these trials indicated that general sanitation and regular removal of diseased pods decreased the incidence of the disease by about half and that near to villages, the fencing of plots to prevent goat damage was beneficial.

545. A disease of cocoa seedlings causing wilting appeared at Njala where seed introduced from Ghana was being nursed. Varieties T 60/F 3, T 72/F 3 and T 76/F 3 were attacked; T 72/F 3 appeared to be the most susceptible.

546. The survey of banana diseases continued. *Mycosphaerella musicola* Leach previously recorded from Njala was found to occur also in Port Loko and Kambia Districts where it is more common on bananas grown on the uplands than on those grown in swamps. In no case was the disease found to be very severe. *Scolecotrichum musae* Zimm., though of no economic importance, was found to occur throughout Port Loko and Kambia Districts.

### Forestry

547. Large areas of degraded soils might be cropped with pines, and to explore this, seed of *Pinus caribaea* was planted in 1957 without mycorrhizal

inoculation. Plantings on alluvial sand soil grew well, but on lateritic soils growth was poor. Mycorrhiza was found on young plants at two sites.

548. The utilization branch continues to gain experience through the conversion of over thirty species of local timber to many uses, especially furniture. In 1957 *Hannoa klaineana* became a popular white timber for the hidden parts of furniture. It works easily and keeps its shape. It is not a common species, but excellent results have been obtained from local seed and a large stock is now available for enrichment planting in exploited forests in 1958 and for the formation of plantations.

#### *Veterinary.*

549. Tests on pigs with the new Antrycide Suramin Complex prepared by the West African Institute for Trypanosomiasis Research indicate protection against *T. simiae* infection but not against *T. congolense*.

### SINGAPORE

#### *Veterinary.*

550. Having determined that superior strains of poultry and pigs should be developed from local varieties, research has followed two lines. The first has been to establish (a) management and feeding practices and their results within the two industries and (b) characterisation of the animals, particularly fowls. The second is to observe results of genetic techniques employed to bring about the development.

551. A Review of Poultry and Pig Production in Singapore has been made by survey. A series of studies of characterisation of local fowls has been undertaken. Data and findings are recorded and papers have been prepared. After selecting 300 fowls, by trapnest and selection index procedure, from 1,000 local Canton-type fowls, the parental generation of the first of three strains is being incubated and brooded. Parents for the other strains have been selected. In pigs, native and European pigs have been crossed reciprocally. Their progeny give the parental generation of the project. A new million dollar research station is now under construction at Sembawang for the Singapore Veterinary Department where extended work will be carried out.

#### *Botanic Gardens*

##### *Taxonomy/Ecology*

552. Collecting was done by members of the Department on expeditions to North Borneo and Sarawak and to many areas in Malaya in which several new species have been found. The Department has had the co-operation of the Forest Departments of Sarawak, North Borneo and the Federation of Malaya from which much valuable herbarium material has been received. It has also received valuable material from organisations in neighbouring countries, in particular from a new university, University Andalas, Pajakumbuh, West Sumatra, an area where the botany is little known.

553. A research student (Mr. T. C. Whitmore), attached to the University of Malaya on a C. D. & W. grant made use of the Department for his work on the bark anatomy of Dipterocarpaceae. He made large collections in Malaya and Borneo which have now been despatched to Cambridge for anatomical investigation. Assistance and facilities were given to the Oxford

University Expedition to Sarawak which visited the Usun Apau Plateau. The Keeper of the Herbarium has begun his revision of the Malaysian Myristicaceae for the Flora Malesiana. Dr. Furtado continued his studies of palms, and the Director of marine algae.

#### *Orchid Breeding*

554. Orchid hybridisation continued and orchid hybrids were sent to the R.H.S. Chelsea Show, where the display was awarded the silver-gilt Banksian Medal, and to the Second World Orchid Congress. The Gardens were represented also at many other exhibitions in Australia, India, Pakistan and elsewhere.

#### *Publications*

ADDISON, G. H.—Longevity in Orchid Flowers. *Malayan Orchid Review* 5 (1) 1957.

ALPHONSO, A. G.—Cultivation of Ferns I. *Malayan Agri-horticultural Association Magazine* 14 (1).

ALPHONSO, A. G.—Cultivation of Ferns II. *ibid* 14 (3).

BURKHILL, H. M. Malayan Rubber. *Malayan Nature Journal*. 12 (1).

### SOMALILAND PROTECTORATE

#### *Agriculture*

555. Work is continuing to find the best technique for severing and transplanting date off-shoots successfully. This is necessarily slow as all parent palms are still less than 10 years old and there are not many off-shoots of more than 44 lb. (20 kg) available. Experiments with date introduction in brackish water on the coast have been abandoned.

556. The type of water and soil-retaining earth banks developed for local conditions have now been further improved by the levelling of the fields between the banks. It was demonstrated that even after great reduction of yield by locust attacks farms with these earth banks produce much more than unbanked neighbouring farms. American upland type cotton yielded 1,648 lb. an acre on an observation plot in a banded farm indicating that further experimentation would be worth while. Safflower (*Carthamus tinctorius* L.) also in a banded observation plot, gave the attractive yield of 1,020 lb. an acre and sunflower (*Helianthus annuus* L.) yielded 1,100 lb. an acre.

#### *Forestry*

557. Work on the development of deferred grazing systems on the extensive range and browse lands continued. For the purpose of developing suitable techniques of potential grazing 115 sq. miles of range land were put under permanent control, but some areas had to be opened up prematurely to avoid grass being taken by locusts.

558. The local boxwood, *Buxus hildebrandtii* Baill. was found to be unsuitable for engraving owing to numerous small cracks throughout the wood. Growth increment sample plot measurements were continued in *Juniperus procera* Hochst. forest and experimental introductions of various *Pinus* spp. were started.

*SWAZILAND**Soil Survey*

559. The study and mapping of Lower Usutu Basin soils by a member of the Colonial Pool of Soil Scientists continued. Boundaries of soil units and irrigability classes have been plotted on aerial photographs covering 170 square miles in the Sipofaneni—Tovu, Magongolweni and Picardy—Umfalangwenya districts. Special surveys have been undertaken to assess irrigability in four other localities, and soil maps have been compiled for Goedgegun Experimental Farm.

560. Pot culture of winter-irrigated wheat in the Lower Usutu Soil Survey area showed strong P response in five different soils, with N also beneficial, particularly in soils derived from basic rocks.

*Cattle Breeding*

561. Selective breeding of Nguni cattle at Mpisi Cattle Station has shown a steady improvement in the breed and the collection of data on breeding is being maintained.

*Agricultural Research*

562. A grant of £51,675 from C.D. & W. funds will be used to establish an Experimental Station in the Malkerns Valley at Mdutshane with sub-stations at Goedgegun and at Big Bend. The main lines of investigation will be:—

1. Soil fertility trials. It is necessary to supplement the work of the Soil Surveyor with a comprehensive programme of carefully sited fertilizer trials to assess optimum types and rates of fertilizer application. Approximately £65,000 are spent annually on fertilizers in Swaziland.
2. The establishment and study at Mdutshane of a beef-arable unit designed to pioneer intensive farming—based on the finishing of beef cattle, grass leys on irrigated arable and fodder system. A citrus orchard of 30 acres, aimed primarily at varietal studies, is being established.
3. At Goedgegun the establishment and study of a dairy arable intensive farm unit has been started.
4. The Big Bend sub-station will be mainly concerned with the problem of the rapidly developing sugar industry (2,500 acres of cane in the Big Bend area during 1957).

*Field Trials*

563. Soils of granite origin showed response to 50 lb./acre  $P_2O_5$  of from 327 lb. to 988 lb. maize grain. One trial on the Lebombo volcanic soils showed only small responses to major elements, but an interesting increase from Mg, Mn, B and Mo. Trials with hybrid maize showed no superiority over local open pollinated "Ford Selection". Cotton trials were dominated by heavy incidence of pests. Two trials in the Croydon area showed that the Kapel variety A2106 ex Barberton was higher yielding than the commonly planted variety Muka A7215.

*Herbicide Trials*

564. Mid-summer applications of 2,4,5-T iso-propyl ester to bush, consisting mainly of *Acacia Karoo* gave disappointing results. The most effective treatment was to paint a debarked collar with a solution of  $\frac{1}{2}$  pint 2,4,5-T (2 lb. acid equivalent/gallon) in 2 gallons of Diesel oil. This method cost

6s. per acre, including labour charges. Cutting the top of the tree off completely and painting the cut stump was cheaper (1s. 6d. per acre) but a higher proportion of trees regenerated.

## TANGANYIKA

### *Agriculture*

565. The new laboratories and housing for the Northern Regional Research Centre are nearly complete. Building the extension to the laboratories at the Central Regional Research Centre and additional housing has started. The laboratories for the Southern Regional Research Centre are nearly finished and a new experimental farm has been acquired. Additional laboratories for the Western Regional Research Centre have been planned and houses are being built.

### *Crop Research*

566. *Cashew*. It has been shown that the time of initial build up of *Helopeltis* spp. can vary by several months from place to place. The reasons for this are being investigated as they will have an important bearing on insecticidal programmes. Local clonal material and seed obtained from several countries has been planted. A new pest (*Mecocorynus loripes* Ches.) has been discovered in the eastern portion of the Southern Province where it is causing some damage.

567. *Castor*. The programme for improving castor production by breeding selection has started. A wide range of material has been collected. Local wild castor appears to have a very high degree of resistance to insect pests and it is hoped that this resistance can be introduced into good varieties. Mirid bugs chiefly *Lygus vosseleri* Popp. and the various Pentatomid bugs, cause much damage to buds and developing fruits. Damage by Lepidopterus larvae is less important.

568. *Coffee, arabica*. At the Mbozi station some improvement in the early growth of coffee was obtained by improved planting methods, but dieback suddenly occurred on a number of plants about three years after planting. Root studies showed that although the roots had grown laterally beyond the planting hole in the top soil they did not grow downwards out of the planting hole. Since the dry season lasts some 6-7 months it is necessary to find some method of inducing axial root formation. The cause of stem-pitting is still undetermined.

### *Cotton*. (Empire Cotton Growing Corporation.)

569. An entomologist has been appointed to the Western Region to study the ecology of the American bollworm particularly in regard to its build up on food crops and movements from these to cotton. Fusarium wilt has been discovered in the Geita district. Its incidence is being studied. Investigations to check whether it is possible to reduce the amount of DDT from 8 lb. per acre over a period of 8 weeks to lower amounts showed that whilst lower quantities gave good control, the standard method gave the highest yield.

570. A new multi-strain variety of great promise for the Eastern Province is being bulked up. At Ukiriguru the hybridising programmes with Albar 51 and BAR 15/18 continue. It is now possible to test the best Albar 51 segregates against the straight 0/334 and 1/667 segregates. A highly interesting observation is that these two strains possess a reasonable degree of resistance to bacterial blight.



571. *Sesame*. The non-shattering types obtained from the Americas retained this characteristic, but yielded poorly compared with local types. Promising varieties have been obtained from Venezuela.

572. *Soya*. Promising selections have been obtained from Hernon 257. In the breeding programme desirable types are appearing showing high yield with the pods forming 4-5 inches above ground level and more suitable for combining than Hernon 237. A study of the period of yield formation is producing interesting results.

573. *Inter-cropping*. In a year of favourable rainfall and with a full population of maize and a low population of groundnuts, and *vice versa*, the loss in yield of the principal crop is slight whilst the yield of the minor crop is appreciable.

574. *Tobacco*. Anthracnose has been found in two areas and steps are being taken to prevent further spread. Breeding of strains to suit Iringa conditions is being continued.

#### *Applied Pedology*

575. Soil reconnaissance and analytical investigations have covered a number of irrigation projects. A small project at Mlali, where the soils are mainly youthful micaceous alluvium, has been entirely successful. A large project at Ikowa where the soils are red earths merging into brown and grey types over limestone has so far been successful. The changes in the composition of the dam water and of the shallower soils under irrigation are being studied. At a small project at Mangonyi experimental irrigation of some difficult silty clays is being attempted. Some drainage water has been got through these soils and a first crop of maize was highly successful. A large area in the central portion of the Pangani river basin has been further investigated. The general soil pattern is now clear—there is a central core of old lake beds, fringed by brown clays and these in turn are surrounded by brownish to reddish colluvial soils. The lake beds have formed mostly shallow saline soils and the brown clays are usually saline and alkaline. Field reconnaissance of the Ruvu river basin is in hand.

576. Some work is being done on the regional infertility of the extensive grasslands in the Sao Hill district and a soil from the Singida district where there is possibly a toxic trace element associated with high magnesium is being investigated.

#### *Plant Nutrition*

577. The main crops being investigated are coffee and pyrethrum, and in both these the relation of leaf composition to the cropping cycle is being studied. There are indications so far in coffee of a leaf potash build up at flowering and then successively as the cherry fills out a build up of boron and of calcium. It is hoped that this study will throw light on the biennial bearing habit of coffee. In pyrethrum at the stage three months before flowering when the flower bud primordia form there is a drop in leaf nitrogen and rise in phosphorus followed a month later by a rise in leaf potash and sulphur. Field trials based on the suggestions given by this work are in hand. A magnesium shortage has been found in coffee at Mbozi, where boron and zinc deficiencies have already been established. Field trials with these three nutrients are in hand. Minor investigations include citrus—a zinc deficiency proved, a copper deficiency suspected; “taper point” of coconut—suspected boron or magnesium deficiency; “oily pod” of beans—some shortage of copper in pods; brittle leaf of tobacco—copper shortage in leaf.

*Publications*

VAIL, J. W., CALTON, W. E. and STRANG, R. M.—Dieback of Wattle—a boron deficiency. *E. Afr. agric. J.* **23** (1957) 100.

SOIL MAP OF TANGANYIKA (1 in 3 million).—Tanganyika Atlas (3rd edition). 1956. p. 4.

*Veterinary*

578. *Rinderpest and rinderpest-like diseases.* Research into improving diagnostic techniques was continued, but was hampered by lack of material from the field. Material from game infected with an atypical rinderpest virus was identified as specific rinderpest, but infection could not be established in susceptible cattle.

579. *Mineral Deficiencies.* In a feeding trial with native-owned stock in the Southern Highlands Province striking liveweight gains and improvement in general health were obtained from the feeding of supplements of bonemeal and minor elements. Cobalt and phosphate were the deficient elements in the area.

580. *Ticks.* Ticks resistant to BHC were discovered in three scattered parts of the territory. Work was continued with the testing of new dip formulations and on the development of dip-side tests for BHC.

581. *Livestock Research.* Research into beef cattle production included a study of the value of Boran cattle for grading up the indigenous zebu. The long term breeding project on the cross breeding of Indian and African zebu cattle as dual-purpose animals was continued and also on the selective breeding of borans and of cross bred zebu-European cattle for coastal dairy purposes. The value of Kamorai goats for increasing the milk potential of native goats was studied and black headed Persian sheep were selectively bred for meat and fat production. A large scale experiment on the use of hormone-like substances for synchronizing oestrus in ranch cattle showed that the technique has a possible value for the exploitation of outstanding sires. Assessment of the amounts of milk consumed by calves of zebu cows under the partial suckling methods commonly used in the territory showed a great variation in the amount of milk consumed.

*Publications*

HUTCHISON, H. G.—Experimental Crossbreeding of Cattle in the United States of America *An. Breed. Abs.* **25** (1957) 5.

HUTCHISON, W. G.—Gully Control and Utilization. *East Afr. agric. J.* **33** (1958).

ROBSON, J. and MILNE, A. H.—A preliminary trial with three new drugs as Prophylactics against *Trypanosoma congolense* in Zebu cattle. *Vet. Rec.* **69** (1957) 564.

*Forestry*

582. Research was directed mainly towards the investigation of problems concerning afforestation with exotic conifers, and the replacement of four important indigenous species, namely mvule (*Chlorophora excelsa*), lolyondo (*Olea welwitschii*), Camphorwood (*Ocotea usambarensis*) and swamp podo (*Podocarpus usambarensis* var. *dawei*). In addition, the Division dealt with the planning and statistical analysis of forest enumerations, and the compilation of volume tables.

583. Research on mvule included the stimulation of root suckers by burning stumps of felled trees, a technique now being applied on a field

scale; "nest" planting in a matrix of faster growing general utility species; maintenance of nursery fertility; reduction of gall infestation by spraying with Dioldrex; the effect of weed-growth, burning, and canopy on weed-growth; the selection of clones for vegetative propagation; and the optimum size of "stump" for planting. A predatory snail, *Gonoxis*, was introduced to attempt to control a plague of *Achatina* snails.

584. Further successful experiments were done on the control of termite damage to eucalypts by applying insecticide to the planting holes.

585. The Utilization Division carried out extensive trials on the conversion of local timbers, on suitability of different types of axe and saw, preservative treatment against pinhole borers, marine borers and termites, kiln drying of timbers and mechanical logging costs.

## TRINIDAD AND TOBAGO

### Agriculture

586. *Cocoa*. Early yield data for trials of selected clones on different soil types have given valuable results. Hybridisation to combine resistance to Witches' Broom with yield and quality continues. The possibility of producing hybrid seed from known parents for commercial planting is being explored. Trials with low volume oil-based sprays including copper oxychloride show no control of Black Pod or Witches' Broom disease.

587. *Citrus*. Root stock trials indicate that seedling limes on their own roots are susceptible to epidemic "dying out" whereas limes on other root stocks are immune. Favourable results in the control of grapefruit Melanose and Scab were obtained by the use of low volume sprays with cuprous oxide.

588. *Bananas*. Further trials in the control of Leaf Spot disease (*Mycosphaerella musicola*) have confirmed the effectiveness of low volume oil-based sprays. Trials also indicate the fungistatic effect of oil in reducing spotting after infection has taken place. Present indications are that oil alone is an effective control measure. Trials have shown that infection by the borer weevil (*Cosmopolites sordidus*) can be prevented for two years by one pre-planting application of aldrin.

589. *Sweet Potato*. Quite a substantial increase in yield was recorded with the use of dieldrin for the control of the moth borer (*Megastes grandalis*).

590. *Irrigation—vegetables*. Trials to compare the return from, and cost of, irrigation with portable sprinkler systems compared with hand watering indicate considerably lower cost of irrigation using a sprinkler system.

## UGANDA

### Agriculture

591. *Soil and Vegetation Surveys*. The soils of more than half of the Protectorate have now been mapped on the scale of 1:250,000. During the year Masaka, Mubendo, Bugisu, Teso, Lango, Acholi and Toro districts have been completed on this scale, together with Pian, Karasuk and Bokora counties of Karamoja on the scale of 1:50,000. Vegetation of 20,000 square miles has been mapped on the 1:250,000 scale, comprising Busoga district, the major part of Teso district, substantial areas of Bugiso, Lango, Acholi and West Nile districts and again on the 1:50,000 scale, the above counties of Karamoja.

592. *Soil Physics*. The techniques of E.A.A.F.R.O. for measuring soil-water relationships have recently been applied to the soils of the manorial

experiment Serere (now in its 20th year), and significant differences have shown up in actual moisture content under a standard tension of 330 cms water, static percolation rates and rainfall acceptance rates.

593. *Soil and Plant Chemistry.* Nitrate accumulation studies were continued and again confirmed that this phenomenon has little to do with capillary uplift. Favourable microbiological and climatological conditions working on adequate supplies of soil humus were found to be the chief factors concerned. Certain legumes proved beneficial as green manures on account of the promotion of higher nitrate levels and their ability to fix atmospheric nitrogen. Provence lucerne and Kenya white clover show great promise as soil improvers. In a sand culture experiment with tea, potassium was shown to be deleterious above 500 p.p.m.K. In a pot experiment with soils of varying potassium content, boron deficiency syndromes appeared accidentally in young tea plants and were seen again in both soil and sand culture experiments. This is the first time in the history of the tea bush that its boron deficiency syndrome has been demonstrated.

594. *Fertilisers.* Of the thirteen formal fertiliser trials that were run during the year, only three gave profitable returns. At Ngetta, on old land, a 1025 lb. per acre control yield of seed cotton was significantly increased to 1677 lb. per acre by 40 lb.  $P_2O_5$ , broadcast as double supers. This increase is highly economic for an outlay of shillings 31 brought in shillings 380. It is noteworthy that this trial was sprayed to control *Lygus* and its overall yield was very much greater than average for the farm. At Kawanda, also an old land, a low yield of 214 lb. per acre seed cotton was increased to 379 lb. by an application of 1 cwt. of sulphate of ammonia placed at squaring. This was also highly profitable—an investment of shillings 33 bringing in shillings 96. In a trial with Arabica coffee at Bugusege, dressings of sulphate of ammonia were profitable. Each pound of fertiliser costing shillings 0.28 gave a return of 0.77 lb. of parchment worth at least shillings 1.77. Trace elements were applied in three experiments but yield increases were barely significant and certainly not economic. In Teso district, 144 paired plots of finger millet, with and without mixed fertiliser, gave hopeful signs of the value of fertilisers in that 60 per cent. of the plots treated gave a profitable increase of more than 400 lb. of grain per acre.

595. *Maize.* Attempts were made to shorten the life cycle of the variety Muratha by recurrent selections and by hybridisation with the early maturing variety K.8. An improved seed bulk has been obtained and it is now ready to be tested against the best local varieties.

596. Work was continued on the improvement of the varieties Muratha and K.8 in respect of their resistance to tropical American Maize rust *Puccinia polysora*. Resistance was transferred to both varieties from two tropical American varieties AFRO 24 and AFRO 29. Final selections for resistance and high yielding are complete for Muratha, but further selections for high yield is required for K.8. Early maturing and rust resistant maize is usually susceptible to leaf blight *Helminthosporium turcicum*. Selections for resistance to this disease has only just begun, but meanwhile a partial control has been found with the organo-sulphur-zinc chemical Zineb. In Muratha increased yields from heavier cobs ranged from 28 to 50 per cent. of controls and in K.8 and AFRO 53200 from 39 to 184 per cent. of controls due to both more and heavier cobs.

597. *Sugar Cane.* Satisfactory increases in ratoon yields, which are usually much reduced by Ratoon Stunting disease, have been obtained by heat treatment. Heat treating four hybrid varieties gave a 36.5 per cent. increase on a control yield of 27.4 tons per acre. Cane from heat treated

material had made more nodes with a longer internodal length than the controls, and also had a greater girth. In spite of this there was no difference in the weights of the individual canes. The reduction of yield by RSD appears to be caused by the production of fewer tillers.

598. *Sorghum*. Breeding and selection has begun on sweet, large-glumed varieties which will be bird-resistant and possibly mirid and weevil resistant. In Karamoja, where it is usual to find up to 20 per cent. sorghum heads attacked by smut (*Sphacelotheca sorghi*) complete control and increases in stand were obtained by using seed dressed with Fernasan D (= 20 per cent. gamma BHC + 25 per cent. thiram).

599. *Finger Millet*. Improvement selections have been made for earliness in ripening seed, stiffness of straw and ease of removal of the pericarp. The validity of the erection of a new species name for the "wild headed Ekitu" seed contaminant has been strengthened by chromosome counts. Ekitu, now *Eleusine africana* is a tetraploid while *E. indica* is a diploid.

600. *Bulrush Millet*. An 85-day variety imported from Nigeria has yielded very well, giving 1,000 and 1,500 lb. of grain per acre at Labora and Serere respectively, when planted in late July in poor soil. Little trouble from birds was experienced and it is markedly resistant to *Sphacelia* disease.

#### Entomology

601. *Cotton*. A series of 100 plots were laid down, mainly in the S47 area, to test on farmer's plots the most likely insecticidal control for Lygus. The spray treatment was 1 lb. DDT per acre for four applications spaced at 10 day intervals. A satisfactory yield increase of seed cotton has resulted in Bunyoro (251 lbs./a.), Omoro (Lango) (176 lbs./a.), Anyeke (Lango) (167 lbs./a.) and Lokwatomer (Acholi) (314 lbs./a.). The minimum economic increase is about 130 lbs. per acre. Time of planting-response to spraying curves make it abundantly clear that in the Eastern and Northern Zones by far the greatest increases in yield from spraying, and the highest total yields, are obtained with very early planted cotton. The optimum time for planting in these zones would appear to be late May.

602. *Bananas*. The experiments on control of the Banana weevil (*Cosmopolites sordidus*) have been completed and recommendations for its control with 0.5 per cent. Dieldrin dust have been included in a Departmental Bulletin. Interest among the growers has been slow to develop, but appears to be increasing.

603. *Miscellaneous Pests*. An experiment to control Carpenter Bees (*Xylocopa* spp.) has been completed. A 1 per cent. solution of Dieldrin gives good protection to wood for at least 10 months. 0.5 per cent. Dieldrin dust has been successfully used against various termites.

604. Endrin at 4 oz. per acre was found to give a high percentage (90 per cent.) kill of aphids on cotton; the same insecticide also gave excellent control of Spiny Bollworm (*Earias* spp.) on cotton, applied at 8 ozs. per acre.

605. Malathion was found to give good control of the Maize Tassel Beetle, *Megalognatha rufiventris*, and of aphids on citrus at  $\frac{1}{4}$  pint 50 per cent. emulsion in 4 gallons of water. Malathion with banana bait successfully controlled Fruit Flies, *Drosophila* spp. occurring in large numbers in some houses.

#### Pests of Stored Produce

606. *Maize, Crib Storage*. Two trials have been completed, on the influence of husks on storage, and the use of BHC powder. Tight shucks

protect the maize for 3-4 months before infestation becomes serious, and do not greatly affect the drying rate. Eight ozs. of 0.5 per cent. BHC per cu. ft. of cobs (200 lbs.) gives excellent control of Rice Weevil, *Calandra oryzae*. A trial is in progress comparing full versus half dosage; meanwhile the rate given above is being recommended as standard procedure for maize protection.

607. *Treatment of Stores.* Applications of 50 per cent. DDT (Wettable powder) at 8 oz./1 gall. water/1,000 sq. ft. wall surface have been found remarkably persistent under Uganda conditions. Good kills of *Calandra* are occurring even after 12 weeks. The experiment is continuing.

608. *Losses in African Stores.* Surveys have begun to assess the extent of loss in African stores, and the insects responsible for these losses. In North Uganda considerable loss is evident in stored sorghum and maize, the main insect involved being *Calandra oryzae*, with *Sitotroga cerealella* and *Cryptolestes* spp. locally important. Legumes suffer greatly from *Bruchids*.

### Coffee Research

609. *Control of Couch Grass by Dalapon.* Trials on plots heavily infested with mature couch grass at rates of 5, 10, 15 and 20 lbs./acre in 60 gallons of water caused the foliage to be destroyed, but gave no satisfactory control of the rhizomes. On couch which was regenerating after cultivation, i.e. 4-6 inches high and growing rapidly, a large measure of control was obtained by applications of 10 lbs./acre and above. The ground cover had changed from predominantly couch to soft weeds such as *Galinsoga parviflora* and *Bidens pilosa*. On a different site a similar degree of control was obtained at 5 lbs./acre. Some slight damage to the trees was observed where application was made before a very dry spell. There was no effect on the coffee when application was made during showery weather. The cost of the treatment was about shillings 200 per acre, compared with hand clearing at shillings 600 per acre, and experience has shown that hand clearing even when well supervised does not eradicate this weed.

610. *Investigations on Compatibility in Robusta Coffee.* Controlled pollination made during 1957 gave an average set of 57 per cent. for out-pollinations and 25 per cent. for selfs. It is evident that the setting on selfing was higher than would be expected from plants with a large measure of self-incompatibility. Out-pollinations on the same population of trees on which the selfings were carried out have shown no evidence of cross-incompatibility, so far. The receptacle of flowers which was self-pollinated persisted for a considerable time, although it was obvious that many of them had not been fertilised. The rate of drop of berries from selfed flowers was followed for a period of 200 days to establish at what time it was safe to regard an ovary as fertilised. It was found that there was a high rate of drop for the first 100 days, and very little drop beyond that point. Microscopical examination of a large number of styles from flowers which had been self-pollinated showed that growth of the pollen tube from the stigmatic tissue was very limited. None reached the ovary. Thus the situation stands at the moment that workers in India, the Belgian Congo and French West Africa have found a very high degree of self-incompatibility in their populations of Robusta coffee while Uganda workers have obtained results somewhat at variance with this.

611. *Arabica Coffee Variety Trials.* The first completed set of record sheets for the Bugisu Trials covered the period to the end of the 1957 main crop. These showed that at medium and low altitudes the Kenya selection K.7 had the greatest *Hemileia* rust resistance, and retained its canopy better

than any of the other selections. There was no difference at high altitudes where the incidence of rust has always been low.

612. The trials at Kawanda showed a considerable amount of die-back after last year's heavy crop. Analysis of the yield records showed that the Tanganyika varieties KP 162, KP 423, N 39 and C 40, and the Kenya variety K.7 were the highest yielders, and in one trial gave a yield equivalent to over seven tons of fresh cherry to the acre.

613. *Coffee Root Mealy Bug*. Specimens of mealy bugs found on roots of both Arabica and Robusta coffee from various parts of Buganda and Bugisu, and from the roots of a number of weed species from Bugisu, were identified at the Scott Laboratories, Kenya. Every specimen from coffee was *Pseudococcus latipes*; this species was not found on any of the weed plants, but is widespread throughout the coffee growing areas. It only causes severe and visible damage to plants of up to about seven years of age; on old plants it is often present, but causes no apparent damage. Thus old trees may well provide a reservoir of infection for new plantings. The subterranean habit of the pest makes survey difficult except where its presence is obvious on young plants. Field reports suggest that Root Mealy Bug outbreaks are found most commonly in arable well cultivated soil. An outbreak recorded previously in Buganda was almost entirely suppressed eighteen months after a single application of dust containing 2.6 per cent. gamma BHC. A series of trials was carried out in Bugisu, using a range of insecticides as both liquid and powder. BHC and Aldrin dust proved most effective. Because of the risk of tainted liquor with crude BHC, 2.5 per cent. Lindane dust has been advised as the standard control. Treatment of infested farms is now being carried out in Bugisu by the farmers themselves, with insecticide supplied by the Bugisu Coffee Board. Not only is the pest controlled, but the recovery of the trees is sufficiently spectacular to impress the farmer with the efficiency of the treatment. Liquoring tests on coffee from treated trees have been performed. The evidence for taint by crude BHC was inconclusive and there was none for Lindane.

614. *Capsid, Lycidocoris mimeticus*. A severe outbreak of capsid on Budai Estate, near Masaka, was controlled by 0.2 per cent. w/v DDT sprayed at the rate of 1 pint per tree. Damage was widespread in the Masaka area, but the incidence declined to negligible proportions later in the year.

#### Pastures

615. The number of grasses suitable for pastures under Serere conditions has been narrowed down to three species and suitable legumes to four species. The grasses are *Panicum maximum*, *Hyparrhenia rufa* and *Chloris gayana* (SR.5316); the legumes are *Pueraria thumbergiana*, *P. phaseoloides*, *Desmodium uncinatum* and *Stylosanthes gracilis*. The first two species of grasses yielded over 10 tons per acre per annum of green matter over a period of three years. In a formal trial of grass and grass legume mixtures the inclusion of *Stylosanthes gracilis* in a *Panicum maximum* sward led to a mean increase of 23 per cent. total green matter yield with a slight increase in actual grass yield.

#### Livestock

616. At Serere the herd of 408 Bukedi cattle has been maintained in order to select for better beef and to afford a level of milk production adequate for good calves and also to supply the needs of the farmer. Progeny testing of selected bulls is being carried out and the herd has been reopened to introduce a wider range of breeding stock from Teso District. On the semi-range system of once-a-day milking, the average yield of 120 gallons per lactation is only 10 gallons in excess of the desired culling

level. Although a small supplementary ration of concentrates has failed to increase milk yields, examination of live-weight records and experience during droughts has emphasised the desirability of improving the pastures and their management. At Kawanda the Nganda herd was culled from 181 to 115 head. The semi-range system of management was introduced and a marked improvement in appearance and milk yield was noticeable within two months.

#### *Forest Research*

617. *Silviculture of Natural Forests.* Eight years of local research and study tours to other territories have led to the conclusion that natural tropical high-forest in Uganda is incapable of extensive annual acre yields of saw-timber exceeding 60 cubic feet, 30-40 cu. ft. being nearer the average possibility. Even these yields can be achieved only on a uniform system, the highest possibility of a selection-type system being less than half the above figures. All research in natural forest was therefore reorganised along "uniform" system lines, with considerable simplification and saving in time. Assessments are now based on the Malayan and Queensland concept of the selected "final-crop" tree.

618. *Silviculture of Exotics.* The conclusions reached above gave considerable impetus to softwood research, which was much accelerated by the doubling of field research staff, now numbering nine Rangers and one Assistant Forester. This work is still in the early stages of species trials together with sampling of the existing plantations for accumulation of Yield-Tables.

619. *Utilization.* The twelve projects completed during the year included general tests on *Albizia glaberrima*, *Celtis spp.*, *Fagara macrophylla*, *Lovoa swynnertoni*, *Strombosia scheffleri* and special tests on *Cassipourea elliotii*, *Terminalia velutina* and *Acacia albida*.

#### *Publications*

Papers presented to the Second Inter-African Forestry Conference (Pointe-Noire) included:—

"The measurement of Basal Area increment in tropical high-forest".

"The relative merits of hormonal and arsenical arboricides".

"The volume increment of natural tropical high-forest and the limitations on its improvement".

Papers presented to the Seventh British Commonwealth Forestry Conference (Canberra) included:—

"Some results of stratified random sampling of tropical high-forest".

"Some latin square and randomized block experiments in tropical high-forest".

"Forest mapping from aerial photographs in Uganda".

#### *Veterinary Research*

620. Work was continued on a mouse-adapted vaccine against Nairobi Sheep Disease and a limited survey of the incidence of the disease carried out. Surveys of poultry disease and of the causes of calf mortality were commenced. Further work on the incidence, life history, diagnosis and control of liver fluke (*F. gigantica*) was carried out, special attention being directed towards techniques for accurate diagnosis and treatment.

621. Electrophoretic studies were made on the protein composition of the blood of the new born calf and the post natal changes in the protein fractions. The development of artificial insemination techniques was mainly



directed towards the use of the electro-ejaculator and to the comparative study of oestrus periods in *Bos taurus* and *Bos indicus*.

#### Pasture Research

622. Work continued on the study of legumes and legume mixtures as fodder crops and a comparison of elephant grass with and without irrigation and fertilization was begun. Studies on the effect of cutting and burning on various grass mixtures were made. Further observations on grazing habits in relation to pasture grasses were carried out. Work on the evaluation of fodder and concentrates was continued and a number of digestibility trials with Zebu cattle were undertaken.

#### Publications

MCANULTY, E. C.—Salmonellae in Uganda. *Nature* (Lond.) (In press).

HARKER, K. W.—A note on *Digitaria scalarum* Seed. *E. Afr. agric. J.* (1957).

BREDON, R. M.—Feeding of Livestock in Uganda. *Occasional Bulletin* No. 1.

### ZANZIBAR

#### Agriculture

623. *Clove Disease Research.* Experiments are in progress to find means of restricting the spread of active sudden death disease in plantations of mature clove trees. On the assumption that the disease condition is connected with a root pathogen, trenching and liming are being tested. It is as yet too early to assess results. The prevention of "slow decline", a condition which appears in young clove trees some 12 to 15 years after planting on land where clove trees had previously died from sudden death, is being tested in long term experiments which involved certain preparatory treatments of the ground before planting.

624. *Derris.* Analyses by the Tropical Products Institute of derris root harvested at 12, 18, 24, and 31 months showed that rotenone content decreased with age. Taking yield into consideration, the results indicate that it is preferable to harvest derris at 18 months instead of the customary 30 months.

625. No response was obtained to nitrogen, phosphate or potash fertilizers, in terms of yield or in leaf analysis; rotenone content in this experiment has not yet been determined.

626. *Pineapples.* Coir fibre dust applied as a mulch to pineapples increased the total weight of the first crop with a reduced number of fruits. The mulch is also being tested in conjunction with fruiting hormones which have previously been shown to be capable of inducing early fruiting, but at the expense of plant vigour.

627. *Cattle.* Using the electrical stimulation method, with positioning of the copper-ring finger-electrodes and current variation controlled by a single operator, good quality semen has been obtained from Zebu bulls without difficulty. Artificial insemination began early in 1958.

628. *Rice.* In a system of annual cultivation of dry land rice, increased rice yields have been obtained where catch crops of sweet potatoes and green gram have been grown as compared with clean cultivation or grass fallow. The increases were most marked where farmyard manure was applied to the catch crop.

629. *Soils and Fertilizers.* The need for phosphate in at least two types of soil, and for potash in another, is now firmly established. In pot tests a  
31382

E 2

sulphur deficiency has been shown in four soil types. Field tests with one of these soils suggest that the deficiency would only become pronounced after prolonged cultivation in the absence of manuring. Sulphate of ammonia has given slightly better yields than urea or ammonium nitrate. The microplot technique has been used to compare the value of different plants as indicators of soil deficiencies. Considerable differences in this respect were observed both in these and in pot tests. Trace element status of the principal soils is being investigated by means of pot tests. The value of coir fibre dust as a mulch, and its ash which contains over 11 per cent. water-soluble  $K_2O$ , as a fertilizer, is being investigated with a number of crops.

### VIII. REPORTS OF STANDING SUB-COMMITTEES

#### (a) *Stored Products Sub-Committee*

630. Membership changed by the appointment of Mr. A. D. Ewens in place of Mr. D. D. Jones and of Mr. J. Young in place of Mr. W. L. Bloomfield. Mr. D. W. Hall joined the Sub-Committee. Three meetings were held during the year. The Chairman, Mr. G. V. B. Herford, attended the annual reviewing meeting of the West African Stored Products Research Unit in Nigeria. Mr. Hall visited Nigeria, Ghana, Sierra Leone and the Gambia in connection with cocoa and groundnut storage problems.

631. The Colonial Liaison Officer stationed at the Pest Infestation Laboratory of the Department of Scientific and Industrial Research continues to receive increasing numbers of enquiries from overseas and also requests for analysis of samples of tropical produce. The Unit has been strengthened to deal with this increase in work. The Committee expresses its appreciation of the facilities provided by the D.S.I.R. and for helpful collaboration from the Infestation Control Division of the Ministry of Agriculture, Fisheries and Food. Control of pests in tropical produce affects both overseas territories and imports into the United Kingdom.

#### (b) *Cocoa Research Sub-Committee*

632. This Sub-Committee did not meet. A number of conferences on cocoa have occurred recently which it is thought have adequately provided for discussion of cocoa problems. Mr. Voelcker visited Malaya and North Borneo.

#### (c) *Soils Sub-Committee*

633. Dr. P. C. J. Payne joined this Sub-Committee which met once. Dr. Osmond visited Malta and Dr. Greene visited Swaziland, Nyasaland, Northern Rhodesia, Kenya, Tanganyika and Uganda. He also attended the Inter-African Advisory Committee on the Conservation and Utilization of the Soil which met at Yangambi, Belgian Congo.

634. The Sub-Committee was chiefly concerned with soil surveys which were proceeding in a number of territories including Swaziland, Northern Rhodesia, North Borneo, Hong Kong, British Guiana, Malta and Sarawak.

Colonial  
Economic Research Committee  
Eleventh Annual Report  
(1957-1958)

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London School of Economics and Political Science,  
Houghton Street,  
Aldwych,  
London, W.C.2.

24th September, 1958.

SIR,

I have the honour, on behalf of the Colonial Economic Research Committee, to transmit to you the Eleventh Report of the Committee covering the period from 1st April, 1957, to 31st March, 1958.

I have the honour to be,

Sir,

Your obedient servant,

ARNOLD PLANT,

*Chairman.*

The Right Honourable Alan Lennox-Boyd, M.P.,  
Secretary of State for the Colonies.

## COLONIAL ECONOMIC RESEARCH COMMITTEE

**Membership**

PROFESSOR SIR ARNOLD PLANT, Professor of Commerce, University of London  
(*Chairman*).

PROFESSOR S. H. FRANKEL, D.Sc.(Econ.), Professor of Colonial Economic  
Affairs, University of Oxford.

DR. J. R. RAEBURN, Reader in Agricultural Economics, University of London.

PROFESSOR E. A. G. ROBINSON, C.M.G., O.B.E., Professor of Economics,  
University of Cambridge.

PROFESSOR K. E. ROBINSON, Director of the Institute of Commonwealth  
Studies, London.

PROFESSOR R. S. SAYERS, Cassel Professor of Economics, with special  
reference to Banking and Currency, University of London.

PROFESSOR R. C. TRESS, Professor of Political Economy, University of Bristol.

MR. A. F. COMFORT (*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

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## COLONIAL ECONOMIC RESEARCH COMMITTEE

### Eleventh Annual Report and Bibliography

#### I. INTRODUCTION

- Two meetings of the Committee took place during the year.
2. Professor A. T. Peacock, Head of the Department of Political Economy at the University of Edinburgh, accepted the Secretary of State's invitation to join the Committee. His appointment will take effect on the 1st April, 1958.

#### II. GENERAL

3. Issues against the Economic Research allocation for the quinquennium, which was increased during the year from £70,000 to £100,000, totalled £29,656 on the 31st March, 1958.
4. During the year the Committee considered a number of new projects, discussed in Section V below. Work was also started on two projects approved in the previous year. The difficulty of finding suitable recruits with economic research experience has, however, delayed the carrying out of the Committee's full programme.
5. The Annual Reports of the Institutes of Social and Economic Research include a record of economic research undertaken at the Institutes. The late P. A. Powesland's book "Economic Policy and Labour in Uganda" was published during the year, as was Mr. K. D. S. Baldwin's "The Niger Agricultural Project". Mr. C. S. McMorris's "Small Farm Financing in Jamaica" was published as a supplement to the journal of the West Indies Institute. This was also a notable year for the publication of research in the Colonial Research Studies series (see Section III).

#### III. RESEARCH FINDINGS PUBLISHED

6. As noted in last year's report, Mr. F. H. H. King's "Money in British East Asia" was published in April, 1957. Other reports published in the Colonial Research Studies series were Dr. A. R. Prest's "Fiscal Survey of the British Caribbean", Mr. C. A. Moser's "Levels of Living in Jamaica", and the report by Professor Peacock and Mr. Douglas Dosser on "The National Income of Tanganyika". Professor Gilbert Walker's work on "Nigerian Traffic and Transport" is in the Press.

#### IV. RESEARCH IN PROGRESS

7. Dr. Raeburn and Dr. Johnson have begun work on their large-scale study of the economics of farming systems in Africa. Dr. Raeburn paid a visit to Nigeria, Sierra Leone and Gambia from May to September, 1957, and Dr. Johnson has been working steadily through Nigeria, the Belgian Congo, Northern Rhodesia, Nyasaland and Tanganyika, where he has made contact with local Agricultural Departments who are assisting in the drawing up of the final Report. A further visit by Dr. Raeburn was planned for the summer of 1958, when he intended to visit the East African territories in the company of Dr. Johnson, who would go on to the Somaliland Protectorate in September, 1958. Dr. Raeburn hopes that the completed report on the project will be available in the early summer of 1959.

8. An interim report was received during the year from the Royal University of Malta on the progress of the economic research study together with an interim report by Professor Rev. R. Cirillo entitled "Economic and Social Attitudes of the Maltese Farmer". The University of Durham, who are collaborating in an investigation of Malta's agricultural economy, are now well advanced with a detailed land use survey of the island.

9. In accordance with the arrangements made in the previous year, Mr. E. K. Hawkins of Nuffield College took up an appointment in October, 1957, in Uganda, where he is investigating the question of road development economics. Mr. Hawkins is being assisted both by the Uganda Government and by the Colonial section of the Road Research Laboratory.

10. Mr. Rowe, of Pembroke College, Cambridge, left the United Kingdom in March to undertake an economic survey of the Seychelles, with a view to possible future development of the territory. Mr. Rowe will spend two months in the Seychelles and his report is expected to be submitted in the autumn of 1958.

### V. NEW PROJECTS

11. Arrangements were being made during the year for an Economic Survey of the New Hebrides. This territory, which is an Anglo-French condominium, is considered to be in need of more accurate economic information and statistics which would provide a satisfactory basis for development and taxation policies. Arrangements were well advanced by the end of the year for Mr. J. S. G. Wilson, Reader in Money and Banking at the London School of Economics, to undertake this survey with the aid of an assistant. Mr. Wilson is expected to visit the New Hebrides for approximately three months in the summer of 1958 and his assistant will spend a year in the territory.

12. Now that funds available for economic research have been increased, the Committee are planning to go ahead with a study of the economic background to the development of road and other communications in North Borneo. It has not been possible to recruit a suitable expert for the proposed study of the effect of diamond mining on a predominantly subsistence economy in Sierra Leone, but the matter is under discussion with Professor Jack, who visited Sierra Leone, not under the Committee's auspices, at the request of the Sierra Leone Government in March, 1958.

### VI. PUBLICATIONS BY WORKERS ASSISTED FROM COLONIAL DEVELOPMENT AND WELFARE FUNDS

13. Publications by workers assisted from Colonial Development and Welfare funds (new publications in the year under review and additions to the list of publications noted in the Tenth Annual Report) are:—

Baldwin, H. D. S. "The Niger Agricultural Project". Blackwell, 1958.

Cumper, G. E. "Estimates of Jamaican Commodity Trade". *Social and Economic Studies*, Sept., 1957.

"Expenditure Patterns, Kingston". *Social and Economic Studies*, March, 1958.

Dosser, D. G. M. and Peacock, A. T. "Input-Output Analysis in an Underdeveloped Country. A Case Study". *Review of Economic Studies*. Vol. XXV, No. 1, Nov., 1957.

- Elkan, W. "Regional Disparities in Income and Taxation". E.A.I.S.R. Conference Proceedings, June, 1957.
- "The Kamba Trade in Woodcarvings". E.A.I.S.R. Conference Proceedings. Jan., 1958.
- "Bulk Buying from the Colonies". A Review Article. *Uganda Argus*. April, 1957.
- "Employment of Women in Uganda". *Inter African Labour Bulletin*, Jan., 1958.
- "Introduction to Economic Policy and Labour" by the late P. G. Powesland (edited). E. A. Studies No. 10, 1958.
- Elkan, W. with Gutkind, P. C. W. "Housing in Jinja". E.A.I.S.R. (mimeo). 1958.
- King, F. H. H. "Money in British East Asia". H.M.S.O., 1957.
- "The New Malayan Nation". I.P.R., New York, 1957.
- Moser, C. A. "The Measurement of Levels of Living" with special reference to Jamaica. H.M.S.O., 1957.
- O'Loughlin, C. "Agricultural Sector Statistics in National Accounting". *Social and Economic Studies*, Sept., 1957.
- Peacock, A. T. with Dosser, D. M. "Input-Output Analysis in an Underdeveloped Country—A Case Study". *Review of Economic Studies*. Vol. XXV, No. 1, 1957-58.
- "The National Income of Tanganyika, 1952-54". H.M.S.O. Colonial Research Studies No. 26, 1958.
- Prest, A. R. with Demas, W. G. "A Fiscal Survey of the British Caribbean". H.M.S.O. Colonial Research Studies. July, 1957.
- Smith, R. T. "Economic Aspects of Rice Production in an East Indian Community in British Guiana". *Social and Economic Studies*. Dec., 1957.
- Warmington, W. A. "Developments in the Cameroons I—Progress in Peasant Co-operation". *West Africa*. Nov. 30, 1957.
- "Developments in the Cameroons II—More Plantations". *West Africa*. Dec. 7, 1957.
- In the Press*
- Hawkins, E. K. "Road Transport in Nigeria". (O.U.P.)



Colonial Fisheries Advisory  
Committee Annual Report on  
Fisheries Research  
(1957-1958)

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The Church House,  
Great Smith Street,  
Westminster,  
S.W.1.  
30th October, 1958.

SIR,

I have the honour to transmit herewith the Report of the Colonial Fisheries Advisory Committee for the year ended 31st March, 1958.

I have the honour to be,

Sir,

Your obedient servant,

PERTH,

*Chairman.*

The Rt. Hon. Alan Lennox-Boyd, M.P.,  
Secretary of State for the Colonies.

## COLONIAL FISHERIES ADVISORY COMMITTEE

**Membership**

THE MINISTER OF STATE FOR COLONIAL AFFAIRS (*Chairman*).  
W. B. L. MONSON, C.M.G. (*Vice-Chairman*).  
G. E. R. DEACON, C.B.E., D.Sc., F.R.S.  
C. F. HICKLING, C.M.G., Sc.D. (Fisheries Adviser to the Secretary of State).  
T. S. LEACH, M.C.  
C. F. A. PANTIN, Sc.D., F.R.S.  
G. A. REAY, O.B.E., Ph.D., F.R.I.C.  
F. S. RUSSELL, C.B.E., D.S.C., D.F.C., F.R.S.  
MISS E. TREWAVAS, D.Sc.  
R. S. WIMPENNY, O.B.E., M.Sc.  
PROFESSOR C. M. YONGE, C.B.E., D.Sc., Ph.D., F.R.S.  
W. F. DAWSON, M.B.E. (*Secretary*).

**Terms of Reference**

This Committee was appointed by the Secretary of State for the Colonies in October, 1943, to advise him on problems concerning fisheries (marine and freshwater) in the Colonial Empire.

**COLONIAL FISHERIES ADVISORY COMMITTEE  
REPORT FOR 1957-1958**

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**COLONIAL FISHERIES ADVISORY COMMITTEE**  
**ANNUAL REPORT ON FISHERIES RESEARCH 1957-58**

**I. GENERAL**

1. Two meetings of the Committee were held during the year. Apart from the resignation of Mr. J. Croft-Baker there were no changes in the composition of the Committee.

2. The Committee were called upon to advise on a variety of matters ranging from the annual programmes of work of various colonial fishery research organisations, marine and freshwater, and the disbursement of its allocation of Colonial Development and Welfare research funds, to specific problems such as those affecting future policy governing the fisheries of Lake Victoria. In this latter context arrangements were made with the Ministry of Agriculture, Fisheries and Food for Mr. R. J. H. Beverton, an expert in the field of fish bionomics, to visit East Africa for a period of six weeks to form an on-the-spot scientific assessment of the problem. He duly submitted an interim report to the Secretary of State together with his recommendations which, after consideration by the Committee, were passed on to the East Africa High Commission. Professor Yonge, a member of the Committee, visited East Africa during the year to attend as one of the Secretary of State's representatives at the 9th Meeting of the East African Agriculture, Animal Husbandry, Forestry and Fisheries Research Council. The opportunity was taken for him to visit Fisheries Research Organisations and Fisheries Departments in the East and Central African territories. A visit to the West Indies was undertaken early in 1957 by the Fisheries Adviser. Dr. Hickling subsequently went out to Malaya to take over the direction of the Malacca Tropical Fish Culture Research Institute pending the recruitment of a substantive director. He is not expected to return until the end of the current year.

3. During the course of the year a Colonial Development and Welfare scheme was made to assist the Sierra Leone Government in financing a joint Fisheries Research and Development Unit in Sierra Leone utilizing the facilities and assets of the former West African Fisheries Research Institute. Acknowledgment is due to the Admiralty for continuing to make naval quarters at Kissy available for their research. In addition to promoting the development of Sierra Leone fisheries the Unit has the advantage of ensuring a continuity of fisheries research in West African waters. Another scheme was made to enable the Bellairs Institute in Barbados to carry out a programme of research on the flying fish, *Hirundichthys Affinis*. This research follows up the short study of flying fish previously carried out by Dr. D. N. F. Hall under Colonial Development and Welfare auspices.

4. With the attainment of independence by the Federation of Malaya it became necessary for the administration of the scheme providing for the maintenance of the Fish Culture Research Institute, Malacca, to pass to the Secretary of State. This is an interim measure pending the completion of negotiations with the Federation Government whereby the Institute may enjoy independent status in Malaya under the control of a statutory Board of Management. In November the Fisheries Adviser assumed duty as Acting Director of the Institute, supervised the filling of the numerous experimental ponds and inaugurated the programme of scientific work on which the new Station is to work for the benefit of all tropical dependent territories.

## II. STAFF

5. The staffs of the former West African Fisheries Research Institute and the Regional Fisheries Research Station, Singapore, continued with the writing-up of their scientific papers in the United Kingdom. Some of the West African papers have already been published in scientific journals, one of them in the Colonial Fisheries series. The Singapore staff with the exception of the Director, who has been appointed to Hong Kong University, continue to be engaged whole time on the completion of their papers.

## III. FINANCE

6. At the review by the Colonial Research Council of the central research allocation of Colonial Development and Welfare funds provided under the Act of 1955, the sub-allocation for fisheries was reduced from £930,000 to £843,000. This cut was made to take account of the premature closing down of the West African and Singapore Stations. The total expenditure against the allocation up to the 31st March, 1958, was estimated at £449,000.

## IV. THE FUTURE

7. The closure of the West African and the Singapore fishery research stations, both regional and both considerably endowed with Colonial Development and Welfare research funds, marked the entry of colonial fishery research into a new phase. It would seem that in the current year and for some time to come fundamental research will be regarded in some territories as beyond their means; more and more research institutes will be asked to concentrate on research selected for practical ends. The Colonial Fisheries Advisory Committee recognises, however, this situation, and already is giving all the assistance it can to foster the success of the new programmes. One new experiment in keeping with the mood of the times is the joint research and development scheme in Sierra Leone. This has a valuable potential and will be watched with interest.

## V. REPORTS ON INDIVIDUAL COLONIAL FISHERIES RESEARCH STATIONS

### *Sierra Leone Fisheries Development and Research Unit*

8. Fisheries Research is continuing as a territorial, instead of an inter-territorial, responsibility in West Africa. The West African Fisheries Research Institute has accordingly been replaced in Sierra Leone by a joint Fisheries Development and Research Unit, under the administrative control of the Sierra Leone Government. The Unit occupies a part of the accommodation formerly held by the Institute, including the fully-equipped Laboratory, marine stores, and workshops, and is using the Institute's two motor fishing launches. A slipway has been constructed very inexpensively for the use of the Unit's launches, and other small craft.

9. The Unit in its present form, with research and development sections working side by side, acknowledges the present-day importance of integrating fisheries research with a practical programme of development for the local fishing industry. The scientific direction of the Unit is provided by the Fisheries Adviser to the Colonial Office, who is regularly to visit the Unit for the purpose.

10. There is at present only one scientist in post, but research work has begun, in a programme of marking large numbers of the most important local

commercial fish species. Some 2,000 fish have already been marked and released in the Sierra Leone Estuary. There have been only two recaptures so far; but it takes some time and effort to propagate among the fishing communities the news of the marking programme, and the scale of rewards offered for the return of marked fish recaptured by the fishermen. It is certain that the number of recaptured marked fish returned to the Fisheries Research Unit by fishermen will increase, as the news goes round.

11. The reason for this emphasis on marking is, that this appears to be the only way in which accurate information can be got about the rate of growth, the migrations, and (in certain circumstances) the intensity of fishing mortality, among tropical fish, which rarely show the markings on scales and bones by which their age (and consequently, rate of growth) can be assessed in fish of temperate waters.

12. The fish were captured for marking by trawling, in the course of a trawling survey of the Sierra Leone Estuary which continues the series run for several years by the West African Fisheries Research Institute.

13. The programme of meteorological and hydrographic observations run for several years by the West African Fisheries Research Institute is also being continued.

#### *East African Fisheries Research Organisation*

14. The year's work at Jinja has followed the general theme, that the fertility of the lake depends on the speed at which the turnover of plant material into animals and fish, and of the by-products of these back to plant material, proceeds. The intervention of man, as fisherman, as an extra predator, is not compensated for by a more rapid growth of the surviving fish, since the most important fish, the Tilapias, are herbivorous and already have as much food available as they can consume.

15. In particular, the records of the experimental fishing near Jinja show a clear downward trend in the catch per net, not only of Tilapia but of other species of lake fish. The data show that fishing can adversely affect the numbers of fish in a very short space of time.

16. Seasonal variations in the catch of fish may be due to changes in the oxygen content of the deeper parts of the Lake. During the months of June to September, the deeper waters of the lake may contain sufficient oxygen to support fish life; it may be that the decline in catches close inshore during those months is because the fish have moved out to the new grounds temporarily available to them. Similarly, it is shown that in the southern part of the Lake, a seasonal shortage of fish inshore may be associated with prevailing southerly winds which by driving the surface water offshore, cause the upwelling of colder deoxygenated water.

17. Current-meter observations showed that there are important currents in the Lake; the bottom water may indeed move at a velocity of 10 cm/second. The currents are wind-induced.

18. The problem of the bottom deposits of the Lake has been further studied. The muds may have a protein content as high as 19 per cent., and are a good source of Vitamin B12. As an ingredient in the food of pigs, to the extent of ten per cent., the mud gave encouraging results. The problem is, why this protein remains undecomposed in the mud. It would normally be expected that bacteria and other micro-organisms would speedily decompose such deposits, releasing the materials for re-use by plants. The deposits in fact are a brake on the rapid turnover of material mentioned above.

19. Based on "spawning rings" in the scales, which are assumed to be laid down twice annually, a tentative growth rate has been worked out for *Tilapia esculenta*. No difference was observed between the growth rates of males and females. The fish is fully grown after about 10 years, at a length of about 33 cm. There are variations in the rate of growth as between different parts of the lake.

20. This study has also led to the finding that only about 16 per cent. of the stock of breeding fish, on which the future stock of fish depends, had survived longer than three years in the breeding stock.

21. Work has been done on the food of young fish; *Tilapia esculenta*, *T. variabilis*, the Lung fish *Protopterus aethiopicus*, the mud fish *Clarias mossambicus*, and the *Marmyrus Kannume*. All experiments showed the importance of a supply of food of animal origin for young fish, even these, such as the Tilapias, which are mainly vegetable feeders in later life.

#### *East African Marine Fisheries Research Organisation*

22. This station now has the twin-screw steel diesel research vessel "Manihine" ex-Singapore, in place of the smaller "Research", which has left our service after 10 years of rugged work, during which she did the work required of her at all seasons and in all weathers.

23. In consequence of the greater range and working space of the larger vessel, a new research programme has been prepared. The deeper draught of the "Manihine" precludes work close inshore; but the "Manihine" itself has an 18 feet work boat with a high speed petrol engine; and the station has also acquired, ex-Singapore, the 28 feet diesel launch "Chermin".

24. Work continues on the collection and identification of East African Marine fishes; and during the period some 3,462 fish belonging to some 248 species were caught and identified and biological observations made upon them. On the basis of this material, added to material got in earlier years, a view is being built up on the abundance, migrations, breeding and rate of growth of these fishes.

25. New fishing methods, including coloured nylon gillnets and trammel nets, and the use of explosives, have increased the number and variety of the species caught. Trials have been made with the Japanese-type floating long-line for the big pelagic fish, chiefly tunas.

26. Work is continuing on the brackish water fishponds at Chukwani; a stocking was made with male *Tilapia* only.

#### *Northern Rhodesia-Nyasaland Joint Fisheries Research Organisation*

27. The year was mainly occupied in field work and a great deal of data was collected, much of it relating to the Bangweulu Swamps. In this work the Organisation benefited from the close collaboration of the Fisheries Officers of the territorial Game and Tsetse Control Departments.

28. A fish survey has shown that the systematics of the fishes of the territory is incomplete; the compilation of a new check list, which will include brief ecological notes, has therefore, been undertaken. A similar check list has been compiled of the fishes of Nyasaland and this will be included in the report on the Lake Nyasa Survey, shortly to be published.

29. Studies are being made in the Kariba Dam area of the fishery problems which will arise in connection with the new flood area formed when the dam is completed. Research work included experimental netting and the collection of data on hydrology, biology, and the ecology of the fishes collected. Papers will be prepared on the ecology of the Zambesi Valley in the Kariba Dam area prior to inundation.

30. Laboratory work was started to study the tolerance of local species to low oxygen levels, in view of the oxygen deficiency of almost all the Northern Rhodesia waters where fish mortality is thought to be attributable to this cause. Experimental work was also begun on the effect on fish of water-borne copper sulphate used in the control of bilharzia-transmitting snails. This chemical may affect fish both directly as a poison and indirectly as a destroyer of fish food.

31. During the latter half of the year, considerable improvements were effected in the ponds of the experimental fish farm at Fiyongole and feeding experiments of fish were started. The food used is cassava, which is almost the only foodstuff or waste available for feeding in the present primitive state of farming in the northern areas of Northern Rhodesia. All ponds were drained and the fish checked for unwanted species before selective re-stocking.

*The Fish Culture Research Institute, Malacca*

32. At the beginning of the period reviewed, the ponds had largely reverted to swamp. Most of the station's ponds, in fact, were constructed in what was a swamp; with very acid peaty soil, pH about 4.2-5.0, and a high sulphur content, and supplied with water having an even greater acidity, namely, about pH 3.7-4.2. No poorer swamp land is to be found in Malaya, or indeed in the tropics; an ideal situation for a research station, one of whose functions is to show how such conditions can be improved for fish culture.

33. The effect of limestone in neutralising these acid conditions, has been worked out on the largest scale in 36 ponds each of one acre. Evidently the quantity needed is very much less than the text books prescribe; but so far as is known no research station has previously done this important work. The published tables refer to agricultural practice; the quantity of limestone required for ponds is now shown to be far less. Generally speaking, 15 cwt. of limestone per acre will produce neutrality even in the very acid conditions of the Malacca station.

34. The changes in the vegetation of the ponds, following the cutting and elimination of the emergent swamp vegetation, and the application of lime, have been closely followed. The effect of the lime itself tends to suppress much of the swamp vegetation, while encouraging the growth of true aquatic plants such as *Limnophila villosa* and especially *Chara*.

35. With the clearance of the swamp vegetation, a true plankton began to make its appearance, the nature of the plankton, however, is related to the lime dosage. A real change in the nature of the algal population occurs at about the level of 15 cwt. of limestone per acre.

36. The effect of fertilisers, other than limestone, is also being studied. It appears that the application of nitrogenous fertiliser, in addition to phosphate and potash, tends to favour the growth of diatoms rather than blue-green algae. Diatoms are first class fish food.

37. The epiphytic algae have also been studied—these are the main food of Tilapia. Artificial media have been tried for the culture of epiphytes; the curious fact emerges that the density of epiphytic diatoms settling on glass is significantly higher than on other substrata.

38. This botanical work is linked with a study of the food eaten by the more important fish species.

39. So far as biochemical work is concerned, much time has been spent on the development of apparatus and on methods of analysis to suit conditions found at Malacca. The construction of a polarograph, for oxygen



estimation, the details of which will be published in an appropriate journal, has enabled oxygen analysis to be done easily and quickly. A routine of water analysis has now been established.

40. In all ponds the soil and water acidity has been frequently estimated; in ponds where quantitative fertiliser experiments are in process, the acidity, alkalinity, conductivity, calcium concentration and temperature pattern is measured at weekly intervals. On occasions the dissolved oxygen, sodium, potassium, aluminium, iron, silica, tannin, chloride, sulphate, phosphate, ammonia, nitrate and nitrite, are measured.

41. As a result, the chemical changes following the fertilisation of a newly-established pond can now be forecast with reasonable certainty, and linked to fish production.

42. The digestive process in commercially important pond fishes has been studied. These digestive enzymes in *Tilapia* have been extracted and their activity measured.

43. The station holds stocks of the following fishes :—

- (a) *Tilapia* sp. from Zanzibar.
- (b) *Tilapia mossambica*, local.
- (c) Hybrids of the above two.
- (d) *Tilapia Zillii* from Lake Victoria.
- (e) *Trichogaster pectoralis*, "Sepat Siam".
- (f) The Giant Gouramy.
- (g) Common carp.
- (h) *Puntius javanicus*.
- (i) Chinese grass carp.
- (j) *Catla Catla* from India.

44. As might be expected from such poor conditions, natural fish production in the ponds is very low. They seem able to carry a population of only about 10–20 lbs. of fish per acre, comparable with poor acid peaty waters of Europe.

45. Limed and fertilised, however, the ponds are excellent for fish growth. All species seem to flourish. Marking experiments for example, show that *Tilapia* in mono-sex culture grow from 7 cm., to 24 cm., and a weight of nearly half a pound, in 4 months. Common carp have grown from fingerlings to  $\frac{3}{4}$  lb. in three months.

46. Most interesting, however, has been the work on hybrid *Tilapias*. These hybrids show many very desirable qualities, including great vigour. They show promise of development into a most important domesticated pond fish for commercial or subsistence cultivation.

47. As mentioned above, stocks of Chinese grass carp are being raised, against the visit of a physiologist, who will study their physiology, and especially the factors which may control their breeding. These valuable fish have never been bred in ponds.

48. A visiting Swedish naturalist has made a survey of the distribution of the swamp fishes of Malaya, especially the *Anabantids*, and he also visited Thailand for the same purpose. He is correlating this with the acidity of the water, and with other ecological variables such as light climate, oxygen, and conductivity.

*Fisheries Research Unit, University of Hong Kong*

49. The Fisheries Research Unit is attached to the Department of Zoology of the University of Hong Kong.

50. The Unit's research vessel "Alister Hardy" has been running, at regular intervals, four radiating lines of hydrological and plankton stations based on Hong Kong Island, and extending to a distance of about 80 miles towards the 100 fathom line. The purpose of these repeated observations is to study the effect on local waters of the outflow from the Pearl River Estuary.

51. In addition, cruises have been made to the near, middle, and far distant trawling grounds in the direction of Hainan Island, as part of a trawling survey designed to compare the stock of fishes in these areas during different years and seasons.

52. Certain genera and species of fishes have been selected for special investigations involving age and growth studies. A study of the growth and development of the commercially important species of Penaeid prawns is being undertaken.

53. Since 1954, experiments have been in progress in Deep Bay, New Territories, on the culture of native oysters by the "hanging" method. It was found that the oyster can be very successfully grown by this method. An attempt has been made to transplant oyster culture by this technique to Tolo Harbour, on the opposite side of the peninsula. Japanese oysters grew well, and the experiment was repeated in March 1958. It is hoped that this oyster will become established in Tolo Harbour. Most unfortunately constant depredations have led to the suspension of the experiments in Deep Bay; while industrial developments in the neighbourhood of Tolo Harbour may compel the transfer of experiment there to a new site.

54. Analysis of the commercial catch statistics show a decline in the average catch per haul in 1957, in all classes of trawlers and long-liners.

55. Work on inland fisheries includes a survey of the fish ponds at Un Long.

*Fisheries Research in the Caribbean*

56. The research vessel "Cape St. Mary" has been engaged on trawling and fishing surveys, mostly in British Guiana coastal waters. Successful catches have been taken and the vessel has been averaging 8 to 10 tons of marketable fish on each trip undertaken. For the purposes of the survey, the coastal waters have been divided into seven strips about 30 miles wide. Each is in turn trawled at depths ranging from 10 to 100 fathoms. Statistics and charts showing the size and type of yield, time of year, depth of water, etc., are carefully recorded. Prawns form a very valuable product and investigations are being made to evolve improved methods of large-scale prawn fishing.

57. The Bellairs Research Institute of McGill University began, in co-operation with the Fisheries Officer, Barbados, a series of studies in Barbados designed to gain information on the habits and fundamental biology of flying fish. These studies are being combined with observations on the plankton and hydrographic conditions of the water masses in the area. It is estimated that the work will last about two years.

Colonial  
Medical Research Committee  
Thirteenth Annual Report  
1957-1958

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Medical Research Council,  
38, Old Queen Street,  
Westminster,  
London, S.W.1.  
12th September, 1958.

SIR,

On behalf of the Colonial Medical Research Committee, I have the honour to transmit to you the Thirteenth Annual Report of the Committee, covering the period 1st April, 1957 to 31st March, 1958.

I have the honour to be,

Sir,

Your obedient servant,

H. P. HIMSWORTH,  
*Chairman.*

The Right Honourable Alan Lennox-Boyd, M.P.,  
Secretary of State for the Colonies.

## COLONIAL MEDICAL RESEARCH COMMITTEE

### Membership

- SIR HAROLD HIMSWORTH, K.C.B., M.D., F.R.C.P., F.R.S., Secretary, Medical Research Council (*Chairman*).
- BRIGADIER SIR JOHN BOYD, O.B.E., M.D., D.P.H., D.T.M. & H., F.R.C.P., F.R.S (late R.A.M.C.), formerly Director, Wellcome Laboratories of Tropical Medicine.
- MAJOR-GENERAL SIR GORDON COVELL, C.I.E., M.D., D.P.H., D.T.M. & H., Director, Ministry of Health Malaria Laboratory, Horton Hospital.
- SIR NEIL HAMILTON FAIRLEY, K.B.E., M.D., D.Sc., F.R.C.P., F.R.S., Consulting Physician, Hospital for Tropical Diseases, University College Hospital.
- PROFESSOR A. C. FRAZER, M.D., D.Sc., Ph.D., F.R.C.P., Professor of Medical Biochemistry and Pharmacology, University of Birmingham.
- PROFESSOR P. C. C. GARNHAM, M.D., D.Sc., D.P.H., Professor of Medical Protozoology, University of London.
- PROFESSOR R. M. GORDON, O.B.E., M.D., Sc.D., F.R.C.P., D.P.H., D.T.M., Professor of Entomology and Parasitology, Liverpool School of Tropical Medicine, University of Liverpool.
- DR. F. HAWKING, D.M., M.R.C.P., D.T.M., National Institute for Medical Research.
- PROFESSOR G. MACDONALD, C.M.G., M.D., F.R.C.P., D.P.H., D.T.M., Professor of Tropical Hygiene, University of London, and Director, Ross Institute of Tropical Hygiene.
- PROFESSOR B. G. MAEGRAITH, M.B., B.Sc., D.Phil., F.R.C.P., Professor of Tropical Medicine, University of Liverpool.
- PROFESSOR B. S. PLATT, C.M.G., M.Sc. Ph.D., M.B., Professor of Human Nutrition, University of London.
- DR. A. M. WILSON RAE, C.M.G., M.D., Ch.B., Chief Medical Officer to the Secretary of State for the Colonies.
- SIR LANDSBOROUGH THOMSON, C.B., O.B.E., D.Sc., Second Secretary, Medical Research Council.
- PROFESSOR A. W. WOODRUFF, M.D., Ph.D., F.R.C.P., D.T.M. & H., Professor of Clinical Tropical Medicine, The Hospital for Tropical Diseases.
- DR. R. LEWTHWAITE, C.M.G., O.B.E., D.M., F.R.C.P., Colonial Office (*Secretary*).

### 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, and, in particular, regarding:—

- (a) medical research in the Colonies financed from Colonial Development and Welfare funds ;
- (b) the promotion of such basic and long-term work as is required to be based on the United Kingdom and the supervision of workers engaged for this purpose ;
- (c) the promotion of work in, and for, the Colonies by workers in home universities and research organizations.

In addition the Committee will serve as a focus and clearing house of information.

## SUB-COMMITTEES

## MALARIA

- BRIGADIER SIR JOHN BOYD, O.B.E., M.D., F.R.C.P., F.R.S. (*Chairman*).  
 MAJOR-GENERAL SIR GORDON COVELL, C.I.E., M.D., D.P.H., D.T.M. & H.  
 SIR NEIL HAMILTON FAIRLEY, K.B.E., M.D., D.Sc., F.R.C.P., F.R.S.  
 PROFESSOR P. C. C. GARNHAM, M.D., D.Sc., D.P.H.  
 DR. R. LEWTHWAITE, C.M.G., O.B.E., D.M., F.R.C.P.  
 PROFESSOR G. MACDONALD, C.M.G., M.D., F.R.C.P., D.P.H., D.T.M.  
 PROFESSOR B. G. MAEGRAITH, M.B., B.Sc., D.Phil., F.R.C.P.  
 DR. A. M. WILSON RAE, C.M.G., M.D., Ch.B.  
 DR. F. HAWKING, D.M., M.R.C.P., D.T.M. (*Secretary*).

## HELMINTHIASIS

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 (*Chairman*).  
 BRIGADIER SIR JOHN BOYD, O.B.E., M.D., F.R.C.P., F.R.S.  
 PROFESSOR J. J. C. BUCKLEY, D.Sc., Professor of Helminthology, University  
 of London.  
 SIR NEIL HAMILTON FAIRLEY, K.B.E., M.D., D.Sc., F.R.C.P., F.R.S.  
 DR. F. HAWKING, D.M., M.R.C.P., D.T.M.  
 DR. R. LEWTHWAITE, C.M.G., O.B.E., D.M., F.R.C.P.  
 DR. A. M. WILSON RAE, C.M.G., M.D., Ch.B.  
 DR. J. WALKER, D.Sc., Ph.D., D.Phil., National Institute for Medical Research.  
 DR. W. E. KERSHAW, V.R.D., M.D., D.T.M. & H., Lecturer in Medical  
 Parasitology, Liverpool School of Tropical Medicine, University of  
 Liverpool (*Secretary*).

## PERSONNEL

- PROFESSOR G. MACDONALD, C.M.G., M.D., F.R.C.P., D.P.H., D.T.M.  
 (*Chairman*).  
 MR. J. G. DUNCAN, M.A., LL.B., Assistant Secretary (Personnel), Medical  
 Research Council.  
 DR. A. M. WILSON RAE, C.M.G., M.D., Ch.B.  
 DR. R. LEWTHWAITE, C.M.G., O.B.E., D.M., F.R.C.P. (*Secretary*).

## LEPROSY

- BRIGADIER SIR JOHN BOYD, O.B.E., M.D., F.R.C.P., F.R.S. (*Chairman*).  
 DR. A. R. D. ADAMS, M.D., F.R.C.P., Senior Lecturer in Tropical Medicine,  
 Liverpool School of Tropical Medicine, University of Liverpool.  
 DR. E. M. BRIEGER, M.D., Honorary Pathologist, Papworth Hospital,  
 Cambridge. Member of the Strangeways Research Laboratory,  
 Cambridge.  
 DR. S. R. M. BUSHBY, Ph.D., Wellcome Research Laboratories.  
 PROFESSOR G. A. H. BUTTLE, O.B.E., M.R.C.S., L.R.C.P., Wellcome Pro-  
 fessor of Pharmacology, School of Pharmacy, University of London.  
 DR. R. G. COCHRANE, M.D., F.R.C.P., Technical Medical Adviser, American  
 Medical Missions.  
 DR. P. M. D'ARCY HART, C.B.E., M.D., F.R.C.P., National Institute for  
 Medical Research.

- PROFESSOR S. D. ELEK, M.D., D.C.P., Ph.D., Professor of Bacteriology, St. George's Hospital Medical School, University of London.
- SIR NEIL HAMILTON FAIRLEY, K.B.E., M.D., D.Sc., F.R.C.P., F.R.S.
- DR. F. HAWKING, D.M., M.R.C.P., D.T.M.
- DR. G. R. F. HILSON, M.D., Senior Lecturer, Department of Pathology, St. George's Hospital Medical School, University of London.
- DR. D. G. JAMISON, B.M., B.C.H., Lecturer in Physiology, Corpus Christi College, Oxford.
- DR. E. MUIR, C.M.G., C.I.E., M.D., F.R.C.S.E., LL.D., Hon. Medical Adviser, British Leprosy Relief Association.
- DR. R. J. W. REES, B.Sc., M.B., National Institute for Medical Research.
- DR. D. S. RIDLEY, B.Sc., M.B., Pathologist, Hospital for Tropical Diseases, University College Hospital.
- PROFESSOR J. M. ROBSON, M.D., F.R.S.E., Professor of Bacteriology and Immunology, University of London.
- DR. J. ROSS INNES, M.D., D.T.M., Medical Secretary, British Leprosy Relief Association.
- PROFESSOR E. T. C. SPOONER, M.D., Professor of Bacteriology and Immunology, University of London.
- DR. A. G. MCD. WEDDELL, M.D., D.Sc., Reader in Human Anatomy, University of Oxford.
- DR. R. LEWTHWAITE, C.M.G., O.B.E., D.M., F.R.C.P. (*Secretary*).

ADVISORY WORKING-PARTY ON THE SICKLE-CELL TRAIT AND  
SICKLE-CELL ANAEMIA

- PROFESSOR A. W. WOODRUFF, M.D., Ph.D., F.R.C.P. (*Chairman*).
- DR. A. C. ALLISON, B.M., Ph.D., Student of Christ Church College, University of Oxford.
- DR. G. M. EDINGTON, M.D., D.C.P., Consultant Pathologist, Whiston and Rainhill Hospitals, Liverpool.
- DR. H. FOY, D.Sc., Ph.D., The Wellcome Trust Research Laboratories.
- PROFESSOR P. C. C. GARNHAM, M.D., D.Sc., D.P.H.
- DR. P. W. HUTTON, M.D., M.R.C.P., Medical Specialist, Uganda Medical Service.
- DR. H. LEHMANN, M.D., Sc.D., Ph.D., M.R.C.P., F.R.I.C., St. Bartholomew's Hospital, London.
- DR. A. E. MOURANT, D.M., D.Phil., Lister Institute of Preventive Medicine, London.
- DR. A. B. RAPER, B.Sc., M.D., M.R.C.P., National Institute for Medical Research.
- DR. J. A. FRASER ROBERTS, M.D., D.Sc., F.R.C.P., Clinical Genetics Research Unit, Institute of Child Health, Hospital for Sick Children, Great Ormond Street, London.
- LIEUT.-COL. J. H. WALTERS, M.D., F.R.C.P., Physician, Hospital for Tropical Diseases, University College Hospital.
- DR. J. C. WHITE, M.B., Lecturer in Haematology, Postgraduate Medical School of London.
- DR. G. H. BEAVEN, Ph.D., National Institute for Medical Research.

COLONIAL MEDICAL RESEARCH COMMITTEE  
THIRTEENTH ANNUAL REPORT

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## COLONIAL MEDICAL RESEARCH COMMITTEE

### WORK OF THE COMMITTEE

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

It is gratifying to record the conferment of the honour of Knighthood on Brigadier J. S. K. Boyd, a member of the Committee.

#### *Development of Research Schemes*

2. Sixty-four research projects are in varying degree under the scientific aegis of the Committee. They range from large units, independent and self-contained or attached to existing research organisations and Colonial universities, to projects providing fully or in part for single investigators in the field or in the laboratory. The fostering of research by seeding with grants certain departments of universities in Britain or Colonial territories that are undertaking basic research relevant to the problems of tropical medicine has continued, to the mutual scientific profit of home-based and overseas research workers.

The research project on *trachoma*, suspended in Jordan, was transferred to the Medical Research Council's laboratories in the Gambia, where collaborative effort between staff members of the Lister Institute and the Institute of Ophthalmology, London, has led to the isolation in the Gambia and cultivation in London of a virus believed to be the causal agent of trachoma, the methods used being similar to those recently described by T'ang et al in Peking. Concerning *schistosomiasis*, which is causing increasing concern in certain Colonial territories in Africa, a Mollusc-Borne Diseases Sub-committee has recently been formed with the intention of intensifying research into its many aspects and co-ordinating hitherto fragmentary investigations.

#### *Personnel*

3. The Personnel Sub-committee has continued to advise on all medical appointments to the Research Branch of Her Majesty's Overseas Civil Service, to scrutinise annually the emoluments of all medical members of that Service, and to make recommendations accordingly. During the year two officers resigned. Six new overseas postings were made, four of them Colonial Research Students who had completed their specialised two to three years' training in Britain. Three other Students are under training.

#### *Finance*

4. The appropriate apportionment of funds allocated to medical research under the Colonial Development and Welfare Act of 1955 necessitated assiduous consideration by the Committee, having due regard to existing research projects, the competing claims of new proposals, the need to retain an emergency reserve, and the increasing financial participation of the Governments of Colonial territories. With the attainment of Commonwealth status by Ghana and the Federation of Malaya during 1957, it became necessary to re-adjust the financial provision for those research projects there which had hitherto derived partial support from research funds made available under the Colonial Development and Welfare Acts. In the case of Ghana, negotiations now proceeding make it probable that close liaison will be assured between her own research organisation and medical research projects in other British West African territories.



*Oversea Visits*

5. Eleven members of the Committee and six members of the Subcommittee visited various research units in the field, four of the latter to undertake short-term research projects. Thus the Committee was kept intimately informed of progress and enabled the more effectively to make its financial recommendations for the maintenance, extension or curtailment of research projects.

### REGIONAL ORGANISATIONS FOR MEDICAL RESEARCH IN THE COLONIAL TERRITORIES

*East African Council for Medical Research*

6. This Council held its fourth meeting in Nairobi in February, 1958, which was preceded three weeks earlier by a meeting of its Scientific Advisory Committee and by a successful three-day Scientific Conference on "The Helminthic Diseases and their Effects on Man and Animals". The Conference was opened by His Excellency, the Acting Governor of Kenya, and its President was Professor R. M. Gordon, of the School of Tropical Medicine, Liverpool. Some 60 scientists attended each day. It drew a series of interesting papers and discussions from physicians, medical and veterinary research workers from the field and the laboratory. The Advisory Committee heard from the directors of those East African research units under its aegis the progress of their work, and made recommendations to the Council accordingly; it took note also of the progress and research objectives of medical research units financed wholly by territorial Governments, so that medical research in East Africa might be reviewed in full perspective. The Council subsequently reviewed the Committee's recommendations and advised accordingly the East African Governments and the Colonial Office concerning the priority of projects and the allocation of research funds. In particular, it reviewed and improved the mechanism for the disbursement of *ad hoc* grants from the block grant made available to the Council from Colonial Development and Welfare research funds.

Sir Gordon Covell and Professor G. Macdonald, as delegates of the Colonial Medical Research Committee, attended all meetings, and visited each medical research unit in the region.

*West African Council for Medical Research*

7. The fourth meeting of this Council was held in Freetown, Sierra Leone, in February, 1958. It was attended by the Chairman of the Committee, Sir Harold Himsworth, and its two delegates, Professor B. G. Maegraith and Professor A. W. Woodruff. The Council meeting was preceded by a meeting of its Standing Scientific Committee, at which the reports of the component research units were discussed with their authors, new projects debated, and appropriate recommendations made to the Council. A notable innovation was the recommendation that under the auspices of the Council a Scientific Conference should be held prior to the next Council meeting in 1959; the subject will be, "Tuberculosis and Leprosy". The report of the Panel appointed by the Council last year to sanction disbursements from the block grant for the Region was received.

*Standing Advisory Committee for Medical Research in the British Caribbean*

8. The Standing Advisory Committee held its third meeting in April, 1958, in Jamaica, under the Chairmanship of Sir George Pickering, Regius Professor of Medicine at Oxford, who, with Professor A. C. Frazer, represented the Colonial Medical Research Committee. The meeting was formally

opened at the University College of the West Indies by the Chief Minister, the Hon. Mr. Norman Manley, Q.C., M.M., and addressed by the Minister of Health, the Hon. Mr. C. L. A. Stuart, and Sir George Pickering and Professor Frazer. The medical research activities, current and projected, were reviewed, and appropriate recommendations made. Applications for disbursements from the Regional block grant for medical research were noted.

The meeting was preceded by a Scientific Conference, the theme of which was "Food in relation to Health and Disease". It was attended by some 70 medical, agricultural and veterinary scientists from the various island territories and from British Guiana and British Honduras, and many senior medical students from the University College. Sir George Pickering and Professor Frazer, as the Committee's delegates, discussed with the appropriate authorities throughout the Region the progress of existing medical research units, the opportunities for more, and the administration of medical research in the newly-established Federation of the West Indies.

### REVIEW OF THE WORK IN PROGRESS

9. In addition to the reports from the research units under the scientific aegis of the Committee, summaries are included of medical investigations made by research units or organisations that are wholly supported by the Governments of British Colonial Territories or Mandated Territories. Other summaries are contributed by investigators deputed to work in those territories by research organisations based in the United Kingdom or the United States of America, and supported financially wholly or in part by them. For continuity of context most of them are placed immediately after kindred reports from units that are under the scientific aegis of the Committee.

The Federation of Malaya having attained Commonwealth status on September 1st, 1957, the report from the Institute for Medical Research, Kuala Lumpur, is restricted to the progress of the virus and filariasis research units up to that date, on which contributions made to them under the Colonial Development and Welfare Acts ceased.

#### *Helminthiasis*

##### (a) *Loiasis Research in the Cameroons and Nigeria*

10. *Entomological aspects.* Studies on the factors influencing the longevity of adult *Chrysops silacea* showed that under laboratory conditions flies fed on both blood and sugar lived longer than those fed on sugar alone, and that when the fly had free access to sugar (which presumably is the case in nature) the longevity was in direct proportion to the number of blood-meals taken. No significant differences were observed between the longevity of flies fed on blood containing microfilariae and that of flies fed on uninfected blood.

11. It was known that the natural oviposition sites of *Chrysops* are on the leaves of plants overhanging water or mud, and experiments were made to determine whether the egg-laying females showed any particular preferences. Each consisted of setting up a "Latin Square" of wooden stakes of varying heights and types on which the flies could lay eggs; some were simple, others were surmounted by a flat green board a few inches square. The stakes with the green boards were much more attractive to flies, both *Chrysops* and others. About 75 per cent. of the egg-masses found were on these stakes, and similar ones are now used as successful egg-traps for *C. silacea*, so that large numbers of eggs are available for insecticide studies. The insects did not discriminate between the upper and lower surface of

a board; where there were no boards, the tendency was to lay eggs near the top of the stake. The height of the stakes (between 6 inches and 6 feet) had little effect on oviposition.

12. Work on the larval habitat has shown that very young larvae are nearly always found in mud under water. The older larvae are more widespread, possibly because they are more active and cannibalistic, and tend to be in mud outside the water courses. There is a large increase in the numbers of young larvae in June–July, probably connected with the peak incidence of adult flies in May–June.

Studies on the identification of larvae of different species of *Chrysops* are continuing, and a tentative key has been prepared, based on the pigment patterns on the anal segment and on the shape of the mandibles. This key will be tested next rainy season, during which time it is also hoped to determine finally the numbers of larval instars in the various species.

13. Intensive laboratory tests are being undertaken with various insecticides (D.D.T., B.H.C., Dieldrin and Aldrin) against *Chrysops* larvae under controlled conditions, to determine which insecticide is the most effective on a cost basis. It is now known that *Chrysops* larvae are more resistant to insecticides than the closely related *Tabanus* larvae. Simultaneously experiments are being undertaken to determine the persistence of the various insecticides in the mud where *Chrysops* breed. Breeding sites have been sprayed with insecticide (either with or without previous clearing of the vegetation); and, thereafter, mud samples are collected at intervals and sent to Mr. K. Hocking of the Colonial Pesticides Research Unit at Arusha, Tanganyika, for chemical analysis. When laboratory and field studies are completed it is hoped to undertake trials of insecticides as a means of control in the rain-forest around Kumba.

14. *Parasitological and pathological aspects.* Amongst studies on all aspects of loiasis infection in monkeys, those on the hybridisation of “human” and “monkey” *Loa* have shown that the microfilariae from the first generation hybrid are capable of completing their development in the fly and will in turn produce fertile worms in the vertebrate host.

Now that monkeys can be infected consistently with *Loa loa* it has become possible to initiate trials with drugs of potential prophylactic value. A number of antimonial and arsenical preparations supplied by Dr. E. Friedheim of New York are under trial, but in general it appears that the field of filarial prophylactics is one in which the major drug companies have few drugs of any promise. It is intended to investigate further mass treatment with “Banocide” as a method of breaking the transmission of *L. loa* and effecting control, and to this end more large-scale field experiments at a rubber estate at Sapele in Western Nigeria are planned.

#### (b) *Onchocerciasis*

15. The follow-up of the therapeutic trial of Antrypol and of antimony dimercaptosuccinate (TWSb) continues. After one year it is clear that the effect of TWSb varies in individuals, but that it shows a marked microfilaricidal action and is capable of sterilising or killing a number of adult female worms.

#### *Publications*

BEESELY, W. N.—(1957) “Observations on the behaviour and life history of some West Africa species of *Chrysops*”. *Thesis for degree of M.Sc. Leeds University.*

DUKE, B. O. L.—(1957) "A case of 'streptocerciasis' in a European". *Ann. trop. Med. Parasit.*, **51**, 364.—(1957) "Experimental transmission of *Loa loa* from man to monkey". *Nature*, **179**, 1357.—(1958) "Studies on the biting habits of *Chrysops*. V. The biting-cycle and infection rates of *C. silacea*, *C. dimidiata*, *C. langi* and *C. centurionis* at canopy level in the rain-forest at Bombe, British Cameroons". *Ann. trop. Med. Parasit.*, **52**, 24.

*Idem* and HAWKING, F.—(1957) "The effects of anaesthetics on the migrations of the microfilariae of *Loa loa*". *Trans. R. Soc. trop. Med. Hyg.*, **51**, 88.

KERSHAW, W. E., PLANKETT, R. L., MOORE, P. J., and WILLIAMS, P.—(1957) "Studies on the intake of microfilariae by their insect vectors, their survival, and their effect on the survival of their vectors. IX: The pattern of the frequency of blood-meals taken in by *Chrysops silacea* and of the survival of the fly in natural conditions in the rain-forest of the British Cameroons and on a rubber estate in the Niger delta". *Ann. trop. Med. Parasit.*, **51**, 26.

(c) *Filariasis*.

*East Africa*

16. Dr. P. Jordan, of the East African Institute for Medical Research at Mwanza (Tanganyika) (Director: Dr. E. G. Holmes), has continued the pilot eradication project on Ukara Island, Lake Victoria. Further treatment with diethylcarbamazine (Hetrazan) was given and follow-up blood examinations made. The results obtained were:

Locality	Dosage	Duration of treatment	Total treated	Still positive	Percentage positive
Bukiko ...	200 mg. monthly ...	12 months	126	25	19.8
Bukiko ...	200 mg. monthly ...	18 months	60	4	6.6
Bukiko ...	200 mg. monthly ...	24 months	60	2	3.3
Mbule ...	100 mg. monthly ...	12 months	60	19	31.0
Bubanja ...	200 mg. alternate months	12 months	101	38	37.6

Filarial infections are being sought in dogs and cats, following the finding of microfilariae of *Wuchereria malayi*-type in the blood of these animals on the Kenya Coast. *Dirofilaria immitis* is the only infection found so far, being particularly common on the islands of Zanzibar and Pemba off the Tanganyika coast. An unshathed microfilariae showing a nocturnal periodicity was found in the mongoose, *Herpestes sanguineus*; adults found in the peritoneal cavity are awaiting identification. A vector is being sought.

17. The trial of prednisolone acetate in the treatment of elephantiasis was completed; in only one case was permanent improvement obtained. The results of a similar trial in which hyaluronidase was given intra-arterially suggest that this route of administering the drug is valueless. Work began on the use of sodium fluoride in the treatment of bancroftian elephantiasis. Some claim that it reduces the high serum-calcium levels said to occur in this disease, and decalcifies calcified adult worms blocking the lymphatics. Three cases investigated so far have failed to show a raised serum-calcium. Lymphogram investigations of elephantoid legs suggest that in advanced cases the lymphatic vessels are destroyed.

18. *Laboratory studies*. Investigations of filarial infections in *Anopheles gambiae* and *Culex fatigans* suggest that when mosquitoes feed on persons with high microfilaraemia densities, a crowding-out of ingested microfilariae occurs with the excretion of large numbers of embryos. When the mosquitoes

feed on a person with fewer microfilariae in his blood, fewer ingested microfilariae are excreted.

19. In an attempt made to assess the prophylactic effect of Hetrazan on infective larvae of *Wuchereria bancrofti* in vitro, 20 ml. of blood were taken from volunteers, who were then given 500 mg. of the drug, repeated 3 hours later. One hour later still, when the blood level of the drug would be high, another 20 ml. of blood were drawn. Sera from both specimens were prepared under sterile conditions. Penicillin in a dose of 400 units per ml. was added to all sera. Large numbers of *Culex fatigans* which had previously fed on a person with microfilariae of *W. bancrofti* in his blood were dissected alternately in the two samples of sera. Any infective larvae seen were transferred into sterile capillary tubing. The ends were sealed with plasticine and the tube fixed to a numbered slide. The movements of the enclosed infective larvae were readily visible under a dissecting microscope. The larvae were observed two or three times in the 24 hours until they appeared not to move, and were apparently dead. The length of life of each larva was calculated and the mean length of life of all the larvae in the "blank" and "drugged" sera was determined. The results of three such experiments were :

	Blank Sera		Hetrazan Sera	
	Numbers of Larvae	Mean length of life	Numbers of Larvae	Mean length of life
Experiment I ... ..	79	34 hours	94	27 hours
Experiment II ... ..	51	23 hours	63	37 hours
Experiment III ... ..	68	57 hours	60	56 hours

Thus the sera containing the Hetrazan had no lethal effect on the infective larvae. Hence the drug is unlikely to have any direct action on infective larvae introduced into the body : but it may yet through indirect means be of use prophylactically.

20. Work designed to produce radio-active *C. fatigans* by rearing its larvae in a medium containing  $\text{Na}^{22}$  in a concentration of  $1\mu\text{c}$  per ml. has begun. It is hoped to obtain active infective larvae of *W. bancrofti* by feeding the emerging mosquitoes on an infected person, and to follow the migrations of the larvae in the human body. It may prove, however, that the larvae become so damaged by the gamma rays that they will fail to develop properly.

#### Publications

JORDAN, P.—(1957) "Clinical Bancroftian disease in Tanganyika". *C. Afr. J. Med.*, **3**, 18.

YEH LIANG-SHENG and JORDAN, P.—(1957) "On a new Gordiid Worm, *Pseudogordius tanganyikae* gen. et sp. nov., Parasitic in Man". *Ann. trop. Parasit.*, **51**, 3.

21. *Filarial infections in animals.* The Director of the Institute for Medical Research, Kuala Lumpur, reports that the research group investigating filariasis has found natural infections with *malayi*-like microfilariae in a variety of wild and domestic animals in East Pahang, but the numbers examined are still too few to enable one to assess the importance of the different animals in maintaining a reservoir of transmission. During 1957

infections were recorded for the first time from a tiger, a wild cat, and a moon-rat. Adults of *W. pahangi* were obtained from the tiger and the moon-rat; adults of *W. malayi* have recently been obtained from the leaf-eating monkey.

*Transmission of W. malayi to animals.* The Pahang strain of *W. malayi* has been transmitted by inoculation of infective larvae into long-tailed macaque and Indian rhesus monkeys, the slow loris, the domestic cat, and the Malay civet cat. Judging by the ease of transmission and the behaviour of the infection, cats are the most receptive animal host. Transmission of the infection to cats through the bite of infected mosquitoes was also successful in two out of three attempts. Transmission experiments with the Kedah strain of *W. malayi* indicate that cats are not as receptive to it as to the Pahang strain.

Attempts to transmit *W. pahangi* to six macaque monkeys have been unsuccessful.

22. *Drug treatment of the transmitted infection in cats.* Small doses of Hetrazan have a rapid effect on microfilaraemia in man, but are much less effective against the microfilaraemia in cats. The reason for this difference is not clear; a post-mortem examination of one cat showed that the dose of drug had apparently been large enough to have an effect on the adult worms.

23. *Control experiments in rural areas.* Pilot control experiments have been in progress for three years in the village where the houses are being sprayed with Dieldrin, and for two years in two villages where drugs were given to the inhabitants. In the sprayed area, following no change for the first two years there has now been a slight reduction both in microfilarial rate and in average microfilarial count after three years' spraying. In the drug-treated villages microfilarial rates and average count have risen steadily from the low level prevailing one month after treatment had ended. The presumption is that transmission was never fully interrupted owing to the prevalence of the infection in animals.

Despite the disappointing implications of these pilot experiments, both types of control are being tried over larger areas in the hope that better results will be obtained. House-spraying has therefore been extended to cover a population of about 1,500 persons, and drug treatment has been given to a population of almost 2,000 persons. Assessment of results will require several years' observation; mosquito dissection figures show that transmission has been reduced, but by no means eliminated.

24. *Field Surveys. Krian.* The Institute has collaborated with Dr. S. P. Maurer, Health Officer, Perak North, in the investigation of filariasis in the Krian area. The Health Office staff have collected night blood films and have trapped mosquitoes, and examination of these has been undertaken by the Institute. Filarial infection has been found to be quite widespread throughout the Krian area; the only proved vector to date is *Anopheles barbirostris* (dark-winged).

*Carey Island.* This large island near Port Swettenham contains several settlements of aborigines living in forest reserves around the edge of large blocks planted with rubber. There have been a few filarial infections in past years among the estate labourers, and Dr. E. Lichtenstein, Medical Officer, Department of Aborigines, decided to examine the aborigine populations. The blood films collected by him were examined at the Institute, and a microfilarial rate of 41 per cent. was found (59/144). All appeared to be the Pahang type of *W. malayi*. Mosquito catches from the same areas failed to reveal the probable vector.

25. *Systematics and biology of Mansonia mosquitoes.* Material for a revision of the Malayan species of the genus *Mansonia*, including *Mansonioides* and *Coquilletidia*, has accumulated throughout the year, and a provisional key to the larvae has been prepared. Through the use of a new method of searching for larvae, Mr. Wharton has made considerable progress in the difficult task of locating *Mansonia* breeding places in swamp forest. Five species of *Mansonioides* and one of *Coquilletidia* have been raised in the laboratory from eggs laid by wild-caught females. Two of these, *M. uniformis* and *M. annulifera*, have been established as laboratory colonies.

Information on the feeding habits of *Mansonia* supports the view that *Mansonia* mosquitoes will feed on a wide range of animals. Under laboratory conditions, all species will feed with avidity on man, monkey, slow loris, musang, cat, dog, and squirrel. Precipitin tests on the stomach content of mosquitoes caught resting out-of-doors by day near houses show that only 6 per cent. or less have fed on man, and that most have fed on buffaloes. All attempts to collect blood-fed specimens of *Mansonia* in forest have so far failed.

Observations have continued on the developmental pattern of *W. malayi* from Pahang and from Kedah, and of *W. pahangi*, in different species of mosquitoes; *M. longipalpis* has proved to be a very efficient experimental vector of the Pahang strain of *W. malayi* but a poor vector of *W. pahangi*, and this knowledge has been utilised in an effort to find out whether *W. pahangi* occurs in man. Mosquitoes fed on 42 microfilaria carriers in Pahang at the time of blood surveys all developed a high proportion of mature larvae in 11½ days, thus indicating that the infections were all *W. malayi*.

#### Publications

EDISON, J. F. B., HAWKING, F., and SYMES, C. B.—(1957) "The periodicity of microfilariae. VI. The response of microfilariae of *Wuchereria malayi* and *W. bancrofti*, Pacific type, to various stimuli". *Trans. R. Soc. trop. Med. Hyg.*, **51**, 359.

*Idem* and WHARTON, R. H.—(1957) "The transmission of *Wuchereria malayi* from man to the domestic cat", *Ibid.*, **51**, 366.—(1957) "The experimental transmission of *Wuchereria malayi* from man to various animals in Malaya". *Ibid.*, **52**, 25.—(1958) "Studies on filariasis in Malaya: Treatment of *Wuchereria malayi* carriers with monthly or weekly doses of diethyl-carbamazine". *Ann. trop. Med. Parasit.*, **52**, 87.

WHARTON, R. H.—(1957) "Studies on filariasis in Malaya: Observations on the development of *Wuchereria malayi* in *Mansonia (Mansonioides) longipalpis*". *Ibid.*, **51**, 278.—(1957) "Studies on filariasis in Malaya: Notes on the breeding of *Mansonia (Mansonioides)* mosquitoes in the laboratory". *Ibid.*, **51**, 297.—(1957) "Studies on filariasis in Malaya: The efficiency of *Mansonia longipalpis* as an experimental vector of *Wuchereria malayi*". *Ibid.*, **51**, 422.

*Idem* and STA-MARIA, F. L.—(1958) "Studies of filariasis in Malaya: The effect of residual insecticides on *Mansonia (Mansonioides) longipalpis*". *Ibid.*, **52**, 93.

TURNER, L. H. and EDISON, J. F. B.—(1957) "Studies on filariasis in Malaya: The periodicity of the microfilariae of *Wuchereria malayi*". *Ibid.*, **51**, 271.

#### (d) *Schistosomiasis*

26. Mr. W. F. J. McClelland, B.Sc., continued his studies on snails at Mwanza, Tanganyika, as a visiting worker at the East African Medical

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Survey and Research Institute, where the Director, Dr. E. G. Holmes, generously provided laboratory and housing facilities.

27. Two recent papers by Mandahl-Barth on the systematics of African planorbids have clarified the situation, but have also accentuated several very difficult problems. One is the question of identifying snails of the *Bulinus africanus*-*B. nasutus* complex in Tanganyika, near Mwanza and around Tanga where the identification of snails becomes even less certain than formerly. A study of the shell and anatomy of these forms has continued, and a new line of approach started. Originally this was aimed at spectrophotometric studies on the haemoglobin in solution in the snails' blood; but preliminary results were not reproducible, due probably to the fact that it is difficult to obtain snails' blood free from other body fluids. The emphasis may have to be switched to chromatography and electrophoresis, which may yield the haemoglobin in a pure state for the spectrophotometric work. Recently a fairly simple method of distinguishing snail species by the chromatography of tissue squashes on filter paper discs has been described, suggesting that a comparable method of identifying the planorbids may be found.

28. *Field observations. Examination of snails for infection with trematodes.* The collection of snails was continued and many were examined for cercariae. An important advance was the discovery of snails shedding cercariae thought to be those of *Schistosoma haematobium* on three occasions in one pool and once in another. The snails were probably *B. nasutus*. The maximum number of snails found infected at any one time was three, and few cercariae were obtained from them. Altogether 6 white mice and 4 hamsters were exposed to the cercariae; 3 mice and 1 hamster failed to become infected and, although worms did develop in the others, it was impossible to identify the species of schistosome involved, either because the experimental animal died before the worms became sexually mature, or because the worms were all of the same sex and no eggs were observed. In the past, the apparent absence of infected snails has been a great puzzle which has only partly been solved by finding these few. If the infections were due to *S. haematobium*, their discovery tends to support the suspicion on the grounds of the snail's wide distribution that the form which, for the moment, is called *B. nasutus* is the common intermediate host of that worm.

Further afield from Mwanza 20 dams and pools were visited; 15 yielded snails. No schistosome cercariae were obtained from these snails, but other types of cercariae were shed by *Biomphalaria* and *Bulinus* spp., and also *Lymnaea natalensis*, which produced many small furcocercous cercariae, probably of strigeid type. Occasionally *Bulinus forskalii* is found harbouring larval trematodes, usually pigmented cercariae, probably of cattle paramphistomids.

29. From three specially selected sites, a pool, a dam and a collection of water near the edge of the lake, snails were collected monthly by a standardised method throughout the year, and the fluctuations of the snail population followed. The pool yielded practically no snails after the first month.

Snails were sent by the Medical Officer from Ukerewe Island, where *S. mansoni* causes abdominal granulomata, suggesting that the people are exposed to enormous numbers of cercariae; so far, none of the snails has been infected with schistosomes.

30. Great difficulty is still experienced in breeding certain species for experimental work. However, two local forms of *Biomphalaria* which may be different species have been bred and infected with *S. mansoni* without



difficulty. *Bulinus africanus* has been infected with *S. haematobium*. This snail does not seem to be a very suitable host, as the parasite does not always develop; and there is a high mortality among snails. Cercariae developed in snails kept in an aquarium heated to 28° C. in 34 days, whereas they required 43 days for development in tank at room temperature of 25° C. Attempts to infect *B. tropicus zanzebaricus* have consistently failed.

(e) *Guinea-worm*

31. Mr. S. D. Onabamiro continued his investigations on guinea-worm at University College, Ibadan. Former studies on *Cyclops* from village ponds in areas of heavy guinea-worm infestation in Nigeria revealed that many were infected with the larvae of two different nematode parasites, *Dracunculus medinensis* and *Camallanus lacustris*; the adults of the latter live in the intestinal walls of frogs. Wherever these two larval nematodes share the same *Cyclops* host the development of each is retarded in varying degrees; in particular it was noted that the enclosed larva of the guinea-worm failed to go through its second moult within the *Cyclops*, and therefore remained incapable of infecting man.

32. In order to obtain fuller data of statistical reliability, more studies on this phenomenon began last year, and so far seem to indicate that this method could be utilized for reducing the incidence of the guinea-worm in rural areas where funds are not available for digging enough wells or for the supply of piped water. A survey was made to determine (a) the numbers and species of frogs in the village ponds during the different seasons of the year; (b) the proportion of such frogs infested with adult *Camallanus* worms as compared with uninfested specimens in different areas of the Western Region of Nigeria; (c) the rate at which the frogs discharge the larvae of *Camallanus lacustris* into water; (d) the span of life of free living *Camallanus* larvae in pond water; and (e) the degree of selection by *Cyclops* of both the larvae of *Camallanus lacustris* and *Dracunculus medinensis* when these are available in approximately equal numbers. The results are being analysed.

33. A survey of *Cyclops* and guinea-worm made in the Eastern Region of Nigeria revealed two main foci of guinea-worm infestation in the Region, viz., in two Divisions of the Ogoja Province, of which the Abakaliki Division is the worse, and in Nsukka Division in the Onitsha Province. In Nsukka, a hilly country, water is very scarce and there are no perennial village ponds of the type usually found in the Western Region. The water table is very low: the guinea-worm infestation here is due to drinking water from temporary stagnant pools formed by the drying up of rivers; so that the time of contracting the infestation may be restricted to those two or three months in the year when the rivers break up into these pools. For the rest of the year the villagers have to use water stored up in pots or trek long distances to fetch water from the few rivers that flow all the year round.

In the Abakaliki area, on the other hand, most of the countryside is flat low-land with an impervious substratum of cretaceous shale which is conducive to the existence of ponds. Most of these ponds contain water throughout the year and have a rich *Cyclops* fauna. Here, then, the people can contract the infestation from the water throughout the year.

34. A simple method of straining out *Cyclops* from suspected water has been devised through the use of a brass sieve fitted to the mouth of the family water pot, and is being introduced into some villages in the Eastern and Western Regions. The sieve has 100 meshes to the inch and is 8 inches in diameter. If pots are specially made so that sieves fit properly into

the opening, water fetched from the village ponds and stored in the pots passes through the sieves and all species and sizes of *Cyclops* are effectively strained out. This ensures that the water from the ponds is rendered free of guinea-worm larvae. An education campaign is being conducted in a few selected villages to get the people to use this method, and observations are being made of the results obtained.

#### Publication

ONABAMIRO, S. D.—(1957) "Intestinal poly-parasitism among Nigerian school-children". *W. Afr. J. biol. Chem.*, 1, 71.

#### Malaria.

##### East Africa

35. At the East African Institute of Malaria and Vector-borne Diseases the teaching and consultative activities of the Institute have been greater than in recent years, and the research aspects have been reduced owing to the absence on leave, or resignation, of research officers.

36. In the entomological field, Dr. M. T. Gillies has been studying anopheline dispersion in the foothill country below Amani. The method has been by the recapture of *Anopheles gambiae*, marked with spots of poster paint of a variety of colours, in a considerable number of catching stations spread over a two-mile radius. It is intended, so soon as the necessary equipment is received, to supplement this method of marking with that of radio-isotopes. The results as yet obtained are tentative, as no more than some one per cent. of marked specimens are recaptured. However, it appears that the range of dispersion in this locality falls off sharply beyond one mile. Moreover it has been shown that, while the majority of mosquitoes are caught in the first or second week after release, small numbers are still caught in the third or fourth week.

37. Chemical investigations have been continued by Dr. J. Press, of the World Health Organisation, and Dr. T. E. Fletcher. Estimations of the serum proteins in children protected from malaria in the Pare area of Tanganyika have shown an appreciable decrease in gamma globulin, as compared with a group of unprotected children, with corresponding changes in the other protein-fractions. A study of the degree of exposure to Dieldrin of men engaged in spraying houses is drawing to a conclusion. The estimations have been made on a series of absorbent pads applied to the clothes and skin, and it is hoped to relate them to detailed observations that have been made on the activities of the sprayers during the day. No toxic symptoms have as yet been seen.

37A. The question of sorption of insecticides into mud walls has been taken up, as there seemed to be need for broad field observations on walls in the tropics as compared with the more analytical studies carried out in England and elsewhere. This broader approach will take into consideration the whole structure of the constituent soils, and will have to be correlated with the bio-assay of the treated surface. Dr. Press has shown that elution of soil samples with insecticide suspensions, and the assessment by chromatography of the sorption that ensues, give results comparable with other methods of measurement of sorptive capacity of soils.

38. In the Pare-Taveta Scheme the fourth round of spraying was completed, while parasite and spleen rates continued to fall. There is now very little transmission in the area, as indicated by infantile infections, and parasites are very infrequent in adults. Infections are being acquired outside the area; but it is at present impossible to distinguish the relative parts

being played by such reinfections, compared with the persistence of residual infections, in the production of the parasitaemias observed.

39. House populations of anopheline vectors remain low, and there has been no observable change in anopheline habits so far as resting places and night-biting activity is concerned. There does, however, still remain a large outdoor, cattle-feeding population of *A. gambiae*, more particularly in those areas where cattle are numerous and outside resting places adequate. The converse is equally apparent. A few *A. funestus* have been found present as larvae in one part of the area where houses are few; but for the most part it is still true that the few members of the *funestus* group caught are non-vectors.

40. Much attention has been given to the matter of anopheline resistance to Dieldrin, and large numbers of adults have been tested for resistance to 0.4 per cent. test papers. So far none has been found resistant, and tests on walls have shown no failure to kill the *gambiae* adults applied to them.

#### Publications

GILLIES, M. T.—(1957) "Modified technique for the age-grading of populations of *A. gambiae*". *Ann. trop. Med. Parasit.*, **51**.—(1958) "Age groups and the biting-cycle in *A. gambiae*". *Bull. ent. Res.*, **48**, 553.

MACLEAN, G., WEBBE, G., and MSANGI, A. S.—(1958) "Report on bilharzia and molluscan survey in the Tanga District". *E.A. med. J.*, **35**, 7.

WEBBE, G., and MSANGI, A. S.—(1958) "Observations on three *Bulinus* species on the East Coast of Africa". *Ann. trop. Med. Parasit.*, **52**, 302.

WILSON, D. B.—(1957) "Construction irrigation and malaria". *E.A. med. J.*, **34**, 479.—(1957) "Malaria in the African". *Cent. African Med. J.*, **4**, 73.

#### Gambia

41. At the Medical Research Council's Laboratories in the Gambia, the permanent staff have continued the observations, begun in 1951, on two groups of Gambian children, one of which from birth has been protected from malaria by weekly doses of chloroquine or Daraprim, the other group remaining unprotected.

42. The results to date of an investigation of the serum protein pattern of Gambian infants, children and adults have shown that, in falling shortly after birth to rise again a few months later, serum gamma globulin levels in Gambian infants appear to behave like those in white children. It appears, however, that the level at birth is higher in Gambian infants and that the post-natal drop is not as marked as in European or American children. The mean serum gamma globulin value of twelve-month old infants protected from birth against malaria by weekly chemoprophylaxis is not significantly different from that of unprotected controls. By the twenty-fourth month of life, however, the unprotected children possess significantly higher levels than their protected counterparts. The values for unprotected children at the end of the third, fourth and fifth years of life approximate to those levels found in Gambian adults. The protected children show at the third, fourth and fifth years significantly lower values.

43. Two groups of lactating Gambian women have been observed for two years. One group received weekly suppressive doses of chloroquin or Daraprim, while the other was untreated. A significant fall in serum gamma globulin values was observed in the treated group at the twelfth month and a further and equal fall at the twenty-fourth month; no change in the control group was detected. These findings indicate that malaria profoundly affects the

production of gamma globulin in Gambians, and the possibility that this represents an immunological response of the host to the parasite must be borne in mind.

44. Serial observations of the effects of malaria on a group of unprotected children over the first twenty-four months of life have now been made. Results are not fully analysed, but suggest the existence of three successive stages of host-parasite relationship, viz., a *first stage*, which is a period of relative insusceptibility; this merges into a *second stage*, in which the primary attack is generally mild in nature and sometimes completely asymptomatic; this stage then merges into a *third stage*, in which subsequent attacks increase in clinical importance producing considerable morbidity and mortality.

These observations suggest the progressive attenuation of some factor protective against both parasitaemia and the clinical effects of parasitaemia in Gambian children over the first two years of life.

45. A trial of the antimalarial activity of 2:5 bis (cyclohexylaminomethyl) naphthalene 1:6 diol dihydrochloride was concluded. An effect on human plasmodia less marked than that of chloroquine, Daraprim or proguanil was demonstrated.

46. From May, 1957, to date the 700 inhabitants of a rural Gambian village (Keneba) have received fortnightly Daraprim prophylaxis (children under 5 years 12.5 mg.; others 25 mg.). Drug administration was made by nominal roll. Results so far available indicate that parasite rates in all age groups fell profoundly following the first treatment cycle, and remained exceptionally low throughout the ensuing months. One case of Daraprim-resistant parasitaemia was detected. A start has been made to assess what improvements in health have followed these antimalarial measures.

#### Trinidad

47. Under a Research Scheme financed jointly by the Government of Trinidad and funds available to the Committee, Professor Colin Pittendrigh, of Princeton University, U.S.A., undertook a pilot survey of the problem presented in Trinidad by malaria due to *Anopheles bellator* and other members of the Kerteszia group, which comprises 80 per cent. of all malaria in Trinidad, and involves 120,000 acres of land under cocoa cultivation in the centre of the island and 90,000 employees. It poses special problems in that *A. bellator* bites out of doors, and breeds in species of Bromeliad epiphytes growing on shade trees; each epiphyte may hold one to two litres of water, in which the mosquito breeds.

48. Professor Pittendrigh, who had studied this problem in Trinidad some ten years ago, has confirmed in a preliminary report the existing view that the only vectors involved in this area are *A. bellator* and *A. homunculus*, that the most effective point of attack is on the epiphytes, either by spraying them with copper sulphate (or other poison) to a height of some 50 feet on the shade trees, or by a search for another species of non-epiphyte-bearing shade tree to replace the present "Immortel" shade tree. His final report is awaited on the relative roles, as counter-measures, of chemoprophylaxis, of improved and extended spraying, and of a substituted shade tree. A further research project will then be considered.

49. Professor B. G. Maegraith and Mr. M. V. Riley, B.A., have contributed the following summary of their studies at the Liverpool School of Tropical Medicine on tissue enzymes in malarial infection.

Previous work by Mrs. A. Wilson on the cytochrome oxidase and succinoxidase complexes of suspensions of homogenized rat and mouse liver

disclosed differences between tissue from normal animals and from those infected with *P. berghei*. Conditions of assay in these experiments were inexact owing to the irregular nature of the homogenates; therefore study has since been concentrated on the mitochondria, aided by the loan of an appropriate centrifuge by the Medical Research Council. Mr. Riley has now reached the stage in which he can obtain standard conditions for the study of mitochondrial systems, which have been checked by the Cell Metabolism Research Unit, Oxford (with the kind co-operation of Sir Hans Krebs); and regular comparative assays in normal and infected tissue in rats and mice, and some preliminary assays in monkey tissue, are now being made.

50. Information is being collected on rates of oxidation of succinic acid and on the cytochrome-oxidase systems, using cytochrome-C prepared in America. Other studies include the energy yield in terms of phosphate uptake in relation to succinic acid and other substrates including L-glutamic acid and beta-hydroxy butyric acid (with associated co-enzymes). Impairment has been noted of some enzyme systems in the infected animals as compared with normals; but occasional trouble in obtaining direct comparisons has occurred, due to difficulties in preparing standard mitochondrial suspensions. Work on *P. knowlesi* infections in monkeys is in progress, including the study of the effects of parasites on standard enzyme systems in normal mitochondria and the investigation of the parasitic pathways.

### *Virus Diseases*

#### *(a) The West African Council for Medical Research, Laboratories, Lagos, Nigeria*

51. *Epidemiology, Influenza.* From August, 1957, onwards, Dr. M. F. Jamison was investigating an outbreak at Kano, Northern Nigeria, of a febrile illness clinically resembling influenza, seeking to establish whether the causal organism was the same as that isolated elsewhere in the world and to establish its source and route of dissemination. By amniotic inoculations of throat-washings from Kano, Lagos and Accra and the use of specific antiserum the causal virus was shown to be Influenza A/Asia 1957, a finding later confirmed by the W.H.O. World Influenza Centre at the Medical Research Council's laboratories in London. Clinically, secondary bronchitis and bronchial pneumonia, but no influenzal pneumonia, were noted. The infection had apparently been introduced by air-transport, most probably by pilgrims returning from Mecca. Further spread within Nigeria by the main trade routes from Kano was traced.

52. *Poliomyelitis.* Tests on some 250 sera from the Katsina Province of Northern Nigeria have been completed by Dr. J. H. S. Gear in Johannesburg. They indicate that the rate of infection with poliomyelitis of all three types is very high, thus confirming the belief that infection with the disease is very prevalent in Nigeria.

53. Three viral agents isolated from the sera of three febrile patients from Accra, Ghana, and three viral agents isolated from febrile children at Ilesha, have been established in mice, and shown to be smaller than  $0.22\mu$  in diameter. The three Accra strains of virus are neutralized by dengue immune serum.

*Yellow fever mouse protection tests* made on 73 human sera from all age groups in Maiduguri and Abeokuta have shown an overall immunity-rate of 43 per cent. in those two regions. The sequence of cell changes in the livers of monkeys infected with yellow fever has been studied by electron microscopy. Although yellow fever was not seen with certainty,

many interesting features, such as the amorphous nature of the intranuclear inclusions, were noted.

*Coxsackie Virus.* A case of Bornholm disease occurred in a male adult European on the laboratory staff. Clinically the disease was classical, of moderate intensity and of eight days' duration. Material was prepared from the faeces on the sixth day and inoculated intracerebrally into one day old mice. They became sick on the sixth day, and by further brain passage by the subcutaneous route in baby mice the strain was established. Autopsy of the mice, and the histological examination of the interscapular fat pad and of muscle, together with the clinical history of the patient, all indicated that the causal agent was a Group B Coxsackie virus. It has been sent to the Virus Reference Laboratory at Colindale, London, for confirmation and typing.

54. *Cytological and cytochemical studies.* Dr. W. G. C. Bearcroft has undertaken these on the liver cells of 13 rhesus monkeys experimentally infected with yellow fever. By serial liver biopsies the sequence of nuclear and cytoplasmic changes has been traced, and, in particular, the distributions of deoxyribonucleic acid (DNA) and of ribonucleic acid (RNA) within liver cells were determined by various cytochemical tests.

*An outbreak of subcutaneous tumours* affecting 35 rhesus monkeys in the monkey colony maintained at the laboratories was studied. During a period of ten weeks the condition spread rapidly within the colony. Animals of all ages were affected. In most, the tumours appeared predominantly on the lower part of the limbs. They became multiple, and recurred after excision. In size they measured usually  $3 \times 1.5$  cm. Histologically, amongst a variety of cell types the predominant type is a large cell, having a large ring-like nucleus with a prominent nucleolus and containing one or more acidophilic bodies resembling virus-induced inclusions. The tumours proved transmissible to another rhesus monkey, though not to a monkey of another species or to infant mice. Tumour material was sent to Dr. C. H. Andrewes at the National Institute for Medical Research, London, who reports that the disease has been established there in monkeys and appears to be caused by a virus.

55. *Entomological studies.* Mr. J. P. T. Boorman has completed a two-year study of the bionomics of mosquitoes at the village of Ilobi, designed especially to indicate with what degree of success a pilot scheme for the eradication of *A. aegypti* might meet, since in Nigeria epidemics of yellow fever transmitted by this mosquito occur from time to time. The results indicated that four species may be potential vectors, viz., *A. aegypti*, *A. africanus*, *A. luteocephalus* and *A. circumluteolus*. The investigation has been comprehensive. Suffice it to note that *A. aegypti* was found to bite more inside huts than outside; that the resting places of blood-fed females eluded discovery; that the mosquito was seldom taken outside the edge of the village, so that, in so much as the nearest village was one mile away, on complete eradication it would be unlikely to re-appear unless by accidental importation, which road transport might effect.

Field and laboratory studies were undertaken by Mr. G. Surtees to determine the factors which limit the breeding of *A. aegypti*. In the villages the principal factors concerned appear to be contamination of water with organic substances and the surface area and depth of water at the breeding sites, whereas in the houses they are light intensity and water temperature.

Other research projects have included a study of the use of radio-active isotopes in the marking of *A. aegypti*, the mosquito larvae being grown in radio-active media. Preliminary results show that S-35 is readily taken up

by the larvae, mostly during the second and third instars, that larval and pupal pelts are very slightly active, and that radio-active adults lay radio-active eggs, about half the activity of the eggs being concentrated in the egg-shell.

#### Publications

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*Idem* and ROCHE, P.—(1957) "The Nigerian butterflies, Part I: Papilionidae". *Ibadan University Press*.

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SURTEES, G.—(1958) "Laboratory studies on the survival of the eggs of *Aedes (Stegomyia) aegypti* L under adverse conditions". *Ibid.*, **7**, 52.—(1958) "The production of D.D.T. resistance in a Southern Nigerian strain of *Aedes (Stegomyia) aegypti* L, under laboratory conditions". *Ibid.*, **7**, 114.

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

56. The mechanism of transmission and maintenance in nature of the "arbor" (arthropod-borne) viruses in their many aspects continued to be the main interest of the Institute. The addition of a clinical worker to the staff allowed the beginning of a systematic programme to identify the viruses importantly concerned in the causation of fever in man in Uganda. No isolations have yet been made in the Entebbe area or from a small epidemic reported from Tanganyika, but preparations for the isolation of virus have borne fruit since the end of the year, and several strains of influenza virus await typing. No viruses likely to be arthropod-borne have yet been isolated.

*Rabies* appeared in the Entebbe area for the first recorded occasion, and the Institute was largely responsible for identification of the agent both by isolation and histological examination of tissues of infected animals.

57. *Rift Valley Fever Virus*. Studies on *Arvicanthis abyssinicus*, a common rodent in Uganda, indicated that it may be important as a host in maintaining this virus in nature.

*Zika virus* was isolated from *Aedes africanus* mosquitoes caught in forest near Entebbe.

58. *Yellow fever* has continued important as a basic study, being the best known epidemiologically of the "arbor" viruses. A small sample of sera from Socotra showed no evidence of virus activity in that island, as also in the previous localities studied in that region, mostly in Southern Arabia. Positive sera were found in a sample from Chikwawa District in Nyasaland from which area immune galagos were reported last year. A detailed analysis of the sera collected in Northern Rhodesia in 1950–52 showed, in the four Districts mainly involved, Balovale, Kalabo, Mongu and Senanga, that both sexes are exposed to infection; rates are generally higher in males than in females. Infection rates in males generally increase with age; but in females this appears in several localities or tribes to be true only up to about twenty-four years of age. In last year's Report the occurrence of immune bush-babies in Districts of Northern Rhodesia where human immunes were common was recorded. A small sample of sera from Feira District, where human immunes are rare or absent, has afforded several positives; so that it is clear that immunity in galagos and in man are not



co-extensive. Twenty-five monkey sera from Tanganyika were all non-immune. But from Tororo, Uganda, five immunes were found among 13 Brazza's monkeys. (*Cercopithecus neglectus*), a monkey not previously studied; laboratory investigations showed that it was likely to be an efficient host for yellow-fever virus in nature. The haemagglutination-inhibition antibody reaction of a bush-baby, *Galago crassicaudatus*, on infection with Asibi yellow fever virus was studied; no antibody could be detected.

59. Owing to the work involved in identifying the many virus isolates made last year, and the absence on a Fellowship of the scientist in charge of that work, only a small isolation programme was possible. No isolations were obtained from blood-sucking insects. Recent isolations of "arbor" viruses in the United States from the salivary glands of insectivorous bats stimulated a similar study here; some definition of the importance of these animals in the dissemination of rabies in Africa is needed, particularly as that disease has been found not to be confined to blood-sucking bats in the New World. One agent, as yet unidentified, but not rabies, was recovered from a common insectivorous bat in Entebbe.

Viral agents have continued to be received from other laboratories in Africa for identification, as also has pathological material for opinion.

60. *Studies on birds.* The importance of birds in the epidemiology of viruses has been well established in other parts of the world, but a systematic investigation in Entebbe has not yet afforded any definite lead.

61. *Entomology.* In this field most attention has been devoted to mosquitoes, with particular emphasis on the *Aedes* (*Stegomyia*) spp. The intermittent trap for the sampling of insects attracted to live bait reported on last year was further developed, and has continued to give encouraging results. Attempts to define the mechanism of determination of cyclical biting behaviour in mosquitoes have led to studies of other cyclical phenomena in mosquito behaviour, in particular, of oviposition. It is felt that a clearer understanding of the determination of biting behaviour may lead to a clearer appreciation of the population dynamics of different mosquito species, and hence to the factors determining vector capability. The recent addition of an entomologist exclusively to work out methods of age determination of mosquitoes should further the progress of this work.

62. *Aedes aegypti* has been extensively studied in Entebbe and on the Kenya Coast to determine if the population of this species is made up of "races" differing biologically. Attention has been mainly directed to the determination of its blood-hosts, and methods have been developed to collect resting blood-fed females in the field in significant numbers. It is clear that man is an important host for *A. aegypti* both in Uganda and on the Kenya Coast. The hosts of some other mosquitoes have been determined; thus *Aedes simpsoni* feeds mainly on man, *Taeniorhynchus fuscopennatus* mainly on mammals, while the other *Taeniorhynchus* spp. attack mainly birds.

63. The Institute continued to enjoy the stimulation of frequent visits by scientists from many parts of the world; they numbered 158, from fourteen countries.

During their conference in Kampala the Association of Physicians of East Africa visited the Institute on 27th to 29th June, 1957. The Acting Director introduced a discussion with a paper on the etiology of "dengue", and thereafter the delegates were shown the various aspects of the work of the Institute.

This summary would be incomplete without recording the appreciation of the Institute of the handsome grants offered to it in the last year, by



the Rockefeller Foundation for the purchase of equipment available only in the United States, and by the World Health Organization for the prosecution of research into mosquito behaviour in and above the forest canopy, an environment thought to be of great potential importance in the survival and dissemination of viruses.

*Publications*

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*Idem* and HADDOW, A. J.—(1957) "Laboratory observations on the oviposition cycle in the mosquito *Aedes (Stegomyia) africanus* Theobald". *Ibid.*, **51**, 170.

HADDOW, A. J., and GILLET, J. D.—(1957) "Observations on the oviposition cycle of *Aedes (Stegomyia) aegypti* (Linnaeus)". *Ibid.*, **51**, 159.

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LUMSDEN, W. H. R.—(1957) "The activity cycle of domestic *Aedes (Stegomyia) aegypti* (L) (Dipt., Culicid.) in Southern Province, Tanganyika". *Bull. ent. Res.*, **48**, 769.—(1957) *Proc. of the Tenth Internat. Congr. of Entomology*.

MIMS, C. A.—(1957) "The invasion of the brain by yellow fever virus present in the blood of mice". *Brit. J. Exp. Path.*, **38**, 329.

WEINBREN, M. P., HADDOW, A. J., and WILLIAMS, M. C.—(1958) "The occurrence of Chikungunya virus in Uganda. I. Isolations from mosquitoes. (M.P.W., A.J.H., and M.C.W.) II. The occurrence of Chikungunya virus in man, on the Entebbe peninsula. (M.P.W.) III. Identification of the agents. (M.P.W.) *Trans. R. Soc. trop. Med. Hyg.*, **52**, 253.

WEINBREN, M. P., and WILLIAMS, M. C.—(1958) "Zika virus: Further isolations in Zika area, and some studies on the strains isolated". *Ibid.*, **52**, 263.

WEINBREN, M. P., WILLIAMS, M. C., and HADDOW, A. J.—(1957) "A variant of Rift Valley Fever Virus". *S. Afr. Med. J.*, **31**, 951.

WEINBREN, M. P., and MASON, P.—(1957) "Rift Valley Fever in a wild rat, *Arvicanthus abyssinicus*: a possible natural host". *Ibid.*, **31**, 427.

(c) *The Trinidad Regional Virus Laboratory, Port of Spain*

64. From this laboratory, established in 1953 by the Division of Medicine and Public Health of the Rockefeller Foundation with the co-operation of the Government of Trinidad for the study of viruses in man, animals and arthropods in the Caribbean region, the Director, Dr. Wilbur G. Downs, reports that the research programme continues to be centred around studies on the epidemiology of Ilheus infection in Trinidad. At the same time, work has progressed slowly but steadily on St. Louis virus and Mayaro virus epidemiology. A number of unidentified viruses recovered from man, animals, birds, and insects have claimed attention: and surveys have been conducted on other West Indian islands.

65. *Ilheus virus*. During the year this was recovered four times from mosquitoes, once from a pool of *Aedes scapularis* and thrice from pools of *Psorophora ferox*. It was also recovered from one of the mosquito-catchers early in the course of a very mild febrile illness, but not from birds or animals. In transmission studies, this agent was successfully transmitted by *Aedes aegypti*, *Aedes scapularis*, *Aedes serratus*, *Culex quinquefasciatus*, *Psorophora albipes*, and *Psorophora ferox*. In experimental infections, 4 species of local birds out of 17 tested showed ability to circulate virus, and serological conversions were demonstrated in birds belonging to 4 species. Circulating virus was not detectable in serum titres higher than  $10^{-1}$ . In experiments inoculating bats with *Ilheus virus*, 2 species showed ability to circulate virus and serological conversions were observed in 3 species. Titres of circulating virus were low.

66. *Ilheus virus* continues baffling. Human immunity rates are high in Eastern Trinidad, virus is recovered frequently from mosquitoes, yet three years of effort have resulted in no virus isolations from well over a thousand clinical cases of fever seen in the region, and two isolations from our own mosquito-catchers who are bled weekly as a routine. One of the latter isolations was in complete absence of evidence of illness, the other was accompanied by a mild illness. It appears probable that its present course in Trinidad is that of a widespread agent effecting a lot of immunizing and producing but little illness. Yet two years ago a virus recovery was made from a seriously ill case with pronounced encephalitic signs.

67. *St. Louis Virus*. Little significant progress has been made except for the amassing of negative findings. No virus isolations were made from insects, birds or animals during the year, and no human cases were seen. In mosquito studies successful transmissions have been made by *Aedes aegypti*, *Aedes serratus*, *Culex quinquefasciatus*, *Mansonia arribalzagai*, *Mansonia venezuelensis* and *Psorophora ferox*. In nestling birds, virus circulation was demonstrated in 4 of the 5 species experimentally inoculated. Circulation was in several instances in quite good titre. These results present a distinct contrast to those obtained with *Ilheus virus*. With experimental inoculation of bats, virus circulation was determined for 3 species, but titres were low.

68. *Mayaro Virus*. An isolation of this virus was made from a mosquito, *Mansonia venezuelensis*, further establishing its position in the arthropod-borne virus group. The strain from mosquitoes is a particularly interesting one, showing some pathogenicity for adult mice. A haemagglutinating antigen can be readily made from infected mouse brain. An island-wide survey for Mayaro immunity revealed an interesting localization of the infection to the south-eastern quarter of the island. A laboratory infection occurred, fortunately not severe. In mosquito studies successful transmission was effected by *Aedes scapularis*. Limited experimental infection of birds was attempted, and circulating virus in low titre detected in one bird on the third post-inoculation day. Results in bats were more impressive, with circulating virus demonstrated in four species of bats, in one instance at a level of  $10^{-5}$  on the fifth post-inoculation day.

69. Ten isolations of *Asian influenza virus* were made during an influenza outbreak in August and September, and a number of other cases were seen. A *poliomyelitis* outbreak occurred, and serum and stool specimens from over 100 cases were supplied to another laboratory for study (voluntary study). *Leptospirosis*, following studies of J. C. Broom, has been shown to be the presumptive cause of illness in nearly 15 per cent. of the fever cases seen at the Sangre Grande Clinic.

Studies continued on the large group of unknown viruses, and a battery of immune sera was produced. Most of the agents are in such low titre that the preparation of satisfactory haemagglutinating or complement-fixing antigens is impossible. However, using the neutralization test and the battery of sera, considerable progress was made in the formation of several groups of agents.

70. Serum surveys were made on the islands of Barbados and Antigua. Previous surveys have been conducted in Grenada, Jamaica and the Rupununi Savannah region of British Guiana, and on a few serum specimens sent by the Director of Laboratories, British Guiana, taken from aborigines along the Mazaruni River. Testings are being conducted on these various sera using haemagglutination-inhibition, complement-fixation and neutralization tests. Some overall immunity patterns are beginning to emerge. Dengue appears to be widespread (absent from the Rupununi Savannah of British Guiana) and present on all the islands. St. Louis appears to be a common infection in Jamaica, less common in Trinidad, and uncommon or possibly absent in the Rupununi region of British Guiana. It is apparently absent from Tobago and Grenada, but its status is still undetermined in Barbados and Antigua. Mayaro virus appears to be very common in south-eastern Trinidad and the Rupununi Savannah of British Guiana and not on the other islands. Ilheus virus thus far has been found to be present only in Trinidad and British Guiana.

No evidence of recent yellow fever activity was observed in 1957 in Trinidad or in the other island surveys.

71. Progress has been made in studies of the haematophagous insects of Trinidad, and knowledge of a number of groups including mosquitoes, black flies, biting midges, Phlebotomus, fleas, mites, bedbugs, ticks and lice has been very considerably advanced. Progress includes not only taxonomy and "lists", but also ecological and life-history data. Knowledge of host ranges of a number of ticks, mites and parasitic flies is being extended.

#### Publications

ANDERSON, C. R.—(1957) "St. Louis virus in Trinidad". *W. Ind. med. J.*, **6**, 249.

*Idem*, AITKEN, T. H. G., DOWNS, W. G. and SPENCE, L.—(1957) "The Isolation of St. Louis Virus from Trinidad mosquitoes". *Am. J. trop. Med. & Hyg.*, **6**, 688.

*Idem*, DOWNS, W. G., WATTLEY, G. H., AHIN, N. H., and REECE, A. A.—(1957) "Mayaro Virus: A new human disease agent. I. Isolation from blood of patients in Trinidad, B.W.I." *Ibid.*, **6**, 1012.

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*Idem*, ANDERSON, C. R., and CASALS, J.—(1957) "The isolation of St. Louis Virus from a nestling bird in Trinidad, B.W.I." *Am. J. trop. Med. & Hyg.*, **6**, 693.

LANE, J. and AITKEN, T. H. G.—(1956) "Chaoborinae from Trinidad, B.W.I." *Ann. ent. Soc. America*, **49**, 530.

AITKEN, T. H. G.—(1957) "Virus transmission studies with Trinidadian mosquitoes". *W. Ind. med. J.*, **62**, 229.

(d) *Research on trachoma: Lister Institute, London, and Fajara, Gambia*

72. A collaborative research project between the Lister Institute and the Institute of Ophthalmology, London, undertaken initially in Jordan to

isolate and study the viral agent of trachoma, and supported by funds in part obtained by Sir Stewart Duke-Elder and in part contributed by the Colonial Office and by the Wellcome Trustees, had perforce to be suspended in Jordan; and sources of trachomatous material were sought in the Gambia, as briefly reported last year.

73. Dr. L. H. Collier and Mr. J. Sowa have reported that strains of a virus were isolated in the Gambia from ten trachomatous patients by methods similar to those used and recently described by T'ang *et al* in Peking. They were freeze-dried as crude yolk-sac homogenates from embryonated hens' eggs and sent by air-mail to the Lister Institute. One of these strains, designated G.I., was passaged four times before despatch, was later further passaged and studied at the Lister Institute. Smears from infected yolk-sacs contained numerous elementary bodies, mostly extracellular, staining characteristically with Giemsa and with Castaneda's stain, and, by electronmicroscopy, appearing strikingly similar to the elementary bodies described by earlier workers elsewhere.

74. At the same time comparative studies were made of a virus isolated in China from trachomatous patients by T'ang *et al* in 1957, and brought from Peking by Professor E. T. C. Spooner. By the criteria of morphology, experimental pathology in the hen's egg, and serology, the Chinese and the G.I. strains revealed a very close relationship with each other and with the virus of the psittacosis-lymphogranulomatous group of infections.

75. To strengthen the evidence afforded by the above laboratory procedures, the G.I. strain was studied in a European human volunteer in London; conjunctival lesions resulted which closely resembled those seen in the early stages of natural trachoma; typical experimental infections were obtained, and typical inclusion bodies were demonstrable. The study continues, but the above data constitute reasonable proof that the strain G.I. is a causal agent of trachoma.

#### *Publication*

COLLIER, L. H., and SOWA, J.—(1958) "Isolation of trachoma virus in embryonate eggs". *Lancet*, **1**, 993.

#### *Animal-borne diseases in Malaya*

76. *Influenza*. Important among other activities of the Division of Virus Research and Medical Zoology at the Institute for Medical Research at Kuala Lumpur during 1957 was the pandemic of "Asian" influenza which had spread to most of the world before the end of the year. The first case was recognised in Kuala Lumpur early in May, and preliminary tests of the virus isolated showed that, although it was a strain of influenza "A", it differed sharply from all the other "A" viruses against which antisera were available. Freeze-dried samples of the strain were sent by air to the World Influenza Centre in London and to Washington in mid-May, and were among the first examples of the new strain to reach there. In Malaya, the virus laboratory made virus isolations from civilians and antibody tests on serum samples sent in from suspected cases, while the United States Army Medical Research Unit made an extensive study of the disease as it affected the army. Samples of 15 strains of virus were sent to London and Washington, most of them isolated by the American unit. A summary of the main features of the epidemiology, clinical picture, and preliminary virology was prepared by the virus research officers in collaboration with a private practitioner in Kuala Lumpur, and was published in Britain and Australia in order to provide early information about the disease to doctors in those countries.

At the height of the epidemic some children were reported from Kuala Lumpur General Hospital to be suffering from meningism and convulsions. A virus isolated post-mortem from one brain specimen has not yet been characterized, but does not appear to be an influenza virus.

77. *The yellow fever hazard.* About a third of the sera examined in the surveys of human sera had neutralizing antibody to yellow fever, but the indications were that this finding almost certainly represents a group reaction due to infection, not with yellow fever, but with other members of the "B" group of arthropod-borne viruses. Whether the presence of such antibodies would help to prevent the establishment of yellow fever in these communities is at present a matter for speculation. Further studies were made on the antibody response in groups of Malaysians inoculated with 17D vaccine. Subcutaneous inoculation gave generally satisfactory results; vaccination by the multiple puncture technique was less successful.

78. *Arthropod-borne viruses.* Surveys of human and animal sera from different localities for antibodies to arthropod-borne viruses were completed. Neutralizing antibodies to Japanese encephalitis virus were common in two coastal communities, less common inland in rice-growing valleys, and much less common in the mountains. Neutralizing antibodies against the two dengue viruses were found in 80-90 per cent. of the rural population examined, but dengue-1 was less common in mountain areas. Antibodies to several of these viruses were frequent in domestic and forest animals, but there is considerable difficulty in deciding whether these represent specific or group reactions. Dengue virus circulation experiments in squirrels did not help to solve this problem. Attempts were made to isolate dengue virus from wild-caught mosquitoes both directly and after passage through laboratory-bred *Aedes aegypti*. One "B" group virus has been isolated but not yet identified, and five other possible isolates from *A. aegypti* and one from *A. albopictus* are under investigation.

79. Investigations in Washington have confirmed that the virus TP21, isolated in 1956 from an ixodid tick, is antigenically very similar to other tick-borne viruses of the Russian spring summer/louping ill complex. Because these are known to be potentially dangerous to laboratory workers, work on them has been suspended until the staff can be immunised. The possible importance of this virus is emphasized by the recent finding of a closely related virus responsible for fatal disease in man and monkey in India. Neutralising antibodies against TP19, the other virus isolated in 1956 from a tick, appeared relatively common in rural communities and in domestic animals.

80. *Leptospirosis.* The results of the examination of about 2,500 wild animals (mainly small rodents) for leptospirosis are being summarized. Evidence of leptospiral infection was commonest in rats, especially ricefield rats, but was also found in palm civets, domestic cats, squirrels, bats, house shrews, porcupines, mouse deer, and flying lemurs. There was a tendency for certain serotypes to be associated with particular places, and the widest range of serotypes was found in forest animals. These investigations were carried out in collaboration with Dr. J. C. Broom at the Wellcome Laboratories of Tropical Medicine in London. Four strains of leptospira isolated in Malaya were tested for survival at ten pH levels from 5.3 to 8.0, and a marked difference in behaviour between serotypes was found.

81. *Animals and parasites.* Although 2,230 animals were examined, random trapping of small mammals was on a reduced scale, and more time was devoted to mark-recapture observations. These have provided information on the ability of rats to find their way home over distances up to one mile.

A rat-trap with a counterweight enabling it to be hooked over branches has proved effective in trapping squirrels, and information about their survival rate is now being obtained.

Some thirty new species of mites have been described, and work is in progress on the identification of Malayan ticks and the study of their life cycle.

*Study No. 28.* This Study, "Malaysian Parasites, XVI-XXXIV", was published towards the end of the year. Edited by Dr. J. R. Audy, and comprising 19 papers, it is the second of a series intended to record information relating to various groups of external and internal parasites of man and animals in the Malaysian region.

#### Publications

AUDY, J. R.—(1957) "A checklist of trombiculid mites of the Oriental and Australasian regions". *Parasitology*, **47**, 217.—(1957) "Photographing vegetation". *Malay. nat. J.*, **11**, 81.

VERCAMMEN-GRANDJEAN, P. H., and AUDY, J. R.—(1957) "Note concernant la taxonomie des trombiculidae avec, comme corollaire, le revision et l'élargissement du genre *Schoutedenichia* Jad. and Verc., 1954". *Ann. Parasit. hum. comp.*, **31**, 427.

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MCCRUMB, F. R., STOCKARD, J. E., ROBINSON, C. R., TURNER, L. H., LEVIS, D. C., MAISEY, C. W., KELLEHER, M. F., GLEISER, C. A., and SMADEL, J. E.—(1957) "Leptospirosis in Malaya—1. Sporadic cases among military and civilian personnel". *Amer. J. trop. Med. Hyg.*, **6**, 238.

MACDONALD, W. W.—(1957) "*Aedes aegypti* in Malaya, III. Experiments on control and eradication". *Ann. trop. Med. Parasit.*, **51**, 175.

SMITH, C. E. G.—(1957) "A localised outbreak of dengue fever in Kuala Lumpur: serological aspects". *J. Hyg., Camb.*, **55**, 207.

*Idem*, TURNER, L. H., and HELLIWELL, C. J. V.—(1957) "Far East influenza". *Brit. med. J.*, **1**, 1412 (also *Med. J. Australia*, **1**, 929).

*Idem*, and WESTGARTH, D. R.—(1957) "The use of survival time in the analysis of neutralization tests for serum antibody surveys". *J. Hyg., Camb.*, **55**, 224.

82. Paragraphs 82-87 summarize the studies of the U.S. Army Medical Research Unit (Malaya) undertaken in collaboration with the staff of the Institute for Medical Research, Kuala Lumpur, the nearby British Military Hospital and the Walter Reed Army Institute of Research, Washington. Much of the Unit's work during 1957 aimed to identify viruses previously isolated, to assess the prevalence of infection with these viruses in the local population, and to decide which of them may be important causes of human disease. Additional information was also obtained on the ecology of mosquitoes from different types of terrain; and new laboratory colonies of two species of *Aedes* were established. Two main new developments were the influenza epidemic, and a detailed investigation of illnesses occurring in Singapore which were presumed to be virus encephalitis.

83. *Influenza.* In April, 1957, the Unit was notified about an outbreak of febrile illness in Johore in a Gurkha battalion which had recently arrived from Hong Kong. Virus isolations and serodiagnosis established that the causal agent was an influenza virus "A" of a new strain, later named

A/Singapore/1/57. During May, as the outbreak spread, viruses were isolated from a number of military and civilian patients, and seven were studied in detail. All were closely related to each other, and to the strains isolated in Singapore and by the Institute staff.

Many doctors, both in the armed services and in civilian practice, gained the impression that the attack-rate among Asians was much higher than among Europeans. In civil life, comparison is invalidated by the wide disparity in living conditions and consequently in probable exposure to infection; but, in army camps and barracks, living conditions and standards of hygiene and nutrition are very similar for all races. A clinical survey in a number of camps indicated that the incidence of clinical influenza was about 9 per cent. among European soldiers; about 30 per cent. among Malaysians, and about 32 per cent. among Gurkhas.

Blood specimens were collected from a proportion of the men in each unit who had remained well throughout the epidemic, as well as from the sick. Tests on these specimens indicated that symptomless infection was also very much commoner among the Gurkhas and Malaysians than among the Europeans. The combined incidence of clinical disease and symptomless infection was over three and a half times higher in the Asians (Gurkhas and Malaysians) than in Europeans. The reasons for this racial difference are uncertain.

84. *Virus encephalitis in Singapore.* A study of hospital records from the British Military Hospital and the General Hospital in Singapore showed an incidence of about 11 non-fatal and 3 fatal illnesses per month, which clinically were considered to be either encephalitis or aseptic meningitis, during the previous 2½ years. In 10 months from October, 1956, a physician attached to the Unit attended 102 non-fatal and 20 fatal illnesses of the same nature. Detailed clinical and laboratory investigations were made on these patients. Japanese encephalitis virus was incriminated as the cause of eighteen of the non-fatal illnesses, and the same virus, or a closely related one, was isolated from autopsy specimens from four of the patients who died. Three other viruses isolated from autopsy specimens have been investigated but not yet identified.

85. *Viruses isolated from wild-caught mosquitoes.* Thirty-four viral agents were isolated from wild-caught mosquitoes in the period 1954–1956, eighteen of which have since been identified as Japanese encephalitis virus. The remainder have been classified into eight separate groups, and have yet to be identified; none has been reported previously from Malaya, and one is a new member of Casal's group B arthropod-borne viruses. Neutralising antibodies against four of these unidentified viruses were found to be present in 15 per cent. or more of serum specimens from 97 Asian adults; infection with at least some of them therefore appears to be quite common, but whether or not they also cause human disease is not yet known. The isolation of these 34 virus strains has involved inoculations from 1,518 pools of mosquitoes, totalling almost 320,000 specimens into adult or suckling mice.

86. *Fevers of unknown origin.* The investigation of acute fevers without readily detectable cause was started in 1954, and over 1,100 patients have now been studied. In the first phase, two different groups of adult males were studied; in the second phase, attention was directed to the obscure febrile diseases of children. One-third of the fevers among adults remain undiagnosed, and over three-quarters of those among children. The incidence of the disease diagnosed has varied widely among the three groups of patients. Thus leptospirosis was responsible for 39 per cent. of the fevers



in British troops, but only for 15 per cent. in adult Asians and 2 per cent. in Asian children; the figures for dengue and related viruses in the same three groups were 8 per cent., 26 per cent. and 9.5 per cent. respectively. Six viruses were isolated from children during the acute febrile period of illness; although none has as yet been positively identified, at least three appear to have caused the illness with which they were associated. Antibodies to three were very common in sera from adult Asians, and infection with at least one of them is widespread in children in Selangor over the age of 2 years.

87. *Ecology of mosquitoes.* Although isolation of viruses from mosquitoes was stopped in 1956, ecological studies in three types of terrain have been continued. Forests in the foothills at Gombak were unusually rich in diversity of species, but none of the 107 different species found was present in large numbers; 94 of the 107 species were restricted to the forest habitat. In coastal nipah palm and mangrove swamps 52 species were found; some *Aedes* species were present in large numbers, and attack-rates of 90 mosquitoes per man per hour were frequently encountered; again, 29 of the 52 species were restricted to the coastal habitat. Yet a third type of mosquito fauna was encountered in semi-rural open scrub country, the dominant group being *Culex* (*Culex*). Eighty-nine species of mosquitoes have been found to engorge on human blood to such a degree that the abdomen still visibly contains blood next morning, and with some species this is the first time that they have been recorded as biting man.

*Laboratory colonies.* A colony of *Culex gelidus*, established for the first time in 1956, continues to thrive. Colonies of *Aedes* (*Aedes butleri*) and *Aedes* (*Skusea*) *amesi* have also now been established, and these mosquitoes can be successfully reared in cages as small as 9 cubic feet, with guinea-pigs as the source of blood-meals.

#### *Relapsing Fever in East Africa*

88. Progress was made by Dr. G. A. Walton and Mr. K. L. Cockings at the East African Institute for Medical Research, Mwanza, Tanganyika, in the quantity production of preserved and living material of pure and surmisedly pure cultures of six biological variants of *Ornithodoros moubata*, in confirming their characteristics up to the third generation, and in testing their reactions to desiccation as a further means of differentiation preparatory to making a study of the taxonomy of the whole group.

89. The wild Form C was shown to consist of two distinct forms designated Form C and Form F. A quite distinct domestic form (Form E) was found to have a wide distribution in South Africa; and all known preserved collections of wild *O. moubata* obtained from five species of tortoise were received from South Africa for inclusion in the taxonomic study, and have been provisionally called Form G. The pure cultures of Forms A, B, C, E and F bred true to type, and five surmisedly pure cultures of Forms A, E and F were shown to conform to the type.

90. The South African Form E (now identified from the Transvaal, S.W. Africa, Angola and Bechuanaland as far north as the Rhodesian border) is immediately distinguished by the complete extrusion of the semi-active larva from the eggshell for five days after hatching, and by the appearance of some adult females after only three nymphal instars. The majority of the Form E females become adult after four nymphal instars and only a very small proportion require five. In all East African forms the female requires at least five nymph stages (up to 12 per cent. of the domestic forms, and up to 40 per cent. of the wild forms, require six



nymphal instars), and the inactive larvae remain inside the split eggshell for seven days after hatching.

The wild Form F is distinguished from the wild Form C, or any other form, by its larger and darker eggs and larger nymphs, there being in fact no overlap in size of the first nymph with those of any other form.

91. Preliminary results from the desiccation of the various forms in dry air at 90°F. indicate that Form E from South Africa may be exceptionally resistant. The wild Forms C and F, despite their extreme resistance to starvation, may be no more resistant to desiccation than the domestic Forms A and B. The domestic Form D from the arid areas of Tanganyika appears to be the least resistant. This last anomalous result might be explained by the ability of this form to feed with equal facility on the blood of man or domestic fowls, whereas the other domestic forms feed almost exclusively on a single host.

#### Publications

WALTON, G. A.—(1957) "Observations on biological variation in *Ornithodoros moubata* Murray (Argasidae) in East Africa." *Bull. ent. Res.*, **48**, 559.—(1958) "Studies on *Ornithodoros moubata* Murray (Argasidae) in East Africa. Part I. Observations on distribution, food and climatic requirements in relation to relapsing fever as evidence of biological variation." *E. Afr. Med. J.*, **35**, 57.—(1958) "Studies on *Ornithodoros moubata* Murray (Argasidae) in East Africa. Part II. Experimental and microclimatic evidence of biological variation." *Ibid.*, **35**, 3.

#### Identification of blood-meals

92. Mr. B. Weitz and Miss Lee-Jones of the Lister Institute of Preventive Medicine continued their studies on the feeding habits of blood-sucking arthropods. Although no major field experiments took place this year a very large number of blood-meals were tested for identification of the host by the precipitin and inhibition of agglutination tests. The main findings are briefly summarized below.

#### Tsetse flies

93. *East Africa.* Dr. P. E. Glover and his co-workers of the Department of Veterinary Services at Kabete, Kenya, collected over 300 blood-meals from *Glossina longipennis* at Kiboko on the Nairobi-Mombasa road. These flies mostly fed on rhinoceros (75 per cent.) and buffalo (54 per cent.), thus showing a preference for these two hosts. No area has yet been found where *G. longipennis* lives without rhinoceros, and a search is being made for such an area to find alternative hosts. The feeding habits of *G. swynnertoni* in Talek, on the S. Kenya border, were of the same pattern as found previously in Tanganyika, the warthog being its main host.

Collections of engorged *G. morsitans*, *G. morsitans submorsitans*, *G. fuscipleuris* and *G. pallidipes* were made in Uganda by Mr. A. Robertson, Director of Tsetse Control, Kampala, chiefly from areas where game control had been in operation for varying lengths of time. The results of identification of the blood-meals of these flies were of considerable interest to the local problems of detecting the hosts responsible for the persistence of the fly after shooting game. The Suidae were once more the main hosts of these flies, particularly giant forest hog and bushpig as a source of food of *G. fuscipleuris* in these areas.

It was of interest to find two *G. morsitans submorsitans* from Northern Uganda and two *G. swynnertoni* from Kenya which had fed on either

hartebeest, wildebeest or topi. (These three closely allied species are indistinguishable serologically.) Previous tests had suggested that these hosts were never fed on, but apparently some feeding occurs. As previously, no feeds on zebra were found from any species of fly.

94. *West Africa*. The identifications of the blood-meals of flies from West Africa continued, and yielded preliminary information on the habits of these flies. On the whole the problem of feeding resembles that of the East African flies with the same type of habitat, e.g. *G. palpalis* fed on whatever hosts were available, including man, and also on reptiles and occasionally on birds; *G. fusca* largely fed on bushbuck, but also on Red river hog; *G. medicorum* and *G. longipalpis* also seemed to favour bushbuck. About 20 per cent. of feeds of *G. tabaniformis* were from porcupine and 65 per cent. from Red river hog; *G. morsitans* had much the same feeding habits as it has in East Africa.

95. Work began on the serological identification of tsetse flies of East Africa with a view to identifying their predators. Unfortunately the fly tissues appear to have a low antigenicity and the preparation of suitable antisera is presenting difficulties. Miss Lee-Jones is studying the sensitivity and the specificity of these reactions. It appears that about 1/50 to 1/100 of a fly would be recognised in the ingesta of a predator, and in co-operation with Dr. Southon of Shinyanga a programme has been arranged to test the stomach contents of dragon flies which have been artificially fed on various species of insects, including tsetse flies. No definite conclusion can be reached until this work has been done.

#### *Mosquitoes*

96. Collaboration with various units working in the field on problems connected with mosquitoes, such as the eradication of malarial mosquitoes, has continued. The feeding habits of various Malayan mosquitoes, including *A. hackeri*, *A. pujutensis*, *A. baezai*, *A. barbirostris*, *A. hyracanus*, *A. kochi* and others, have been studied in co-operation with Dr. J. A. Reid, of the Institute for Medical Research, Kuala Lumpur. Preliminary results show that *A. hackeri* and *A. pujutensis* both feed largely on primates, including some of the monkeys (*Presbytis* and *Macaca* species); *A. baezai* is thought to feed mostly on a bovid in the forest which could be mouse deer (*Tragulus* sp.). These results are to be confirmed as there is the possibility of other bovids being involved.

Other work has been done on the wild hosts of *A. gambiae* and *A. funestus* in Kenya with Dr. McMahon and in South Africa with Dr. Brink. Collaborative studies have also been made with Dr. D. H. Colless of Singapore and Dr. M. T. Gillies and Dr. A. Smith of Tanganyika.

Investigations of the feeding habits of *Culicines*, including *Taeniorhynchus pseudoconopas*, *T. fraseri*, *T. aurites*, *T. maculipennis*, *T. metallicus* and *T. fuscopennatus*, were completed with Dr. M. C. Williams and Dr. G. A. H. McClelland of the East African Virus Research Institute, Entebbe; it was found that these species very largely fed on birds, except for *T. fuscopennatus* which had a tendency to feed on primate and bovid hosts.

97. In studies on the antigens of East African trypanosomes, the main difficulty has been to obtain sufficient concentration of antigenic material from trypanosomes. It has been possible, by growing *T. brucei* in rats and freeze-drying the trypanosomes collected at the height of parasitaemia, to produce antisera against their antigens. Various methods of analysis, including serological tests, precipitin and tanned red cell agglutination tests, electrophoresis in starch gels and starch blocks, and various gel diffusion tests, are being investigated.

*Publications*

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*Physiological and nutritional research**(a) Tanganyika and Uganda*

98. Amongst the aspects of malnutrition studied at the East African Institute for Medical Research, Mwanza, Tanganyika, by Dr. E. G. Holmes, Dr. Sylvia Darke and Mr. Walter Reed, an investigation of the absorption of foodstuffs by Africans is now in its final phase. Light hookworm infestations, such as are common in Mwanza, certainly do not affect absorption. Dr. Darke is now making observations in Kampala, where heavy infestations are common and when completed the results may well show whether heavy hookworm loads interfere with absorption.

The work with radioactive isotopes is being developed, Tritium, Sodium 22, Bromine 82 and Carbon 14 are all being used for various purposes.

99. A series of determinations of total body water using tritiated water have been made on patients in the Unit's Metabolic Ward and on prison inmates. The figures obtained, expressed as a percentage of body weight, were in general somewhat lower than those previously obtained by the urea method, though those for the ward patients (few of whom were suffering from obvious malnutrition) gave figures near those previously obtained by the urea method for controls and for malnourished subjects after re-feeding. In some cases, where successive determinations on the same subject have been made, it was once more observed (as with the urea method) that changes in total body water (and therefore of total body solids) bore no constant relationship to changes in body weight. Determinations of extra-cellular water ("bromine space") were made using Bromine 82. (Owing to its short half-life this isotope is somewhat awkward to use in Africa.) The results obtained on subjects in the ward gave a mean figure which was in agreement with that obtained by using the formula given by Bradley, Davidsson, MacIntyre and Rapaport (*Bioch. J.* 6233P, 1956) in their paper on the use of the method, and were close to the mean figure previously obtained for "thiocyanate space" in controls in Kampala. It may therefore be that the same "space" (whatever its physiological significance) is measured by Br. 82 and by thiocyanate.

This preliminary work on body composition will continue. The fact that has already emerged, which previous work suggested, is that changes in body weight cannot be regarded, without reservation, as representing changes in body tissue, even in the absence of clinical oedema, or conditions that would be expected to increase or diminish extra-cellular fluid.

100. Attempts are being made to work out a technique for the determination of body fat in the living subject. Experiments are also being made to determine the 24-hourly cutaneous loss of nitrogen in this climate. Results so far do not indicate that previous experiments on nitrogen balance have been affected by an under-estimation of cutaneous nitrogen loss.

*Malnutrition and the eye*

101. Preliminary observations by Dr. D. S. McLaren suggest that the following conditions, in which nutrition is known, or is thought, to play a part, merit study in this area: xerophthalmia, "spontaneous clean iris prolapse", nutritional amblyopia, and trachoma. It is also planned to investigate the possible relation between the refractive state and nutritional status.

Previous experimental work has shown that the sulphhydryl ( $-SH$ ) content of the lens is markedly lowered in protein deficiency. Sulphhydryl determinations have been made on the normal lenses of a variety of species, including man; and an experiment is in progress to ascertain whether there is a return to normal levels on cessation of a prolonged period of low protein intake. Absorption spectrum studies of soluble lens proteins have revealed interesting differences in subjects of different ages; cataractous lens material is also being examined by the same method.

102. Dr. R. F. A. Dean, Director of the Medical Research Council's Infantile Malnutrition Research Unit at Kampala, has contributed the following summary of the activities of the Unit, which are being directed increasingly towards the practical application of the knowledge gained in the last few years.

The demonstration that large quantities of fat can be included safely and advantageously in the diets of severely malnourished children suggests that the use of edible oilseeds without extraction of the oil may be more beneficial in prophylaxis and even more economical than the use of de-fatted "meals". A cheap food made from locally-available materials, of which the chief is groundnuts, is being tested. It is briefly cooked into biscuit and hammer-milled to a fine powder that can be fed alone (mixed with water) or incorporated into a cereal porridge or into any staple. It contains about 20 per cent. protein and 25 per cent. fat; it keeps well, probably because it is dry and its fat is all of vegetable origin. Readily accepted by children, it is being given in the Unit's wards as the alternative to a mixture in which the protein is all derived from cow's milk. Both treatments produce clinical improvement, but the milk diet is more rapidly effective, and causes greater alterations in the serum. The differences may be related to differences in the amino-acid or other constituents of the diets and may, therefore, help to give information about the specific needs of children suffering from protein deficiency. The powder is also being distributed, in competition with dried skimmed milk, at the Unit's Child Welfare Clinic, which now has an average attendance of over 300, and is chiefly concerned with the value and possibilities of supplementing the home diets of young children. Although distribution schemes multiply, there is a great lack of accurate information about their true worth. (The development and testing of the new food is being helped by a grant made by the Protein Committee of the National Academy of Sciences.)

The Unit has begun a detailed study of the absorption of food from the gut in malnourished children. Preliminary work on the emptying-time of the stomach and transit-times through the small intestine has already given interesting results, and various ways of measuring the rates at which nutrients appear in the blood, and are removed, are being explored. Absorption is obviously of fundamental importance, but has been largely neglected in work on protein deficiency.

103. The collection and analysis of data on growth and development have continued. The small pelvis that may be one of the chief causes of obstetric difficulties of the adult African women in the Kampala district

appears to be an innate characteristic that can be demonstrated even in the infant, and is probably unrelated to the plane of nutrition.

A study of the children of upper-class Baganda families by the best psycho-motor tests at present available has shown that the social and educational advantages offered prevent the falling-off in performance of the tests that was noted regularly in former years in the children 3 to 4 years old in poorer families: a similar falling-off does not occur in Europe and the United States. The study has also confirmed the need for new tests founded on African cultures: the existing tests too obviously betray their origins in the European culture in which they were evolved.

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#### *Jamaica*

104. *Tropical Metabolism Research Unit, Jamaica*. Dr. J. C. Waterlow, the Director of this unit of the Medical Research Council, reports that the treatment of malnourished infants in the Unit's ward continued, and problems related to malnutrition were investigated further. Some adults, mostly diabetics under Dr. J. A. Tulloch, were also studied there. As is briefly reported later, visits to the Unit by Dr. J. D. Judah, Dr. K. R. Rees and Dr. Oliver Wrong for specialised studies were of much scientific profit.

105. *Balance studies in infants*. Nitrogen, phosphorus, potassium and sodium balances were done for periods of a month or more. Most cases were grossly deficient in potassium; some, but not all, were also low in phosphorus. During recovery the ratio of phosphorus to nitrogen retained is usually higher than the ratio in normal cellular tissue. Most cases absorb and retain nitrogen with remarkable efficiency, at a rate of four times that of the child growing normally. A few of the seriously-ill babies do not retain nitrogen, and these will be more conveniently studied with radioactive methionine.

Human breast milk and a cow's milk mixture of equal protein content have been compared. A slightly better retention of nitrogen occurs on the breast milk diet, but the difference is not statistically significant. This work is being done in collaboration with Professor P. Gyorgy of Philadelphia.

106. *Body composition*. Total body water was measured by injecting tritiated water intramuscularly and determining the concentration of the isotope in the urine and serum. Oedematous cases on admission have an average of 88 per cent. total body water, which falls to 67 per cent. on discharge. There is often a persistently high body water—about 80 per cent.—for weeks after clinical oedema has disappeared. The location of the excess water, whether it is extra- or intra-cellular, is being investigated with radioactive bromide.

Muscle biopsies were done on some 30 babies when oedema had first disappeared, and again just before discharge. Nitrogen, deoxynucleic acid (D.N.A.)-phosphorus, total phosphorus, potassium, sodium, chloride and creatine were measured on these specimens of approximately 100 mg. tissue. Potassium is low in the initial specimens compared with the final value and with the known composition of normal muscle, which re-emphasizes the severity of the original potassium depletion. Some initial specimens are also low in phosphorus. Nitrogen and D.N.A.-phosphorus measurements show an average loss of 35 per cent. of muscle protein in the malnourished state. The creatine content shows no consistent pattern so far. The creatinine output, supposedly an indicator of muscle mass, is reduced in the malnourished infant much more than the body weight, and increases during treatment much more rapidly. Skinfold thicknesses and limb circumference measurements show similar trends.

These studies indicate that in the malnourished baby the decrease in intracellular solids is much more severe than the deficit in body weight.

107. *Enzyme studies.* Work continued on liver enzymes measured in biopsy specimens, consisting of 1-2 mg. tissue, taken from babies soon after admission and again after recovery. The severe protein depletion of the liver cells found in earlier work suggested changes in the inter-relationships of enzyme systems rather than in their amounts. Attention was concentrated, therefore, on the more complex systems involving coupled reactions and apparently depending on intact mitochondrial structure, such as the oxidation of Krebs cycle substrates, oxidative phosphorylation and the uptake of phosphorus into phosphatides. Results suggest that even in the severely malnourished liver the oxidation rate is normal, but the uptake of phosphorus, which was followed with the radioactive isotope, and the formation of high-energy phosphate bonds, seem to be diminished. Oxidative phosphorylation has also been measured in livers from diabetic patients, and seems to be decreased when the diabetes is not controlled. Malic and glutamic dehydrogenases and transaminase were measured spectrophotometrically in liver specimens. Dr. J. D. Judah and Dr. K. R. Rees gave valuable assistance in this work. The levels of transaminase and isocitric dehydrogenase were determined in sera from sick babies. Some cases show high levels initially, which may indicate some tissue destruction superimposed on malnutrition, but the changes bear no obvious relation to clinical condition.

108. *Other laboratory work.* The loss of muscle protein in weanling rats fed on a simulated poor Jamaican diet was found to be even greater than the loss of liver protein. When refed on an adequate diet, the rats synthesize protein and D.N.A. much more slowly in muscle than in the liver. It is hoped to separate the different fractions of rat muscle by salt extraction and electrophoresis.

The free amino-acids of human milk were examined by chromatography; glutamic acid was found to be the one present in the largest amounts. This work continues in collaboration with Dr. J. Cravioto of Mexico City.

*Nutrition surveys.* Dr. Wills continued her examination of children aged 0-7 years in eight different country districts, measuring weights, heights, arm circumferences and skinfold thicknesses at two-monthly intervals on 190 children. The calorie and protein intakes of a few children living at home were carefully evaluated.

This survey, and that by Dr. K. L. Standard reported below, have afforded valuable data on the backgrounds from which the clinical conditions seen in the ward develop.

109. *Special enzymological studies.* In collaboration with Dr. J. C. Waterlow, the Director of the Unit, and Dr. K. R. Rees, these studies on human liver were made by Dr. J. D. Judah, of the Department of Morbid Anatomy, University College Hospital Medical School, London, assisted by a travel grant recommended by the Committee. The summarized observations of Dr. Judah are as follows. The main difficulties in such studies being the question of scale, since the material is mostly obtained by needle puncture, and ignorance of the behaviour of the tissue under the conditions used, the main aim was to establish dependable techniques and to make it possible for a single biopsy to be used for several determinations.

110. It was found that the Cartesian diver method could be applied to rat-liver homogenates very successfully. Using radioactive phosphate, it was possible to measure oxidative phosphorylation with good accuracy. By differential centrifugation of a total of 4 mg. of liver the various cellular fractions could be isolated. Thus the usual manometric procedures can be scaled down for use with small amounts of tissue.

In studies of spectrophotometric estimations of single enzymes, it proved possible to estimate malic dehydrogenase, isocitric dehydrogenase, glutamic dehydrogenase and transaminase in the small quantity of tissue available. Exemplifying the scale of the experiments, it was possible to measure oxidative phosphorylation using only 1  $\mu$ l. of 10 per cent. homogenate, and all estimations could be made simultaneously on 30–40  $\mu$ l. of such an homogenate.

111. A main objective was to use the gasometric methods to determine the activity of the integrated system of tricarboxylic acid cycle enzymes, and the spectrophotometric methods to decide whether selected single enzymes were functioning, the enzymes being chosen so as to afford some idea of mitochondrial integrity. In addition to the work with liver, methods were established for the estimation of various serum enzymes.

112. Aided by a grant recommended by the Committee, Dr. Oliver Wrong, of the Department of Medicine, University of Manchester, visited the Unit for five weeks to study, and advise on, certain electrolyte abnormalities occurring in infants severely ill with protein malnutrition who have a low serum albumen and gross oedema, and of whom 20 per cent. die. In particular Dr. Waterlow's group desired a lead on whether those abnormalities were due to disturbed renal function, or how otherwise they could be explained.

By various methods Dr. Wrong confirmed the frequent presence of acidosis in infantile malnutrition, and that it appears to depend on the severity of the accompanying diarrhoea. Evidence suggested that potassium depletion, known to disturb excretion of an acid urine, was responsible for the defect. Probably tubular abnormalities, which were demonstrated, would prove to be the result of potassium deficiency rather than of protein deficiency; and further work directed towards discovering the extent and cause of this deficiency was outlined.

113. *The Applied Nutrition Research Unit.* This Unit of the Government of Jamaica works in close relation with the Tropical Metabolism Research Unit. Dr. K. L. Standard, the Medical Officer-in-Charge, made a clinical nutritional survey of 40 families in five representative areas of Jamaica. Data on family food consumption were collected by the questionnaire method. The results are under analysis, prior to submission to the Government. In brief, Dr. Standard concludes that malnutrition still presents a serious challenge; although clinical signs of specific deficiencies are less common than ten years ago, three-quarters of the children between 1 and 7 years are sub-normal in weight, and more than half are below normal height. These



findings are confirmed by the survey of over a thousand infants and pre-school children in different areas made by Dr. V. G. Wills, a member of the staff of the Tropical Metabolism Research Unit. Dr. Standard found in many areas a high incidence of dental caries, which was inversely related to the fluorine content of the drinking-water, which was estimated by the Government Chemist.

114. Miss Helen Fox, Dietitian to the Unit, compiled a summary of all the available data on nutrient values of West Indian foods. She also assisted Professor MacKay in analysing the data on dietary intake of school-children obtained by him in a previous survey. These results show a dietary protein intake of the order of 40 g. per day, of which about fourth-fifths were from vegetable sources, mainly cereals. Since the biological value of cereal proteins is much enhanced by legumes, she began a study of the composition of the proteins in some Jamaican beans, devising a technique for estimating the basic amino-acids, particularly lysine, which is liable to be limited in diets of this type.

Mr. Mendes, Biochemist, has continued to work on the effect of malnutrition on the protein content of muscle in man and in rats fed on a Jamaican diet. Having shown that the total protein content was very severely reduced, the next step was to study the changes occurring in the different protein fractions of muscle. The preliminary results have been published.

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WILLS, V. G., and WATERLOW, J. C.—(1958) "The death-rate in the age-group 1-4 years as an index of malnutrition". *J. trop. Pediatr.*, **3**, 167.

115. *Mechanism of action of hypoglycin.* Dr. J. Patrick, of the Faculty of Physiology at the University College of the West Indies, Jamaica, investigating this problem with Dr. P. C. Feng, reports that his preliminary findings indicate that hypoglycin lowers both the blood-sugar and liver glycogen of rats made diabetic with alloxan, and that hypoglycin has no significant



effect on the utilization of glucose by the isolated rat diaphragm. Both these results conform with previous conclusions that the effect of hypoglycin is primarily on the carbohydrate metabolism of the liver. In rats treated with hypoglycin, liver transaminase was apparently unaffected. Fructose tolerance is not decreased, which is in contrast to the glucose tolerance of these rats. That glucose metabolism is affected while fructose metabolism is not would suggest that hypoglycin may affect the primary phosphorylation of glucose by the liver. Preliminary experiments indicate that there is a rise in blood-ammonia after administration of hypoglycin to rats; this may be significant in view of the demonstration of Greenstein *et al* that rises in blood ammonia may be accompanied by marked disturbances in carbohydrate metabolism.

116. *Effect of diet on the carbohydrate metabolism of the liver.* Work by Dr. Patrick, with Mr. A. Chung and Dr. E. A. Keen, has continued on the effect of variations in the carbohydrate, fat and protein content of the diet on the metabolism of rat-liver. The rate of lipogenesis by rat-liver as measured by conversion of radioglucose into fat by liver slices in vitro seems to be mainly a function of the carbohydrate content of the liver. The liver enzyme glucose-6-phosphatase does not appear to be significantly affected by feeding rats "lipogenic" diets, so that changes in the activity of this enzyme cannot be held responsible for the effects observed. Studies began on the changes induced by "lipogenic" diets on the amounts of reduced and oxidised co-enzymes I and II in the liver; changes were observed, but interpretation awaits further work. The effect of diet on the conversion of radio-glucose into protein in rats is also being studied.

117. *Constituents of human liver in various diseases.* Dr. Patrick, in collaboration with Dr. J. A. Tulloch and Dr. J. C. Waterlow, has continued the study on the changes in enzyme activities in the livers of patients with diabetes. It had been shown that a characteristic decrease in the activity of liver glucose-6-phosphatase occurs when the diabetic patients are stabilized. Effort is now directed towards the investigation of the time relationships involved in these changes. If the decrease in the activity of the enzyme occurs immediately after the administration of insulin before the diabetes is stabilized, it would suggest that this enzyme does in fact control the blood-glucose level. Micro-assays of two other enzymes, transaminase and glucose-6-phosphate dehydrogenase, have been developed and work begun on the estimation of these enzymes in liver biopsy material from diabetic patients. The continuation of this work should gradually build up a much more complete account of the biochemistry of the liver in human diabetes than has been heretofore available.

#### *Publications*

PATRICK, S. J., and TULLOCH, J. A.—(1957) "Glucose-6-phosphatase activity in human diabetes". *Lancet*, 1, 811.

#### *Nigeria*

118. Dr. O. A. R. Bassir, Lecturer in Physiology at University College, Ibadan, having established the range of the average normal values of the constituents of breast milk of Nigerian women, and their variations in different stages of lactation and feeding, turned to another aspect of the work. Groups of lactating mothers in Lagos are given daily supplements of soya bean flour prepared for human consumption by the Federal Government's Institute of Applied Technical Research in Oshodi. They and their controls (who do not receive the soya supplement), are in the first six months of breast feeding. Every four weeks the rate of production of milk by each woman is determined by the technique of test-weighing the baby. It is hoped that

the effect of supplementing the indigenous diets of African mothers with plant proteins will be reflected not only in an increased output of breast milk but also on the rate of growth of the infants who are breast-fed.

In view of the low calcium levels of the breast milk of Nigerian women described by him in an earlier report, possible changes in the calcium, phosphate, and phosphatase concentrations are also being sought.

Earlier paper-electrophoretic separation of milk proteins of Nigerian women showed the presence of a fraction of low mobility which seems to be identifiable with the fraction designated "cream" by Dr. Bassir. Experiments are therefore in train designed to record the electrophoretic pattern of whole milk which has been freed of this lipoprotein fraction.

#### *Publications*

BASSIR, O. A. R.—(1958) "Nutritional studies on breast milk of Nigerian women". *J. trop. Pediatrics.*, 4, 3.

#### *United Kingdom*

119. Professor B. S. Platt, Director of the Human Nutrition Research Unit of the Medical Research Council, London, has provided the following summary of those activities of his Unit which were directly related to nutrition research in Colonial territories. Aided by a travel grant recommended by the Committee, while participating in a W.H.O./F.A.O. Special Training Course and Seminar for nutrition workers at Kampala he visited the East African Institute for Medical Research at Mwanza at the invitation of its Director, Dr. E. G. Holmes, for discussions on the biochemical and nutrition research there proceeding, particularly in relation to the research programmes of Dr. D. S. McLaren and Miss P. G. Lutz, B.Sc., who were training under him, as Colonial Research Students, at the Human Nutrition Research Unit of the Medical Research Council, London, prior to being posted to Dr. Holmes' Unit. Dr. D. S. McLaren obtained the Ph.D. Degree (Lond.) on the results of his studies on the effects of malnutrition, in particular of protein-deficiency, on the eye; he also received a Ciba Foundation Award for an essay on "Age and nutrition in the aetiology of cataract". Miss P. G. Lutz also obtained the Ph.D. Degree (Lond.) for studies on the biochemistry of human milk, particularly the nature of its proteins and the effect on them of the state of nutrition of the mother; this investigation was greatly facilitated by the co-operation of Dr. Holmes and Dr. Sylvia Darke of the Institute at Mwanza, Dr. F. Sai of Ghana, and others in the Belgian Congo, India and Britain, who provided milk samples from normal and malnourished mothers.

#### *Publications*

LUTZ, P. G.—(1958) "The effects of the differences in the nutrition of lactating animals on the properties of their milk". *Ph.D. Thesis, Univ. of London.*

*Idem* and PLATT, B. S.—(1958) "The amounts and distribution of the nitrogenous components of the breast milk of British, Indian and African mothers, with special reference to the curd:whey protein ratio". *Proc. Nutr. Soc.*, 17, iii.

MCLAREN, D. S.—(1957) "Some effects on the eye of malnutrition, especially of deficiency of protein". *Ph.D. Thesis, Univ. of London.*—(1957) "Congenital malformations of the eye of the rat in protein deficiency". 4th Internat. Congr. Nutrition.—(1957) "Chronic protein deficiency and some congenital abnormalities of the eye of the rat". *Proc. Nutr. Soc.*, 16, xxiii.

*Idem* and BAGCHI, K.—(1958) "Some biochemical, histological and clinical effects of malnutrition on the eyes of experimental animals". *Ibid.*, 17, xix.

PLATT, B. S., McLAREN, D. S., and BAGCHI, K.—(1956) "Effects of protein deficiency and methionine antimetabolite on the eye". *Rep. 3rd Inter-African (C.C.T.A.) Conf. Nutr., Luanda.*

*Investigations on sickle-cell trait and sickle-cell anaemia*

120. These have continued, as a collaborative effort by workers in the field and in laboratories in Britain. Dr. J. C. White, of the Postgraduate Medical School of London, and Dr. G. H. Beaven, of the Medical Research Council's Laboratories, London, assisted by Miss M. J. Ellis, B.Sc., have continued their studies on the occurrence of foetal haemoglobin. They report that when more than 10 per cent. of the total pigment is present as Hb-F, comparable estimates are obtained from either the rate of alkali-denaturation or ultra-violet spectrographic analysis. For traces of Hb-F below 10 per cent. these methods lack sensitivity, but a combined technique of partial-denaturation and spectrographic analysis of the residue yields good estimates of the Hb-F down to the 1 per cent. level. Systematic examination of hereditary haemoglobinopathies reveals the highest percentage of Hb-F in post-natal life in thalassaemia major (80-90 per cent.), followed by the mixed syndrome of Hb-E thalassaemia disease (up to 31 per cent.). Other mixed syndromes involving thalassaemia and sickle-cell genes also exhibit a variable persistence of Hb-F; in sickle-cell/thalassaemia disease, 4.3-16 per cent.; in homozygous sickle-cell disease, 3-21 per cent.; and in sickle-cell/Hb-C disease, 1-4 per cent. About half the heterozygous individuals with sickle-cell or thalassaemia trait possess traces of <5 per cent. of Hb-F, but this is rarely present in traits for haemoglobins C and E.

121. No Hb-F has been found in severe hypochromic anaemia due to iron-lack or blood-loss. Search for Hb-F is, therefore, valuable in establishing true hereditary hypochromic anaemias of thalassaemia type, and examples have been found in families of purely Anglo-Saxon stock. Co-existent iron-deficiency and thalassaemia may occur in infancy particularly, and changes in the Hb-F with growth and iron-therapy may be useful in diagnosis. Some severe anaemias in Britain, such as pernicious anaemia and refractory anaemia with hyperplastic bone marrow, may possess traces of foetal haemoglobin, and are not conditions of a clearly hereditary nature.

Study of the behaviour of haemoglobin on paper electrophoresis has been continued, and comparative studies by boundary electrophoresis carried out in conjunction with Drs. Shooter and Skinner at University College, London. A particularly valuable technique for identification of natural haemoglobin mixtures has been by boundary electrophoretic resolution after addition of a third known haemoglobin.

*Publications*

BANNERMAN, R. H. O., and WHITE, J. C.—(1957) "Sickle-cell disease and pregnancy". *J. Obs. Gyn., British Empire*, 64, 682.

SHOOTER, E. M., SKINNER, E. R., and WHITE, J. C.—(1958) "The electrophoretic analysis of human haemoglobins". *Biochem. J.*, 69, 27.

122. Dr. H. Lehmann, of St. Bartholomew's Hospital, London, reports that, working with various collaborators (named below in brackets), the main emphasis of his studies was concerned with Asiatic populations. In Turkey a small population enclave near the Syrian border, the Eti-Turks, were systematically examined with Dr. M. Aksoy. In contrast to the true Turks

they possess the sickling gene at high frequency, and haemoglobin E can be found occasionally. In one family both haemoglobins occurred together; a new condition, sickle-cell haemoglobin E disease, could thus be studied. There was some evidence in favour of the inheritance of the genes for haemoglobins G and E being closely linked. In true Turks haemoglobin D can be found occasionally; one family with haemoglobin D was found with Dr. Aksoy near Mersin in Turkey; another, a Turkish Cypriot, was seen in London.

From India a Gujerati family with both haemoglobin J and thalassaemia was investigated (with Dr. L. D. Sanghvi and Mr. P. K. Sukumaran); and another family with haemoglobin J only. An instance of haemoglobin K was seen (with Dr. J. A. M. Ager) in a family in London of South Indian origin, and a new haemoglobin, L, was described in a Punjabi Hindu and his mother. A second instance has since been seen in Bombay by Dr. Sanghvi and Mr. Sukumaran.

Several Mongoloid populations were surveyed. In Malaya a high incidence of haemoglobin E was seen, and occasionally haemoglobin H and thalassaemia also (with Dr. R. B. Singh). With Dr. M. J. Colbourne a survey of Sea and Land Dyaks was made; no abnormal haemoglobins (with one exception) and no thalassaemia were discovered. With Dr. H. Thein, Burmese in Great Britain were surveyed. A high incidence of haemoglobin E was found. With Dr. J. M. Staveley of Auckland, New Zealand, several hundred Maoris and related Polynesian peoples were examined, without finding abnormal haemoglobins amongst them.

123. In Singapore a new haemoglobin was discovered in a Chinese family—haemoglobin Q; and a new haemoglobinopathy, haemoglobin Q-H disease, was observed (with Dr. F. Vella and others). In a partly Chinese family in London a new abnormal foetal haemoglobin was examined (with Dr. J. A. M. Ager and Dr. G. H. Beaven); this work is maturing, and the haemoglobin has been called provisionally "Haemoglobin Bart's." In the mother a new hitherto unrecognised haemoglobinopathy is being investigated.

Work on abnormal haemoglobins in animals continued, and differences could be seen in the haemoglobin distribution of cattle in Uganda according to their origin (with Dr. D. H. L. Rollinson, Animal Health Research Centre, Entebbe). Following A. D. Bangham's original observations in British cattle, where haemoglobin B indicated an origin from India of the Jersey and related breeds, a higher incidence of haemoglobin B was seen in Uganda in the Shorthorn Zebu, which is related to *Bovis indicus*, than in the Longhorn Ankole which is derived both from *Bovis indicus* and *Bovis taurus*.

#### Publications

AGER, J. A. M., and LEHMANN, H.—(1957) "Intra-erythrocytic haemoglobin crystals". *J. clin. Path.*, **10**, 336.—(1957) "Haemoglobin K in an East Indian and his family". *Brit. med. J.*, **1**, 1449.—(1957) "Haemoglobin L: a new haemoglobin found in a Punjabi Hindu". *Ibid.*, **2**, 142.

LEHMANN, H., and SINGH, R. B.—(1956) "Haemoglobin E in Malaya". *Nature, Lond.*, **178**, 695.

*Idem*, NORTH, A., and STAVELEY, J. M.—(1958) "Absence of the Diego blood group and abnormal haemoglobins in 92 Maoris". *Ibid.*, **181**, 791.

*Idem* and ROLLINSON, D. H. L.—(1958) "The haemoglobins of 211 cattle in Uganda". *Man*, **62**.

AKSOY, M., and LEHMANN, H.—(1957) "The first observation of sickle-cell haemoglobin E disease". *Nature, Lond.*, **179**, 1248.

COLBOURNE, M. H., IKIN, E. W., MOURANT, A. E., LEHMANN, H., and THEIN, H.—(1958) "Haemoglobin E and the Diego blood group antigen in Sarawak and Burma". *Ibid.*, **181**, 119.

BANGHAM, A. D., and LEHMANN, H.—(1958) "Multiple haemoglobins in the horse". *Ibid.*, **181**, 267.

VELLA, F., WELLS, R. H. C., AGER, J. A. M., and LEHMANN, H.—(1958) "A haemoglobinopathy involving haemoglobin H and a new (Q) haemoglobin". *Brit. med. J.*, **1**, 752.

124. Mr. E. B. Skinner, B.Sc., and Dr. E. M. Shooter in the laboratories of Professor E. Baldwin at University College, London, have continued their work on the factors affecting boundary shapes in moving boundary electrophoresis. Measurements of conductivity and pH in the various phases separating during electrophoresis confirm that the boundary shape is determined by these two variables. The mechanisms governing the changes in these two quantities are however complete, and are dependent on the interaction of haemoglobin with salt ions as well as on the already well known electrophoretic phenomena.

The analysis of haemoglobin systems in specifically chosen buffers (e.g. phosphate buffer pH 6.40 and ionic strength 0.04) has been further pursued. Thus the analysis at constant composition of artificial mixtures of haemoglobins A, S, E and C has shown that these haemoglobins migrate in the following order of positive mobility  $C > E > S > A$ . The different position of haemoglobin E in the mobility spectrum in phosphate and cacodylate/sodium chloride buffers suggests that the interaction between haemoglobin E and salt ions differs from the interaction of the other three haemoglobins with these ions, and therefore that the structure of haemoglobin E differs markedly from haemoglobins A, S or C. Analyses (in collaboration with Dr. N. A. Barnicot and Mr. Garlick) of haemoglobin G specimens have shown that this haemoglobin migrates between and can be resolved from haemoglobins A and S. The haemolysate of the homozygous specimen revealed about 2-3 per cent. of a faster migrating haemoglobin as well as the haemoglobin G, and in this respect is analogous to the haemolysate of cells from a normal adult.

Small changes in the haemoglobin composition of stored cells or haemolysate from the normal adult or individuals with thalassaemia minor can be followed by analyses in the phosphate buffer. In collaboration with Dr. J. C. White it has been found that haemoglobin A<sub>2</sub> is only stable in concentrated oxyhaemoglobin solution for about four days at either +2° or -20°C. After this period the haemoglobin A<sub>2</sub> content falls, another component appears and finally both are degraded. In carbonmonoxyhaemoglobin solutions at 2° C. degradation of haemoglobin A<sub>2</sub> occurs after seven days. Cells stored in acid citrate dextrose at 2°C., however, show no change in haemoglobin composition over three weeks.

#### *Publications*

ROSEMEYER, M. A., SHOOTER, E. M., and SKINNER, E. R.—(1958) "Conductivity and pH measurements in protein electrophoresis experiments". *Biochem. J.*, **69**, 27.

#### *Leprosy*

##### *Nigeria*

125. Dr. T. F. Davey, Senior Specialist, Nigeria Leprosy Service, Uzuakoli, has provided the following summary of the work done by his Research Unit, which is administered as part of the Nigeria Leprosy Service, Eastern Region, and to which the Federal Government contributes financially.

126. *Therapeutic studies.* The controlled trial of diphenyl thiourea compound Ciba SU 1906 (D.P.T.) has now completed its third year, and continues to fulfil its early promise. No signs of drug resistance have been encountered, and the progress of lepromatous cases as measured by decline in bacterial index exceeds that of controls on routine D.D.S. treatment. Several non-lepromatous cases discharged from treatment in a residual condition have remained in good health after nine months of observation.

Expanded trials in which six Settlements are co-operating are now in their second year. They cover a total of 167 patients, and findings after one year's experience can be summarized as follows. All centres have confirmed the freedom from toxic action possessed by the drug; its favourable action in neuritis and other complications of D.D.S. treatment have been noted; progress both clinical and bacteriological during the first year has been at least as good as, and in some cases better than, that of controls on D.D.S. treatment; D.P.T. can safely be used in combination with D.D.S. in standard dosage, and so far has produced results better than those seen with D.D.S. alone; and that it also can be used safely in combination with I.N.H., good therapeutic results having been obtained with a dosage of 1.0 to 1.5 gm. D.P.T. daily together with 100 to 200 mg. I.N.H.

The metabolism of D.P.T. is complicated, and it is still not possible to base the dosage regimen on any knowledge of its absorption and excretion. A trial of the drug on twice weekly administration is in progress. Clearly it has a place in leprosy treatment and supersedes thiosemicarbazone as an alternative to D.D.S. In patients with complications of leprosy it appears to be the drug of choice. The cost is high, however, and so it cannot replace D.D.S. for mass treatment in the immediate future.

*Diamino-diphenyl sulphoxide (D.D.S.O.).* During 30 months a pilot trial covering 24 patients has demonstrated that this drug possesses chemotherapeutic activity of the same order as D.D.S. when administered in a daily dose of 100 mg. In addition, in 33 patients of all types who have received experimentally 300 mg. twice weekly for 12 months it has proved quite effective.

On a basis of experience so far, D.D.S.O. resembles D.D.S. in activity and in toxicity. In some patients progress has been greater than would have expected with D.D.S., and all have had a notable freedom from subjective signs of neuritis. Any therapeutic advantages it may have over D.D.S. will, however, need a longer assessment. Clinically, D.D.S.O. does not appear to offer merely another method of administering sulphones, and the study of its absorption and excretion is of interest.

*Pyrazinamide.* In a pilot trial of 11 leprosy patients this drug was given alone in doses of 250-500 mg. daily. This is considerably lower than the dosage employed in short courses of treatment in tuberculosis, but low dosage was prompted by the necessity to continue treatment in leprosy for long periods without risk of toxic action, and also by the experimental finding that low concentrations had anti-tuberculous activity. No toxic effects occurred, but the therapeutic action was erratic. Some cases improved, one or two markedly so; others showed degeneration. The trial was abruptly ended after 15 months, when unmistakable signs of drug resistance appeared in two lepromatous cases. Both have subsequently shown satisfactory improvement under treatment with D.P.T.

*Diethyl-dithiol-isophthalate. I.C.I. Compound 15,688.* This substance, a member of yet another group of compounds possessing powerful anti-tuberculous activity, has been tried for five months. It is administered by inunction. As yet no opinion can be expressed on its usefulness. Undoubtedly

in lepromatous cases a powerful chemotherapeutic activity is evident sometimes in the first few weeks of treatment, but the effect is irregular and calls for further study. For the patient it would be sound psychology to have a drug which, supplementing oral treatment, could be applied directly to the diseased skin. Unfortunately, although readily absorbed, its penetrating odour does not commend it in its present form, and something more aesthetically acceptable is awaited.

*Sulphone by injection.* Following previous work at this Unit on Avlo-sulphone Soluble, a study has been made of a suspension of D.D.S. containing a new dispersing agent from the I.C.I. Laboratories. It has been demonstrated that with this preparation it is possible to maintain satisfactory blood levels of D.D.S. by injections given at fortnightly intervals.

127. *Immunology. Tuberculin-lepromin relationships.* Extensive comparative studies of the tuberculin and lepromin reactions in school children in rural and urban areas have been followed by the similar investigations of entire village communities. The results indicate that although in an urban community where tuberculosis is rife it is possible that tuberculosis infection is inducing reactivity to lepromin to some extent, other influences are also involved, and in rural areas there appears to be no direct causal relationship between one sensitivity and the other. Evidence is strong that non-specific constitutional and geographical factors have an influence on lepromin reactivity in these areas.

*B.C.G. in very early leprosy.* In a study of the effect of B.C.G. on tuberculin and lepromin sensitivity in very early cases of lepromatous and pre-lepromatous leprosy, in 30 such cases tuberculin conversion was induced in 60-70 per cent., but there was no significant enhancement of sensitivity to lepromin. These findings have an important bearing on the usefulness of B.C.G. in the prevention of leprosy.

*Inducement of positive lepromin reactions by extracts of normal skin.* The observation of Kooij and Gerritsen that extracts of normal skin can induce a positive Mitsuda reaction has been confirmed in an experiment on 50 patients. At the same time a comparative study was made of refined and crude lepromin in the same patients. Very little difference was found between the activity of refined lepromin and extract of normal skin in inducing the Mitsuda reaction, both being inferior to crude lepromin in this respect.

*Asian influenza and lepromin reactivity.* Immediately following the epidemic of Asian influenza, lepromin tests were repeated on many patients to ascertain whether that infection had any depressant action on lepromin sensitivity. No such action could be demonstrated.

128. With records available of many patients who have had long courses of D.D.S. treatment, it has been possible to produce graphs showing average decline in bacterial index during D.D.S. treatment. These are now used as the standard against which new drugs are assessed, and have largely eliminated the need for individual controls.

#### *Publications*

DAVEY, T. F., DREWETT, S. E., and STONE, C.—(1958) "Tuberculin and lepromin sensitivity in E. Nigeria". *Lep. Review*, **29**, 81.

LOWE, J., and DAVEY, T. F.—(1956) "Tuberculin and lepromin reactions in Nigeria: an analysis of the data of Lowe and McNulty". *Internat. J. Leprosy*, **24**, 419.

DAVEY, T. F., GARRETT, A. S., NICHOLSON, B., CORCOS, M., FERN, E., MATHESON, R., and MACDONALD, A.—(1958) "The treatment of leprosy with



diphenyl thiourea compound SU 1906 (D.P.T.). A second report on the progress of the pilot trial with a review of the findings in expanded trials". *Lep. Review*, 25.

#### Uganda

129. From Makerere College, Kampala, Dr. R. F. Naylor, Lecturer in Chemistry, has been investigating the effect of sulphones on the metabolism of cultured Mycobacteria, mainly *M. phlei*. He finds that the drug 4:4-diamino-diphenyl sulphone has a slight but definite inhibiting effect on the oxidative metabolism of saprophytic mycobacteria. However it is in growth experiments that the most marked and consistent effects can be obtained. The degree of inhibition is governed by a number of factors including concentration pH, and p-aminobenzoic acid antagonism.

130. On another investigation, on the use of tetrazolium salts to detect enzyme activity, he comments that until *M. leprae* can be cultured in the laboratory, experiments are limited to those that can be carried out on a sufficiently small scale to use bacteria taken from a human lesion. Continued study of the use of tetrazolium salts to detect dehydrogenase activity in *M. leprae* has been inconclusive. Various methods have been tried for the separation of bacteria from tissue (under conditions which will not damage the enzyme systems), and the resulting material has been suspended in phosphate buffer. Using penicillin to control the growth of contaminants, there is evidence of general dehydrogenase activity, but in the vast majority of cases either the tetrazolium is not penetrating the bacteria or they possess no activity. However, comparison of results obtained with bacteria from untreated and treated cases does suggest that there is a significant difference in the amount of dehydrogenase reached from the organisms. Further work is needed to verify this.

131. Dr. E. M. Brieger, at the Strangeways Research Laboratory, Cambridge, continued his study of the host-cell parasite relationship in lepromatous leprosy as revealed by electron micrograms of thin sections of lepromatous nodules. The field work was done in October, 1957, during a second visit to the Leprosarium of the African Inland Mission at Oicha, Belgian Congo, with the co-operation of Dr. C. K. Becker. An attempt was made to clarify the histologist's concept of the "foamy cell". The leprosy bacillus being an intracellular parasite, at least at certain stages of the disease, produces different cell responses which find their expression in structural changes in both bacilli and host cell.

132. A special study was made of the cell type known as the lepra cell which is predominant in chronic and treated cases. In the electron microscope it is characterised by intra-cytoplasmic inclusions, which consist of an osmophilic granular matrix and contain a system of vacuoles in which bacillary material is seen. These vacuoles have definite limiting membranes which probably represent the cell walls of degenerating bacilli. In more active and untreated cases, cells of the lepra cell type are rare or absent. In these cases clusters of bacilli are seen in cigar bundle arrangement within the degenerating cytoplasm of cells whose nuclei are enlarged and appear as empty vesicles. Vacuolisation of the cytoplasm, which is also seen in other pathological conditions, is non-specific.

133. To observe how bacilli in these two types of tissue response would react if tissue fragments were cultured in vitro, fragments of biopsy material were grown as organ cultures on rayon strips over embryo extract plasma cloths at 37° for periods up to 6 weeks, the strips being transferred to fresh medium every three days. Explants were fixed in buffered osmium



tetroxide, partially dehydrated, and left in 70 per cent. alcohol for transport. In the few untreated cases so far examined the growth changes observed suggested multiplication, which became evident only after 4-6 weeks culturing. In the electron micrograms at this stage the whole field was covered with colonies of filamentous bacilli, and these were not seen in the intermediate stages of cultivation. In chronic and treated cases no such development was observed. Further experiments are necessary to verify these preliminary observations and to explain the factors responsible for the changes seen.

134. In a study of the fate of bacilli in organ cultures of normal tissue, infected *in vitro* with bacilli from an active case, explants were made of adult guinea-pig spleen (proved to be an excellent medium for the tubercle bacillus) and of skin and spinal cord of a 12-day chick embryo. These experiments need to be repeated before definite conclusions can be reached. It could be seen, however, that a few macrophages had taken up bacilli, but the infection did not spread. After two weeks of culturing, isolated macrophages were still seen packed with bacilli.

135. The studies of morphological changes in cells and bacilli, as seen in electron micrograms before and during treatment, are being continued with a view to establishing a criterion of the effects of treatment. In October, 1957, a re-examination of treated cases previously examined in 1956 showed they had clinically improved, but they were still biopsy positive. In the paraffin sections the bacilli were of the granular type and less acid fast. The electron micrograms showed bacillary material inside osmophilic structures, and free bacilli were rarely seen.

136. From the National Institute for Medical Research, London, Dr. R. J. W. Rees of the Medical Research Council, reports as follows on his laboratory studies.

*Macrocyclon*. Supplies of this new drug were made available in February, 1958, to Dr. J. A. McFadzean at the Sungei Buloh Settlement, Federation of Malaya, for a pilot trial in leprosy. Invaluable information in the safety of giving *Macrocyclon* intravenously to man has been provided by Professor J. Crofton, Edinburgh, who started a pilot trial on 10 cases of advanced pulmonary tuberculosis early in November, 1957.

137. *Tissue culture studies with M. lepraemurium* have been vigorously pursued. The preliminary report of last year of significant though limited multiplication of *M. lepraemurium* in spleen explant cultures obtained from infected mice has been fully substantiated. Unfortunately this type of culture cannot be maintained in a healthy state for the long-term studies required to obtain continuous multiplication of a slowly growing organism. Such studies require the use of an established line of cells that can be infected with bacilli *in vitro*. Multiplication of *M. lepraemurium* in a strain of rat fibroblast cells (strain 14 pf) has now been successfully initiated. In the three most successful experiments the bacterial population increased approximately 5.5, 4.4 and 3.1 fold, respectively. There was no significant increase in the number of bacilli in similar cultures containing high concentrations of isoniazid and streptomycin. In general the initial rate of multiplication observed *in vitro* corresponded closely with that obtained *in vivo* in the mouse (12 days). Initiation of multiplication of *M. lepraemurium* in an established line of tissue cells (strain 14 pf) offers, for the first time, a reasonable system in which to study the conditions required for continuous multiplication.

138. *Morphological studies of M. lepraemurium and M. leprae.* Two distinct morphological types of rat leprosy bacilli have been identified by electron microscopy, and these morphological differences (so-called "normal" and "degenerate") are correlated with infectivity for the mouse. Similar differences have now been found in human bacilli (*M. leprae*) from lepromatous nodules. These studies have revealed that a high proportion (up to 80 per cent.) of the human bacilli are "degenerate" even when obtained from untreated cases. These latter findings in human leprosy are in contrast to our experience with rat leprosy, where even in advanced disease 80 per cent. or more of the bacilli are "normal". This would suggest that in man, even in lepromatous leprosy, there is greater host resistance than in the rat. It still remains to be seen whether there is a correlation between the proportion of degenerate bacilli and the type of disease in man. (These studies have been carried out in collaboration with Dr. R. C. Valentine).

139. *Attempts to transmit M. leprae to experimental animals* are being pursued systematically, using mice and rats; but there is no evidence, so far, of multiplication of the human bacilli.

In *immunological studies in rat leprosy* preliminary experiments have shown that B.C.G.-vaccinated mice develop considerable immunity to a subcutaneous challenging infection with *M. lepraemurium* and, furthermore, heat-killed B.C.G. produces better immunity than heat-killed *M. lepraemurium*. B.C.G. vaccination produces even greater protection when the challenging infection is introduced into the skin by multiple puncture (tattooing). The latter observation is of considerable interest since this is the most likely natural route of infection in man.

*Supplies of fresh leprosy tissue to laboratories in Britain.* The service, initiated during a visit by Dr. Rees to East Africa early in 1957, for the supply of fresh leprosy tissue to workers in Britain is proving very effective, and has been extended to West Africa and Malaya. With excellent co-operation from the leprologists in the field and the British Overseas Airways Corporation, and using a simple, though efficient, Medical Research Council type of "ice-box", fresh tissue can be obtained within 24-48 hours from the time of biopsy.

#### *Publications*

REES, R. J. W.—(1957) "The chemotherapeutic activity of Triton WR 1339 and Macrocyclon in murine leprosy". *Amer. Rev. Tuberc.*, **76**, 915.—(1957) "Some experimental approaches to leprosy." *E. A. med. J.*, **34**, 351.

*Idem* and WONG, P. C.—(1958) "Limited multiplication of *M. lepraemurium* in tissue culture". *Nature, Lond.*, **181**, 359.

140. *Liaison of oversea leprosy research centres with research centres in Britain.* Aided by grants recommended by the Committee, this liaison has been maintained by the frequent despatch to Britain by air of leprosy material from overseas, and by visits of British workers to oversea centres for short-term projects.

Among the latter, Dr. D. S. Ridley, Pathologist to the Hospital for Tropical Diseases, London, studied for two months at the East African Leprosy Research Centre, Itesio, Uganda, in collaboration with its Director, Dr. J. Garrod, the determination of the rate of progress of lepromas in patients on sulphones and other drugs by the method of serial biopsy. His interim conclusions were that lepromas in Africans in that locality are less uniform than in Europeans or Asians, and that the best indication that a case will progress rapidly is the number of lymphocytes and fibrocytes in the skin lesions before treatment.

141. Dr. D. G. Jamison, of the Department of Human Anatomy, Oxford, spent three months at leprosy centres in Northern Nigeria where, with the co-operation of the Senior Specialist (Leprologist), Dr. C. M. Ross, Dr. Hilton and others, he undertook studies designed to relate the clinical lesions of leprosy to their histopathology. In particular, he studied the phenomenon of the conversion from tuberculoid to lepromatous lesion, which in a few cases occurred despite treatment, indicating that some bacterial multiplication and perhaps nerve involvement can occur under cover of sulphone administration. From patients whose sensory disturbances were investigated in detail, biopsies of skin and nerves were taken for study at Oxford by neurohistological techniques by Dr. A. G. M. Weddell, Reader in Human Anatomy, Dr. Elisabeth Palmer and himself. The results are being correlated with the clinical data. Dr. Weddell reports that there are indications that these studies will eventually make it possible to assess the severity of the disease process in leprosy in a given subject in terms of changes in cutaneous sensory acuity and in the neurohistological picture which it presents. Preliminary studies suggest that these changes are directly related to prognosis in untreated cases and give some indication of the response which sulphone therapy would give, and that neurohistology affords a safer guide prognostically than a history and clinical examination alone. The disease in selected cases will be followed up by biopsies for five years. Other projects will include the examination of those who have never had contact with leprosy for charting the sensory acuity of the body surface, and inoculation studies designed to note the reaction of the Schwann cells to injection or inunction into skin and cornea.

142. As noted earlier, Dr. J. A. McFadzean is undertaking chemotherapeutic trials in Malaya, where he is also pursuing epidemiological and immunological studies. Dr. E. M. Brieger spent some weeks at Makerere College, Uganda, and the Oicha Leper Settlement in the Belgian Congo, to obtain leprosy material prepared by special techniques for his electron microscope studies.

#### *Tuberculosis*

##### *East Africa*

143. *Therapeutic trials in pulmonary tuberculosis.* Professor A. W. Williams of the Faculty of Medicine, Makerere College, Kampala, and Dr. J. Pepys, of the M.R.C.'s Tuberculosis Research Unit, London, have reported further on the joint trials proceeding in Kenya, Uganda and Tanganyika, the objectives of which are:

- (a) *therapeutic*, to study the effectiveness and toxicity of isoniazid in high dosage and the prevention of toxicity by pyridoxine; to relate these to individual variation between patients in the rapid inactivation of isoniazid in the body; and to obtain data of regimes continued for a longer period than had been attempted before under controlled conditions in hospital. The other regimes are PAS—isoniazid, and isoniazid in standard low dosage alone.
- (b) *bacteriological*, to obtain information upon emergence of resistant strains in relation to isoniazid dosage and to individual variations in isoniazid inactivation; also upon attenuation of virulence and the catalase activity of isoniazid resistant organisms, in relation to clinical progress.
- (c) as a separate subsidiary aspect, *serial tuberculin testing* before and during treatment which is being done on a uniform basis at all centres.

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Intake of patients began in May, 1957, and was closed on 30th September, but later extended to 31st December to allow replacement of patients lost to the investigation because of withdrawal owing to pre-treatment resistance, pregnancy, non-co-operation, or pre-treatment cultures having proved negative.

The flow of reports from all laboratories and clinical units is received at the Tuberculosis Research Unit, London, the co-ordinating centre for the investigation, where analysis of results is done and current trends are closely watched. Co-ordination in matters of local concern is at Kampala at the Department of Medicine in the Medical School.

Of 177 patients initially accepted, 148 remain. Of these 49 have completed six months of treatment, and 131 three months.

The three regimes of chemotherapy being used are (i) P.A.S. 10 g. with isoniazid 200 mg., daily; (ii) 800-1,200 mg. isoniazid, according to weight, with pyridoxine, daily; (iii) isoniazid 200 mg., daily.

144. The incidence and severity of drug reactions are low, and have not necessitated changes of treatment in any case. The results relating to sputum conversion after three months are:—

Regime (i)	Negative on direct smear: 87 per cent.	Negative on culture: 55 per cent.
Regime (ii)	Negative on direct smear: 68 per cent.	Negative on culture: 42 per cent.
Regime (iii)	Negative on direct smear: 59 per cent.	Negative on culture: 35 per cent.

145. *Thiosemicarbazone and isoniazid.* The results of the pilot trial ("T.B.1") undertaken early in 1957 for three months at three centres, as reported last year, gave results which were unexpectedly favourable in respect of the prevention of isoniazid resistance. Comparison of the results of this T.B.1 trial with those of P.A.S./isoniazid ("P.A.S.") and sulphone/isoniazid ("D.D.S.") groups was made after three months, and showed that the T.B.1 series gave figures only a little inferior to the P.A.S. group and greatly superior to the D.D.S. group in the following respects, (a) grading of culture positivity at 3 months; (b) conversion of sputum to negativity on culture, and (c) isoniazid sensitivity and resistance in positive culture. Radiographic analysis is awaited. Average weight gain was less over 3 months in the T.B.1 pilot series than in the P.A.S. or D.D.S. groups. There is some evidence that this is related to T.B.1 toxicity, at a daily dose of 200 mg.

The results suggest a useful rôle for T.B.1 in combination with isoniazid, particularly if these satisfactory bacteriological and sensitivity changes can be reproduced with a smaller dose of T.B.1 less likely to produce toxic effects and suitable for administration over long periods. A thiosemicarbazone-isoniazid regime would be cheaper than either streptomycin or the P.A.S. combination, and possibly cheaper than the high dose isoniazid-pyridoxine regime at present under investigation. The cost of one year's treatment with T.B.1 plus isoniazid would be about £1 17s. 6d. a year, as against £5 a year for P.A.S. plus isoniazid, and 10s. a year for isoniazid (200 mg. per day) alone.

No firm conclusion can be drawn from the small 3 months' pilot trial. The dose was probably too high; the period of treatment was too short; no control series was planned.

146. Thus the need for a further full-scale study of T.B.1 with isoniazid seemed imperative, and funds have been voted jointly by the East African Governments and by the Committee from its medical research allocation

to enable an additional study on 150 patients to begin in July, 1958, beyond which it will be concurrent with the existing comprehensive trials, including the follow-up phase, until 1960-61.

#### *West Africa*

147. *Chemotherapy trials.* Dr. W. J. Bell, the Director of the West African Tuberculosis Research Unit, which has its headquarters at Kumasi, has initiated trials with various régimes of treatment in three groups of patients, as below. The trials are designed to show whether definitive long-term chemotherapy is of lasting value in pulmonary tuberculosis as seen in West Africa, and to determine the most practicable régimes for each group.

(i) *In-patients.* These are treated for three months with either streptomycin (1 g. daily) and isoniazid (300 mg. daily), or streptomycin (1 g. daily) P.A.S. (12 g. daily) and isoniazid (300 mg. daily), being allocated to either of these régimes at random. On leaving hospital, all patients are offered nine months' further treatment with P.A.S. (12 g. daily) and isoniazid (300 mg. daily). Treatment is discontinued at the 12th month, unless there is an indication to the contrary, and thereafter the individual is investigated monthly to determine the relapse-rate.

(ii) *Urban out-patients.* Those urban cases who on account of non-availability of beds cannot be offered hospital treatment, are allocated to one of two out-patient régimes of chemotherapy, either streptomycin (1 g. daily) combined with isoniazid (300 mg. daily) for three months, and thereafter P.A.S. (12 g. daily) combined with isoniazid (300 mg. daily) for a further nine months, or P.A.S. (12 g. daily) combined with isoniazid (300 mg. daily) for twelve months. Cases are allocated to either of these two régimes at random, and treatment is discontinued at the 12th month unless there is an indication to the contrary. An attempt is made to review all cases monthly thereafter with a view again to determining relapse-rate.

(iii) *Rural out-patients.* Patients reporting from the rural areas of Ashanti, and who cannot be offered hospital treatment, are allocated to one of two régimes, either P.A.S. (12 g. daily) combined with isoniazid (300 mg. daily) for 12 months, or P.A.S. (6 g. daily) combined with isoniazid (300 mg. daily) for 12 months. It is hoped to determine whether P.A.S. given in this lower dosage—more acceptable to the patient over a long period of time—is sufficient to prevent isoniazid resistance.

A total of some 400 patients are under trial in the above groups, and it should soon be possible to discontinue admission to them and to undertake analysis of the results.

148. *Co-operative chemotherapy trials.* In co-operation with the Tuberculosis Research Unit, Regional physicians throughout Nigeria (at Lagos, Port Harcourt, Kaduna, and Ibadan) are undertaking an investigation of various further régimes of chemotherapy with a view particularly to determining the cheapest, most effective and most easily administered régimes that can be applied to the treatment of pulmonary tuberculosis, bearing in mind the local conditions in the various areas of that country. This work should prove complementary to that sited at Kumasi.

*Steroid trial.* As part of a broader plan to determine the best use that can be made of short-term hospitalisation, the role of the steroids as adjuvants to standard chemotherapy will be investigated. A strictly controlled trial comprising a three months' period of hospital treatment has begun. On leaving hospital each patient will be treated with a standard out-patient régime of chemotherapy for a further nine months. Prednisolone will be the steroid of choice.

149. *Epidemiological studies.* These will begin as progress in the above trials permits, and will be undertaken on a co-operative basis with various centres throughout West Africa. To this end a conference of Regional tuberculosis physicians from Ghana, Nigeria, Sierra Leone and the Gambia is projected in Lagos in the near future at which an integrated programme of epidemiological research on a wide front will be drawn up.

*Research at the Medical Research Council Laboratories, the Gambia*

150. The Director, Dr. I. A. McGregor, has furnished a summary of the activities of the Laboratories during the year. Excerpts from it pertaining to malaria and trachoma have been given in their appropriate context earlier in this Report at paragraphs 41 and 72 respectively. Other activities are noted below.

151. *Bancroftian filariasis.* Observations on the long-term therapeutic effects of Hetrazan on *W. bancrofti* infection were maintained and their scope increased by the introduction of further investigations in which small doses (5 mg./Kg. base total dose) have been administered to microfilaria carriers. Results continued to indicate that the maximal therapeutic efficiency of Hetrazan is not apparent for many months following treatment.

*Hookworm.* Assessment of the therapeutic value of the compound 1. Bromo 2 Naphthol in hookworm infections has continued, but unfortunately the promise of initial results has not been fulfilled. The drug appears inconsistent in its effects, and the excellent results reported by Japanese workers have not been confirmed.

152. *Virus infections.* In February, 1958, sera from adults resident in a rural district were investigated for specific antibodies to certain virus diseases. The antibody estimations were made at the National Institute for Medical Research, London, by Dr. J. S. Porterfield. The results are summarised below :

Virus	Percentage of sera positive	Geometric mean Titre
Polio I ... ..	100	6.8
Polio II ... ..	100	5.7
Polio III ... ..	100	6.4
Western Equine Eucephalomyelitis ... ..	4	—
Semliki Forest ... ..	61	3.0
Yellow Fever ... ..	96	2.9
Zika ... ..	80	3.1
Uganda S ... ..	55	1.8
Trinidad Dengue ... ..	86	3.5
West Nile ... ..	100	5.8
Bunyamwera ... ..	65	1.3

153. *Entomology.* In the Keneba area observations on the bionomics of the prevalent anopheline mosquitoes and on the efficiency of the residual insecticides Dieldrin, D.D.T. and B.H.C. have continued. Particular attention has been paid to the behaviour of mosquitoes of the *gambiae-melas* complex in village houses and in outside resting places.

154. *Visiting workers.* The work of the visiting Trachoma Research Group has been reported at paragraph 72. Dr. B. R. Laurence, Ph.D., of the London School of Hygiene and Tropical Medicine, investigated the breeding sites and host plants of *Mansonioides* mosquitoes throughout the rainy season of 1957. In another project a trial of the relative merits of a number of oily penicillin preparations was made by Dr. J. Humphrey, of the National Institute for Medical Research, London, at the request of the World Health Organisation.

*Publications*

ALLISON, A. C.—(1957) "Malaria in carriers of the sickle-cell trait and in new-born children". *Exp. Parasit.*, 6, 418.

WOODRUFF, A. W., and SCHOFIELD, F. D.—(1957) "Haemoglobin values among Gambians". *Trans. R. Soc. trop. Med. Hyg.*, 3, 217.

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McFADZEAN, J. A., and WEBB, R. A.—(1957) "Trace element deficiencies in Gambia". *Ibid.*, 5, 425.

SMITHERS, S. R.—(1957) "The occurrence of *Schistosoma mansoni* in the Gambia". *Ann. trop. Med. Parasit.*, 4, 359.

GOODWIN, L. G., and STANDEN, O. D.—(1958) "Treatment of ascariasis with various salts of piperazine". *Brit. med. J.*, 1, 131.—(1958) "Piperazine in treatment of hookworm infection". *Ibid.*, 1, 135.

*Research on the biology of sandflies in East Africa*

155. Mr. D. Minter, B.Sc., based on the laboratory of Dr. R. B. Heisch in Nairobi, continued his studies of the highly complex problem of the identification of the vector of kala-azar in the Kitui area of Kenya. Attempts to establish a number of *phlebotomus* species in culture had only limited success, as although many species have successfully completed the cycle from egg to adult in the laboratory, in no case has it been possible to continue for a further generation, due to the extremely high mortality in the larval stages. As a by-product of this aspect of the work, much preserved material of eggs, larvae, and pupae is available for subsequent morphological study and description.

Latterly priority has been given to a more extensive search of the two epidemic kala-azar areas in the hope of discovering other species of sandfly that may have been overlooked in the routine searches. As a result an apparently new species of the sub-genus *Sintonius* has been found in both areas, and its systematic status is being investigated. A visit to Tanganyika and Zanzibar to collect sandflies produced no new species, but widened the known distribution of the few forms found.

156. Much information has been obtained on the ability and readiness of various species of sandfly to feed on different animals. The most important observation in this series was that *P. martini* (the only anthropophilic sandfly of the major group known to occur in both kala-azar areas, and therefore a prime suspect as a possible vector of kala-azar), will feed as readily on dogs and ground squirrels as on man. The dog-feeding observation, made in nature, may have significance in the light of earlier work in the Middle East; a gland-smear survey of dogs in the two areas has begun. The feeding of *P. martini* on ground squirrels may also be important, for Dr. Heisch has isolated a virulent strain of *Leishmania* from this animal, and *P. martini* is found in nature in the burrows of ground squirrels; it is therefore possible that further studies may implicate this animal as a reservoir of the human infection.

Other studies of *P. martini* have shown that a second blood-meal is normally necessary for survival and the maturation of eggs, from which one may cautiously deduce that it is relatively long-lived. It is possible that in nature the interval between the first and second feed may be sufficiently long to allow the development of infective leptomonads. This observation helps to explain the difficulties experienced in keeping *P. martini* alive after feeding on human volunteers suffering from the disease. It is hoped in future to reduce these losses by offering a second feed.

157. Observations were made on the behaviour of *P. martini* populations found in the shafts of termite hills. Briefly they show that they are present in the shafts by day, and move up or down according to conditions of illumination and humidity. Between 5.30-6 p.m. an exodus begins, which is completed about 7 p.m., and may be a mating flight. Between 7-7.30 p.m. the insects return to the outside of the shafts, from which the unfed females come to bite human bait. Biting activity ceases by about 9 p.m. A return to the inside of the shaft commences between first light and dawn (i.e. 5.30-6.30 a.m.) and is completed by 8 a.m.; during this period, biting may occur, but is normally less intense than in the evening.

*East African Institute for Medical Research*

158. This Institute (Director: Dr. E. G. Holmes) was formerly designated the East African Medical Survey and Research Institute; the altered title has been adopted in conformity with the alteration in its research objectives, amongst which medical surveys now figure much less prominently. Four main research projects are in progress there, viz. filariasis, schistosomiasis (Mr. W. F. H. McClelland), relapsing fever (Dr. G. A. Walton) and nutrition; all these substantial contributions to the year's research under the aegis of the Committee have been summarized earlier in this Report in their appropriate context, *vide* paras. 16, 26, 88 and 98, respectively.

159. *Haematology*. Dr. A. R. Moore investigated the white cell count of the blood at Kikale, a place 50 feet above sea level on the Tanganyika coast, at Mwanza (3,700 feet) and at Eldoret in Kenya (6,800 feet). The total white blood count at Eldoret was slightly lower than that at Kikale, the difference being just statistically significant. The preponderance of lymphocytes over neutrophils previously noted in Mwanza was also obvious in the other two localities, and the decrease in the total white cells at Eldoret, as opposed to Kikale, appears due almost entirely to the higher eosinophil count at Kikale. These findings do not support the suggestion made by earlier workers that the change in the total white count and the distribution of the types of white cells depend upon altitude above sea level.

He has also confirmed that among Africans, pregnant women, as opposed to non-pregnant women, have a neutrophil/lymphocyte ratio comparable with that commonly found among Europeans. This change persists for the first week of the puerperium, but by the second week the figures are already tending to revert to those found among non-pregnant women. Another and rather surprising finding is that the eosinophilia, approximately 10 per cent., drops during pregnancy, and drops still further during the first week of puerperium, after which it tends to rise again. Helminthic infestation is so common that much work would be needed before it could be shown that this was not the cause of the original high eosinophil count. There is, however, no reason to suppose that infestation becomes less during pregnancy and the puerperium.

160. *Miscellaneous investigations*. In addition to Mr. W. F. J. McClelland's studies, various surveys for schistosomiasis were made in the Lake Province and on Ukerewe Island in collaboration with Dr. S. H. Wydell, the Medical Officer there.

A new species of *Paragordius* was reported from a European child, and a full description published.

Dr. Margaret Benton has continued her observations on the effect of malaria prophylaxis on the serum proteins of infants.

*Publications*

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571.—(1957) "A short account of a medical survey in the Kisii District of Kenya". *Ibid.*, **35**, 1.

RHODES-JONES, R.—(1959) "Intestinal myiasis in Tanganyika". *J. trop. Med. Hyg.*, **60**, 169.

YEH LIANG SHENG and JORDAN, P.—(1957) "On a new Gordiid worm, *Pseudogordius tanganyikae* gen. et sp. nov., parasitic in man". *Ann. trop. Med. Parasit.*, **51**, 313.

#### *Dermal leishmaniasis in British Honduras*

161. The Director of Medical Services, British Honduras, had noted that in recent years cutaneous leishmaniasis had become a problem in his territory and he requested help from the Committee. A scheme was therefore prepared for a pilot joint investigation for a period of six weeks by Professor P. C. C. Garnham and Dr. D. J. Lewis, with the triple objective of ascertaining the incidence of the disease, collecting man-biting species of *Phlebotomus* for study of their habits and search for leptomonads in them, and searching for an animal reservoir. The following is a summary of their preliminary observations.

They arrived in British Honduras in January, 1958, and worked mostly at El Cayo, near the Guatemalan border, making numerous sorties to forest areas where cutaneous leishmaniasis or *Phlebotomus* was prevalent. The weather was exceptionally dry, so that man-biting *Phlebotomus* quickly disappeared, which curtailed observations on the insects and prevented infectivity experiments.

162. *Distribution and incidence of the disease.* Cutaneous leishmaniasis of the New World occurs in three forms, (i) the classical "espundia" of Brazil, Peru and elsewhere, with involvement of the nasal mucosa in 80 per cent. of cases; (ii) a milder form occurring in Guiana, Panama and Costa Rica; and (iii) the chicleros' ulcer or "bay sore" of Mexico, Guatemala and British Honduras, which is largely confined to the ear. The organism is *Leishmania brasiliensis*, which is split up by some workers into sub-species. About 50 cases of "bay sore" were seen and detailed notes made of 33; the lesion affected the ear in 27. It was recent only in 10; in the remainder it was very chronic, in some of 30 years' duration, with much erosion (or destruction) of the outer ear alternately healing and ulcerating. Diagnosis was made by the typical appearance of a painless lesion, not responding to penicillin. The organism is practically impossible to find in all but the newest lesions; and the Leishman-Donovan bodies (of the *tropica* type) were found in four cases only. The Montenegro skin reaction, however, provided a useful guide to diagnosis in any suspected case which could be kept under observation for 72 hours.

163. The infection is probably widespread in the forests of British Honduras. It is confined to those who work in the forest or who sleep there for long periods during the rains; thus it occurs in the chicleros (chewing gum collectors), in whom an 80 per cent. incidence is alleged, and in some mahogany tree cutters. The disease is easily cured if treated early; but, if untreated, it becomes very chronic, sometimes destroying half the ear and attacking the nose. The forest area of British Honduras probably harbours an animal reservoir of the disease.

164. *Transmission.* Taxonomic study of the *Phlebotomus* collected is still in progress. Altogether 287 specimens of *Phlebotomus* were obtained. Of 151 individuals taken on human bait, 25 were *P. cruciatus*, 58 *P. shannoni*, 22 *P. panamensis*, 28 *P. ylephyletor*, 12 *P. (Brumptomyia) sp.*, 5 *P. guyanensis* and 1 *Phlebotomus sp.*, near *anduzei*, all caught in dense forest

during the hour after dusk, usually about 70 per hour or a mere three or four. The proportion of species varied from place to place. A modified Shannon trap (an illuminated tent-like structure with human bait) yielded *P. cruciatus* and *P. panamensis*; but catching on man proved quicker and easier, and gave information about man-biting species. A horse-baited trap of the Magoon type, normally used for mosquito surveys, produced *P. shannoni* and *Phlebotomus* sp. near *anduzei*. A few *P. panamensis* and *P. shannoni* on a horse standing on a road in the forest showed that these species will venture into the open for a short distance at least. Many *Phlebotomus*, chiefly not man-biting species, were smoked out of cavities among buttress roots and from caves. No *Phlebotomus* were found in and near houses, or in villages or towns. Man-biting species of *Phlebotomus* were common in thick forest during the rains.

It seems probable that the man-biting species of *Phlebotomus* are confined to "high bush", or at least to forest which still contains many high trees even if the canopy is incomplete. They will bite on the edge of such forest, in glades or even on a road running through; but apparently never in houses in towns. It seems most likely that infection of chicleros occurs during the night when they lie under poor nets, covered by a blanket, with little but their ears exposed. A number of freshly-caught *Phlebotomus* were ground up in saline and examined for leptomonads, but none were found. A horse-baited trap would probably yield the large number of flies necessary for such work.

165. *Animal Reservoirs.* Although other workers minimize the importance of animal reservoirs of the disease, Fairchild *et al* obtained results in Panama indicating that wild rodents might be involved; and the epidemiology of the disease in British Honduras indicates clearly that it is a zoonosis. Many animals were therefore examined for cutaneous lesions (from which smears were taken, or biopsies for sectioning) and for culture on N.N.N. Medium of heart blood. But smears and biopsies made from lesions on dogs, wild rodents, gibnuts, grey foxes, opossums and armadillos were all negative. Prolonged observations are clearly essential in such incrimination studies.

166. *Control.* It appears quite impossible to control the insect vectors, or the animal reservoir, scattered as they are through large areas of dense trackless forest. Personal protection by repellants and nets, possible in theory, is probably impracticable under the arduous conditions of a chiclero camp. Treatment with tartar emetic, stibophen, or other antimonials effects rapid cure of early cases of the disease; but the happy-go-lucky chiclero usually fails to complete the course, and the lesions become chronic. It is doubtful if such treatment would have much value in control of the disease, because of the animal reservoir.

Immunization of man against cutaneous leishmaniasis is extensively practised in the Old World, and it seems an obvious method for use in the New World. A few not very successful attempts have been made in Southern countries. It is intended to prepare for trial a vaccine from an attenuated strain brought back from British Honduras.

167. *Further research.* From this pilot survey the need clearly emerges for research on the distribution and bionomics of British Honduras *Phlebotomus*, particularly the man-biting species. Especially, it is important to identify the vector, to find how far it will emerge from the forest and if it could inhabit the large cocoa estates and banana plantations which are being developed. A study of the biting times of nulliparous and parous flies should show the hour at which people are most likely to be infected.

A thorough study of *Phlebotomus* distribution may not facilitate control, but will confirm where the danger of infection lies. It is intended to appoint an entomologist and a parasitologist for a three-year study of the problem.

*Miscellaneous projects aided by small research grants.*

168. Many small grants were given for a miscellaneous range of problems to make possible study of some facet that might otherwise be neglected. One such grant was again given to Professor J. N. P. Davies, of the Faculty of Pathology at Makerere College, Uganda, to provide a qualified assistant (Mrs. R. M. Coles, B.Sc.) for the analysis and distribution of the varied biopsy and autopsy material available in his laboratory. Amongst interesting objectives being studied by him are the neoplasm, multi-central sarcoma of the jaw, which occurs in a particular radioactive geographical zone in Uganda; Kaposi's sarcoma of the skin; and the body-weights, body-heights and heart renal weights in health and disease in Uganda Africans. Much material and relevant records have been supplied to scientists at St. Louis, U.S.A., Khartoum and the Imperial Cancer Research Laboratories, London.

**RESEARCH WORK UNDERTAKEN AND FINANCED BY THE  
MEDICAL DEPARTMENTS OF COLONIAL TERRITORIES**

169. A summary of the objectives of such current medical research in Colonial Territories, including Colonial University and Colleges, has been provided by various Governments. It is not possible to include it in full in a necessarily restricted report of this nature. Much of it is being undertaken in collaboration with the staff of research projects financially sponsored, at least in part, by the Committee, and has been recorded in the foregoing pages. Thus in Nigeria interesting research on the chemotherapy of tuberculosis is being undertaken by Dr. Henshaw at Port Harcourt and Dr. Hetreed in Ibadan in collaboration with Dr. Bell's Unit in Kumasi. In Kenya, Uganda and Tanganyika investigations by the territorial specialist tuberculosis officers are the basis of similar chemotherapeutic trials being undertaken in conjunction with the faculty of Medicine at Makerere College and the Medical Research Council. In Tanganyika studies are being made on drug resistance in malaria by Dr. Clyde and of the snail vectors of schistosomiasis by Mr. Webbe, both of the Tanganyika Malaria Field Unit at present sited at Amani alongside the E.A. Institute for Malaria and Vector-borne Diseases. Again, in Tanganyika interesting clinical studies on schistosomiasis by Dr. S. H. Wydell on Ukerewe Island have led to complementary laboratory work by Dr. W. F. J. McClelland of the E.A. Medical Research Institute at Mwanza. In British Guiana, the preliminary results of drug-treatment of bancroftian filariasis by Dr. Winston Adams, of the Government Medical Service, are being followed closely by the Standing Advisory Committee for Medical Research in the British Caribbean. In Fiji, the Government Medical Services are collaborating by complementary medical studies with the entomological studies of Mr. G. F. Burnett, seconded from the Pesticides Research Unit at Arusha, Tanganyika, to take charge of research on filariasis in Fiji.

170. From the Division of Insect-Borne Diseases of the Kenya Medical Department Dr. R. B. Heisch and his colleagues report further observations on Kala-azar and sandflies. *Leishmania donovani* was isolated from a ground squirrel (*Xerus rutilus*) and gerbils (*Tatera sp.*) in the kala-azar areas. The significance of these results is not yet clear. Further attempts were made to infect *P. martini*, but without success.

*Rickettsiae* of the *R. conori* type were isolated from rodents (*Otomys*, *Lemniscomys* and *Arvicanthis* sp.). Dr. J. H. S. Gear, of the South African Institute for Medical Research, has found that rickettsial strains isolated from ticks and rodents in Kenya are identical with, or very closely related to, those causing tick typhus in South Africa. Complement-fixing antibodies to *R. conori* var. *piperi* and *R. acari* are present in Nairobi rodents, while Nakuru rodents also contain antibodies to *R. mooseri* and *R. prowazeki*. (The complement-fixation tests were kindly undertaken by Dr. Gear.)

Considerable progress was made with the filariasis work on Pate Island. *Culex fatigans* is apparently the only vector of *W. bancrofti*. *Aedes pembaensis* transmits various animal filariae. These include a *Wuchereria* of the malayi-type, *D. corynodes*, *D. repens* and probably *D. immitis*. Most of the 3rd-stage larvae of the filarial species can be distinguished and identified in "wild" mosquitoes. On the Tana River the *Wuchereria* of the malayi-type is transmitted by *Taeniorhynchus* species.

The development of *S. recurrentis* was studied in lice. There was no "negative phase."

Colonial  
Pesticides Research Committee  
Eleventh Annual Report  
(1957-1958)

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

6th October, 1958.

SIR,

I have the honour to enclose herewith the Eleventh Annual Report of the Colonial Pesticides Research Committee for the year 1957-1958.

I am,

Sir,

Your obedient servant,

W. J. HALL,

*Chairman.*

The Right Honourable Alan Lennox-Boyd, M.P.,  
Secretary of State for the Colonies.

## COLONIAL PESTICIDES RESEARCH COMMITTEE

### Membership

- DR. W. J. HALL, C.M.G., M.C., D.Sc., Director, Commonwealth Institute of Entomology (*Chairman*).
- PROFESSOR G. E. BLACKMAN, M.A., Department of Agriculture, University of Oxford.
- BRIGADIER P. J. L. CAPON, M.D., Director of Army Health, War Office.
- DR. J. CARMICHAEL, C.M.G., D.Sc., M.R.C.V.S., late Colonial Veterinary Service.
- MR. W. F. DAWSON, M.B.E., Secretary, Tsetse Fly and Trypanosomiasis Committee.
- PROFESSOR P. C. C. GARNHAM, M.D., D.Sc., D.P.H., Director of Department of Parasitology, London School of Hygiene and Tropical Medicine.
- MR. G. V. B. HERFORD, C.B.E., M.Sc., Pest Infestation Laboratory, Department of Scientific and Industrial Research.
- MR. A. S. G. HILL, B.Sc., F.Inst.P., Chemical Defence Experimental Establishment, Ministry of Supply.
- DR. J. C. F. HOPKINS, D.Sc., A.I.C.T.A., Director, Commonwealth Mycological Institute.
- DR. H. G. H. KEARNS, Ph.D., Department of Agriculture and Horticulture, University of Bristol.
- DR. R. LEWTHWAITE, C.M.G., O.B.E., D.M., F.R.C.P., Secretary, Colonial Medical Research Committee.
- PROFESSOR J. W. MUNRO, C.B.E., M.A., D.Sc., Imperial College of Science and Technology.
- DR. C. POTTER, D.Sc., D.I.C., Head of Insecticides Department, Rothamsted Experimental Station.
- MR. D. RHIND, O.B.E., F.L.S., Secretary, Committee for Colonial Agricultural, Animal Health and Forestry Research.

### Ex-Officio Members

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

MR. C. A. KIRKMAN (*Secretary*).

MR. K. WILSON-JONES, M.Sc. (*Scientific Secretary*).

Officer-in-Charge, Colonial Pesticides Research—DR. R. A. E. GALLEY, Ph.D., D.I.C., F.R.I.C.

The terms of reference of the Committee are :—

- (i) to advise the Secretary of State for the Colonies on any problems concerning the use of pesticides which may be referred to the Committee by him ;
- (ii) to examine and advise upon research and experimental projects relating to pesticides which may be referred to it ;
- (iii) to initiate research in pesticides which is approved as desirable by the Secretary of State and to carry out experimental field work with these materials ;

- (iv) to co-ordinate agricultural, medical and veterinary interests in the use of pesticides in the Colonies and to ensure that the latest scientific information on these materials is available to those concerned with their use in the Colonies.

The work of the Committee is assisted by three Sub-Committees whose membership is as follows :—

#### SUB-COMMITTEE ON INSECT VECTORS OF DISEASE

- PROFESSOR P. C. C. GARNHAM, M.D., D.Sc., D.P.H., Director of Department of Parasitology, London School of Hygiene and Tropical Medicine (*Chairman*).
- DR. J. R. BUSVINE, D.Sc., London School of Hygiene and Tropical Medicine.
- MAJOR-GENERAL SIR GORDON COVELL, C.I.E., M.D., D.P.H., D.T.M. & H., Ministry of Health Malaria Research Laboratory, Horton Hospital, Epsom.
- DR. W. J. HALL, C.M.G., M.C., D.Sc., Director, Commonwealth Institute of Entomology.
- DR. F. HAWKING, D.M., D.T.M., National Institute for Medical Research, Mill Hill.
- DR. R. LEWTHWAITE, C.M.G., O.B.E., D.M., F.R.C.P., Secretary, Colonial Medical Research Committee.
- PROFESSOR G. MACDONALD, C.M.G., M.D., D.P.H., D.T.M., Director, Ross Institute of Tropical Hygiene.
- SIR ERIC PRIDIE, K.C.M.G., D.S.O., O.B.E., F.R.C.P., Chief Medical Officer, Colonial Office.
- MR. R. MOWFORTH (*Secretary*).

#### SUB-COMMITTEE ON METHODS OF APPLICATION

- DR. H. G. H. KEARNS, Ph.D., Department of Agriculture and Horticulture, University of Bristol (*Chairman*).
- MR. J. D. FRYER, M.A., Department of Agriculture, University of Oxford.
- MR. S. H. O. FRYER, A.M.I.Mech.E., Chemical Defence Experimental Establishment, Ministry of Supply.
- DR. A. B. HADAWAY, D.I.C., Ph.D., Colonial Pesticides Research Unit, Porton.
- MR. A. E. H. HIGGINS, A.R.C.S., D.I.C., Imperial College of Science and Technology Field Station, Silwood Park.
- MR. R. F. HILL, A.F.R.Ae.S., Colonial Pesticides Research Unit, Porton.
- MR. E. R. HOARE, B.Sc., A.M.I.E.E., National Institute of Agricultural Engineering.
- MR. J. E. MAYNE, Colonial Liaison Officer, National Institute of Agricultural Engineering.
- MR. A. C. PEACOCK, B.A., A.R.I.C., Chemical Defence Experimental Establishment, Ministry of Supply.
- MR. C. A. KIRKMAN, Secretary, Colonial Pesticides Research Committee.
- MR. K. WILSON-JONES, M.Sc., Scientific Secretary, Colonial Pesticides Research Committee.
- MR. R. MOWFORTH (*Secretary*).

## CROP PROTECTION SUB-COMMITTEE

- DR. W. J. HALL, C.M.G., M.C., D.Sc., Director, Commonwealth Institute of Entomology (*Chairman*).
- DR. R. A. E. GALLEY, Ph.D., D.I.C., F.R.I.C., Officer-in-Charge, Colonial Pesticides Research.
- MR. G. V. B. HERFORD, C.B.E., M.Sc., Pest Infestation Laboratory, Department of Scientific and Industrial Research.
- DR. J. C. F. HOPKINS, D.Sc., A.I.C.T.A., Director, Commonwealth Mycological Institute.
- PROFESSOR J. W. MUNRO, C.B.E., M.A., D.Sc., Imperial College of Science and Technology.
- MR. G. W. NYE, C.M.G., O.B.E., Agricultural Adviser, Colonial Office.
- MR. D. RHIND, O.B.E., B.Sc., F.L.S., Secretary, Committee for Colonial Agricultural, Animal Health and Forestry Research.
- MR. C. A. KIRKMAN (*Secretary*).



COLONIAL PESTICIDES RESEARCH COMMITTEE  
ELEVENTH ANNUAL REPORT

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## COLONIAL PESTICIDES RESEARCH COMMITTEE

### ELEVENTH ANNUAL REPORT

#### PART I. GENERAL

1. Meetings of the Main Committee and Sub-Committees were held as follows:

Main Committee : 28th May, 1957, and 17th October, 1957.

Sub-Committee on Insect Vectors of Disease: 30th May, 1958.

Sub-Committee on Methods of Application : 8th October, 1957.

Crop Protection Sub-Committee: 25th March, 1958.

Colonial Spraying Equipment Committee : 29th October, 1957.

2. No resignations from or further appointments to the Committee and Sub-Committees have taken place during the year.

3. *General.* The move of C.P.R.C. Headquarters and Information Service to the new Tropical Products Institute was completed in December, 1957.

The Auster J-5G aircraft has now been delivered to C.P.R.U. Arusha, and is already being used on insecticide, as distinct from assessment experiments. The West African Fungicides Team, so far consisting only of a mycologist and a chemist, has now commenced operations based on W.A.C.R.I. at Moor Plantation, Ibadan, with the study of the use of fungicides against Black Pod of Cacao as its primary objective ; and a team from Arusha is being detached to work on the coast, at Tanga, on problems of *Pseudothraupis* control.

#### 4. Staff

*Headquarters :* Dr. R. A. E. Galley attended two meetings in Geneva sponsored by the World Health Organization. The first was concerned with the phenomenon of sorption of insecticides by mud surfaces and its effect on mosquito control problems and the second was concerned with research on problems associated with the development, by insect vectors of disease, of resistance to insecticides. He also attended the IV International Congress of Crop Protection in Hamburg during September, 1957. Mr. K. Wilson-Jones visited a number of research stations in East and West Africa, S. Rhodesia and the Sudan during June-July, 1957, and attended the IV International Congress of Crop Protection in Hamburg during September.

*Home :* Mr. R. F. Hill visited East Africa in connection with the re-erection of the Auster aircraft following its transfer to the Arusha unit. Mr. A. H. Parker (Entomologist) resigned during the year, to take up the appointment of Lecturer at the University College of Khartoum, and his post was filled by Mr. P. T. Walker from Arusha.

*Overseas :* Mr. K. S. Hocking, Officer in Charge of the Colonial Pesticides Research Unit at Arusha, paid two visits to Nigeria in connection with *Chrysops* and Tsetse control measures. Mr. E. C. Hislop and Mr. P. O. Park were transferred early in 1958 to Nigeria to form the nucleus of the West African Fungicides Research Team, whose first objective will be investigations into the more efficient use of fungicides against Black Pod (*Phytophthora palmivora*) in Cacao. Dr. G. W. Ivens attended the CCTA/CSA symposium on Water Hyacinth at Leopoldville during December, 1957. Mr. K. S. McKinlay visited the Swaziland Irrigation Scheme during December, 1957, to advise on rice pest control experiments. Mr. H. C. M. Parr visited Mauritius in February, 1958, to report and advise on the control of *Stomoxys*. Mr. P. T. Walker, entomologist, moved from the C.P.R. Unit at Arusha to C.P.R.U. Porton.

## PART II. REVIEW OF RESEARCH WORK

## Colonial Pesticides Research Unit, Porton

(Dr. A. B. Hadaway in charge)

5. *Sorption of Insecticides by Dried Soils.* The first samples of soils sent under arrangement with W.H.O. from territories where malaria control schemes are in progress have been examined for sorptive activity at Porton. A few, from Iran, were less active than the standard, highly active Uganda mud. Others, from Zanzibar and Sudan, showed a wide range of activity, and certain of these have been indicated for field observations.

6. *New Insecticide Formulations.* Various insecticide wettable powders which have been formulated with additives, in endeavours to counteract the rate of loss of the insecticide by sorption, have been tested biologically. The relative effectiveness of dieldrin and dieldrin/resin deposits was found to vary with the method of testing and the behaviour of the insect species used. Incorporation of a wax into a gamma-BHC dispersible powder improved the residual effect on plywood panels against *A. stephensi* mosquitoes; there was no substantial improvement, however, on highly sorptive Uganda mud bricks. A new insecticidal lacquer, possessing the advantage of drying without the necessity of adding an accelerator, has been tested under laboratory conditions. Compared with a standard U.F. alkyd lacquer at the same concentration of insecticide it was only about half as effective as the standard when pick-up depended upon diffusion from the film into the insect; a situation which is probably quite common in practice.

7. *Residual Toxicity of Insecticide Deposits on Various Building Materials.* Following the experiments described previously, the biological activities of insecticide deposits at different times after application have now been determined. The test insect was female *A. stephensi* and the building materials which were treated with insecticides were unpainted plywood, plywood coated with a cellulose paint, plywood coated with an oil paint, rough sawn unplanned Malayan wood (meranti), split bamboo, palm thatch, grass thatch (Uganda) and grass thatch (Sudan). There was little difference in the initial effectiveness of deposits with the exception of the Malayan wood, in which case penetration of spray droplets below the fibres reduced the dosage available to mosquitoes alighting on the rough surface. Initially gamma-BHC was more active than dieldrin or DDT. Residual toxicities were essentially the same with the exception of plywood coated with oil paint; in this case persistence was increased although the contact action was reduced.

8. *Organo-Phosphorus Insecticides.* Further experiments have been carried out with these materials against female *Aedes aegypti*. Promising results were obtained with chlorthion which was comparatively more persistent than diazinon and more lethal than malathion. Biological tests have shown that the activity of deposits of organo-phosphorus wettable powders varies considerably on different materials, being less on porous materials than on plywood panels. The low biological activity on mud bricks, even immediately after spraying, is to a great extent due to the properties of the wettable powders used. In these the liquid insecticide is displaced from the carrier on dispersion in water and, in effect, a coarse emulsion is sprayed. This is absorbed by the porous substrate and the actual surface dosage available to insects is therefore very much less than the nominal one. Recent tests have shown that these substances do not diffuse deeper into the mud blocks as the chlorinated hydrocarbons do. Instead they stay in the superficial layers on mud and suffer progressive decomposition. Thus seven days after spraying on Uganda mud chlorthion was completely, and diazinon partially, hydrolysed.

9. Work on the mode of action of organo-phosphorus insecticides in mosquitoes has been restricted to preliminary observations on the properties of the esterases of *Anopheles stephensi* and *Aedes aegypti*. In most of the work o-nitrophenyl acetate has been used as the substrate and the extracts have been made from whole insects. *A. stephensi* is a more potent source of esterase activity than *A. aegypti*; various compounds are found to inhibit the esterase activity of the extracts.

10. *Environmental Conditions*. Studies on the influence of temperature and humidity upon the action of insecticides have continued with an investigation into the effect of humidity during the pre-treatment period. In general this factor does not appear to have a marked effect on the susceptibility of mosquitoes to DDT.

**Agricultural Research Council Unit of Experimental Agronomy,  
Oxford**

11. *Field Studies*. Further experiments on the effect of MCPB and 2, 4-DB on crops and weeds have been carried out with a small scale logarithmic sprayer. Considerable attention has been given to dalapon as a herbicide for controlling grasses. The possibilities of use of mecoprop, trichlorobenzoic acid and simazin have also been explored.

12. *Laboratory and Greenhouses Studies*. Experiments have been started with a number of different herbicides with a view to controlling *Striga* spp. but a rapid solution to this problem is not anticipated because of the long period required for germination of the seed. The range of species employed to investigate the selectivity of potential new herbicides has been extended to include tropical crops and a greater range of compounds has been tested for pre-emergence selectivity. Further pot experiments have fully confirmed the promise of simazin for controlling germinating weeds in maize. Research on the use of mixtures of herbicides has continued. Further progress is reported on the phytotoxic and selectivity factors involved in the translocation of herbicides through the plant. A radio assay technique based on carbon 14 has been developed to assist these investigations. Observations have also been made on auxin-stimulated respiration and on the growth of etiolated sections of pea internodes following exposures to indolylacetic acid, 2, 4-D and 2, 5-dichlorobenzoic acid and observations have continued on the physiological changes in temperate and tropical species that follow treatment with growth regulators.

**Imperial College Field Station, Silwood Park**

13. *Olfaction in Insects*. Certain fatty acids and the ammonium esters have been tested as olfactory stimulants against the tsetse fly *Glossina morsitans*. The free acid vapours attracted the flies at concentrations just above the threshold values but at higher levels, and generally when admixed together, they became repellent. The esters, which proved to be heat stable up to 80° C, behaved as attractants over a distinct range. *Stomoxys* sp., a biting fly, is to be used for future work since *Glossina morsitans*, because of its habit of resting for long periods, has proved unsatisfactory.

14. *Mode of Action of Insecticides*. The contamination of blowflies exposed to filter paper treatment with oil made radioactive with hexadecene partially saturated with iodine 131, is being investigated. The quantities taken up and absorbed are measured by counting the activities of external washings and tissue extracts of exposed flies. Additional information concerning the location of the oil is derived from autoradiograms of parts of the integument and of frozen sections of tissues. Studies have commenced on the distribution of different insect esterases and lipases and their possible inhibition by various

chlorinated hydrocarbon insecticides. Metabolism of the latter is being studied by a chromatographic technique capable of detecting as little as one microgram.

#### Long Ashton Research Station, Bristol

15. A member of the staff visited North Borneo between November, 1957, and March, 1958, to investigate methods of spraying Abaca hemp for the control of Bunchy Top disease, the vector of which is *Pentalonia nigronervosa*. Investigations, particularly on the effect of wetting agents on insecticidal efficiency, were carried out and tentative recommendations made.

16. Other work has included the investigation of fluorescent materials as tracers for the distribution of spray material on plant surfaces, the development of new and better sampling techniques for spray materials, and analytical work for micro quantities of spray materials including dieldrin. On the physics side, a new compressed air nozzle, giving improved droplet spectra coupled with greater efficiency has been under development.

#### Rothamsted Experimental Station

17. *Evaporation of Insecticides*. Experiments on the rates of evaporation of various DDT deposits have continued, and comparable studies have been commenced on the behaviour of deposits of other insecticides. The reasons for the unreliability of bio-assays using *Tribolium castaneum* as test insect have been investigated and a report is in course of preparation. A technique has however now been worked out using the housefly *Musca domestica* as test insect, which is yielding very satisfactory results.

#### Colonial Pesticides Research Unit, East Africa

(K. S. Hocking in charge)

18. *Experiments on Tsetse*. Bush clearing has been carried out in the Loljoro area, south of Arusha to isolate three blocks of infested woodland for experiments. One of these has been sprayed from the air and another has been given residual insecticide treatment from the ground. Treatment and observations continue. A block of tsetse country at Chungai (Central Province of Tanganyika) has been isolated by the Provincial Administration for experiments by the C.P.R.U. A pilot scale experiment will be carried out here later based on the results of the Loljoro trials. The aim of the experiments is to discover what reductions in the present high cost of aerial treatment can be made as a result of using lower volume dosages and a modified treatment schedule.

The Kabiganda Valley experiment in S.W. Uganda consists of 15 square miles of *G. morsitans* infested country which is being treated with residual deposits of insecticide applied to the favoured resting places of the fly. The treatments are being followed chemically as well as by bio-assay. Of the four modifications of the treatment applied the cheapest costs as little as 4s. per acre.

In the laboratory, interest has centred round the colonies of *G. morsitans* of which the third is now running. As the technique has improved, so has the average length of life of the flies, and their reproductive capacity has increased.

19. *Experiments on Mosquitoes*. On the Taveta-Pare scheme which is jointly operated by C.P.R.U. and the E.A. Institute of Malaria and Vector-borne Diseases, little is new to report. No further infected anophelines have been recorded since the last report (1956-57) and no notable changes in the human indices have been recorded. Observations on the exposure hazard (to

dieldrin) of the workers have been carried out. Trials of new formulations of insecticides which it is hoped will be resistant to sorption on mud walls are in progress.

A larvicide experiment, using a granular formulation of dieldrin applied from the air, was carried out in early 1956 in the environs of Dar-es-Salaam. The formulation ensured that the insecticide would penetrate vegetation and the granules arrive in the water beneath. It is estimated that a 90 per cent. reduction in the adult *A. gambiae* population resulted in and around the treated area.

No cases of resistance of *A. gambiae* to insecticide have so far been found either in the field in East Africa (including the Taveta Pare scheme) or in the laboratory colonies.

20. *Pseudotheraptus*. Work at Tanga was started in June, 1957, and a small outstation laboratory set up on the Government Dairy Farm there. Short-term trials are carried out principally at Tanga; longer-term experiments will be carried out in co-operation with the Zanzibar authorities on that island. A colony of *Pseudotheraptus* has been started at Tanga.

Recording has commenced on a number of plots at Tanga, to discover (1) the number of nuts shed at various stages of development, (2) the number of (1) with signs of *Pseudotheraptus* damage, and (3) the number of puncture marks on the damaged nuts. A "blanket" treatment has been applied by the Auster aircraft to a large plot in order to determine the behaviour of the coconut palms under as complete protection as possible.

#### 21. *Biting Fly Research Team, Uganda.*

(a) *Laboratory Studies*: The colony of *Stomoxys calcitrans* has been maintained throughout the year. The average weight of blood taken at each feeding has been shown to be approximately three times the body weight of the fly. Other studies on the life history of the fly are being made.

Further attempts to pass *Trypanosoma congolense* through rats have been unsuccessful.

(b) *Field Work*. A field station has been established during the year at Bukomero. Its purpose is to enable the natural breeding habits and behaviour of *Stomoxys* to be studied in relation to grazing cattle. A short survey of the *Stomoxys* problem in Mauritius has recently been completed, following a visit by H. C. M. Parr early in 1958.

22. *Other Agricultural Pests*. Experiments have been carried out to evaluate dosage distributions on cotton which has been treated with insecticides applied from a knapsack sprayer equipped with various attachments. Other experiments to determine the persistence of different insecticides on cotton and coffee leaves have been started. Methods are being worked out for treating seed beans with insecticides and work is in progress on the persistence of insecticides in tropical soils. Results from this latter so far indicate that there is no difference between the behaviour of dusts and emulsions.

23. *Fungicides*. Work is proceeding on the testing of various materials for controlling Halo-blight in infected dwarf bean seed, and is shortly (on the transfer of the team to West Africa) to commence on the control of Black Pod disease of cocoa. Chemical methods for estimating fungicidal residues on crop plants are being explored.

24. *Herbicides*. A report has been prepared summarising the results obtained with herbicides against several woody species including *Acacia* spp. *Combretum* spp. *Tarchonathus* sp. *Euclea* sp. and others, also on the control

of mangroves in Sierra Leone. Field trials have been carried out to compare the effect of various herbicides on pyrethrum, coffee and maize and in controlling the aquatic weeds *Eichornia crassipes* and *Pistia stratiotes*.

25. *Miscellaneous*. Four machines have been tested for suitability in applying fungicides to coffee. Other projects include studies of spray drift, droplet assessment, and improvements in the analysis of insecticides containing chlorine.

#### **Filariasis Research Unit, Fiji**

(G. F. Burnett)

26. *Field Work*. Regular surveys have been carried out in four villages at about three monthly intervals. *A. polynesiensis* is reported from Nukui and Korotongo; in the latter case it has been found breeding in thousands of crab holes nearby. *A. fijiensis* appears to be the main vector at Mau and Wainiyabia. House spraying has been carried out at Colo-i-Suva with DDT and at Mau with dieldrin emulsion. The treatment became effective in each case after 2-3 days.

The officer in charge was absent on leave during the early part of the year 1957-58.

#### **I.C.T.A. Herbicide Unit, Trinidad**

27. *Herbicide Studies*. Experiments are described on the control of weeds in rice (*Oryza sativa*) with single and mixed herbicides. The effect of various herbicides upon germination yield and quality of maize (*Zea mays*) has been studied.

The responses of groundnuts (*Arachis hypogea*) to pre- and post-emergence applications of MCPB and of yams (*Dioscorea* sp.) to various herbicides, have been investigated.

#### **Western Sokoto Malaria Control Pilot Project**

28. *Persistence of Insecticides*. (a) *Investigations*. An experiment has been performed to determine the effect of humidity on the persistence of residual insecticides deposited on mud walls. The mechanical analysis and the sorptive properties of three typical Nigerian building muds have been correlated and it has been shown that sorption is dependent upon the surface area of the fraction of clay of particle diameter less than  $66\mu$ .

Other experiments were carried out to observe the persistence of insecticides on thatch. Preliminary results show that there is a considerable difference between the persistence on thatch and mud walls and that the rate of loss of different insecticides increases in the order dieldrin, DDT, gamma-BHC, respectively.

(b) *Western Sokoto*. Evidence has been obtained suggesting a trend towards increased persistence of DDT in the surface half millimetre of wall due to the superimposition of successive half yearly dosages. Dieldrin, at approximately one-sixth of the DDT dosage, does not show this trend. Six months after the sixth application three times the initial dosage of technical DDT is in the surface half millimetre, but only one-quarter of the dieldrin dosage. BHC continued to show a high initial loss from the surface during the first month after application followed thereafter by a gradual decline.

#### **Coconut Pest Research, Zanzibar**

29. Results from the hundred acre experiment continue to show satisfactory increases in yield of coconuts and of treatment. The entomologist was on leave during the later part of the year under review and the writing up of the results of the work to date is proceeding.



**PART III. PESTICIDES RESEARCH NOT UNDER THE AEGIS OF  
THE COMMITTEE**

*Aden*

30. *Agriculture. Insecticides.* A study of the various pests of cotton has been started. Experiments to determine the time of emergence from the soil of Sudan bollworm have been arranged.

*Fungicides.* A preliminary field trial on the control of Abyan Root Rot indicated that a degree of control can be achieved by the application of formalin during field flooding.

*Barbados*

31. *Agriculture. Insecticides.* Promising results for the control of Cane root borer (*Diaprepes abbreviatus* L.) have been obtained in preliminary trials with the newer chlorinated hydrocarbon insecticides applied as soil treatments.

Laboratory work has been started to study the effects of insecticides on cane plants and on root borer larvae.

*Bermuda*

32. *Agriculture. Insecticides.* A vigorous campaign of spraying was carried out in all citrus orchards against the Mediterranean fruit fly (*Ceratitidis capitata*). Malathion 25 per cent. wettable powder was used as the toxicant and Staley's No. 2 sauce bait included in the spray as an attractant. Plastic traps, baited with angelica seed oil were set up in the orchards to check on the presence of the flies and to measure the effectiveness of the sprays. Spraying was carried out on a regular ten-day schedule from the middle of May until the end of August.

Excellent control of fruit fly was achieved in the treated orchards. Furthermore, through the use of the traps, valuable information was obtained on the seasonal trends and infestation centres of the fruit fly.

*Herbicides.* Studies designed to find a suitable control for the pernicious weeds *Oxalis* spp. were concluded. Kuron used in the form of a 2 per cent. solution proved to be extremely effective in controlling these weeds. Best results are obtained when the *Oxalis* is sprayed in full growth.

*British Guiana*

33. *Agriculture. Insecticides.* Control measures were taken against the following pests:

An outbreak of locusts (*Tropidacris latreillei*) on coconuts by aerial spraying with dieldrin.

Stainers (*Dysdercus ruficollis*) and jassids by low volume spraying with dieldrin.

A serious outbreak of Army worm (*Laphygma frugiperda*) on maize in the North West District by dusting with BHC.

Outbreaks of the defoliating coconut caterpillar (*Brassolis sophorae*) and moth borer (*Castnia daedalus*) by spraying with 1 per cent. dieldrin.

*British Solomon Islands*

34. *Agriculture. Insecticides.* During 1957 attention has been concentrated on developing a direct method of controlling *Amblyopelta* with insecticides, although trunk spraying is still being carried out in a limited area in an attempt to prevent the spread of harmful ants and of nutfall.

*Forestry.* A water-borne solution of sodium arsenite is in use for tree poisoning. This chemical is to be compared with hormonal contact arboricides.

#### *Cyprus*

35. The treatment of large quantities of citrus fruit to eliminate the Mediterranean Fruit fly (*Ceratitis capitata*) is being carried out with ethylene dibromide. Studies on field control with dieldrin, malathion and dipterex were also made.

#### *Fiji*

36. *Agricultural. Insecticides.* The campaign against Rhinoceros Beetle in coconuts continues by treatment of the crowns of the trees with BHC-sawdust mixture. About 700,000 crowns-treatments are applied annually. Diazinon has been shown to be more effective, but also more expensive.

*Fungicides.* Control of Leaf Spot of bananas by means of high-volume zinc-based sprays at 100-150 galls per acre has been shown possible, but uneconomic. Control is now being achieved by a low-volume (2 gallons per acre) application of a proprietary oil diluted with diesel oil.

#### *Gambia*

37. *Fungicides.* With experiments using Agrosan seed dressing, dressed seed gave significantly higher yields of unshelled nuts over the controls; the distribution of "Agrosan" to farmers is being made on a limited scale in 1958.

#### *Jamaica*

38. *Agriculture. Fungicides.* Trials have been arranged to test the relative merits of Bordeaux mixture and Dithane against Black Pod of Cacao (*Phytophthora palmivora*). Investigations are continuing into the disorders of various crops including "Brown Stem" and blistering of oranges and "Unknown" disease of coconuts.

*Forestry.* Research is being carried out on the efficacy of soil drenches with formaldehyde, aluminium sulphate and ferrous sulphate against damping off disease of Pine seedlings.

#### *Kenya*

39. *Agriculture. Insecticides.* Satisfactory control of Antestia (*Antestiopsis lineaticollis* Stal.) on coffee has been obtained with malathion 50 per cent. emulsifiable concentrate applied at 2 pints in 80 gallons water per acre.

Field experiments using dieldrin  $\frac{1}{2}$  per cent. bands against White Stem borer (*Anthores leuconotus* Pasc) confirmed the value of this method of control. An experiment on ant and mealybug control in pineapples was laid down using planting material treated by dipping in diazinon or fumigated with methyl bromide.

*Fungicides.* In an endeavour to overcome phytotoxic effects caused by spraying a soluble mercury fungicide to control coffee berry disease two trials with different fungicides have shown that one insoluble mercury preparation is at least as effective as phenyl mercuric acetate and that captan preparations are likely, also, to effect appreciable control of the disease.

*Herbicides.* 2, 4-D ester and 2, 4-D amine at 1 lb. acid equivalent per acre were the most promising materials tested for the control of broadleaved weeds in sisal.

40. *Veterinary. Hides and Skins Research.* For the protection of skins against hide beetle attack treatment with 0.05 per cent. gamma-BHC was more effective than the standard treatment with 0.25 per cent. sodium arsenite.

*Forestry.* For the protection of freshly felled logs against attack by Ambrosia beetle, treatment with oil sprays of 1 per cent. and 2 per cent. gamma-BHC has been recommended.

#### *Mauritius*

41. *Agriculture. Insecticides.* Attempts are being made to develop Dwarf Beans (*Phaseolus vulgaris*) as a field crop. This has been found possible by the control of *Melanoagromyza phaseoli* Coq. by spraying c' aldrin at the two leaf stage.

*Fungicides.* Results from the use of antibiotics on the virulent Bacterial Wilt disease of tomatoes, *Pseudomonas solanacearum* were not encouraging. No control was achieved by weekly sprayings of Streptomycin at concentrations of 100, 200 and 400 parts per million.

#### *Nigeria (Federation)*

##### *Nigeria (Eastern Region)*

42. *Herbicides.* Further trials are being arranged to determine details of application of herbicides on rice.

##### *Nigeria (Western Region)*

43. *Agriculture. Insecticides.* Capsid control experiments have confirmed that three monthly applications of BHC at 4 oz. per acre, starting in August, will reduce capsid damage to negligible proportions.

Satisfactory results in controlling yam beetles (*Heteroligus claudius*) on farmers' plots have been obtained from the use of 0.45 per cent. BHC dust.

#### *North Borneo*

44. *Agriculture.* Satisfactory initial mortalities are reported from the use of endrin at 0.0125 per cent. or malathion at 0.025 per cent. against the aphid *Pentalonia nigronervosa* on abaca. For residual effect endrin at 0.05 per cent. was found effective after 8 days and both 0.5 per cent. Agrocide and 0.1 per cent. malathion after 4 days. The endrin formulation also appeared to withstand weathering better than any other.

Abaca leaves could be wet completely with a spray or dip containing "Manoxol N" at 0.05 per cent.

#### *Northern Rhodesia*

45. *Agriculture. Insecticides.* Tests with various insecticidal treatments for the control of termite damage in young wheat showed that virtually 100 per cent. control was possible by the use of Dieldrex A, a combined dieldrin/mercurial seed dressing at 3 oz. per 100 lb. seed.

*Arboricides.* A good kill of many of the species found in *Combretum-Commiphora* thicket was obtained by the application of 2, 4, 5-T in all strengths over 2 per cent. on both cut stumps and as basal spray. Applications are now being made with a 2 per cent. basal spray over an area of some 3 to 4 acres to test the economics of the method.

46. *Medical. Tsetse Control.* The application at Kandabwe of 30 per cent. technical gamma BHC as a thermal aerosol from light weight TIFA's resulted in 99 per cent. fly mortality.

At Mwezia, insecticides applied as a thermal aerosol were used in conjunction with discriminative clearing to reduce fly density in an area into which villages were being moved. The cumulative effect of all these measures has led to virtual elimination of resident fly in the resettlement area.

#### *Nyasaland*

47. *Agriculture. Insecticides.* Chemical methods for the control of cotton stainers (*Dysdercus* spp.) are to be supplemented by the removal, in one area, of *Sterculia africana*, the main arboreal host. Laboratory work is being initiated into the life history and control of the red bollworm *Diparopsis castanea*.

*Herbicides.* Preliminary experiments with herbicides on tea showed that 15 lbs. of TCA per acre used as a post emergent spray gives good control of grass weeds for 8-10 weeks and the addition of 1 lb. of 2, 4-D gives some control over the broad leaved weeds. Dowpon gave good control of grass weeds but may cause damage to the tea.

#### *Sarawak*

48. *Medical.* The most important medical research done during 1957 was that connected with the malaria project where the main emphasis was the extension of spraying to cover the whole country. Transmission was halted in all areas except for three foci in the area sprayed with dieldrin where the probable vector was *A. barbirostris*.

#### *St. Vincent, The West Indies*

49. *Agriculture. Herbicides.* Encouraging results have been obtained with the pre-emergence application of 2, 4-D and MCPA herbicides to arrowroot and extensive trials on a field scale are in progress. Post-emergence applications of a range of herbicides to control weeds in arrowroot have been disappointing.

Successful general control of weeds in banana fields has been obtained by the use of sodium arsenite herbicide but on account of the danger to the careless and unskilled operators it is being successfully replaced by a combination of pentachlorophenol in oil and contact herbicides.

#### *Sierra Leone*

50. *Agriculture. Fungicides.* Observations have been kept on the incidence of *Piricularia oryzae* in the nurseries as the start of an investigation into the factors which determine the severity of this disease.

Encouraging results have been obtained in the use of 1 per cent. Carbide Bordeaux for the control of Cacao "Black Pod" disease.

*Herbicides.* Herbicide trials have shown that 2, 4-D ester in diesel oil is the most effective of the substances used on both *Avicennia* and *Rhizophora* mangrove. Without frilling of the trees, 4 per cent. strength gives a good kill but if the trees are frilled the strength can be reduced to 2 or even 1 per cent.

A further experiment on *Paspalum vaginatum* has shown that burning immediately prior to spraying reduced the strength of the effective dose of Dalapon to 10 per cent. Cutting before spraying leads to an increased strength needed to kill the grass.

#### *Tanganyika*

51. *Veterinary.* Ticks resistant to BHC were discovered in 3 scattered parts of the territory. Work has continued on the testing of new dip formulations and on the development of dip-side tests to determine the BHC content.

*Trinidad and Tobago.*

52. *Agriculture. Fungicides.* Trials with low volume sprays containing cuprous oxide to control fruit blemishing of grapefruit caused by Melanose (*Diaporthe citri*) and Scab (*Elsinoe fawcetti*) showed promise.

Further trials in the control of Banana Leaf Spot disease (*Mycosphaerella musicola*) have confirmed the effectiveness of low volume oil-based sprays.

53. *Medical.* Extensive tests with four well-known organophosphate insecticides viz. : malathion, diazinon, parathion and dipterex were carried out against 4th instar larvae of DDT resistant *Aedes aegypti*. A paper on this work is now nearly complete and will be published soon.

Two new field stations were established in the malarious districts of Matura and Caigual. Subsequent bromeliad surveys and human bait captures have established high *A. bellator* densities. Copper sulphate spraying of bromeliads has already begun in the latter district.

*Uganda*

54. *Agriculture. Insecticides.* As a result of trials comparing the effectiveness of insecticides for the control of coffee root mealy bug (*Pseudococcus* sp.) lindane 2.5 per cent. dust is now recommended for this purpose.

*Biting Ants.* In the berry borer control trial at Namalere it was found that 18.5 per cent. dieldrin liquid concentrate at  $\frac{1}{3}$ – $\frac{1}{2}$  pint to 4 gallons of water (about 0.2–0.3 per cent.) gave good control of biting ants. With low levels of infestation spot spraying of nests was sufficient; with higher levels it was necessary to spray the whole tree.

*Capsid; Lycidocoris mimeticus.* A severe outbreak of capsid on Bundae Coffee Estate near Masaka, was controlled by 0.2 per cent. w/v DDT sprayed at the rate of 1 pint per tree. Damage was widespread in the Masaka area, but the incidence declined to negligible proportions later in the year.

Good control of the Maize Tassel Beetle, *Megalognatha rufiventris* and of aphids on Citrus has been obtained with malathion 50 per cent. emulsion applied at  $\frac{1}{4}$  pint in 4 gallons of water.

Endrin at 4 oz. per acre was found to give a high percentage (90 per cent.) kill of aphids on cotton; the same insecticide also gave excellent control of Spiny Bollworm (*Earias* spp.) on cotton applied at 8 oz. per acre.

Excellent control of rice weevil *Calandra oryzae* has been reported using 0.5 per cent. BHC at 8 oz. per cu. ft. of cobs. (200 lbs.).

Almost complete protection of beans stored in iron drums was achieved over a period of six months with BHC dust. Promising results have been reported using DDT 50 per cent. wettable powder for the treatment of stores. Applied at the rate of 8 oz. in one gallon water to 1,000 sq. ft. satisfactory control of *Calandra* is occurring after 12 weeks.

Protection of wood against attack by the Carpenter bee (*Xylocopa* sp.) has been obtained by treatment with dieldrin 1 per cent. solution. Dieldrin 0.5 per cent. dust has given satisfactory results against various termites.

*Fungicides.* In Karamoja where it is usual to find up to 20 per cent. sorghum heads diseased with smut, *Sphacelotheca sorghi*; complete control and increases in stand have been obtained by using seed dressed with "Fernason D" (= 20 per cent. gamma BHC + 25 per cent. thiram).

*Herbicides.* A large measure of control of Couch grass (lumbugu) has been obtained, shortly after regeneration, with dalapon at 5 lbs./acre.

*Zanzibar*

55. *Fungicides.* Experiments are in progress to find means of restricting the spread of active sudden death disease in plantations of mature clove trees.

## PART IV. APPENDIX

## Reports and Publications

*CPRU Porton*

\*Studies on some aspects of the effect of the solvent on the toxicity of solutions of insecticides. A. B. Hadaway and F. Barlow. CIRU/Porton/Report No. 116.

\*Rotary atomisers. R. T. Jarman. CIRU/Porton/Report No. 127.

\*Studies on aqueous suspensions of insecticides. Part VI. Further notes on the sorption of insecticides by soils. F. Barlow and A. B. Hadaway. CIRU/Porton/Report No. 133.

\*Part VII. The influence of relative humidity upon the sorption of insecticides by soils. F. Barlow and A. B. Hadaway. CIRU/Porton/Report No. 134.

\*A comparison of a new insecticidal lacquer with the standard urea-formaldehyde formulation. F. Barlow and A. B. Hadaway. CIRU/Porton/Report No. 138.

\*A preliminary report on the residual properties of DDT and dieldrin on some materials used for house construction. F. Barlow and A. B. Hadaway. CIRU/Porton/Report No. 139.

The sorptive properties of soils from districts where control of mosquitoes is being attempted by house spraying. I. samples from Iran. F. Barlow and A. B. Hadaway. CIRU/Porton/Report No. 140.

\*Work in the Sudan and a visit to East Africa. (Microclimate of cotton). R. T. Jarman. CIRU/Porton/Report No. 141.

\*The toxicity of three organic phosphorus insecticides to house-flies and mosquitoes. A. B. Hadaway and F. Barlow. CIRU/Porton/Report No. 142.

\*Effect of acetone concentration and larval density on the mortality of *Aedes aegypti* larvae exposed to DDT and dieldrin. A. H. Parker. CIRU/Porton/Report No. 143.

The sorptive properties of soils from districts where control of mosquitoes is being attempted by house spraying. III. samples from Sudan. F. Barlow and A. B. Hadaway. CIRU/Porton/Report No. 147.

\*Further tests with dieldrin/resin wettable powder formulations. A. B. Hadaway and F. Barlow. CIRU/Porton/Report No. 151.

\*The residual toxicity of BHC on wood. A. B. Hadaway and F. Barlow. CIRU/Porton/Report No. 152.

\*The determination of DDT in peat samples. F. Barlow. CIRU/Porton/Report No. 153.

The residual toxicity to *Anopheles stephensi* of BHC dispersible powders. A. B. Hadaway and F. Barlow. CIRU/Porton/Report No. 154.

The residual toxicity to mosquitoes of insecticide deposits on various building materials. A. B. Hadaway and F. Barlow. CIRU/Porton/Report No. 155.

*Silwood Park*

Olfactory stimulation of tsetse flies and blowflies. J. C. Hughes. Bull. ent. Res., 1957, 48, 561-579.

Olfactory stimulation of *Glossina palpalis* by combustion products from petrol engines. J. C. Hughes. Bull. ent. Res., 1957, 48, 581-3.

The uptake of DDT and other lipophilic particles by blowflies walking over deposits. M. Gratwick. Bull. ent. Res., 1957, 48, 733-740.

The contamination of insects of different species exposed to dust deposits. M. Gratwick. *Bull. ent. Res.*, 1957, **48**, 741-753.

Studies concerning the uptake of contact insecticides. Part II. C. T. Lewis and J. C. Hughes. *Bull. ent. Res.*, 1957, **48**, 755-768.

#### *U.E.A. Oxford*

Selective toxicity in relation to specific differences in retention penetration and uptake. G. E. Blackman. IV Intern. Crop Protection Conference, Hamburg, 1957.

Studies in the principles of phytotoxicity V. Interrelationship between specific differences in spray retention and selective toxicity. G. E. Blackman, K. Holly and R. S. Bruce. *J. Exp. Bot.* (In press).

The potential value of herbicides in nature reserves. J. D. Fryer. Read to Linnean Soc. April, 1957. (In press).

Choosing the best herbicides for cereals. J. D. Fryer. *Agriculture*, 1958, **64**, 585-592.

The use of mixtures of phenoxyacetic and phenoxybutyric acids. K. Holly. *Plant Prot. Conf. Hamburg*, 1957.

A.R.C. Unit of Experimental Agronomy, Greenhouse and pot culture experiment section at University Field Station, Wytham, the present position. K. Holly. A.R.C. Unit Report D.79.

A direct-plating method for the precise assay of Carbon-14 in small liquid samples. C. C. McCready. *Nature*. (In press).

Growth of etiolated sections of pea internode following exposure to indole-3-acetic acid, 2,4-dichlorophenoxyacetic acid and 2,5-dichlorobenzoic acid. D. J. Osborne. *Plant Physiol.*, 1958, **33**, (i), 46-57.

The stimulatory effect of indole-3-acetic acid on the uptake of amino acids by tissue of *Helianthus annuus*. L. Reinhold and R. G. Powell. *J. Exp. Bot.*, 1958, **9**, (25), 82-97.

Annual review of plant physiology, 1958, Vol. 9. E. K. Woodford, K. Holly and C. McCready.

#### *Long Ashton*

Spray application problems: the performance of a power knapsack mist blower. T. E. Cobbald. *Ann. Rep. Long Ashton Res. Sta.* 1957. (In press).

Spray application problems: a compressed air nozzle for small volume spraying. T. E. Cobbald. *Ann. Rep. Long Ashton Res. Sta.* 1957. (In press).

Spray application problems: the use of fluorescent materials as tracers in spray liquids. H. R. Mapother. *Ann. Rep. Long Ashton Res. Sta.* 1957. (In press).

Spray application problems: mercury deposits on apple fruits and foliage. J. A. Pickard and J. T. Martin. *Ann. Rep. Long Ashton Res. Sta.* 1957. (In press).

#### *CPRU Arusha*

Trials of residual insecticides against Anophelines in African-type huts. G. F. Burnett. *Bull. ent. Res.*, 1957, **48**, 631-668.

Unusual orographic cloud formation. H. H. Coutts. *Weather*, 1957, **12**, 320-322.

Portable recording anemometer for remote locations. H. H. Coutts. *Weather*, 1958, **13**, 36.

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Experiments on the synthesis of the pyrethrins. Part XIII—total synthesis of ( $\pm$ )-*cis*- and -*trans*-chrysanthemumdicarboxylic acid, ( $\pm$ )-*cis*- and -*trans*-pyrethric acid and rethrins II. (Work done at King's College, University of London.) L. Crombie, S. H. Harper and K. S. Sleep. J. Chem. Soc., 1957, 2743-2754.

Observations on laboratory colonies of the tsetse flies *Glossina morsitans* West. and *Glossina austeni* Newstead. R. Foster. Parasitology, 1957, 47, 361-374.

The effects of a chemical defoliant on an isolated tsetse community and its vegetation. J. D. Fryer, D. L. Johns, and D. Yeo. Bull. ent. Res., 1957, 48, 359-378.

Notes from East Africa. G. W. Ivens. P.A.N.S., Section C, 1957, 3, (4), 205-208.

Some possible uses for arboricides in East Africa. G. W. Ivens. Proc. IVth Intern. Congress Crop Prot. Hamburg, 1957.

Studies of crop loss following insect attack on cotton in East Africa. I. Experiments in Uganda and Tanganyika. K. S. McKinlay and Q. A. Geering. Bull. ent. Res., 1957, 48, 833-849.

A preliminary note on the control of red bollworm, *Diparopsis castanea*, with insecticides. K. S. McKinlay, E. C. G. S. Review, 1957, XXXIV, 253-57.

The persistence of insecticide deposits applied to the bark of coffee trees (*Coffea arabica*) I.—DDT deposits. J. Robinson and E. T. Mesmer. East African Agric. J., 1957, XXIII, 130-134.

The persistence of insecticides in tropical soils. I.—preliminary investigations. J. Robinson and E. T. Mesmer. East African Agric. J., 1958, XXIII, 199-202.

Insecticide studies on East African agricultural pests. I—*Epilachna hirta*. II—*Cylas punaticollis*. P. T. Walker. Bull. ent. Res., 1957, 48, 341-347.

The progress of stalk borer control in East Africa. P. T. Walker. Proc. IVth Intern. Congress Crop Prot. Hamburg, 1957.

\*The use of glossy paper for determining droplet sizes. D. Yeo and H. H. Coutts. Nature, 1957, 179, 864-865.

The susceptibility of *Anopheles gambiae* Giles, from Mombasa and district, to DDT, BHC and dieldrin. J. A. Armstrong. C.P.R.U. Tanganyika Misc. Report No. 181.

A preliminary study of machines used for fungicidal applications in coffee plantations. D. Yeo and H. H. Coutts. C.P.R.U. Tanganyika Misc. Rep. No. 182.

A preliminary note on the control of the red bollworm *Diparopsis castanea* with insecticides. K. S. McKinlay, C.P.R.U. Tanganyika Misc. Report No. 183.

Chemical estimations, Nandi Malaria Control Scheme—3rd cycle. P. O. Park. C.P.R.U. Tanganyika Misc. Report No. 184.

Aircraft applications for Anopheline control—prevention of a seasonal increase with a granulated formulation. D. Yeo and D. Bagster Wilson. C.P.R.U. Tanganyika Misc. Report No. 185.

Dosage distributions upon hand-sprayed cotton. D. Yeo. C.P.R.U. Tanganyika Misc. Report No. 186.

\*Report on a visit to Sierra Leone, April 15th-June 6th, 1957. C.P.R.U. Tanganyika Misc. Report No. 187.



\*Proprietary herbicides in East Africa. G. W. Ivens. C.P.R.U. Tanganyika Misc. Report No. 188.

\*Tsetse movement between isolated bush areas. R. Foster. C.P.R.U. Tanganyika Misc. Report No. 189.

Swaziland Irrigation Scheme—insect pests of rice. K. S. McKinlay. C.P.R.U. Tanganyika Misc. Report No. 190.

The progress of stalk borer control in East Africa. P. T. Walker. C.P.R.U. Tanganyika Misc. Report No. 191.

Hormone contamination in a sample of Didimac. P. O. Park. C.P.R.U. Tanganyika Misc. Report No. 192.

Experiments with mosquitoes during 1957. K. S. Hocking. C.P.R.U. Tanganyika Misc. Report No. 193.

A note on the use of Dalapon to control couch-grass in coffee. G. W. Ivens. C.P.R.U. Tanganyika Misc. Report No. 194.

Report on the Water Hyacinth Conference, Leopoldville, December, 1957. G. W. Ivens. C.P.R.U. Tanganyika Misc. Report No. 195.

Progress Report on coconut pests. K. S. McKinlay. C.P.R.U. Tanganyika Misc. Report No. 196.

Report on a visit to the Northern Region of Nigeria. K. S. Hocking. C.P.R.U. Tanganyika Misc. Report No. 197.

Insecticide contents of soils, submitted by the Helminthiasis Research Scheme of the West African Council for Medical Research. P. O. Park. C.P.R.U. Tanganyika Misc. Report No. 198.

Notes on some recent experiments in Nigeria on the bioassay of sprayed surfaces. Working paper No. W.P:6/8 prepared by D. M. Langbridge, V. Ramakrishna and R. Elliott for the W.H.O. Expert Committee on Insecticides Resistance and Vector Control meeting at Geneva in October, 1957.

\* Circulated to the Committee.

# Colonial Products Council Fifth Annual Report (1957-1958)

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Courtauld Institute of Biochemistry,  
The Middlesex Hospital,  
Medical School,  
London, W.1.

SIR,

I have the honour to enclose herewith the Annual Report of the Colonial Products Council for the year 1957-1958.

I am,

Sir,

Your obedient servant,

E. C. DODDS,  
*Chairman,*

The Right Honourable Alan Lennox-Boyd, M.P.,  
Secretary of State for the Colonies.

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- PROFESSOR SIR ALEXANDER TODD, M.A., D.Sc., F.R.I.C., F.R.S., Professor of Organic Chemistry, University of Cambridge.
- DR. J. WALKER, D.Sc., Medical Research Council.
- PROFESSOR SIR SOLLY ZUCKERMAN, C.B., M.A., M.D., D.Sc., F.R.S., Office of the Lord President of the Council.
- MR. W. F. DAWSON, M.B.E. (*Secretary*).
- \*DR. P. C. SPENSLEY, M.A., B.Sc., D. Phil., F.R.I.C. (*Scientific Secretary*).
- \*DR. S. S. BAMPTON, B.Sc, Ph.D., is to succeed Dr. P. C. Spensley as Scientific Secretary to take effect from 1st August, 1958.

The terms of reference of the Council are :

- “ 1. To consider how, by the application of research, greater use can be made of Colonial plant and animal products.
2. To advise the Secretary of State as to (a) the Colonial raw materials (plant and animal) which are likely to be of value to the manufacture of products required by industry, and (b) the research and development which should be initiated on such products.”

COLONIAL PRODUCTS COUNCIL  
FIFTH ANNUAL REPORT, 1957-58

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## COLONIAL PRODUCTS COUNCIL AND TROPICAL PRODUCTS INSTITUTE

### FIFTH ANNUAL REPORT

#### PART I. GENERAL

1. *Rehousing, Renaming and Expansion of the Colonial Products Laboratory.* Because of the plans for the extension of the Imperial College of Science and Technology, the Colonial Products Laboratory and Colonial Products Council Secretariat were required to leave the Imperial Institute building and in December, 1957, they moved to new premises in Gray's Inn Road, Holborn. The building concerned had been fitted out to provide the organisation with excellent modern laboratory, library and office accommodation and on a scale that would allow the staff to be increased substantially. This expansion of staff which had been planned on lines approved by the Council, was for the purpose of conducting more fundamental research on tropical products than had hitherto been possible and of providing sections to deal with economic and development studies; the advisory services of the organisation were also to be strengthened. Simultaneously with the move to Gray's Inn Road the title of the organisation was changed to the Tropical Products Institute. The new address is: 56/62, Gray's Inn Road, London, W.C.1. (Tel. CHAncery 5412-9.)

2. *Council Meetings.* The Colonial Products Council met informally in March to inspect the Institute's new premises in Gray's Inn Road.

3. *Membership.* The membership of the Council has remained unchanged.

4. *Visits.* Dr. R. A. E. Galley, Director of Research, with Dr. R. Holroyd, a member of Council, visited the West Indies in July to attend a meeting of the Sugar Research Scheme Advisory Committee at the Imperial College of Tropical Agriculture. While there, they visited the Colonial Microbiological Research Institute in Trinidad and the University College of the West Indies in Jamaica.

Dr. R. H. Kirby, Head of the Fibres and Papermaking Materials Section, visited the Northern Region, Nigeria, in September/October at the request of the Ministry of Trade and Industry to take part in trials there concerned with the mechanised production of *Urena lobata* fibre.

Dr. W. D. Raymond, Head of the Oilseeds and Foodstuffs Section, visited Nigeria and the British Cameroons in February at the invitation of the Nigeria Produce Marketing Board to study the palm oil industry and to advise on methods of processing for improving the quality of native-produced oil.

Mr. D. Halliday, of the Oilseeds and Foodstuffs Section, attended the Conference on the Dehydration of Foodstuffs, organized by the Food Group of the Society of Chemical Industry, which was held in Aberdeen in March.

5. *International Meetings.* Dr. Kirby and Mr. A. E. Chittenden attended the third meeting of the European Group of the American Technical Association of the Pulp and Paper Industry held in Graz, Austria, in July.

Dr. Raymond attended the 16th International Congress of the International Union of Pure and Applied Chemistry held in Paris in July.

6. *Committee Meetings.* A meeting of the Consultative Committee on Essential Oils was held in November, under the Chairmanship of Professor D. H. R. Barton, successor in this capacity to the late Sir John Simonsen.

The development of Naval Stores industries in Colonial Territories was discussed and problems concerning the production of essential oils in the East African territories were considered.

A special meeting of the Consultative Committee on Vegetable Fibres was held in May to discuss the marketing of *Phormium tenax* fibre from St. Helena.

## PART II. INQUIRIES, INVESTIGATIONS AND RESEARCH

7. This part of the Report is divided into three sections covering, (a) inquiries dealt with at the Tropical Products Institute, (b) investigations carried out at the Institute and (c) work, principally research and development, carried out elsewhere under the direction or with the assistance of the Council.

### (a) INQUIRIES DEALT WITH AT THE TROPICAL PRODUCTS INSTITUTE

8. The Institute has dealt with 807 inquiries during the year; 42 inquiries were in hand at the end of the period. Examples of those dealt with are given below:—

#### Essential Oils

9. *Geranium Oil*. The sustained high price of geranium oil throughout the year has aroused considerable interest among those wishing to enter the essential oil field. Inquiries about the possibility of its production were received from Kenya, Tanganyika and Northern Rhodesia and in all cases the Institute has been careful to stress in its reply the importance of starting with cuttings of planting material of suitable varieties, since the trade is only interested in supplies of this oil of a quality closely resembling that of the established sorts. The examination of the first sample of oil from plants grown by the Kenya Department of Agriculture from cuttings of the Bourbon variety of geranium obtained from Reunion, is of importance in this connection. The examination is described in Part II (b) of this report.

Besides answering inquiries from potential growers, the Institute has supplied information to producers wishing to improve the quality of their oil, or increase their output. In particular, modifications to existing stills, to enable these to deal more expeditiously with the larger harvests expected, have been suggested, and details of oil-fired steam generators for operating the stills have been supplied.

#### Spices

10. *Pepper*. Information about the artificial drying of pepper (*Piper nigrum*) has been supplied to Fiji and Sarawak. In Sarawak growers were concerned about the low level to which pepper prices had fallen. It was thought that the demand for Sarawak pepper, especially in the United States, might be limited by an alleged abnormality in its composition, and an examination of the constitution of Sarawak pepper was, therefore suggested.

#### Oils and Oilseeds

11. *Groundnuts*. Particulars of machines suitable for grading groundnuts were supplied to Northern Rhodesia. The causes of the smaller yield of kernels obtained from whole groundnuts in some parts of the Gambia were discussed with particular reference to the biological aspect of the problem. It was recommended that samples be taken from the crop during delivery for determination of the proportion of kernels present. Inquiries have been

received from the Bechuanaland Protectorate and Tanganyika concerning groundnut decorticators. Reference was made to recently developed hand-operated machines which sell at about £16 each in Nigeria. The results of West African tests on these machines were given and factors affecting the yield of whole kernels were described.

12. *Coconut Products*. The Department of Agriculture, Fiji, was advised on the production of desiccated coconut. Information about the use of copra cake as an animal feedingstuff, the grading of copra and the manufacture of coconut oil soap, was supplied to Tonga. The importance of studying post-harvest deterioration, whether caused by bacteria, moulds or insects or by chemical change, was stressed. An economist about to visit the Seychelles was supplied with information regarding their exports of copra and coconut oil, the industrial uses of coconut oil and the preparation of ball copra. Information on various meters suitable for determining the moisture of copra in the field was supplied to Western Samoa through the Office of the New Zealand Government Trade Commissioner.

13. *Olive Oil*. Advice was given to the Government of Cyprus on methods for controlling the adulteration of olive oil. Details of tests were supplied for detecting the usual adulterants employed in Cyprus, such as soya bean, cottonseed, coconut, niger seed and groundnut oils.

14. *Castor Seed*. Owing to the increasing industrial applications of castor oil and its products, firms in the United Kingdom are interested in fostering the production of seed. Advice on the possibility of producing and marketing castor oil in the British Solomon Islands Protectorate was given to the High Commissioner for the Western Pacific. Similar information was supplied to inquirers interested in producing castor seed in Fiji, Southern Rhodesia and the British Cameroons. Samples of seed from some of these areas were subsequently received.

15. *Tung Oil*. Inquiries have related mainly to production of tung oil in Nyasaland, outlets for which continue to cause anxiety. The general market for paint oils has diminished with the increasing applications of synthetic materials and alkyds. In addition to this tendency for the market in paint oils to decrease, increasing supplies of tung oil, especially from the Argentine and China, have been appearing on the market. The general effect has been to depress the price of paint oils and that of tung oil in particular. Although much research has been devoted to finding new uses for tung oil, progress in this field has not resulted in the appreciable disposal of tung oil in any new market.

### Grain Crops

16. *Maize*. About 50,000 tons of maize, surplus to local requirements, are produced annually in Northern and Southern Rhodesia, and it had been suggested that the surplus should be processed within Rhodesia to furnish starch and other products. After examining the technology and economics of the proposal, it was recommended that a factory for processing the starch should not be erected at present.

17. *Millet*. Particulars of two small-scale hand-operated mills suitable for grinding finger millet were supplied to the Education Department at Kampala, Uganda; ground finger millet is required for supplementing the diet of school children.

18. *Wheat*. At a meeting held at the Cereals Research Station, St. Albans, to discuss the probable cause of the reported deterioration in the baking quality of Kenya wheat, it was decided that more precise information was required from Kenya. However, the probable cause of the deterioration seemed to be



the fall in the crude protein content of the wheat. It was, therefore, suggested that a premium should be offered in Kenya for a wheat of high protein content.

### Fruit, Nuts and Vegetables

19. *Canned Papaya.* The canning industries of the Federation of Malaya and of Singapore are dependent upon the marketing of canned pineapple; additional products would be valuable and experiments have been undertaken on the production of a pack of canned papaya (pawpaw). With the co-operation of members of the Institute's Consultative Committee on Fruit Products, a commercial appraisal which took into account the opinions of retail grocers and housewives, on an experimental sample, was obtained. Unfortunately, the reactions of both the trade and consumers were unfavourable and the development of the pack could not be recommended. Apart from the technical problems that are involved in canning papaya, the flavour does not appeal to the vast majority of the British public and the present very limited United Kingdom imports of the commodity appear to be sufficient for trade requirements.

20. *Maltese Horticultural Products.* In connection with the development of horticultural products in the Maltese Islands, notes were prepared for the Government of Malta concerning the possibilities of expanding the flower and vegetable seed industry, and also regarding the United Kingdom market for table grapes. Information was supplied to the Department of Agriculture on the preservation of cauliflowers in brine and in connection with the present export trade in fresh flowers. Observations were also made and commercial opinions given, concerning the market suitability of an experimental consignment of new potato varieties. With the co-operation of the Fruit and Vegetable Canning and Quick Freezing Research Association a grading assessment was provided on samples of Maltese canned processed peas.

21. *Fruit Juices.* A number of inquiries were dealt with on the subject of fruit juices. Consideration is being given in Kenya to the development of a citrus juice industry; the Department of Agriculture was provided with information regarding the requirements of United Kingdom soft drinks manufacturers and the market position. The canning of citrus juices for local sale is proposed in Uganda and an outline of processing methods, with particulars of suitable equipment was supplied. In the Federation of Malaya experiments are in progress on the production of a pineapple juice concentrate, and observations, commercial opinions and advice were provided on experimental samples of the product. Information on the preparation of passion fruit juice was supplied to the Nyasaland Fruit Growers Association through the Department of Agriculture, but it was necessary to advise that commercial outlets for this juice are at present very limited.

22. *Dates.* Interest is being taken in the development of the date crop in the Wadi Hadhramaut, Aden Protectorate. Information has been supplied to the authorities regarding the various types of dates sold in commerce, and concerning the harvesting, preparation, curing, packing and marketing of the crop.

23. *Cashew Nuts.* The cashew nut tree can be grown in many Colonial countries, and export of the raw nuts from Tanganyika to India for processing is a well-established trade. Attention to the development of the crop is being given in several other countries, although difficulties are likely to be encountered in the preparation of the kernels for export markets. In this connection, the Departments of Agriculture, in Kenya, Dominica and Jamaica were provided with information relating to the preparation and marketing of the kernels.

24. *Tomato Products.* Several inquiries concerning tomato products were received, in spite of the highly competitive nature of the trade in these commodities. Particulars were supplied to the Departments of Agriculture in Antigua and Trinidad concerning the processing of canned tomato puree or paste and the availability of suitable small-scale manufacturing equipment; information on the production of tomato juice was furnished to Nyasaland.

#### Other Foods

25. *Butter and Cheese.* Advice was given to Jamaica about the storage of tinned butter and cheese intended for issue to schools. It had been found that on storage the tins of butter and cheese became distended. Probable explanations for this "blowing" were given and an offer was made to examine some tins in order to define more precisely the cause of the trouble.

26. *Cocoa.* The authorities in Ghana were informed that new markets for cocoa beans would probably be based on their use for flavouring rather than as a source of cacao butter. Observations about the price of the beans and the effect of substitutes appearing on the market were made. The use of cocoa pod meal for feeding livestock was considered. Experiments on a limited scale in Costa Rica and Honduras have shown that a percentage of animal rations can be made up with cocoa pod meal, but further carefully controlled trials would be necessary before an authoritative opinion on their value could be given.

27. *Coffee.* Advice was given to the authorities in the Northern Region, Nigeria, about the grading of robusta coffee. Detailed information concerning the manufacture of soluble coffee was supplied to the West Indies.

28. *Arrowroot Starch.* Advice was given to Antigua about the design of a factory for producing arrowroot starch and about the marketing of the product. Misgivings were expressed at the proposal to sell the product on the world market.

29. *Sago Starch.* It was suggested to the authorities in Sarawak that the difficulties experienced in supplying quality sago starch to the United Kingdom market could be overcome by the application of modern technology.

30. *Fish and Fish Products.* A close study was made of the report of a private consultant upon the Barbados Abattoir and Fish Marketing Scheme and further information has been sought on several matters arising therefrom.

The prospects for a shark industry for the Pitcairn Islands were examined. The markets for shark products were ascertained and did not appear to justify encouragement of the proposed industry. The conclusions drawn from these inquiries were communicated to the Governor of the Pitcairn Islands.

#### Tobacco

31. *Tobacco Leaf.* Details of methods of chemical analysis of leaf have been supplied to several inquirers at home and overseas. Information regarding curing processes, storage conditions and publications dealing with growing has been provided for various official and trade bodies.

#### Vegetable Insecticides

32. *Pyrethrum.* A detailed survey of the future prospects for pyrethrum insecticides, based on scientific and trade opinions from a number of sources, has been prepared for the Pyrethrum Board of Kenya. It was concluded that there was scope for increased usage of pyrethrum in food warehouses and in the treatment of edible stored products, and that reductions in price of the

material would play a part in stimulating demand. In agricultural applications there might be occasional possibilities for the use of pyrethrum but in general its price and technical limitations would be serious disadvantages.

Observations on the possible role of oxidase enzymes in the decomposition of pyrethrins in the flowers have been made in response to an inquiry from the Pyrethrum Board of Kenya.

### Synthetic Insecticides

33. *Methods of Analysis.* Inquiries on methods of and apparatus for the analysis and determination of synthetic insecticides, both as formulations and as residues on stored products, have continued to be received, and appropriate information has been supplied to laboratories in West Africa and to visiting scientists from Jamaica and East Africa.

### Vegetable Drugs

34. *Vinca rosea.* A firm of manufacturing chemists in this country asked for assistance in locating alternative sources of this plant, the leaves of which find some use in preparations for the relief of diabetic symptoms. The firm were put in touch with growers in Tanganyika and, as a result of a survey, it was found that additional supplies might also be obtainable from several of the Caribbean islands.

35. *Miscellaneous.* Particulars relating to the cultivation and marketing of chamomile flowers and belladonna herb have been furnished to a prospective grower in Tanganyika, and a note on the supply position and markets for atropine and hyoscine has been prepared for the Department of Commerce and Industry in that territory. Other inquiries have been concerned with the sources, distribution or utilization of cascarilla bark, *Strophanthus* species, *Hibiscus sabdariffa* seeds and diosgenin-containing species of *Dioscorea*.

### Vegetable Fibres and Canes

36. *Urena lobata Fibre.* In connection with the mechanized production trials with this fibre which are being carried out in the Northern Region, Nigeria, information was furnished to the Ministry of Trade and Industry there regarding machinery, processes and methods employed for similar work with jute and *Hibiscus cannabinus* fibre in British Guiana and elsewhere.

37. *Carludovica palmata Fibre.* Full information was given to the Department of Agriculture, Jamaica, on the extraction, preparation and bleaching of the fibre from the leaves of *C. palmata* in Ecuador for the manufacture of "Panama" hats.

38. *Abaca Fibre.* A firm of engineers in the United Kingdom had been asked to make a "lagotan" machine which is used for extracting the fibre from the leaf-sheaths of *Musa textilis* in the Philippines and elsewhere. They were given a description of the machine and its methods of working, and were also supplied with drawings of the machine.

39. *Coir Rope.* A firm of rope manufacturers submitted samples of a rope which had deteriorated during storage in Ghana. Examination showed that the damage resembled that caused by "heart damage" in jute when it is baled wet. However, a sample of the rope which was submitted to the Commonwealth Mycological Institute showed no traces of moulds likely to have caused a breakdown of the fibre. This type of damage seems to be very rare in coir fibre and the firm were, therefore, asked to submit fresh samples

of the rope from Ghana packed in a polythene bag so that further investigations could be made.

### Papermaking Materials

40. *Waste Materials for Building Board Production.* Inquiries concerning this subject have been received from Trinidad (bagasse), Kenya (waste wood and sawdust), Zanzibar (coir), Ghana (tropical timber), Nigeria (groundnut shells), Malaya (rice husks) and other territories. Information on both resin bonded and cement/fibre board production was desired in most cases. As a result of these inquiries the Institute has started to amass and examine as much data as possible on the technical and economic possibilities of the small industries based on these waste materials.

### Hides and Skins

41. *Improvement of Quality.* Considerable efforts were made to bring about improvement in the quality of hides and skins imported from East Africa and Nigeria. In this connection the Institute provided liaison between the appropriate Colonial Departments and tanners in the United Kingdom.

Courses in leather manufacture and visits to various tanners in England were arranged for several Hide Improvement Officers from the territories mentioned.

### Tanning Materials

42. *Pecan Shells.* Information was given to a United Kingdom inquirer about the kind and quantity of tannins present in pecan shells and about the industrial exploitation of these shells as tanning materials.

43. *Dom Nuts.* Advice was given on the value of dom nuts as a source of tannins.

## (b) INVESTIGATIONS CARRIED OUT AT THE TROPICAL PRODUCTS INSTITUTE

44. During the year under review the Institute has completed 94 investigations; 41 investigations were in hand at the end of the period. Examples of those completed are given below:—

### Essential Oils

45. *Oil of East African Sandalwood Roots.* Oil of East African Sandalwood (*Osyris tenuifolia*) from Kenya has only a very limited market since it is not truly comparable in odour with East Indian Sandalwood oil (*Santalum album*), which is used in the perfume, cosmetic and soap industries for perfume compositions of the heavy or oriental type. There has always been the possibility, however, that some useful isolate might be present in *O. tenuifolia* and although a partial examination of the commercial oil has been made (Y. R. Naves and P. Ardizio, *Bull. Soc. Chim. Fr.*, 1954, 334) no detailed investigation of the root oil from this species had been carried out previously. As this might be expected to contain a larger proportion of the more valuable oxygenated constituents, the Institute asked for a sample of the roots for examination.

Distillation of the ground roots gave a yield of 2.75 per cent. w/w of oil, calculated on the moisture-free material. The oil was found to contain over 95 per cent. of alcohols, very largely lanceol, but with traces of what appeared to be related sesquiterpene alcohols, and 2.5 per cent. of the sesquiterpene hydrocarbon  $\beta$ -bisabolene. The remainder of the oil contained traces of acids

and esters which were not identified. Unfortunately, there is at present no outlet for lanceol in the perfumery or chemical industries.

46. *Geranium Oil from Kenya*. As mentioned in Part II (a) of this report, geranium oil has been the subject of many inquiries during the year and hence the examination of a sample of oil from plants grown in Kenya from cuttings obtained from Reunion has been of particular interest.

The oil was distilled at the Scott Agricultural Laboratories, Nairobi, the yield being 0.19 per cent. w/w based on the fresh leaves. When the analytical constants were determined at the Institute it was found that, in comparison with those recorded in the literature for genuine Bourbon geranium oils, the values for the Kenya oil for the specific gravity, optical rotation, refractive index and ketone content were all high. Whilst the "total alcohol" content was satisfactorily high, the low content of "citronellol" was rather a disappointing feature as this type of oil is frequently valued on the amount of "citronellol" present.

Trade opinions on the oil were rather varied, but it was generally agreed that the top note was rather different from that of genuine Bourbon geranium oil, being rather "green" and flat. Since it appears that the leaves were harvested a little before maturity and after a period of unseasonal rain, it may be that further crops will yield oils more closely resembling the Bourbon type. In view, however, of the difficulties involved in starting production from a very small number of plants, the attempt can be considered to be promising.

47. *Naval Stores in Mauritius*. In connection with an investigation into the possibility of developing a Naval Stores industry in Mauritius, an examination has been carried out on the oleo-resin obtained from stands of *Pinus elliottii* growing there. Steam distillation gave a yield of 18.5 per cent. w/w of turpentine oil which conformed to the Specification of the British Standards Institution for turpentine, Type 1; and, except for rather too high a residue after polymerisation also satisfied the American Society for Testing Material Standard for gum spirits of turpentine. Examination of the turpentine by gas chromatography showed that it contained 55.4 per cent of  $\beta$ -pinene and 38.8 per cent. of  $\alpha$ -pinene. This is most unusual, since  $\alpha$ -pinene predominates in the turpentine obtained from this species in the United States, as indeed it does in most other turpentines. The analytical constants of the rosin, obtained as the residue from the distillation, were rather outside the ranges of constants for American rosin, although the discrepancies were not large.

A larger consignment of oleo-resin will be examined at the Institute in the near future.

### Spices

48. *Cinnamon*. Cinnamon is exported from the Seychelles in the form of irregular pieces of whole (unscraped) bark; it is of rather poor flavour and has a low market value. On the advice of the Institute, attempts are being made to improve the quality and value of the spice to help offset the decline in the demand for cinnamon leaf oil, one of the Colony's most important exports. Preliminary samples of quills, made of scraped bark according to the method used in Ceylon, prepared on several estates, both official and private, were examined at the Institute. These were mostly well prepared but variable in flavour. Small lots of quills subsequently marketed in London failed to realise their full value because the quills were too thick for market requirements. Means of improving the quills were suggested.

### Gums and Resins

49. *Gum Arabic from Somaliland Protectorate.* In view of the interest shown by United Kingdom firms, a number of attempts have been made to establish new sources of gum arabic in Colonial or Commonwealth territories but, apart from some production in Nigeria, these have been largely unsuccessful. As a result of further efforts, a sample of gum obtained from *Acacia senegal* trees growing in the coastal strip of Somaliland Protectorate, was sent to the Institute for examination to ascertain its suitability for use in the manufacture of confectionery. It was shown that, owing to the presence of insoluble material in the sample, and since its solution in water exhibited a very high viscosity and was dark coloured, it would be unsuitable for that purpose. Recommendations were made about the selection and grading of gum of this type so that a better quality product could be obtained.

### Oilseeds, Oils and Fats

50. *Shea Nut Butter.* The tree *Butyrospermum parkii* grows in tropical Africa in a belt roughly from the equator to about 15° North latitude; it is found in the British Colonies of Nigeria and Uganda as well as in Ghana and in French territories. The tree has long been an important source of fat, and at the beginning of the century was as important in the household economy of West Africa as is olive oil in Italy. Exports of shea nuts, which amounted to 10,000 tons from British West Africa in 1915, have sunk to almost negligible proportions. The butter is still extracted from the nuts by primitive processes and the quality of the product often leaves much to be desired. The Department of Commerce and Industries in the Northern Region of Nigeria is endeavouring to develop more modern methods of processing so as to place on the West African market a material of high quality.

Mention has been made in *Colonial Research* 1955-56 of the examination of samples which had been deacidified by vacuum steam distillation; further samples refined by this technique have been examined at the Institute during the year under review. These were darker than the original crude sample and dilatation measurements showed that the physical properties of the steam-refined sample were very different from those of the original crude butter, probably due to inter-esterification having occurred. The characteristics were such that the butter was no longer of a suitable consistency for the manufacture of cooking fat for pastry shortening.

51. *Palm Oil.* Nigeria, with a production of some 200,000 tons a year, is a principal source of this important vegetable oil, which is derived from the pericarp of the fruits of the oil palm, *Elaeis guineensis*. About 95 per cent. of the oil produced in Nigeria is obtained from semi-wild trees whose fruits are harvested and processed by small producers, whereas oil from other producing countries, such as Malaya, is derived principally from plantations.

Investigations are continuing on the effects of primitive harvesting and processing methods on the bleachability of palm oil and in connection with this standard comparison tests using Fullers' earth and heat bleaching have been devised. The use of these tests has enabled the Institute to investigate the effects on bleachability of heat, metallic contamination and oxidation, which may occur during processing, transport and storage.

The presence of carotenoids, to an extent of about 0.1 per cent., is responsible for the orange colour of this oil. These consist mainly of  $\alpha$ - and  $\beta$ -carotenes and lycopene, with lesser amounts of  $\gamma$ -carotene and xanthophylls. A method for the quantitative chromatographic separation and determination of the main carotenoid constituents has been developed.

and the investigation of a number of samples of oils derived from various selected strains of *dura* and *tenera* varieties of oil palm, growing on the West African Institute for Oil Palm Research estate, showed that they had total carotenoid contents ranging from 44 p.p.m. to 1,525 p.p.m. In all but three of the palest oils the carotenoids included more than 50 per cent. of  $\beta$ -carotene. The three exceptions, which were from *dura* trees, each had a preponderant amount of lycopene and were relatively easy to bleach with Fullers' earth. The other samples investigated varied greatly in their bleachabilities, those derived from *tenera* trees being generally easier to bleach than those from *dura* trees. It was found, however, that these differences could not to be attributed solely to differences in carotenoid composition.

### Grain and Root Crops

52. *Rice from Nyasaland.* Following a complaint regarding the unpleasant odour which rice from Nyasaland of the Faya variety emits on cooking, two samples of export grades of broken rice manufactured from this variety, and a sample of unmilled Faya paddy, were examined. All three samples, including the paddy when dehusked at the Institute, gave a mouse-like odour on cooking. Laboratory tests for external contamination (e.g. with rodent urine) and for bacterial infection were negative: the odour is an inherent characteristic of this scented variety of rice.

53. *Parboiled Rice from British Guiana.* Investigation of five samples of parboiled rice originating from different processing plants in British Guiana, revealed but little variation in vitamin status. Their thiamine and nicotinic acid contents were high compared with typical figures for parboiled rice reported in the literature. Comparison with reported average values for hulled and milled rice has shown that parboiling has decreased the loss in pantothenic acid incurred by the milling process, but may be responsible for increased loss of pyridoxine.

54. *Cassava Roots from the British Cameroons.* A sample of cassava from the British Cameroons proved to be of good quality, and to have a low fibre content of 1.8 per cent. on a moisture-free basis. Trade opinions indicated that there would be a better market for the root if it were ground.

### Starches

55. *Arrowroot Starch from St. Vincent.* Samples continue to be received from St. Vincent, and these have been investigated, particular attention being given to their degree of whiteness. Details were supplied to the St. Vincent Co-operative Arrowroot Association of a starch colour grader which would enable them to check the quality in St. Vincent.

56. *Sago Flour from Sarawak.* Complaints regarding the quality of sago flour arriving in this country from Sarawak continue to be received and, as a result of the examination of samples at the Institute, specifications were drawn up for standard Sarawak sago flour in respect of moisture content, viscosity, degree of whiteness, fineness, crude fibre and ash contents. It was suggested that these tests should be applied in Sarawak to a proportion of all samples. For routine control, simpler methods were advised which included visual examination of colour, moisture determination and application of a sieve test used in the trade.

### Fruit and Fruit Products

57. *Tomato Paste.* Further work has been carried out on behalf of the Department of Trade and Industry, Malta, on commercial samples of tomato paste produced by a number of manufacturers. The latest investigation

was undertaken to assess the progress that has been achieved since the previous season in improving the quality of the commodity. Although the examination of the present samples indicated that the manufacturers concerned are preparing rather better pastes than formerly, the results obtained showed that further improvements are desirable in the products of all factories. Advice was given on matters that appeared to merit attention on the part of individual processors.

58. *Oranges*. At the request of the Government of Cyprus London Office, the Institute co-operated with the Department of Agriculture by making maturity tests on samples of Cyprus oranges drawn from a commercial consignment of the fruit shipped to the United Kingdom market.

#### Tobacco

59. *Quality of Leaf*. The smoking quality of four samples of cigarette leaf from Jamaica was acceptable and a trade report considered that some of the grades might be of interest for blending. It was recommended that a larger consignment should be shipped to test the market.

Two samples of leaf from Sierra Leone have been examined. Chemical analysis of these was normal and smoking quality was reasonable but preparation and general appearance were poor. Suggestions for improvement in various respects were made.

#### Vegetable Insecticides

60. *Pyrethrum*. Under the research scheme, financed by the Kenya Department of Agriculture, work has been continued on the isolation of the four insecticidal constituents of the pyrethrum flower. It has been found that "pyrethrin I" can be separated from "pyrethrin II" by precipitation of the latter from a hydrocarbon solvent at a low temperature. The final separation of cinerins I and II from pyrethrins I and II has been by displacement chromatography on alumina. A short communication on some aspects of this work has been published. Specimens of the four separated constituents have been submitted to Rothamsted Experimental Station for biological evaluation. Work on non-pyrethroid substances extracted from the exhausted marc has been continued.

A number of samples of pyrethrum extract have been analysed, some in connection with a test of the keeping qualities of new types of extract and others in connection with the use of the insecticide in West African food storage experiments.

61. *Derris*. Further determinations of the rotenone content of derris roots lifted at 18 and 24 months have been made for the Department of Agriculture, Zanzibar, in connection with a field experiment to study the effect of spacing and time of lifting. Contents of 7-8 per cent. of rotenone have been found, these being not appreciably higher than those found in samples lifted at 12 months. The experiment is to be repeated, but from these preliminary findings it appears that the normal two-year maturation period of this crop could be considerably reduced.

The Institute is taking part in a collaborative experiment on methods of rotenone determination, proceeding under the auspices of a joint committee set up by the Pharmaceutical Society and the Society for Analytical Chemistry.

#### Synthetic Insecticides

62. *Analysis*. Assistance has continued to be given to the Colonial Liaison Section of the Pest Infestation Laboratory by carrying out determinations of insecticide residues in various commodities undergoing storage trials; these have included groundnuts in Nigeria and Gambia, cocoa in Nigeria and rice



in Trinidad, the insecticides involved being DDT, malathion and BHC. Samples of DDT BHC, and dieldrin from tropical storage trials have been tested for the World Health Organization.

#### Vegetable Drugs

63. *Yams*. Two samples of Jamaican yams of different species, *Dioscorea polygonoides* and *Rajania cordata*, have been examined for diosgenin content. About 0.2 per cent. of this substance was found in the specimens of *D. polygonoides*, but such a content would be too low for the material to be of interest as a commercial source. No sapogenins were found in the sample of *R. cordata*.

64. *Aloes*. A sample of aloes prepared in the Somaliland Protectorate (probably from *Aloe abyssinica*) has been examined. The product conformed generally to the standards of the *British Pharmacopoeia* 1953, but aloin could not be prepared from it by the normal process. A firm of manufacturing chemists to whom the sample was submitted considered that further investigations might be justified and it was suggested that a larger sample should be prepared.

#### Vegetable Fibres

65. *Fibre Identification*. As in previous years considerable demands were made on the services of the Institute by inquirers who submitted fibres for identification. Since these fibres were usually the less common bast and leaf fibres each examination involved a comprehensive microscopical examination. These less common fibres included a sample of yarn made from fibre obtained from a plant belonging to the genus *Bromelia*, a piece of bagging woven from strips of fibrous bark obtained from "China jute" (*Abutilon avicennae* Gaertn.) and a brush-making fibre identified as "Mexican fibre" (*Agave lecheguilla* Torrey).

#### Papermaking Materials

66. *Ricinodendron rautanenii*. Work on this timber was mentioned in last year's Report. Despite treatment of the freshly felled timber with fungicide and transport by air to the United Kingdom, it still proved impossible to obtain a sample of timber entirely free from sap stain. Consequently, the use of this timber for paper pulp production is not to be recommended unless the problem of fungal attack can be overcome.

67. *Pinus species*. It was hoped to elucidate further the pulp characteristics of *P. caribaea* timber during the trials on several *Pinus* species from Mauritius. The material from this colony, however, was identified as *P. elliottii*, *P. taeda*, and *P. tabuliformis* on arrival in this country. The pulping trials on these timbers are approaching completion, and it appears that the *P. elliottii* and *P. taeda* have the same properties as the material from the United States, but *P. tabuliformis* seems to have similar characteristics to *P. caribaea*.

#### Publications

68. (i) Publications in the *Institute's Journal, Colonial Plant and Animal Products*.

"Sources of Starch in Colonial Territories: I Sago Palm". Johnson, Miss R. M., and Raymond, W. D., 1956, 6, 20.

"The Effect of Antiguan Well Water on the Quality of Starch extracted from Arrowroot Rhizomes". Raymond, W. D., and Squires, Miss J. A., 1956, 6, 42.

"Report on Ricé Straw from British Guiana for Paper making". Chittenden, A. E., and Morton, D., 1956, 6, 53.

"Vetiver Roots from British Guiana". Coveney, R. D., and Pickering, G. B., 1956, 6, 63.

"Cinnamon and Cassia: Sources, Production and Trade: Part II. Cassia". Brown, E. G., 1956, 6, 96.

"The Effect of Acid Treatment during the Parboiling of Paddy on the Aneurin Content of the Resultant Rice Product". Raymond, W. D., and Squires, Miss J. A., 1956, 6, 117.

"*Aleurites montana* Nuts from Nyasaland". Raymond, W. D., and Ward, J. B., 1956, 6, 120.

"A survey of World Production in Canned Fruit". Kay, Mrs. D. E., and Smith, E. H. G., 1956, 6, 139.

"Studies on Illipe Nuts from Sarawak and the Federation of Malaya". Raymond, W. D., and Ward, J. B., 1956, 6, 243.

(ii) **Publications in Other Journals.**

"A Method for the Separation of the Constituents of Pyrethrum Extract". Spickett, R. G. W., *Chem. and Ind.* 1957, No. 18, 561.

"The Estimation of Saturated Acids in Mixed Fatty Acids in Natural Fats". Spickett, R. G. W., Thorpe, E. F. J., and Ward, J. B., *Chem. and Ind.*, 1957, No. 23, 734.

"Sugar Cane Wax". Spickett, R. G., *Mfg. Chem.*, 1957, 28, 165.

"Hides and Skins of Africa". Greenwood-Barton, L. H., *The Times British Colonies Review*. First Quarter 1958, No. 29, p. 8.

(c) **WORK CONDUCTED OUTSIDE THE TROPICAL PRODUCTS INSTITUTE BUT UNDER THE DIRECTION OR WITH THE ASSISTANCE OF THE COLONIAL PRODUCTS COUNCIL**

**Colonial Microbiological Research Institute, Trinidad**

69. *Microbial Synthesis.* The investigation of conditions giving maximal yields of cellulose by *Acetobacter* species in static culture has been completed and the results prepared for publication. The chief difficulty is that in static culture the organisms may take up to 28 days to produce maximal yields. For large scale production an increase in the growth rate is obviously essential. It has now been found that provided the organism can be made to grow as a finely shredded pulp by severe agitation in baffled flasks, rather than as a single large solid mass or pellicle, cellulose synthesis can be completed in 2 days with a conversion of 11-12 per cent. of the initial total sugar to cellulose. The adaptation of this finding to large scale work is being investigated.

The possibility of converting the citric acid in lime residues to glutamic acid with yeast autolysates has been investigated but only very low yields were obtained.

The possibility of microbial conversion of limonene, a terpene hydrocarbon available in large quantities from citrus oils, to products of greater economic value is being explored. Two fungi have been isolated, after an extensive screening programme, capable of attacking the limonene with the formation of terpenoid products. The conversion is being followed by a novel chromatographic procedure. The chemistry of the products is now being studied in collaboration with the Tropical Products Institute.

A study of the growth of certain microorganisms in "continuous" fermenters has begun.

70. *Plant Pathogens.* In collaboration with the Department of Agriculture of Trinidad and Tobago, a disease of grapefruit thought to be an outbreak of "Black Spot" (*Guignardia citricarpa*) is being investigated. Although

fruiting bodies of *Guignardia citricarpa* (pycnidial stage—*Phomopsis citricarpa*) were found to occur on the dead leaves under the trees, this organism could not be identified in connection with fresh leaves or fruit. The lesions on the living grapefruit are due to a *Mycosphaerella* sp. (pycnidial stage—*Septoria*) which hitherto appears not to have been described, at least on citrus; fruiting bodies were found in lesions on the rind of the fruit. This species has also been found on the leaves of Mountain Immortelle (*Erythrina micropteryx*) and Pink Poui (*Tabebuia pentaphylla*) but it has not yet been possible to obtain fructifications on artificial media.

The gram-negative bacterial flora of sugar-cane leaves bearing "stripe" symptoms has been studied as an aid to the identification of the bacterial diseases of sugar-cane. The organisms are differentiated according to the type of metabolism of glucose. The group having an oxidative (anaerogenic) metabolism includes all the pseudomonads and xanthomonads. *Xanthomonas albilineans*, the causative organism of Leaf Scald, has been studied with isolates from Martinique and St. Lucia. The organism has not been found in Trinidad. An organism very similar to *Xanthomonas vascularum*, the pathogen causing "Gumming" disease, has been isolated. However, only varieties resistant to this disease are now grown in the West Indies.

A bacteriological and biochemical study of *Pseudomonas solanacearum*, a versatile pathogen of economic plants in tropical and sub-tropical countries, has begun. In Trinidad, tomatoes and bananas are severely affected, and the Department of Agriculture are trying to control the disease by systematic antibiotics. All fresh isolates of *Ps. solanacearum* so far examined have shown classical smooth-rough variation correlated with virulence. Virulent strains from banana plants are of reduced virulence for tomato plants.

*Marasmius perniciosus*, a fungal pathogen, producing excessive and abnormal branching in cacao plants, a condition known as "Witches' Broom", has been studied in pure culture in an attempt to detect the production of biologically active substances similar to gibberellin. The investigation was made in collaboration with the Plant Physiology Section of the Imperial College of Tropical Agriculture who conducted the tests for growth-stimulating substances. Under a variety of conditions where culture filtrates from *Gibberella fujikuroi* gave pronounced stimulation, *Marasmius perniciosus* was either inactive or inhibitory. It would appear that gibberellin type compounds are not involved in Witches' Broom.

71. *Antifungal Antibiotics*. The isolation and testing of soil actinomycetes for the production of antifungal substances was practised through most of the year but has now been discontinued and studies concentrated on the most promising isolates. Of the 3,500 isolates examined, 225 produced reasonable activity when grown in submerged aerated culture and of these 150 have been tested by chromatography to differentiate them from antibiotics already described; actidione, for example, is frequently found. Those extracts which contain antibiotics which are apparently new have been examined, in the u.v. spectroscope. Of the 74 extracts examined, 60 contain only polyenes, six contain other active substances in addition to polyenes, and eight isolates produce only active substances which are not polyenes. The latter 14 isolates are now being investigated to determine the optimal conditions for production of the non-polyene antifungal antibiotics.

72. *The Hankey Culture Collection*. Routine provision of cultures and bacteriological examinations for local industries has continued throughout the year. Eighty-five cultures were sent overseas on request. The Collection now contains 931 cultures (385 fungi, 156 yeasts, 239 bacteria, 151 actinomycetes).

During the last few years a collection has been made of different strains of an, as yet, unidentified purple pigmented pseudomonad which occurs not infrequently in local soil and river water samples. The pigment, which has hitherto been undescribed, has now been isolated in crystalline form and its structure is being investigated. The organism also produces non-pigmented material of considerable interest and it is being grown on a large scale in the "continuous" fermenters for harvesting of cell material.

73. *Curing of the Cacao Bean.* The work on this subject has been reviewed and recommendations for future studies made. A description and specification of a simple standardized method for curing small samples of cacao for quality assessment, suitable for use by the plant breeder, has been reported. The investigation on the glycosidase enzymes has been published.

The interaction of proteins and polyphenols during curing has been investigated. The enzymes, and indeed all the proteins, are rendered insoluble by phenolic tanning immediately following the death of the bean. The enzymes, although insoluble, remain active but at much reduced rates. The interaction has a considerable effect on the quality of the processed bean. The criteria necessary to evaluate the satisfactory completion of a commercial fermentation are being studied.

74. *Plant Polyphenols.* A preliminary report on the structure of peltogynol, for long the only known crystalline leucoanthocyanidin, has been published. The second leucoanthocyanidin, present in the "purpleheart" wood has now been shown to be a stereoisomer of peltogynol differing only in the configuration at C<sub>4</sub> in the flavanoid structure.

An investigation of the intermediates in the oxidation of catechol by polyphenol oxidase has been published. The oxidation of naturally occurring catechols is being studied for intermediates of possible biological activity.

The structural investigation of the cacao leuco-cyanidin compounds continues. They have been shown to be composed of epicatechin and flavan-diol units but the location of the linkages between the units remains to be settled for the elucidation of the structures. The more complex cacao "tannins" are now being investigated.

In collaboration with the Banana Cytogeneticist of the Imperial College of Tropical Agriculture, the main anthocyanidin of *Lochnera rosea* has been shown to be hirsutidin.

75. *Miscellaneous Investigations.* During the year under review the Institute has been called upon as before to assist various industries and organizations:—

- (a) *The Coconut Growers' Association, Limited, Trinidad* : Maintenance of cultures used in the manufacture of margarine.
- (b) *Trinidad Petroleum Development Company, Limited* : Oil field water analyses for the presence of sulphate-reducing bacteria.
- (c) *The Commonwealth Bureau of Biological Control* : The Green Muscardine fungus *Metarrhizium anisopliae* is being grown in bulk for trial in the field against "frog-hopper" infestation of sugar-cane.
- (d) *Paint Manufacturers and Agents* : Scrapings of mildewed paint are continually received for identification of the infecting agent.

76. *Visits.* While on leave in the United Kingdom, the Director attended the XVI International Congress of Pure and Applied Chemistry, Paris, and the Cocoa Conference, London, where he read a paper. The Biochemist also read a paper at the Cocoa Conference, London. The Process Microbiologist read a paper at the B.W.I. Sugar Technologists' Meeting in Antigua. The

Senior Microbiologist visited university and industrial bacteriological laboratories in the North-Eastern Section of the United States of America. The Curator, while on leave, attended a course on plant pathology at Kew.

77. *Publications*. "Absorption Chromatography on Silica-treated paper." Roberts, J. B., *Nature*, 1958, 181, 338.

"The Characteristics of *Xanthomonas albilineans* causing Leaf Scald in St. Lucia and Martinique." Hayward, A. C., B.W.I. Sugar Technologists' Meeting, Antigua, 1957.

"An Appraisal of Fundamental Research on Cacao Curing at the Colonial Microbiological Research Institute." Forsyth, W. G. C., Cocoa Conference, London, 1957.

"Curing Cacao in the Laboratory." Quesnel, V. C. J., Cocoa Conference, London, 1957.

"Cacao Glycosidase and Colour Changes during Fermentation." Forsyth, W. G. C., and Quesnel, V. C. J., *J. Sci. Food Agric.*, 1957, 9, 505.

"The Interaction of Polyphenols and Proteins during Cacao Curing." Forsyth, W. G. C., Quesnel, V. C. J., and Roberts, J. B., *J. Sci. Food Agric.*, 1958, 9, 181.

"The Preparation of Cacao for the Market." Forsyth, W. G. C., and Quesnel, V. C. J., *Cacao (Turrialba)*, 1957, 3, (12), 2.

"Constitution of Peltogynol." Chan, W. R., Forsyth, W. G. C., and Hassall, C. H., *Chem. & Ind.*, 1957, (9), 264.

"Intermediates in the Enzymic Oxidation of Catechol." Forsyth, W. G. C., and Quesnel, V. C. J., *Biochem. Biophys. Acta*, 1957, 25, 155.

"Anthocyanidins of *Lochnera rosea*." Forsyth, W. G. C., and Simmonds, N. W., *Nature*, 1957, 180, 247.

#### **British West Indies Sugar Research Scheme at the Sugar Technological Laboratory, Imperial College of Tropical Agriculture, Trinidad**

78. *Research Programme*. During the past year there has been some reorientation of the work of the Scheme so that now more emphasis is placed on sugar technology and less on the study of by-products. The investigation of the manufacture of hardboard from bagasse is, however, continuing.

79. *Lead Error in the Polarisation of Raw Sugars*. In May 1957 the Director attended a meeting in London between representatives of the British National Committee of the I.C.U.M.S.A. and delegates of the Commonwealth sugar-producing regions to discuss the table of corrections proposed by the Committee. This would have had the effect of reducing the polarisation of raw sugar but it was agreed that different results from those used in the preparation of the table were now being obtained and a statement was issued that at present the use of lead error corrections is not justified.

80. *Clarification Studies*. Investigations into the behaviour of cane juices have been continued, using juices which had been filtered through cotton wool to remove coarsely dispersed material, the removal of which does not affect the clarification behaviour of the juice.

A study of the particles in stable suspension in juice has revealed that three main types are present: "wax" particles, composed of high molecular weight esters, alcohols and oil-soluble resins, which do not all originate from the cuticle of the cane stalk since removal of the rind before milling does not affect the concentration of these particles in the expressed juice; chloroplasts and other polysaccharide-containing plastids, released from the cane cells

which are ruptured during the milling process; and mineral particles most of which probably contain silica or silicates.

The heterogeneity of the dispersed phase is marked by adsorption of micro-molecular substances from solution and a further investigation into the nature of the adsorbed material has provided some evidence that it is a mucoid in which protein is conjugated with a muco-polysaccharide through an ionized carboxyl group. It has been shown that the concentration of sucrose in cane juice is sufficient to stabilise the adsorbed protein against denaturation. There is also evidence that the same is true of proteins in solution and that the stabilisation effect accounts for most, if not all, of the large quantity of protein which is not coagulated on boiling.

The study of the principle of flocculation by adsorption of particles on to an inorganic precipitate, for example calcium phosphate or sulphite, produced in the juice, has been extended to include the action of poly-electrolytes and mineral clay adsorbents, such as bentonite.

The precipitation of calcium phosphate and the effect of coprecipitation of magnesium have been studied with pure solutions and the results obtained have been compared with those from the examination of the settling of commercial juices during clarification. An investigation is now being made of factors which may account for the differences in the behaviour of the two systems.

81. *Determination of Calcium and Magnesium in Juice.* For the clarification studies it was necessary to have a reliable and accurate method for determining calcium and magnesium in raw juice. A careful examination of the conditions for their accurate analysis was undertaken and a method has been developed which overcomes the difficulties and errors of procedures used previously.

82. *Chemical Removal of Evaporator Scale.* No further work has been carried out on the removal of evaporator scale with E.D.T.A. since the mechanism and economics of this method are now fairly well understood. However, a trial with sodium citrate is to be made at a sugar factory and laboratory experiments on dissolving blocks of Plaster of Paris have been carried out to aid the design of the factory experiment. The experiments are not yet complete but some interesting results are emerging. Up to about pH 10 only 85 per cent. of the citrate is precipitated as calcium citrate and, since in the regeneration process the calcium citrate is filtered off and the filtrate discarded, 15 per cent. of the citrate is lost each time the solution is regenerated. It was found that the addition of extra calcium ions was an expensive way of reducing the citrate loss in the filtrate. Other results indicate that the addition of alkali to the sodium citrate in order to dissolve the silica in the scale was unlikely to succeed.

83. *Cleaning the Steam Side of Evaporator Tubes.* There has always been some doubt as to whether the classical method of floating kerosene on water and emptying out the water from the steam chest is very effective in cleaning the steam side of evaporator tubes. Recently some tubes from a factory were examined and the deposits on the steam side were found to consist mainly of copper oxide, which could be dissolved by soaking in 5 per cent. E.D.T.A. solution for a week. A detergent solution removed a residual wax-like deposit which occurred in some cases. It is not yet known whether it is always possible to clean the outside of evaporator tubes so easily or whether the cleaning which has been carried out represents any great advantages in heat transfer. A simple apparatus is being constructed to measure the heat transfer in evaporator tubes before and after cleaning.

84. *Treatment of Oliver Filtrate in a Sand Filter.* The subsequent filtration of Oliver filtrates is unattractive because of the high cost of suitable existing processes. It was thought that a new design of sand filter in which the filtration is carried out upwards, might be able to be used for this purpose but from experiments carried out it does not appear that it will operate successfully on Oliver filtrates.

85. *Laevulinic Acid.* This work has been brought to a conclusion and a detailed report has been submitted to the Argus Chemical Corporation who were joint sponsors of the project. Following uneconomical pilot plant runs, laboratory experiments were carried out on isolation techniques. It was found that concentration of the reaction product of sucrose, or molasses, and acid was possible at atmospheric pressure and that the formic acid and most of the hydrochloric acid were removed in the distillate. If the concentration were carried too far a serious loss of laevulinic acid ensued. This was one of the reasons for the poor recoveries previously found in the pilot plant. A possible method of overcoming this was considered but was not proceeded with as it had been decided that the laevulinic acid process would not be a successful commercial venture at present.

#### University College of the West Indies

86. *Aloins and Related Compounds.* Following the appointment of Dr. L. J. Haynes, to the Chair of Chemistry at the University College of the West Indies, Mr. J. I. Henderson has transferred there from Edinburgh, to continue his study of the ingredients of aloe species. A sample of Natal aloes, differing from Cape aloes in appearance and composition, has been investigated and the structure of nataloin, one of its constituents, is being determined.

87. *Studies on some West Indian Medicinal Plants.* Mr. N. McG. Philip has also joined Professor Haynes from Edinburgh and has started the examination of some of the local plants used as native medicines in infusions known as "Bush Teas", to show which have genuine pharmacological activity and to isolate the active principles from them. The plants investigated so far are *Momordica charantia*, Cascarilla bark, *Jatropha gossypifolia* and *Andrographis maniculata*. To establish the pharmacological value of the plants studied, aqueous extracts which have been made are being tested by the Pharmacology Department of the College.

#### Makerere College, Uganda, Department of Chemistry

88. *Natural Products of East African Plants.* Dr. W. J. Peal has continued his research on the chemistry of local plants. Out of nine species of yam collected on an expedition to the Mubende district of Uganda, only one was found to contain diosgenin; there were no detectable differences in the yields of steroids found in male and female specimens. One of the substances which had been obtained, together with diosgenin, from the yam, Kaama, was shown to be a 25D-spirosta-3:5-diene. This compound was found to be a product of the acid catalysed dehydration of diosgenin which was occurring during the acid hydrolysis of the plant saponin. An interesting research field has been opened up by this important and unexpected discovery and the reactions of the derivatives of C<sub>3</sub> hydroxy steroids with acids are now being studied. The sterol from tea has been isolated and identified almost certainly as  $\alpha$ -spinasterol. A yield of 0.6 per cent. diosgenin (on a moisture-free basis) has been obtained from unripe fruits of *Balanites aegyptiaca* and the yield from ripe fruits is now being investigated; this work is being carried out in collaboration with the Uganda Development Corporation.

**Makerere College, Department of Agricultural Engineering**

89. *Methane Fermentation.* Mr. W. Boshoff has carried out laboratory experiments on the value of various materials as possible "starters" for methane fermentation at different temperatures and levels of initial feed. Decomposed cow dung has been the only successful inoculum medium so far and it was found when using this that gas production between 21° and 24°C. was about half that at 32°C. and that, at this latter temperature, a linear relationship existed between the total gas yield after 36 days and the initial feed. Two further installations based on 44 gallon drums have been developed for pilot studies and a suitable plant is now operating. With no artificial heating the temperature of the substrate varies from 23° to 29°C. during a 24-hour day but no appreciable rise in volatile acid concentration has been observed. The maximum gas recovery has been 5 cu. ft. per day when charging the plant daily with 500 gm. (air dried) elephant grass, increasing the charge to 600 gm. gave no higher gas output.

**Forest Products Research Laboratory, Princes Risborough**

90. *Methods of Preparing Pulps.* Further comparisons have been made between the semi-chemical and the Defibrator methods of preparing pulps for the manufacture of hardboard from a number of tropical hardwoods of high density and the extent to which the various pulps respond to refining treatment in the Sprout-Waldron refiner has been studied. There are considerable differences in this respect between timbers of similar density and these are probably related to structural features of the woods.

91. *Ricinodendron rautanenii.* Board-making trials have been carried out on this Northern Rhodesian timber which is of little commercial value because of its very low density and correspondingly poor strength properties. Because of the low density of the material it was possible to make pulp of reasonable quality by passing green chips directly through the disc mill without any prior treatment. Hardboards prepared from the pulps by hot pressing had rather low strength and water resistance but these properties could be improved to the extent required by the British Standard Specification by oil-tempering with small amounts of linseed oil. This process has the great merit of simplicity. Stronger boards were made from pulps which had been partially refined or which had been prepared by treating chips in the Defibrator, but in both cases some further treatment was still needed to bring the water resistance of the boards to an acceptable level.

92. *Pinus caribaea.* Trials have been carried out on a sample of this timber from British Honduras, which consisted of 25 per cent. highly resinous heartwood and 75 per cent. non-resinous sapwood, using the sapwood alone and then a mixture of heartwood and sapwood in the above proportions. With the Defibrator process, both materials yielded boards of good strength. Boards from the sapwood-heartwood mixture had the better water resistance, because of the resin content of the heartwood, and satisfied the requirements of standard hardboard after a simple heat treatment or could be readily made into super hardboard by oil-tempering. The boards made from sapwood could be brought up to standard hardboard quality by partially refining the pulp or to super hardboard by oil-tempering.

**Birmingham University, Department of Pharmacology**

93. *Pharmacological Screening Unit.* This can now be considered to have come into full operation with the appointment of Dr. H. S. A. Sherratt as Pharmacologist. He is undertaking the pharmacological examination of substances arising from work sponsored by the Colonial Products Council in other places.



**Birmingham University, Department of Chemistry**

94. *Sugar Derivatives*. Mr. J. G. Featherstone, supervised by Professor M. Stacey, has been investigating the structure of oligosaccharides obtained by controlled fragmentation of chitin and by synthetic routes. The aim of this work is the development of a general method for the determination of structure of disaccharides which contain amino-sugars. An exploratory examination has been started of the amino-sugar content of ancient plant products, such as peat known to contain chitin in their normal state. Work has continued on the enzymic synthesis of cellulose.

**The Royal College of Science and Technology, Glasgow**

95. *Steroids*. Under the supervision of Professor F. S. Spring, Mr. D. S. Savage has discovered a remarkable aromatisation reaction which is characteristic of some sterol derivatives. The products of these reactions have been identified and the mechanisms of the reactions studied.

**Leeds University, Department of Leather Industries**

96. *Mangrove Bark*. Supervised by Professor D. Burton and Dr. H. E. Nursten, Mr. T. Dalzell has started a study of the chemistry of the constituents of mangrove bark and related vegetable tanning materials. Attention has been directed particularly to *Rhizophora mucronata* the species of mangrove of greatest importance. Extracts of two samples of this species, one air dried and the other deliberately excluded from contact with air, and of some other samples of mangrove and other tanning materials have been examined spectrophotometrically. Various samples of mangrove, originally showing considerable differences seemed to become spectrophotometrically identical on ageing. The extraction of the two samples of *R. mucronata* by means of thirty different solvents has also been studied.

**Imperial College of Science and Technology, London**

97. *Chemistry of Limonin*. Mr. S. K. Pradhan has been continuing his investigation of limonin at Imperial College, following the appointment of his supervisor, Professor D. H. R. Barton, to the Chair of Chemistry there.

**University College, Swansea**

98. *Monamycin*. Mr. K. E. Magnus has now completed his work on this antibiotic, under the supervision of Professor C. H. Hassall, and has returned to Jamaica.

**Work on Plant Materials supplied by the Council**

99. During the year, many further samples of tropical plant species were supplied at the request of research workers and the following are examples of results achieved with them.

*Hagenia abyssinica*. Dr. T. H. H. Quibell of the University of Manchester has been investigating the occurrence of protokosin in the flowers of this species. So far he has been unable to isolate this particular compound although there seemed to be present fairly large quantities of a mixture of related substances. The only sample of flowers from which protokosin has been isolated was obtained from the bazaar in Addis Ababa. It seems therefore that physiological variation occurs in the plant.

100. *Momordica charantia and Areca catechu*. These two species are being examined by Dr. A. Mackie of the Heriot-Watt College, Edinburgh, for anthelmintic principles. A white solid giving a positive test for alkaloids, a

material which is probably impure stigmaterol, glucose and a few amino acids have been isolated from the seeds of the former. From the seeds of Penang Mabok, a variety of betel nut (*Areca catechu*), a fat has been isolated and a mixture of fatty acids which was obtained on saponification is being investigated.

101. *Shorea leprosula*. Dr. J. McLean at the Royal College of Science and Technology, Glasgow, has been unable to isolate any triterpenoids from the wood of *Shorea leprosula* but investigation of the non-saponifiable matter present in the fat extracted by petrol has shown it to contain  $\beta$ -sitosterol and a long chain alcohol which is either ceryl alcohol or lignoceryl alcohol.

102. *Hepatotoxic Agents*. At the Medical Research Council's Toxicology Research Unit, Dr. R. Schoental has continued her survey of plants for hepatotoxic constituents. No significant liver lesions were observed in rats given extracts from the following plants: two species of *Trichodesma* from Nigeria, one *T. africanum* and the other an unknown species from Katsina, *Senecio biafrae* from Sierra Leone; *Crotalaria goreensis* from Ghana. However, liver damage typical of that produced by pyrrolizidine alkaloids was obtained with extracts from *Crotalaria retusa* from Ghana and *Heliotropium indicum* from Nigeria. Only traces of alkaloidal substances were present in *Senecio biafrae* and the *Trichodesma* plants; *T. africanum* contained a large quantity of mucinous material.

103. *Cyperus articulatus*. The preliminary studies carried out on the essential oil, obtained by steam distillation, of the rhizome of this species by Dr. A. R. Pinder of University College, Cardiff, have proved very interesting. Following fractional distillation of the oil, two new ketones have been isolated, one a monoterpene and the other a sesquiterpene. It has not been possible to separate any other constituents of the fractions by chemical means but the three volatile fractions have been subjected to chromatography which promises to be a useful method of separation.

104. *Agave sisalana*. Dr. G. O. Aspinall and Dr. A. Canas-Rodriguez, at Edinburgh University, have continued the study of the polysaccharides of *Agave sisalana* flesh. Two rare sugars have been identified as minor components of the water-soluble polysaccharides. The main chemical features of sisal pectic acid have been established and in the course of the work a new method of approach involving the conversion of the acidic polysaccharide into a neutral polysaccharide by reductive methods has been thoroughly examined.

Committee on Colonial  
Road Research  
(1957-1958)

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Road Research Laboratory,  
Harmondsworth,  
Middlesex.

30th July, 1958.

SIR,

I have the honour, on behalf of the Colonial Road Research Committee, to transmit to you the Third Report of the Committee covering the period 1st April, 1957 to 31st March, 1958.

I have the honour to be,

Sir,

Your obedient Servant,

W. H. GLANVILLE,  
*Chairman.*

The Rt. Hon. Alan Lennox-Boyd, M.P.,  
*Secretary of State for the Colonies.*

## COMMITTEE ON COLONIAL ROAD RESEARCH

### Membership

- DR. W. H. GLANVILLE, C.B., C.B.E., M.I.C.E., F.R.S., Director of Road Research (Chairman).
- T. L. BOWRING, Esq., C.M.G., O.B.E., M.I.C.E., M.I.Struct.E., Adviser on Engineering Appointments, Colonial Office (from April, 1958).
- SIR GEORGE BURT, K.B.E., M.I.C.E., F.I.O.B., Messrs. J. Mowlem & Co. Ltd.
- R. L. FITT, Esq., M.I.C.E., Sir Alexander Gibb and Partners.
- H. GRACE, Esq., S.M.M.Sc., M.I.C.E., M.A.SCE, A.M.I.W.E., Messrs. Scott & Wilson, Kirkpatrick & Partners (from January, 1958).
- R. U. LAW, Esq., M.I.C.E., Messrs. George Wimpey & Co. Ltd. (to January, 1958).
- J. S. MCNEIL, Esq., B.Sc., M.I.C.E., A.M.I.Mun.E., Ministry of Transport and Civil Aviation.
- SIR HERBERT MANZONI, C.B.E., M.I.C.E., M.I.Mun.E., City Engineer and Surveyor, Birmingham (from January, 1958).
- S. MEHEW, Esq., O.B.E., M.I.C.E., M.I.Mun.E., A.M.T.P.I., County Surveyor, Derbyshire.
- F. W. PARKER, Esq., Messrs. Frederick Parker Ltd.
- J. L. PHIPPS, Esq., M.B.E., Shell Petroleum Company, Ltd.
- J. RAWLINSON, Esq., C.B.E., M.I.C.E., M.I.Mech.E., M.I.Mun.E., County Surveyor, London County Council (to January, 1958).
- SIR REGINALD TAYLOR, C.M.G., M.I.C.E., Engineer-in-Chief, Crown Agents and Engineering Adviser to the Secretary of State for the Colonies.
- PROFESSOR GILBERT WALKER, D.Litt., Faculty of Commerce and Social Science, University of Birmingham.
- SIR HUBERT WALKER, K.B.E., M.I.C.E., Adviser on Engineering Appointments, Colonial Office.
- DR. R. S. MILLARD, B.Sc., M.I.C.E., Head of Colonial Section (ex officio).
- F. H. P. WILLIAMS, Esq., M.A., A.M.I.C.E. (Secretary).

In addition to the above members, Colonial Governments are asked to nominate delegates for each meeting. The following attended the 4th meeting held on the 3rd July, 1958.

- A. T. ARMSTRONG-WRIGHT, Esq., A.M.I.C.E., Public Works Department, Hong Kong.
- E. BISZEWSKI, Esq., A.M.I.C.E., Public Works Department, Uganda.
- W. B. DEAL, Esq., M.V.O., Director of Public Works, Aden.
- J. F. HOUNSLOW, Esq., Public Works Department, Kenya.
- S. H. KEMSLEY, Esq., Public Works Department, Bermuda.

- D. J. KUYPER, Esq., B.Sc.(Eng.), Public Works Department, Kenya.
- H. LAND, Esq., B.Sc., A.M.I.C.E., Assistant Director of Public Works, Tanganyika.
- R. C. MARC, Esq., M.Sc., A.C.G.I., D.I.C., M.I.C.E., A.M.I.Struct.E., Adviser, Ministry of Works, Northern Nigeria.
- G. D. G. PLUMMER, Esq., A.M.I.C.E., Deputy Director of Public Works, Eastern Nigeria.
- M. C. RHODES, Esq., B.Sc.(Eng.), M.I.C.E., Assistant Director of Public Works, Nyasaland.
- R. A. SANDFORD, Esq., Public Works Department, Singapore.
- G. T. SKELT, Esq., B.Sc.(Eng.), A.M.I.C.E., Assistant Director of Public Works, Sierra Leone.
- R. L. SWAN, Esq., B.Sc.(Eng.), Public Works Department, Northern Rhodesia.
- J. K. WATSON, Esq., O.B.E., Director of Public Works, Uganda.
- F. H. WOODROW, Esq., C.B.E., Director of Public Works, Tanganyika.
- I. WYN PUGH, Esq., C.B.E., Director of Federal Public Works, Federation of Nigeria.

COLONIAL ROAD RESEARCH COMMITTEE  
THIRD ANNUAL REPORT

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**COMMITTEE ON COLONIAL ROAD RESEARCH****THIRD ANNUAL REPORT**

1. The year under review has seen the completion of the original Colonial Development and Welfare Scheme, under which the Colonial Section at the Road Research Laboratory came into being in November, 1955. The period since then has been one of growing activity. Throughout the period the Section has been able to advise the Colonial Office, overseas governments and engineers operating overseas, on an increasing scale, on matters of road traffic and road engineering. Results are beginning to emerge from the researches initiated during the past two years.

2. The Committee held its third meeting in June, 1957. It was attended by representatives from the following overseas governments: Aden, Hong Kong, Kenya, Nigeria (Federal), (Eastern Region), (Western Region), Northern Rhodesia and Sierra Leone.

3. The Committee is pleased to note that more of the overseas territories are taking the necessary steps to train staff and to equip materials testing laboratories. Some territories have had such laboratories established as useful concerns for some years. Others are now developing them: this is the first essential step in securing the useful application of the results of the research. With few trained engineers available, particularly in the smaller territories, difficulties will continue in making the best use of modern techniques and of locally available roadmaking materials. At their second meeting the Committee recommended the formation of a small pool of materials (research) engineers to be attached to the Road Research Laboratory and to be available for service in the overseas territories according to need. For various reasons it has not yet been possible to implement this recommendation. The Committee considers that such a pool is vital to the good use of funds available for road construction in the smaller territories and it would like to see a pool brought into being as soon as possible.

*Visits*

4. Mr. Evans toured Nigeria in April–May, 1957 with the object of making a survey of the lateritic gravels and decomposed rocks used for road bases. During this tour he arranged for the collection of samples representative of some 120 deposits. These are now under examination at the Laboratory.

5. Dr. Millard visited Mauritius, South Africa and the Central African Federation in September and October, 1957. In Mauritius the methods of road construction were reviewed with the Public Works Department and arrangements were made for data to be obtained on the engineering properties of the soils on the island in the course of a survey which is to be undertaken by the Mauritius Sugar Industries Research Association<sup>(1)</sup>. The visit to South Africa was made at the invitation of the Council of Scientific and Industrial Research and to Southern Rhodesia at the invitation of the Commissioner of Roads and Road Traffic. The Committee's research programme has much in common with the research programme of the newly-formed National Institute of Road Research in South Africa and the possibilities of co-operation on common problems were discussed<sup>(1)</sup>. Following the visit to Central Africa proposals have been made for one of the senior soil chemists of the Laboratory to visit the Rhodesias and Nyasaland to review in detail the soils available and the uses that can be made of them in road construction.

6. Mr. Williams and Mr. O'Reilly visited Kenya in November, 1957 to make arrangements and select sites for the investigation to study moisture conditions under roads overseas which is being undertaken with the

co-operation of the Ministry of Works in Kenya. Mr. Williams continued from Kenya to make a month's tour of Uganda, the Somaliland Protectorate and Aden. A party of three led by Mr. O'Reilly left for Kenya in the middle of March, 1958 and they will remain in the territory for 15 months on this study.

7. Mr. Hillier of the Traffic and Safety Division of the Road Research Laboratory visited Lagos in November, 1957 at the invitation of the Ministry of Lagos Affairs, Mines and Power, to carry out a preliminary traffic survey in connection with the siting of the proposed new Carter Bridge. The survey is to be completed by a visit of Mr. Hillier and Mr. Tresidder in April-May, 1958.

8. Mr. Smith, the economist of the Section, visited Uganda in March, 1958 to initiate studies on the effect of standards of road construction on the development of the economy of the country, with particular reference to feeder roads. A Nuffield Research Fellow is at present in Uganda, at the request of the Protectorate Government, studying problems of investment in communications. This work is being undertaken as part of the programme of the Colonial Economic Research Committee. It is hoped that Mr. Smith's study will contribute to this besides providing information for application in other territories.

9. At the request of a British firm of contractors and at their expense, Mr. Williams paid a three-week visit to Iran in May, 1957 to investigate the failure of a short length of road between Kazvin and Takestan. The investigation showed that the sub-base gravel used in constructing the road was inadequate to carry the exceptionally heavy traffic. Such investigations are a useful means of extending the Laboratory's experience and knowledge of particular overseas conditions and the Committee is glad to record that the Section can offer such assistance to consultants and contractors.

#### *Research Activities*

10. *Roadmaking materials.*—During the year the Laboratory played a major part in the preparation of papers for a Symposium on "Airfield construction on overseas soils" organised by the Institution of Civil Engineers<sup>(2)</sup>. In this Symposium, the formation, classification and characteristics of the major groups of tropical soils were considered and the information given is of as much importance to the road engineer as to the airfield engineer.

11. The investigations have been continued of the properties of lateritic gravels used for constructing road bases in Uganda, Northern Rhodesia and the Gambia. The investigation of the properties of six lateritic gravels from Uganda has now been completed and a report has been issued<sup>(3)</sup>. The samples tested were texturally gravel-sand-clays with fines of medium to high plasticity. The coarse fraction of the laterites was porous and lacked strength, although the fully laterised material was stronger and had a higher specific gravity than the partially laterised material. Because of the weakness of the coarse fraction some breakdown to a finer material occurred during compaction tests. Organic matter contents were found to be low, indicating no chemical hindrance to the use of cement stabilisation materials. California bearing ratio tests of the samples compacted by approximately British Standard and modified A.A.S.H.O. compaction resulted in C.B.R. values respectively of about 50 and from 100 to 200 per cent, at low moisture contents. At high moisture contents the C.B.R. of all six soils fell to below 10 per cent. The investigation showed that none of these materials was likely to be satisfactory for road bases under a thin bituminous surfacing, especially where wetting could occur. Tests to determine the suitability of the six laterites for stabilisation with Portland cement and hydrated lime are in progress. The results suggest



that the soils can be satisfactorily stabilised with 4 per cent. by weight of either stabiliser, although the lime-treated soils suffered a greater loss of strength on immersion in water at an age of 7 to 14 days than the cement-treated soils.

12. Six lateritic and quartzitic gravels from Northern Rhodesia have been studied to investigate their suitability for stabilisation with hydrated lime for use as road bases and also to investigate the criteria employed by the Northern Rhodesian Public Works Department to select soils for this purpose. The soils were found to be similar in properties to lateritic gravels studied from Uganda and the Gambia and had, when in the natural state, maximum California bearing ratios of 50 to 60 per cent. when compacted by approximately British Standard compaction. The addition of 4 per cent. of British hydrated lime had the effect in all cases of considerably reducing the loss of strength on immersion in water. The strength of unsoaked soil-lime specimens was also increased especially when moulded at moisture contents slightly below optimum. In general the results suggested that all the samples submitted should be satisfactorily stabilised with hydrated lime. A report has been prepared giving the results of this work<sup>(4)</sup>.

13. Classification and chemical tests have been completed on samples from a lateritic gravel profile 11 feet deep from Bakoti Quarry, Gambia, and a report has been issued<sup>(5)</sup>. The tests showed that the properties of the samples changed little with depth, although the coarse fraction was larger and the individual particles harder at the greater depths. The fine material in the gravels had a comparatively low plasticity index. In general, the laterite in the quarry was found to be similar to the lateritic gravels from Uganda.

14. Six samples of gravel and six samples of soil have been received from Kenya and classification and stabilisation tests are being carried out on them. In the examination of a heavy "red coffee" clay from Kabete, near Nairobi, the low activity suggests that kaolinite is the predominant clay mineral. California bearing ratio tests showed that the compacted soil should usually provide a stable subgrade. Although 10 per cent. of Portland cement failed to increase the strength of the soil sufficiently to make it suitable for road bases, with 10 per cent. of hydrated lime adequate strengths for road base materials were obtained. The investigation of the soil from Kabete has been reported<sup>(6)</sup>.

15. Two samples of soil from Sarawak are at present being investigated in the Laboratory by an engineer from Nigeria. With one of the soils, from the Bukit-Chankol Road, low strengths were obtained when treated with 10 per cent. of ordinary Portland cement. The second soil, from the Kepulu Road, has given satisfactory strengths when treated with 10 per cent. of cement. The cause of the low strengths with the former soil is being further investigated.

16. The construction of the Maiduguri-Bama Road in Northern Nigeria is providing the opportunity for a full-scale road experiment to examine the performance of bitumen-sand stabilised road bases. In such mixtures in the past it has been normal to employ bitumen contents of the order of 4½ to 6 per cent., in the attempt to obtain a durable riding surface. In such mixtures sufficient bitumen is required to provide a material which is resistant to abrasion; where the material is used as a road base, with a protective surfacing, it is possible to use less bitumen and in this experiment a comparison is to be made between the performance of bases of varying thickness and varying bitumen content. The experiment is being undertaken in co-operation with the Federal Government of Nigeria, a firm of consulting engineers and a firm of bitumen suppliers. Preliminary tests suggest that it may be possible

to employ bitumen contents of 3 per cent. or less. The experimental lengths of road are to be constructed towards the end of 1958.

17. *Pavement design and soil moisture movement.* Reference has already been made to the investigations arranged in Kenya with the co-operation of the Ministry of Works and the Road Authority. Six sites have been selected on roads traversing red clay, black clay and volcanic soil. Measurements of moisture changes in the soils and their effect on strength are to be made throughout the yearly climatic cycle. In addition, the analysis of data on the movement and distribution of moisture in soils under airfields in tropical and sub-tropical areas, collected by the Air Ministry and referred to in the second Annual Report of the Committee, has been continued. In this analysis due account is being taken of the variations in moisture content due to soil type and density. Although the sites at which these data were obtained are not situated in Colonial Territories, the conclusions which can be drawn from the results will apply in many of the overseas territories.

18. Measurements from Abu Sueir and Kabrit airfields, Egypt, have been analysed in conjunction with the results of laboratory tests, and a report, the third in the series, has been issued(?). The airfields are situated in the low-lying arid region of North Egypt near the Suez Canal. The water-table at Abu Sueir is probably at a considerable depth. At Kabrit, which is on the shore of the Bitter Lakes, the water-table appears to be maintained at the level of the water in the lakes, and was at 9-11 ft. below the surface of the pavement over the period of the test (January, 1953-July, 1954). Both airfields are constructed on sand subgrades. At Abu Sueir airfield no significant difference was found between the average moisture contents of the soil at similar depths under the pavement and in the adjacent unpaved soil. The moisture contents both in the exposed soil and under the pavement were generally less than 4 per cent. Under these conditions of deep water-table and low rainfall, moisture conditions in the soil were largely determined by the average humidity of the air. The measurements at Kabrit showed that the soil immediately under the pavement had an average moisture content of 9 per cent. and was approximately 3 per cent. wetter than the exposed soil. The soil layer between depths 2-5 ft. was drier and in this stratum there was no marked difference between the paved and unpaved areas. At this site the relatively shallow water-table controlled the moisture distribution beneath the impervious pavement, whilst in the verge evaporation reduced moisture contents mainly at the surface.

19. The analysis of data from Khartoum airfield, Sudan, is complete and a report will shortly be issued. The subgrade consisted of a sandy clay. At this site there is some evidence of lateral variations in moisture content in the soil with the distance from the edge of the pavement. The subgrade close to the edge appears significantly wetter than the soil nearer the centre of the runway. The subgrade at the centre of the runway appeared to be getting wetter during the period of the measurements and it is possible that in time the moisture content will increase to the value of that of the subgrade near the edge of the runway. The higher moisture contents found near the edge of the runway are less than the moisture contents predicted from the results of laboratory tests on soil samples originally in the saturated condition and a knowledge of the water-table level. The method of predicting moisture contents under roads developed at the Road Research Laboratory for use in Great Britain could therefore be safely used at Khartoum, and possibly at similar sites. This would represent more economical design than would arise from soil tests carried out on samples in the soaked condition though it is possible that the resulting pavement thickness predicted by the tests would still be somewhat over-designed.

20. Edge effects of the type noted at Khartoum are particularly important on roads and are likely to be most pronounced in areas where there is a well-defined seasonal variation in climate. The investigation in Kenya during 1958-59, referred to elsewhere, may yield useful information on the magnitude of moisture variations at typical sites and their effect on the strength of the road structure. At a later stage more detailed investigations will be made to determine the mechanisms of moisture movement under roads in areas with marked seasonal cycles of rainfall and temperature.

21. A report has also been prepared on three airfields in Southern Rhodesia, Heany and Kumalo airfields near Bulawayo, and Thornhill airfield near Gwelo<sup>(6)</sup>. All three airfields are situated on silty soils overlying decomposed schist. At Heany and Kumalo there is evidence of a marked increase of moisture content under the pavement at a time when rain had almost ceased. The cause may be due to (1) moisture migration in the vapour phase due to a temperature gradient; (2) to subterranean drainage from higher ground; or (3) to changes of soil type over the test area. Further research is required, and arrangements have been made with the Commissioner of Roads and Road Traffic for an officer to visit Southern Rhodesia to ascertain fully the cause of the moisture changes. At Abu Sueir, Kabrit and Khartoum airfields climatic and soil conditions are favourable to flow of moisture in the vapour phase but if such flow does take place at these sites it is not of sufficient magnitude to be apparent in the moisture content measurements.

22. At the request of the Director of Public Works, Aden, recommendations have been made on the design of an aircraft parking area at Khor-maksar airfield, Aden, required to carry Britannia aircraft. Soil tests showed that the medium-fine sand at the site should be compacted as close to 11 per cent. moisture content as possible so that a dry density of at least 100 lb./cu. ft. could be obtained. Vibratory compaction equipment was recommended. With this density a California bearing ratio of 15 per cent. was estimated for the subgrade. For the sub-base, the addition of large graded material to the sand was considered necessary to bring the C.B.R. value up to approximately 30 per cent. Alternatively, stabilisation with Portland cement was suggested.

23. *Plastic white line road markings in the tropics.* Experience with white line road markings has been disappointing in the Far Eastern territories. Reports have come from Malaya, Singapore and Hong Kong that the material becomes discoloured shortly after laying, and in some instances deforms under traffic. From experience in the United Kingdom where this material was developed, it is known that the consistency of the fluxed rosin binder is vital to the performance of the plastic and the behaviour of the materials in the Far East is consistent with the use of too soft a fluxed rosin for the prevailing road conditions. Information on the ranges of road temperature occurring in Hong Kong, obtained during the visit there in 1956, showed that throughout the year the new road surface temperatures were approximately 20°C. higher than in Great Britain. This information has made it possible to design a series of plastic white line mixes with a range of fluxed rosins of varying consistency. These materials have now been manufactured and have been despatched to Hong Kong for examination in full-scale road trials.

24. *Traffic and economics.* During the year a small group has been formed in the Colonial Section to study road traffic and the economics of road construction in the overseas territories. At the request of the Ministry of Lagos Affairs, Mines and Power of the Nigerian Government, an investiga-

tion is being undertaken of traffic problems in Lagos in connection with the proposed replacement of Carter Bridge, which joins Lagos to the mainland. After the preliminary visit in November, 1957 a report has been prepared containing general recommendations on the siting of the bridge and suggesting various measures for improving the traffic conditions in Lagos. The report also contains recommendations for a detailed study of the traffic pattern in the vicinity of the bridge so that provision can be made for any changes that become necessary due to the resiting of the bridge. Arrangements have been made for two officers from the Laboratory to go to Lagos to carry out this work shortly. Arrangements have also been made for the Head of the Traffic and Economics Section of the Laboratory to visit Hong Kong in the near future, at the request of the Hong Kong Government, to investigate the rapidly growing traffic problem of the congested urban area. The first object of these investigations is to obtain solutions to particular local problems; out of them should come information on the traffic pattern characteristics of these communities.

25. A programme of research has been prepared for studying the value of economic development associated with the construction of roads in under-developed territories. During the visit to Uganda in March, 1958 information was collected on the development associated with road construction in the West Nile area and this information is now being analysed.

26. A note reviewing existing methods of accident reporting in use in Colonial territories has been completed<sup>(9)</sup>. Most territories collect data on road accidents and there are about 12 territories which maintain a fairly detailed and comprehensive system of recording. Most of these systems have been based on the United Kingdom method of accident reporting and some follow it exactly. A number of the smaller territories are now beginning to develop formal methods of assembling accident data and most territories are prepared to make returns of annual statistics to this country as a help to colonial road safety research. Fatalities due to road accidents range from nil in some territories to about 400 per annum in the larger ones; it is estimated that the overall fatal injury rate for all colonial territories is approaching 3,000 per annum. The note discusses the items of information that it is desirable to include in accident reports. It is thought that the standardisation of, say, two uniform systems of accident reporting to cover conditions in both large and small colonies would be helpful and it is suggested that a conference should be held to discuss this question and to determine to what extent agreement is likely to be reached.

27. *Other investigations carried out in the Road Research Laboratory.* The Committee notes with interest other investigations which have been in progress as part of the programme of the Road Research Board and which are of special interest to the overseas territories. Brief notes on some of these are given below.

28. The study of the performance of compaction plant is of particular interest to overseas engineers. In continuing this work an investigation has recently been completed of the performance of a 3 $\frac{3}{4}$  ton vibrating roller, which has been found to be effective over a wide range of soils and under the dry conditions experienced in many of the overseas territories. Pneumatic-tyred rollers are coming into greater use overseas because of their convenience and flexibility in operation. A study has recently been completed of the effect of wheel loading and tyre pressures on the performance of pneumatic-tyred rollers and reports on this are shortly to be circulated.

29. Road construction over unconsolidated estuarine and other alluvial soils presents considerable problems in some territories. Information on the

design and construction of vertical drains to accelerate the consolidation of such soils, has been reviewed and a report has been circulated.

30. Routine soils testing on any scale requires considerable resources of time and effort. A number of investigators have attempted to reduce the amount of time required to evaluate the liquid limit of a soil. The method used is to make one determination of the number of blows at one moisture content and then to obtain the liquid limit by calculation. Examination of a range of soils from Great Britain and from overseas has indicated that this one point method of determining the liquid limit is reliable and reasonably accurate provided a recommended procedure is followed. The method will not be suitable where only semi-skilled workers are employed to carry out the tests, because of the particular importance of great accuracy in the single determination made. Nevertheless, there will be circumstances overseas where the method can be employed and a report describing the procedure has been circulated.

31. Although there may be differences in the pattern of driving between Great Britain and overseas territories, the general principles which have emerged from studies of accidents and driver behaviour at rural junctions in Great Britain should apply equally overseas. During the year the results of investigations on this subject have been summarised in order to deduce the principles which should be followed in designing the layout of rural junctions. Information on this has been circulated in a note which also contains information and comments on details of junction design.

#### *Training and Information Services*

32. At the courses on Soil Mechanics, Bituminous Materials and Concrete, held at the Laboratory in the winter of 1957-58, 38 of the 224 places were again taken up by engineers from the overseas territories. There were in addition a number of consulting and contracting engineers interested in road construction overseas. Six Colonial officers attended the courses on Traffic and Safety held in the spring of 1958.

33. Reference was made in the report for 1956-57 to the scheme which is being developed to help in training materials engineers from the overseas territories, at the Road Research Laboratory. This scheme provides the means to equip engineers who already have some practical experience, with a knowledge of the laboratory- and field-testing techniques employed in the survey, design and construction of roads overseas. During the year two officers from Nigeria have been seconded to the Laboratory for periods of six months, as voluntary workers to receive such training. One was from the Northern Nigerian Public Works Department and the other from the Public Works Department of the Western Region. In addition, an officer from the Federal Public Works Department has been seconded to the Laboratory for a period of eight months; this officer has now returned to Nigeria to take charge of the newly-formed Nigerian Road Research Organisation. All three officers attended the courses on Soils, Concrete and Bituminous Materials.

34. An officer taking up an appointment with the Public Works Department in Uganda was attached to the Laboratory for a period of three months and received training in general laboratory testing techniques. The Materials Engineer of the Department of Works and Hydraulics, Trinidad and a member of the staff of the Central Materials Laboratory of Southern Rhodesia worked in the Colonial Section for several weeks in the course of study-leave. The Section has also received one vocational student from Kenya who was attending a course at Durham University; he has assisted in the general programme of work.

35. The Section has continued to receive many enquiries on particular road problems during the year. A growing number of visitors concerned with road traffic and road construction overseas has visited the Laboratory. Amongst these, the Section was particularly pleased to welcome the Federal Minister of Works and Surveys of Nigeria.

36. Engineers in the overseas territories have been kept informed about the activities of the Laboratory by circulating Research Notes which are of particular overseas interest. A list of these is given in Appendix I. During the year arrangements have been made to circulate Notes on road traffic and safety to police departments and other Government departments concerned in this field.

37. An exhibition designed to demonstrate the scope of the work of the Colonial Section was held at the Institution of Civil Engineers in London for a week in February, 1958. This exhibition, which has been designed to be readily portable, shows the different researches which are in progress and gives some indication of their practical results. It is hoped to arrange to show the exhibition at different centres overseas.

38. *Overseas Bulletins*. During the year two further Overseas Bulletins have been issued:

No. 6. "Corrugations on earth and gravel roads. Their formation, treatment and prevention."

No. 7. "Soil-cement stabilised roads in Brunei, Borneo."

Two further Bulletins are in the press. 250 copies of these Overseas Bulletins are circulated to Overseas Governments and Public Works Departments. During the year there has been a considerable increase in requests from other people and organisations concerned with road construction overseas for copies of these Bulletins and with each issue a total number of 430 are now circulated.

#### *Staff and Accommodation*

39. During the year three Experimental Officers have been recruited. The numbers of scientific staff in the Section at the end of March, 1958, are given below with, in brackets, the number of vacancies in each grade.

Scientific Officers	Experimental Officers	Assistant Scientific
7 (2)	9 (3)	0 (4)

40. Since June, 1957, Mr. Evans has been on prolonged sick leave and it is with regret that we record his death in April, 1958.

41. The Section is still housed in temporary buildings; work was begun on the new laboratories in the autumn of 1957 and it is expected that they will be ready for occupation in September, 1958. The provision of accommodation has lagged much behind the growth of the Section and it is already apparent that this new accommodation will not be adequate for the work which will be in progress by the time the building is ready. The building was planned in such a way that extensions can be readily added. Plans for these extensions have been delayed until new financial schemes to cover the future work of the Section have been formulated.

*Finance*

42. When the Colonial Section was established in 1955, it was envisaged that after an initial period of two years, during which time the Section would be supported in full from Colonial Development and Welfare funds, Colonial Governments should be invited to contribute towards the maintenance of the Section. In the event, the Section has been supported in full from Colonial Development and Welfare funds during an initial period of three years and Colonial Governments have been asked to contribute towards the cost of running the Section during the next two years. A number of Governments have already indicated their willingness to contribute.

43. This method of financing the operation of the Section is, however, not ideal. Plans for undertaking research work overseas have to be made well in advance; indeed it is not easy to put into execution any major plans for the future with a scheme whose continuance depends on contributions from the overseas territories with only a short-term commitment. The Committee would record their conviction of the value of the Colonial Section to overseas Governments and they hope that it will be possible to evolve a firm foundation for the continuing development of the Section.

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- (6) (CRR.53) IRWIN, M. J. A laboratory study of the properties and suitability for stabilization with Portland cement and hydrated lime of a red clay soil from Kenya. *Department of Scientific and Industrial Research. Road Research Laboratory Note No. RN/3235/MJI.* (Unpublished.)
- (7) (CRR.40) RUSSAM, K. The movement and distribution of moisture in soils at overseas airfields. III. Abu Sueir and Kabrit airfields, Egypt. *Department of Scientific and Industrial Research. Road Research Laboratory Note No. RN/3085/KR.* (Unpublished.)
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- (<sup>9</sup>) (CRR.57) TRESIDDER, J. O. A review of methods of accident reporting in use in British Overseas Territories. *Department of Scientific and Industrial Research. Road Research Laboratory Note No. RN/3246/JOT. (Unpublished.)*

Road Research Laboratory,

*April, 1958.*



## ROAD RESEARCH

## APPENDIX I

**LIST OF RESEARCH NOTES WHICH HAVE BEEN CIRCULATED  
TO THE OVERSEAS TERRITORIES BETWEEN APRIL 1957 AND MARCH 1958**

**Traffic engineering, road safety and road economics**

<i>RN No.</i>	<i>Title</i>	<i>Date</i>
3052	Draft specification for reflectorising materials for traffic signs ... ..	August, 1957
3057	Junctions in rural areas ... ..	June, 1957
3061	Direction indicators on commercial vehicles ... ..	June, 1957

**Road materials and methods of construction**

<i>RN No.</i>	<i>Title</i>	<i>Date</i>
3004	An investigation of the performance of a 6 $\frac{3}{4}$ -cwt. vibrating roller for compacting soil ... ..	March, 1957
3011	An investigation into the soil conditions under roads in Trinidad, B.W.I. ... ..	April, 1957
3018	Review of trials and experiments on the use of rubber in bituminous surfacings in Malaya and Singapore ...	April, 1957
3020	Laboratory examination of the properties of fifteen tropical soils ... ..	April, 1957
3079	A comparison of values of liquid limit determined with apparatus having bases of different hardness ... ..	July, 1957
3085	The movement and distribution of moisture at overseas airfields—III Abu Sueir and Kabrit airfields, Egypt ...	August, 1957
3086	Roads and road problems in Hong Kong ... ..	July, 1957
3128	The one point method of determining the value of the liquid limit of a soil ... ..	December, 1957
3130	The design and construction of vertical drains to accelerate the consolidation of soils ... ..	December, 1957

Colonial  
Social Science Research Council  
Fourteenth Annual Report  
(1957-1958)

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London School of Economics and Political Science,  
Houghton Street,  
Aldwych,  
London, W.C.2.  
6th October, 1958.

Sir,

I have the honour, on behalf of the Colonial Social Science Research Council, to transmit to you the Fourteenth Report of the Council, covering the period from 1st April, 1957, to 31st March, 1958.

I have the honour to be,

Sir,

Your obedient Servant,

ARNOLD PLANT,

*Chairman.*

The Right Honourable Alan Lennox-Boyd, M.P.,  
Secretary of State for the Colonies.

COLONIAL SOCIAL SCIENCE RESEARCH COUNCIL  
FOURTEENTH ANNUAL REPORT

*Membership*

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

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

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

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

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

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

MISS A. I. RICHARDS, C.B.E., M.A., Ph.D., Fellow of Newnham College,  
University of Cambridge.

PROFESSOR I. SCHAPERA, M.A., D.Sc., F.R.S.S.Af., Professor of Social Anthro-  
pology, London School of Economics and Political Science.

PROFESSOR R. W. STEEL, B.Sc., M.A., Rankin Professor of Geography, University  
of Liverpool.

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

MR. A. F. COMFORT (*Secretary*).

TERMS OF REFERENCE

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

COLONIAL SOCIAL SCIENCE RESEARCH COUNCIL

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# COLONIAL SOCIAL SCIENCE RESEARCH COUNCIL

## FOURTEENTH ANNUAL REPORT

### I. INTRODUCTION

The Council held three meetings during the year 1st April, 1957, to 31st March, 1958. There were six Committee meetings.

2. The composition of the Council remained unchanged during the year. Professor P. E. Vernon, Professor in Educational Psychology, University of London Institute of Education, accepted an invitation to join the Standing Committee on Anthropology and Sociology, and Mrs. E. M. Chilver, Director of the Institute of Commonwealth Studies and a former Secretary of the Council, joined the Committee on History and Administration. The death of the Reverend E. W. Smith deprived the Linguistics Committee of one of its members.

3. The Inter-African Committee on Social Sciences of C.C.T.A. held its fifth meeting in Brussels in March, 1958. Professor Daryll Forde, of University College, represented the United Kingdom and the West African territories, and Professor A. W. Southall, Chairman of the East African Institute of Social Research, represented East Africa at the meeting.

4. Dr. Audrey Richards visited Northern Rhodesia during the year, spending three months among the Bemba.

### II. GENERAL

5. During the year under review, the allocation for Social Research was increased from £525,000 to £600,000. Issues to the 31st March, 1958, totalled £282,337. New grants included one of £32,992 to the new Nigerian Institute of Social and Economic Research, representing 50 per cent. of the estimated recurrent expenditure of the Institute over the period 1st October, 1957-31st March, 1960, the remaining 50 per cent. being provided by the Nigerian Governments. Other important grants made were one of £11,500 to cover the cost of writing the first two volumes of the Regional History of East Africa and one of £6,257 to pay for the study of land holding and land usage in Swaziland, which has now begun. Additional grants were also made to the Rhodes-Livingstone Institute (towards new building costs) and to the East African Institute of Social Research.

6. Work has now begun on the writing of the Regional History of East Africa which is to be produced under the Council's auspices. Volume I, which will cover the period up to 1895, is to be edited by Dr. Roland Oliver of the School of Oriental and African Studies and Dr. Gervase Mathew of Balliol College, Oxford. Volume II, which will continue the History up to 1945, will be edited by Professor Vincent Harlow with assistance from Professor Ingham of Makerere College as regional editor and Dr. R. E. Robinson as consultant editor. Volume III is planned as a series of comparative studies under the joint editorship of Professor Harlow and Miss Margery Perham. Mrs. E. M. Chilver will act as Administrative Secretary for the whole project and has assumed responsibility for liaison with contributors. Arrangements have been made for the History to be published by the Clarendon Press.

7. A report was received during the year from Professor Dike, Head of the Department of History, University College, Ibadan, on the first year's work under the scheme for a History of Benin, which is being financed jointly from

Colonial Development and Welfare funds and from funds provided by the Carnegie Corporation and the Governments of Nigeria. Research in Benin itself is being carried out under the supervision of Dr. R. E. Bradbury. Dr. Philip Dark, a former Research Fellow of the West African Institute of Social and Economic Research, joined the Scheme during the year as Art Historian, and Dr. A. F. C. Ryder is studying European archives which throw light on the early relations of Benin with European powers.

8. The Conservation Foundation of New York submitted a report during the year on the first stage of the inquiry into family attitudes in Jamaica, towards which a contribution was made from C. D. & W. funds on the recommendation of the Council in 1956.

9. As in previous years, a number of U.S. scholars passed through London on their way to undertake social science research in Africa with funds provided by the Ford Foundation. A high proportion of these scholars have gone to Nigeria. A team of three senior members of the Foundation made a further tour of African territories in the winter of 1957-58.

10. The Council revived their open competition for field research grants, and a Selection Board was appointed under the chairmanship of Mr. H. V. Hodson to consider applications from 21 candidates. The Board held their final interviews shortly after the end of the year and recommended grants to two of the candidates.

### III. REGIONAL INSTITUTES OF SOCIAL AND ECONOMIC RESEARCH

11. The full reports of the four Institutes will be found at the end of the present report.

12. The Nigerian Institute of Social and Economic Research, which has succeeded the former West African Institute of Social and Economic Research, began operations in the autumn of 1957 under the directorship of Professor R. H. Barback. Dr. M. G. Smith, Senior Research Fellow at the Institute of Social and Economic Research, University College of the West Indies, is to spend the academic year 1958-59 at the Nigerian Institute. The first meeting of the new Institute's Advisory Board was held shortly after the end of the year under review, and a research priorities programme was approved.

13. The East African Institute of Social Research, in accordance with the revised arrangements noted in last year's report, is now under the Chairmanship of Professor A. W. Southall, Professor of Sociology and Social Anthropology at Makerere College. The Institute have now completed studies of nearly all the major tribes of Uganda and the Council have noted with approval that this basic work has made possible a move into the sphere of studies of carefully defined comparative problems of direct administrative interest.

14. The Rhodes-Livingstone Institute report the completion of the field work on Dr. Elizabeth Colson's study of the Valley Tonga people. Dr. Colson has now left the Institute. Three new research officers were recruited during the year.

15. In the absence of the Director at Yale University during the academic year 1957-58, Dr. M. G. Smith has taken over the direction of the Institute of Social and Economic Research, in the University College of the West Indies.

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

16. *Cyprus*: The Director of Welfare Services, in continuation of the previous work done on Child Care in the island, has completed an evaluation of the Probation system over its first ten years 1947-57. This is intended as the first of a series of studies of the various forms of treatment of criminal offences, to be carried out during the next few years.

17. *Hong Kong*: Details of the research carried out by the University of Hong Kong are given in the Territory's Annual Report for 1957.

18. *Northern Rhodesia*: The Rhodes-Livingstone Museum have continued their work on the traditional material culture of the native tribes of the territory and of the neighbouring Bantu and Bushmen groups, and have held an investigation into witchcraft practices in Barotseland. The Museum have also continued research on African music, and a record library is available for research workers.

19. *Sarawak*: A report was given at the S.E.A.T.O. Round Table Conference at Bangkok in February, 1958, on research carried out since 1945 into social changes among the Kelabits of the Far Uplands. Funds have been made available for the recording and collection of native crafts, now widely threatened with extinction. In collaboration with learned bodies in Thailand and the Philippines, an examination is being held of the historical culture contacts of the people of Sarawak with these countries.

20. Sir Steven Runciman is at work on an authoritative history of Sarawak in historical times.

21. *Singapore*: The Department of Social Welfare have completed a statistical study of the incidence of unemployment. The Social Research Section has begun a pilot survey of rural Singapore.

22. *Tanganyika*: The Government Sociologists have been engaged in population surveys of the Arusha and Meru tribes and in a study of land tenure among the Safwa. A social survey of urban Africans in Dar es Salaam was completed in 1957.

#### V. COLONIAL DEVELOPMENT AND WELFARE PROJECTS IN PROGRESS

##### Projects undertaken by the International African Institute

23. *Handbook of African Languages*. The fourth and final volume of the survey, *Bantu Languages of Africa*, compiled by M. Bryan, is in the press. The authors of the third volume, *Non-Bantu Languages of North-eastern Africa*, A. N. Tucker and M. Bryan, are engaged in preparing a special study of some of the languages of North-eastern Africa, which is to include linguistic material which, for reasons of space, could not be included in Volume three. This study will complete the series.

24. *Linguistic Survey of the Northern Bantu Borderland*. Volume three of the survey still remains to be published in order to complete this series. The cost of publication is being defrayed by the Belgian Government.

25. *Ethnographic Survey of Africa*. One volume of West Africa was published during the year, and another on East Africa is about to go to press. A number of others are in course of preparation.

26. Another volume in the French series has been published, financed by the Government of French West Africa, and others are in the press or in

preparation; one more volume in the Belgian series, published under the auspices of the Musée Royal du Congo Belge, is about to appear.

27. Forty-three volumes in the whole series have now been published, four of which are now out of print. The demand for the Survey continues to be satisfactory, and receipts from sales of the volumes published from the C. D. & W. grant amount to approximately £7,395 at 30th June, 1958.

### **Other African Projects**

#### *Publication of Lord Lugard's Diaries*

28. Miss Perham has continued her work on the remaining volume of the Diaries. The section on Uganda is now in proof and it is hoped to send the section on Nigeria for printing very shortly.

#### *Land Tenure in British Africa*

29. Dr. Meek's book on Land Tenure and Land Administration in Nigeria and the Cameroons was published during the year as No. 22 in the Colonial Research Studies series.

#### *Preparation of Ga-Adangme Dictionary*

30. The first part of Dr. Berry's dictionary (English to Ga-Adangme) has now been sent to the publishers. It is hoped to arrange for publication of the second part (Ga-Adangme to English) in due course.

#### *Study of the Mbembe People, Southern Nigeria*

31. Miss Rosemary Harris returned to the United Kingdom in August, 1957. She arranged to return for a second short field tour in June, 1958.

#### *Survey of Land Tenure and Land Usage in Swaziland*

32. With the agreement of the Council and the Government of Swaziland, the University of Natal, who have assumed responsibility for this project, have appointed Mr. A. J. B. Hughes as the sociologist to undertake this study. His appointment took effect from the 1st January, 1958.

#### *Study of the Indo-Mauritian Social Structure*

33. Dr. Burton Benedict returned to the United Kingdom in November, 1957, on the completion of his field work in Mauritius, and is at present engaged in writing his report. He has produced a number of papers on various aspects of Mauritian life.

#### *Sociological Research in Gambia*

34. Mr. Gamble returned to the United Kingdom at the end of the year under review, having completed the term of his appointment. His *Elementary Wolof Grammar*, *Wolof-English Dictionary*, *Gambian Fula Verb List*, *Firdu Fula Grammar* and *Fula-English Vocabulary* are being produced in duplicated form.

#### *Study of Land-use in Uganda*

35. A preliminary report has been received from Professor Baker, Head of the Department of Geography, Makerere College, on the survey of land use in Ankole being undertaken by Miss B. G. Sloane, the holder of a Goldsmiths' Company studentship, who was awarded a supplementary grant from C. D. & W. funds in the previous year.

#### *Study of a Bamenda Chiefdom in the Cameroons*

36. Dr. Phyllis Kaberry left for the Cameroons in January, 1958. She was expected to complete her field work in September 1958.



*Study of the Somali Tribes*

37. Dr. I. M. Lewis has submitted a copy of his final Ph.D. thesis, and is at present revising it into the form of a final report.

*\*Election Studies*

38. The Council recommended a C. D. & W. grant to Nuffield College to enable Mr. T. E. Smith, O.B.E., a former member of the Malayan Civil Service who is working under the auspices of the College on a study of the administrative and procedural problems of colonial elections, to visit a number of African territories and discuss these problems with officials on the spot.

*\*Study of Land Tenure in Zanzibar*

39. At the request of the Government of Zanzibar, a grant was approved towards the cost of a survey of land tenure in Zanzibar and Pemba, to be carried out by Dr. J. F. M. Middleton, of University College, London, in the second half of 1958.

*\*Study of the Samburu Tribe in Kenya*

40. Mr. Paul Spencer of Wadham College, Oxford, the holder of a William Wyse studentship, was awarded a small supplementary grant to enable him to to spend about 18 months among the Samburu of the area to the South of Lake Rudolf.

*\*History of the Horn of Africa*

41. At the request of the Government of Somaliland Protectorate, a small C. D. & W. grant was made towards the expenses of preparing a history of the Horn of Africa, which is being undertaken by Mrs. L. H. Thomas, the wife of a serving officer of the administration of Somaliland.

**Projects Elsewhere***Study of the Amerindians of British Guiana*

42. Dr. Audrey Butt returned to the United Kingdom in October, 1957, having completed her second field tour.

*\*History of Aden*

43. A grant was made to cover the expense of preparing a history of Aden, with the main emphasis on the British connexion. Mr. R. J. Gavin, of St. John's College, Cambridge, was appointed shortly after the end of the year to write the history.

**VI. THE STANDING COMMITTEES OF THE COUNCIL**

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

*Committee on Anthropology and Sociology.*

Professor I. Schapera, University of London (*Chairman*).

J. H. M. Beattie, Esq., University of Oxford.

Professor Daryll Forde, University of London.

Professor D. V. Glass, University of London.

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

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

E. R. Leach, Esq., University of Cambridge.

Professor P. E. Vernon, University of London Institute of Education.

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\* Projects started in the year under review.

*Committee on History and Administration*

Professor Vincent Harlow, C.M.G., University of Oxford (*Chairman*).  
Mrs. E. M. Chilver, Director of the Institute of Commonwealth Studies,  
Oxford.

Professor G. S. Graham, University of London.

H. V. Hodson, Esq., Editor of "The Sunday Times".

Professor W. J. M. Mackenzie, The Victoria University, Manchester.

Miss Lucy Mair, University of London.

Dr. Eveline C. Martin, University of London.

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

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

Professor C. H. Phillips, University of London.

Professor K. E. Robinson, University of London.

R. E. Robinson, Esq., University of Cambridge.

*Linguistics Committee*

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

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

Professor M. Guthrie, University of London.

*Secretary of the Standing Committees*

D. R. Willmott, Esq., Research Department, Colonial Office.

**PUBLICATIONS BY WORKERS ASSISTED FROM COLONIAL  
DEVELOPMENT AND WELFARE FUNDS**

45. Publications by workers assisted from Colonial Development and Welfare Funds (new publications in the year under review and additions to the list of publications noted in the Thirteenth Annual Report) are:—

Abrahams, R. G. "Arrival in Nyamwezi". East African Conference Papers. January, 1958.

Ardener, E. W. "Review of Die rote Lendenschnur (als Frau im Grasland Kameruns) by Agathe Schmidt". *Africa*, April, 1957.

"Sociological Investigations of W.A.I.S.E.R. in the S. Cameroons" (revised).

Armstrong, R. G. "The Scientific Approach to Human Relations". *Phylon* (Quarterly journal published at Atlanta University). December, 1957.

Benedict, Burton. "Factionalism in Mauritian Villages". *The British Journal of Sociology*. Vol. VIII, No. 4. December, 1957.

Braithwaite, Lloyd. "Progress towards Federation". *Social and Economic Studies* (Special Federation Number). June, 1957.

"Federal Associations in the B.W.I." *Social and Economic Studies* (Special Federation Number). June, 1957.

"Sociology and Demographic Research in the British Caribbean". *Social and Economic Studies*. December, 1957.

"The Present Status of the Social Sciences in the British Caribbean". *Caribbean Studies: A symposium*. November, 1957.

"The Development of Higher Education in The West Indies". *Social and Economic Studies*. March, 1958.

- Butt, Audrey J. "The Mazaruni Scorpion". (A study of the Symbolic Significance of Tattoo Patterns among the Akawaio). *Timehri*, No. 36. October, 1957.
- Clarke, Edith. "My Mother Who Fathered Me". Allen & Unwin. December, 1957.
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 "The Teacher in Rural Jamaica". In Smith & Kruijer "Extensive Manual". 1957.
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 "The Reigns of the Kazembes". N.R. Journal, Vol. III, No. 2, 1956 (published 1957).  
 "Jehovah's Witness at Work: Expansion in Central Africa". *The Times British Colonies Review*, 1st Quarter, 1958.
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 "From Tribal Elders to Trade Unions", in *Africa in Transition* (edited by Prudence Smith), Max Reinhardt.
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 "Anomie in Ashanti." *Africa* XXVII No. 4, October, 1957.  
 "The Fission of Domestic Groups among the LoDogaba." *Cambridge Papers in Social Anthropology*. No. 1, The Developmental Cycle of the Family, ed. Goody.
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 "East African Age-Group Systems: Some Preliminary Considerations." East African Institute Conference Papers. January, 1958.

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- "Urbanisation in Africa South of the Sahara" (part contributor). Report of the World Social Situation, U.N. Bureau of Social Affairs, 1957.
- "Some African Attitudes to Multi-Racialism from Uganda, British East Africa," in *Ethnic and Cultural Pluralism in Intertropical Communities, 30th Session of I.N.C.I.D.I.* Brussels, 1957.
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 "Sierra Leone Parties Line-up" *West Africa*, May 1957.
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 "Family Patterns in Rural Jamaica" *The Welfare Reports*. Vol. 16, No. 3, June 1957.  
 "On Segmentary Lineage Systems" Curl Bequest Prize Essay, 1955. *Journal of the R.A.I.* Vol. 86, Part 2, June 1957.  
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- with  
 G. J. Kruijer. "A Sociological Manual for Extension Workers in the Caribbean." Caribbean Affairs Series, Extra-Mural Dept., U.C.W.I. August 1957.
- Smith, R. T. "The Family in the Caribbean" *Caribbean Studies: A Symposium*. Nov. 1957.
- Sterning, D. J. "Some Problems of Sociological Fieldwork in a Pastoral Society" *Discovery*. London, Dec. 1956.  
 "Transhumance, Migratory Drift and Migration: Patterns of Pastoral Fulani Nomadism". *Journal of the R.A.I.* Vol. 87, Part II, 1957.  
 "Household Viability among the Pastoral Fulani" *Cambridge Papers in Social Anthropology No. 1*. Jan. 1958.  
 "Preliminary Observations on the Balokole Movement particularly among Bahima in Ankole District" East African Institute Conference Papers. Jan. 1958.
- Wachsmann, K. P. "A Study of Norms in the Tribal Music of Uganda" *Ethnomusicology Newsletter* No. 11, Sept. 1957.  
 "A Century of Change in the Folk Music of an African Tribe" *Journal of the International Folk Music Council*, Vol. X, 1958.
- Whiteley, W. H. with A. E. Gutkind. "A Linguistic Bibliography of East Africa." East African Linguistic Studies No. 2.
- Morton-Williams, P. "A Cave-Painting, Rock Gong and Rock Slide in Yorubaland." *Man.*, Nov. 1957.
- Wolfson, Freda. "Pageant of Ghana" O.U.P. 1958.

#### Papers to be Published

- Abraham, R. C. "Ibo Dictionary".
- Acquah, Ione. "Accra Survey". (U.L.P.)
- Ardener, E. W. and Warmington, W. A. "Social and Economic Problems of the Plantation Labour Force of the Cameroons Development Corporation."
- Colson, E. "Domestic Life of the Plateau Tonga of Northern Rhodesia" M.U.P. for the R.L.I.
- Gutkind, P. W. "The Study of Race Relations". *Man*.
- Stenning, D. J. "Savannah Nomads" O.U.P. for International African Institute.

## APPENDIX I

## EAST AFRICAN INSTITUTE OF SOCIAL RESEARCH

REPORT OF THE CHAIRMAN OF THE EXECUTIVE COMMITTEE,  
1957-581. *Publications and Papers*

*Economic Policy and Labour in Uganda*, by P. G. Powesland (edited by W. Elkan). East African Studies, No. 10.

*Townsmen in the Making: Kampala and its Suburbs*, by A. W. Southall and P. C. W. Gutkind, East African Studies No. 9, was re-issued in a printed version owing to the rapid selling out of the original stencilled edition.

*A Linguistic Bibliography of East Africa*, by W. H. Whiteley and A. E. Gutkind. East African Linguistic Studies No. 2, was also re-issued in a printed form owing to the exhaustion of the roneoed edition. It incorporates all supplements issued after the original roneoed version first appeared.

The following papers, read at Institute conferences during the year, have been duplicated and issued to the regular subscribers and to some other applicants:

## Conference June, 1957:

Social Class in Modern Buganda—L. A. Fallers.

The Rise of the Uganda African Farmers' Union in Buganda—A. B. Mukwaya.

The Report of the Income Tax Commission—David Walker.

Regional Disparities of Income and Taxation in Uganda—W. Elkan.

Some Problems of Change amongst the Kuria—M. J. Ruel.

A History of Relations between the Arusha and the Masai—P. H. Gulliver.

Recent Research amongst the Masai—A. H. Jacobs.

The Structure of Shambalai—E. V. Winans.

## Conference January, 1958:

The Kamba Trade in Wood Carvings—W. Elkan.

East African Age-Group Systems: Some Preliminary Considerations—P. H. Gulliver.

Kuria Generation Sets—M. J. Ruel.

Masai Age-Groups and Some Functional Tasks—A. H. Jacobs.

Preliminary Observations on the Balokole Movement particularly among Bahima in Ankole District—D. J. Stenning.

Arrival in Nyamwezi—R. G. Abrahams.

Efficiency against Self Expression in Local Government—A. Hannigan.

The Anatomy of Administrative Origins: Uganda 1890-1902—D. A. Low.

A large number of other manuscripts are in various stages of preparation for publication as volumes or in the East African Studies series.

2. *Staff*

Dr. Fallers left the Institute in June, much to the regret of all, and took up his new post as Assistant Professor of Anthropology in the University of California at Berkeley.

Five new research fellows took up appointments towards the end of 1957. Messrs. Abrahams, Wijeyewardene and Woodburn had graduated from Cambridge University earlier in the year. Mr. Woodburn is assisted by grants from Goldsmiths' Company and Cambridge University. Dr. Peter Lienhardt had previously studied the shaikhdoms of the Trucial Coast on a studentship of the Treasury Committee

for Studentships in Foreign Languages and Cultures. Dr. van Velsen had previously studied the Lakeside Tonga of Nyasaland as a research fellow of the Rhodes-Livingstone Institute.

The staff at the end of March, 1958, was as follows:

Chairman: Dr. A. W. Southall, Professor of Sociology and Social Anthropology.

Anthropologists:

Dr. D. J. Stenning.  
Dr. P. Lienhardt.  
Dr. J. van Velsen.  
Mr. R. G. Abrahams.  
Mr. A. B. Mukwaya.  
Mr. M. J. Ruel.  
Mr. G. Wijeyewardene.  
Mr. J. C. Woodburn.

Sociologist: Mr. P. C. W. Gutkind.

Economist: Dr. W. Elkan.

Linguist: Dr. W. H. Whiteley.

Administrative

Secretary: Miss G. B. Hunter.

The Institute was sorry to lose Miss Berrange who resigned from the post of Publications Secretary in April, 1957. Her place was taken temporarily by Miss E. Mewes.

### 3. *Associated Research Workers*

Mr. Alan Jacobs has continued his research on the Tanganyika Masai and hopes to cover the Kenya Masai also. Another Ford Foundation Fellow, Mr. C. H. Walter Howe, has commenced a study of political values in Uganda. Magister Axel Sommerfelt, a Norwegian social anthropologist, mainly supported by the Norwegian Research Council for Science and the Humanities is making a study of the Kojjo of Western Uganda. Mr. Paul Spencer is engaged on a study of the Samburu in the Northern Frontier Province of Kenya. He is supported by grants from Goldsmiths' Company, the C.S.S.R.C. and a William Wyse studentship. Mr. and Mrs. Dyson-Hudson continue their researches in Karamoja.

Messrs. Burke and Winans have returned to the United States and are writing up their material.

Mr. C. C. Wrigley, a former Research fellow, returned to the Institute and East Africa for some months to further his studies in economic history. The Institute is also housing Mr. E. K. Hawkins of Nuffield College who is carrying out a road survey for the Uganda Government.

### 4. *Work in Progress*

Dr. Fallers continues for the present to co-ordinate the research results of the Leadership Project from his new post.

Dr. Elkan has continued his study of the system of distribution in Uganda.

Dr. Stenning has continued his work in Ankole. One issue to which he has devoted special attention has been the social effects of the Balokole religious movement.

Mr. Gutkind has submitted a joint report with Dr. Elkan on housing needs in Jinja and is still investigating the impact of development schemes in Greater Kampala.

Mr. Ruel has continued his research on the Kuria of the Kenya-Tanganyika border to the east of Lake Victoria.

Mr. Mukwaya has written several papers on the changing structure of African business organisations in the Kampala area during the last few decades. He has been able to draw upon original documents in the vernacular as well as interviewing informants directly.

Dr. Peter Lienhardt is studying the Arab community in Zanzibar, with special reference to the place of the various Islamic sects and the ramifications of family structure.

Dr. van Velsen is studying the Kumam of the Eastern Province of Uganda, an important minority group in process of change from Teso to Lango culture.

Mr. Abrahams is making a general sociological study of the Nyamwezi. He is at present working in the northern part of the country but will attempt to define the main components of variation in this very large area of Tanganyika.

Mr. Wijeyewardene has started research on Swahili-speaking groups of the Kenya and Tanganyika Coast in order to analyse the process of incorporation of diverse elements into this Islamic coastal culture.

Mr. Woodburn is making an anthropological study of the Hadzapi, or Kindiga, a click-speaking tribe of nomadic hunters in the Lake Eyasi basin of Northern Tanganyika.

Dr. Whiteley has collected some more Iraqw linguistic material in Mbulu District in Tanganyika and surveyed the Swahili dialects of Zanzibar and Pemba. Work is currently being concluded on a study of the morphology and syntax of Gusii, which has been continuing since 1955.

In February Dr. Southall attended a Colonial Office conference on Urban Problems at Ndola in Northern Rhodesia as a delegate of the Uganda Government. He has carried out a survey of present information on changes in the structure of the urban family in East and Central Africa for the International Research Office on Social Implications of Technological Change.

The Institute's conference in June 1957 was held at Moshi in Northern Tanganyika, through the kindness of Dr. P. H. Gulliver. In January 1958 the conference was, as usual, at the Institute.

Three research fellows arriving without previous experience of fieldwork (Messrs. Abrahams, Wijeyewardene and Woodburn) were given practical training in this by being taken for short periods of social investigation in suitable areas within easy reach. This was considered of great importance in ensuring success in their subsequent research when they might for considerable periods be far away from the possibility of any direct supervision.

##### 5. *New Constitution*

The new constitution foreshadowed in last year's annual report came into force at the beginning of September when Dr. Southall returned from England to take charge of the Institute. Dr. Elkan had acted as Director during the previous two months. The new scheme has worked well so far, but the financial problems have yet to be solved, since the main financial support which the Institute derives from Colonial Development and Welfare funds comes to an end on 31st March 1960, while no provision for the Institute will be made out of the budget of Makerere College until July 1961.

##### 6. *Visitors*

Among the usual large number of visitors, including many already noted in previous years, the following may be mentioned:

Dr. Audrey Richards, Professor Meyer Fortes, Professor Daryll Forde, Professor Roger Wilson, Professor and Mrs. Melville Herskovits, Professor Leo Silberman and Professor H. J. Rousseau (of the Faculty of Education, University College of the Rhodesias and Nyasaland); Dr. Elizabeth Colson (Boston), Dr. and Mrs. Roland Oliver (S.O.A.S.), Dr. David Apter (Chicago), Dr. Ofori Atta (Ghana), Miss Julia Henderson (U.N.), Dr. J. D. Durand (U.N.), Mr. M. Youldeman (Rockefeller Foundation), Sir Miles Clifford (Leverhulme), Dr. R. D. Baum (U.S. State Department) and eight members of the U.N. Delegation to Tanganyika; Dr. and Mrs. Max Yurgen, Mrs. Rebecca Reyher (New York), Dr. Burton Benedict (L.S.E.), Dr. R. Manners (Brandeis), Dr. J. S. Coleman (U.C.L.A.), Dr. A. Castagno (Columbia), Dr. Karl Rosberg (Boston), Professor Linville Watson (University of Maryland,



Overseas Programme), Professor Wickert (Michigan), Professor U. R. Ehrenfels (Madras) and Mr. Norman Pollock (Institute of Commonwealth Studies, Oxford).

From East Africa, the Institute's visitors included the Chief Secretary of Uganda, Mr. J. K. Babiiha, M.L.C., Uganda, Mr. W. Woods, Tanganyika, Mr. John Leslie, Tanganyika, Mr. Gower, Tanganyika, Mr. P. W. C. Maxwell, Kenya, and Mr. A. Hannigan, Kenya.

## APPENDIX II

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

ANNUAL REPORT 1957-58 (1ST APRIL-31ST MARCH)

#### *Constitution*

A constitution for the Institute was approved by the Council of Ministers of the Federation of Nigeria and by the Council of the University College, Ibadan. Among other things it provides for a change of name and for N.I.S.E.R. to succeed W.A.I.S.E.R. It lays down an important innovation in the affairs of the Institute by providing also for an Advisory Board. The composition of this Board and the appointments made to it during the year are as follows:—

- |  |  |
|--|--|
| (i) The Principal of the University College<br>(Chairman).   | Dr. J. H. Parry.   |
| (ii) The Director  |  |
| (iii) Two members of the Senate of the University College appointed by the Principal after consultation with the Senate.         | Professor K. O. Dike.<br>Mr. A. Ogunsheye.   |
| (iv) One member of the Council of the University College not being a member of the Academic Staff, and appointed by the Council. | Dr. J. B. C. Okala.  |
| (v) Two members appointed by the Governor-General.   | Mr. C. P. Thompson (Deputy Secretary (Economic) Office of the Prime Minister).<br>Mr. S. B. Chambers (Federal Statistician). |
| (vi) One member appointed by each of the Governors of the several Regions and by the Commissioner for the Cameroons.             |  |
| Cameroons ...  | (not yet appointed).   |
| Eastern ...  | (not yet appointed).   |
| Western ...  | (not yet appointed).   |
| Northern ...   | Mr. E. E. Hillier (Senior Social Welfare Officer).   |
| (vii) One member appointed by the Colonial Social Science Research Council.  | (not yet appointed).   |
| (viii) Two members representing the business community and appointed by the College Council.                                     | Mr. L. P. Ojukwu.<br>Mr. E. C. W. Howard.  |

*Finance*

Estimates for the remainder of the quinquennium to 31st March, 1960, were approved during the year as to 50 per cent. by the Federal Government of Nigeria and 50 per cent. from C.D. & W. funds through the Colonial Social Science Research Council.

*Appointments*

The following research appointments were made during the year:—

Senior Research Fellows	—Mr. K. D. S. Baldwin (Economics) Dr. M. G. Smith (Anthropology)
Research Fellows	—Mr. E. W. Ardener (Anthropology) Mr. V. W. Hogg (Economics)
Bursars	—Dr. R. C. Abraham (Linguistics) Miss J. Herskovits (Social History).

With the exception of Mr. Ardener and Dr. Abraham, who were re-appointed after working with the Institute for some years, the above research workers will take up their appointment at various dates during 1958.

Miss M. Slater, M.A., was appointed Secretary to the Institute and assumed duty in September, 1957.

Further research appointments were under consideration at the end of the year.

*Research*

Mr. Ardener has continued his work on a Marriage Stability Survey in the Southern Cameroons. The choice of sample and collection of data in the Victoria Division have been completed. The material is now being treated by the Hollerith Unit of the London School of Economics in order to yield the information required.

Mr. Ardener is also engaged on a Bakweri Grammar and Dictionary. A vocabulary of some 3,000 words has so far been card-indexed in Bakweri-English and English-Bakweri sections.

Dr. Abraham continued his work on an analysis and dictionary of the Ibo language.

The Institute undertook a project of audience research for the Nigerian Broadcasting Corporation. A preliminary investigation, mainly designed to give information to be used in framing a pilot study, was carried out among 50 households in Ibadan. Pilot studies in two areas of Ibadan were then undertaken; the collection of data for these has been completed, and the material is being worked on. Some preliminary results were conveyed to the N.B.C. during the year. This work is guided by a committee whose members are drawn from the Institute, the Corporation, the University College and the public service. The field work is superintended by Mrs. P. H. Stapleton of the Nigerian College of Technology and collection of data is being performed during vacations by students of that institution.

The Director carried out a short study of the effects of development plans on Nigeria's Far Eastern Trade.

The Institute has been associated with the Lagos Executive Development Board in plans for research into petty trading, the results of which will be of assistance to the Board's activities.

*Publications*

The following publications by present and by past members arising out of their work at the Institute, appeared during the year or were in preparation at the end of the year.

1. Abraham, R. C. ... "Yoruba Dictionary" ... In Press, Hodder and Stoughton.
2. Abraham, R. C. ... "Ibo Dictionary" ... In preparation.
3. Acquah, I. ... "Accra Survey" ... In Press, U.L.P.

4. Ardener, E. W. ... Review of "Die rote Lendenschnur (als Frau im Grasland Kameruns)", by Agathe Schmidt. *Africa*, vol. XXVII, No. 3, July, 1957, pp. 303-4.  
"Numbers in Africa" ... *Man*, 226, November, 1957.
5. Ardener, E. W. ... "Sociological Investigations of Waiser in the S. Cameroons". (Roneoed.)
6. Ardener, E. W. and Warmington, W. A. "Social and Economic Problems of the Plantation Labour Force of the Cameroons Development Corporation". In preparation.
7. Baldwin, K. D. S. ... "The Niger Agricultural Project". Blackwell, 1958.
8. Hawkins, E. K. ... "Road Transport in Nigeria". In Press, O.U.P.
9. Lloyd, P. C. ... "The Itsekiri" in "The Benin Kingdom and the Edo-Speaking Peoples of S.W. Nigeria". Ethnographic Survey of Africa. Western Africa, Part XIII, I.A.I., 1957.
10. Morton-Williams, P. "A Cave-Painting, Rock Gong and Rock Slide in Yorubaland". *Man*, vol. LVII, 213, November, 1957.
11. Prothero, R. M. ... "Labour Migration in B.W. Africa". *Corona*, May, 1957.
12. Prothero, R. M. ... "Migratory Labour from N.W. Nigeria". *Africa*, vol. XXVII, No. 3, July, 1957.
13. Warmington, W. A. "Developments in the Cameroons I—Progress in Peasant Co-operatives". *West Africa*, November 30, 1957.
14. Warmington, W. A. "Developments in the Cameroons II—More Plantations". *West Africa*, December 7, 1957.

#### *General Activities*

Facilities and assistance were afforded to various visiting research workers, including several Ford Foundation Foreign Area Training Fellows, both at Ibadan and in the field.

It has been endeavoured to keep in touch with all known workers in Nigeria who are concerned with economic and social research, and to act as a clearing house for information.

Contact has been sought and co-operation maintained with other institutions which have similar interests to those of the Institute in West Africa.

The Director served as arbitrator in two industrial disputes—in the railway industry, and at the ports.

#### *Visitors*

Visitors to the Institute during the year included:—

- Miss Hella Pick (Assistant Editor, "West Africa").
- Mr. R. G. Murray (Nigerian Representative, West African Committee).
- Dr. J. R. Raeburn (Reader in Agricultural Economics, University of London).
- Dr. R. W. M. Johnson (London School of Economics).
- Dr. H. Smythe (Ford Foundation Fellow).
- Mr. R. L. Sklar (Ford Foundation Fellow).
- Mr. F. D. C. Williams (Economic Adviser, Nigerian Federal Government).
- Professor and Mrs. H. Miner (University of Michigan).
- Mr. T. Knowles (Federal Ministry of Education).

Mr. F. Conant (Columbia University, Ford Foundation Fellow).  
 Mr. D. H. L. Parker (United Africa Company, Lagos).  
 Professor R. C. Tress (University of Bristol).  
 Dr. D. F. Roberts (Department of Human Anatomy, University of Oxford).  
 Mr. J. W. Henderson (Chief Executive Officer, Lagos Executive Development Board).  
 Dr. J. T. Saunders (former Principal, University College, Ibadan).  
 Mr. D. M. Williams (Editor, "West Africa").  
 Dr. J. D. Durand (Population Branch, Bureau of Social Affairs, U.N.O.).  
 Professor W. B. Hamilton (Duke University).  
 Mr. and Mrs. P. Leis (North-Western University, Ford Foundation Fellows).  
 Dame Lilian Penson (University of London).  
 Mr. McFarquhar (Western Region Ministry of Agriculture).  
 Mr. M. Faber (Department of Economics, University College of Rhodesia and Nyasaland).  
 Mm. Buelens and de Tavernier (Boerenbond Belge, Louvain).  
 Mr. J. A. Buck and Mr. R. Morling (Regional Town Planning Section, Ibadan).  
 Mr. J. B. Fox, Mr. Wolf and Mr. Sutton (Ford Foundation).  
 Mr. R. Horton (University College, London).  
 Mr. M. Yudelman and Mr. R. July (Rockefeller Foundation).  
 Professor F. Harbison (Princeton University).  
 Mr. T. Haighton (Director, Inter-African Labour Institute, Brazzaville).  
 Mrs. U. K. Hicks (University of Oxford).  
 M. Pierre Verger (attached to I.F.A.N.).

#### *Building*

Arrangements were sought for the removal of the Institute to a new building on the University College site alongside the College's Department of Economics and Social Studies. The University College authorities offered a first-rate site for the purpose; architects have been instructed to draw plans and the first drawings have been received.

#### *Obituary*

It is with great regret that the death of Mrs. Ione Acquah is recorded. She was a Research Fellow from 1953 to 1956. She died in July 1957, having completed her "Social Survey of Accra" but not having seen it published.

R. H. BARBACK,  
*Director.*

NOTE: Future Annual Reports will be headed only by the new name of the Institute.

### APPENDIX III

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

#### ANNUAL REPORT

April 1957—March 1958

#### STAFF

Director—H. D. Huggins

M. G. Smith	C. O'Loughlin
L. E. Braithwaite	C. Jayawardena
G. E. Cumper	L. Best
R. T. Smith	J. Braithwaite
D. T. Edwards	B. Salz

Mr. L. Best, Dr. J. Braithwaite and Dr. B. Salz joined the staff during the year.

In September, 1957, the Director, Dr. H. D. Huggins, proceeded to Yale University on a Guggenheim Fellowship for the academic year 1957-58 and Dr. M. G. Smith acted as Head of the Department.

## ECONOMIC STUDIES

### *Economic Development*

In August, 1957, Dr. Huggins attended the Conference held by the International Economic Association in Rio de Janeiro where he presented a discussion of the relation of "global planning" to economic development. He also helped to organize the Economic Development Conference held at the University College of the West Indies in August, 1957, and with Mr. George Cumper presented a paper on "Economic Development in a Context of Low Population Pressure." The report of this conference has been edited by Mr. George Cumper and will be published by this Institute shortly. The Director has continued work on the problems of economic growth in underdeveloped territories at Yale University.

The Institute is currently studying the distribution of tourist-derived income in Jamaica. Professor Sargent Florence, formerly Chairman of the Faculty of Commerce and Social Science at Birmingham University, acted as consultant in this study, while at the Institute from January to March, 1958.

Mr. George Cumper is editing a book on economic conditions and problems in the British West Indies, which is a joint undertaking of the Institute's economists.

Mr. Cumper has also carried out an analysis of patterns of expenditure by income groups for Kingston, Jamaica, using material gathered by W. F. Maunder in 1954. A paper applying this analysis to the problem of predicting changes in consumption patterns with increases of income will shortly be published. The Jamaica Planning Unit is collaborating in expanding this work and will integrate it with the Jamaican national accounts project. A similar analysis of Barbados consumption data is nearly complete.

Mr. Cumper's report on the employment survey carried out in Barbados in 1955 has been published by the Government of Barbados. Data gathered in this survey were used for an analysis of the economic functions of the family in Barbados. A paper incorporating this analysis is in draft, and a similar analysis of the economic function of the family in certain areas of rural Jamaica has been published. This and earlier studies will be incorporated in a monograph on the role of labour in economic development.

### *National Accounts*

This project is supported by the Carnegie Corporation and by various of the West Indian Governments. During the past twelve months, plans for the project were completed and Dr. C. O'Loughlin, working with the Government of British Guiana, gathered data for estimates of the national income, balance of payments and capital formation accounts of that territory. Dr. O'Loughlin also acted as consultant to the National Income section of the Jamaica Department of Statistics on national accounts, and advised the Government of British Guiana on the problem of maintaining regular national income statistics in the future.

In January-March, 1958, Dr. O'Loughlin held a set of seminars on national accounts problems mainly for officials of the Jamaica Government. She has also forwarded her draft report on British Guiana national accounts to the British Guiana Government, together with papers on British Guiana Balance of Payments and Capital Formation, 1952-56. Dr. O'Loughlin has also prepared a paper on the Rice Sector in the Economy of British Guiana, which will shortly be published.

Dr. Jeannette Braithwaite and Mr. Lloyd Best were recruited early this year for work on the regional national accounts project. The Jamaica Government has asked for further assistance with their national accounts compilation, and Mr. Best has been assigned to work with them. Dr. Jeannette Braithwaite

proceeded to Barbados in mid-March to work on national accounts there, after 2 months preliminary studies at this Institute.

In May this year Dr. O'Loughlin will visit the Leewards and Windwards Islands to make arrangements for work in these areas.

By arrangement with the Institute Mr. A. P. Thorne also visited Jamaica as consultant on the national accounts of that island, during Dr. O'Loughlin's absence in British Guiana.

#### *Agricultural Economics*

Mr. D. T. Edwards has completed his report on the economics of small farming in Jamaica for submission to the University of London as a Ph.D. thesis. The associated study of small farm financing by Mr. C. S. McMorris, has already been published.

Dr. R. T. Smith has published a study of the Economic Aspects of Rice Production in an East Indian Community in British Guiana and Dr. C. O'Loughlin has also prepared a report on The Rice Sector in the British Guiana Colonial Economy.

The Institute has arranged for Mr. David Niddrie of the Department of Geography, Manchester University, to carry out a study of land utilisation in Tobago, from May to September, 1958.

The Federal Government has requested the Institute to submit a list of its programme of research projects in Economics and Agricultural Economics, and this has been sent to them with a memorandum on agricultural research which had been submitted to the Regional Economic Committee in 1955.

#### SOCIOLOGICAL AND ANTHROPOLOGICAL STUDIES

Dr. Beate R. Salz of the University of Puerto Rico, was appointed to the staff of the Institute in January, 1958, for a period of 12 months to carry out a field study of the social structure of St. Lucia. Dr. Salz visited the Institute for preliminary discussions and reading before proceeding to St. Lucia.

Dr. M. G. Smith completed a series of comparative studies of West Indian family organization, which are being revised for publication. In association with Dr. G. J. Kruijer, U.N.E.S.C.O. sociologist seconded to carry out a sociological survey of the Christiana Area, Jamaica, Dr. Smith prepared a summary account of the sociology of rural Jamaica which has since been published.

Data on the stratification of Grenada are now being analysed. Revision of the monograph on Carriacou is nearly complete. Other papers were prepared on field work methods, applied anthropology, and some aspects of Hausa culture.

In association with Mr. P. C. Evans of the Institute of Education, London, who was attached to the Department of Education, U.C.W.I., Dr. Smith made a study of occupational choice among elementary school children in rural Jamaica, which will shortly be published.

Before leaving for the University of California in August, 1957, to take up a nine months assignment, Dr. R. T. Smith prepared papers on various aspects of his field studies among the East Indian peasants of Demerara, British Guiana. His study of rice farming has already been mentioned, and another paper on the Hindu marriage customs prepared by Dr. R. T. Smith and his assistant, Mr. C. Jayawardena, will shortly be published.

Mr. Jayawardena completed one year's field work in British Guiana in October, 1957, and spent 6 months at this Institute working on his materials before returning to British Guiana in February to complete his field studies.

Mr. L. E. Braithwaite visited Trinidad and Tobago in April-May, 1957, in connection with work in progress there. He also directed the field studies of three post-graduate students of Columbia University, New York, in Tobago, during June-September, 1957. A grant for this purpose was made by the Research and Training Program for the Study of Man in the Tropics. Mr.

Braithwaite has since been engaged in drafting a preliminary report of these Tobago studies.

Mr. Braithwaite has drafted studies of educational development and institutions in Trinidad and Tobago for incorporation in a monograph on this subject. This monograph is now being revised.

On behalf of a Senate Committee of the University College, Mr. Braithwaite has supervised the collection and processing of data on the distribution of West Indians at universities overseas, and has made a survey of the present population of graduates in this region.

In November, 1957, this Institute and the Department of Education, U.C.W.I. held a joint seminar on education in Jamaican society. Papers were presented by Mr. R. N. Murray, Chief Education Officer, Jamaica, Professor Margaret Read, Dr. M. G. Smith and Mr. L. E. Braithwaite.

Messrs. George W. Roberts and D. O. Mills, working under the direction of this Institute, completed their study of the local effects of the current Jamaican migration to the United Kingdom. This will be published shortly. Preparations were made for a joint study by Mr. George Roberts and Mr. Lloyd Braithwaite of the sociological and demographic conditions of population, immigration and fertility in Trinidad. Dr. David Lowenthal, Fulbright Research Fellow, attached to the Institute during the period under review, completed a historical study of population in Barbados, which has been published in the Institute's journal.

At the request of the Caribbean Commission, the Director, Dr. H. D. Huggins, Mr. L. E. Braithwaite, Mr. George Cumper and Dr. M. G. Smith of the Institute collaborated with Mr. G. Arthur Brown and Dr. J. Mayone Stycos to provide a documentary paper on the possible solutions to the Caribbean demographic problems for the Conference on Caribbean Demographic Problems held by the Caribbean Commission in Trinidad, July 25 to August 2, 1957. Mr. Braithwaite, who was then in Trinidad, attended this Conference as an Observer for the College, and acted as rapporteur for the discussion of social developments.

On the basis of considerable documentary research, Mr. Braithwaite prepared a monograph on the recent history and background of West Indian Federation. In association with Dr. Roy Augier of the History Department, U.C.W.I. Mr. Braithwaite is also preparing a collection of documents on the historical growth and vicissitudes of Caribbean Federation. A monograph study of Caribbean political systems and their development has been planned. This will contain accounts of territorial units and discussions of regional continuities, variations and problems.

The Institute plans to produce a volume devoted to studies of family and kinship organization in the West Indies in association with Professors Max Gluckman and Sidney Mintz of Manchester and Yale Universities. Field reports on different territories will provide a series of case studies, and the discussion of their implications, continuities and variations will complete the volume.

#### Associate Studies

Professor Sargent Florence, formerly Chairman of the Faculty of Commerce and Social Science at Birmingham University, worked at this Institute from January to March, 1958, on problems of population and economic growth in underdeveloped territories. During this period Professor Florence acted as consultant on the Institute's economic programmes, including the tourist survey, and participated in seminars and discussions with the staff.

Dr. David Lowenthal of the American Geographical Society, undertook a comparative historical-geographical study of the British, French and Dutch West Indies, as a Fulbright Fellow, 1956-57. Two articles by Dr. Lowenthal have been published recently in the Institute's journal.

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In 1956-57 Dr. G. J. Kruijer, U.N.E.S.C.O. specialist from Amsterdam, carried out sociological surveys of one major development area in Jamaica and has published his findings in collaboration with Dr. M. G. Smith of this Institute.

Professor H. A. Peck of the University of Maine worked at this Institute between September, 1957 and March, 1958, carrying out a study of the balance of payments problem in Jamaica. Professor Peck held a grant from the Social Science Research Council.

Professor R. L. Aronson of the Cornell University, Fulbright Fellow, studied various aspects of labour recruitment in Jamaica. As part of this study, Professor Aronson has made a field study of Jamaican workers in the bauxite industry.

Professor Orme Phelps of Claremont Men's College, California, Fulbright Fellow, has been making a study of labour-management relations in Jamaica and of the development of Trade Unionism in Jamaica.

Mr. Lambros Comitas, post-graduate anthropology student of Columbia University, carried out studies of fishing communities in Barbados and Jamaica under a Fulbright Fellowship. In Jamaica Mr. Comitas worked under the supervision of Dr. M. G. Smith.

#### Awards

Dr. H. D. Huggins was awarded a Guggenheim Fellowship for the academic year, 1957-58, for work on problems of economic growth. Dr. Huggins took up his Fellowship at Yale University.

Dr. C. O'Loughlin received the degree of Ph.D. from the Australian National University for her study of the Pattern of the Fiji Economy, 1950-53.

Dr. Jeannette Braithwaite received the degree of Ph.D. from the Queen's University, Belfast, for her study of Some Aspects of Economic Development with special reference to the West Indies.

Dr. R. T. Smith was invited to act as Visiting Lecturer in social anthropology at the University of California from September, 1957, to June, 1958. Besides lecturing on social structure and Caribbean sociology, Dr. Smith also advised on programmes of community research planned by the Department of Anthropology, Californian University.

Dr. M. G. Smith has been appointed Senior Research Fellow of the Nigerian Institute of Social and Economic Research for a 12-month field study of the political history of Muhammadan emirates in Northern Nigeria.

During the period under review the Research and Training Program for the Study of Man in the Tropics of Columbia University asked the Institute to allow Mr. L. E. Braithwaite to act as Director for their field studies in Tobago.

#### Other Activities

Dr. Michael Hoffman, Director of the Economic Development Institute of the International Bank for Reconstruction and Development, in discussions with the Director of the Institute, Dr. H. D. Huggins, has proposed a joint six-weeks seminar in economic development and planning to be held at this Institute in the summer of 1959 under the joint auspices of the economic Development Institute and the Institute of Social and Economic Research, U.C.W.I. This proposal has been placed before the University authorities for their consideration.

Mr. George Cumper has been appointed to the Rural Passenger Transport Commission and to the Standing Committee in the Teaching Service in Jamaica. He has also represented the Institute on the newly established Scientific Research Committee, which is advisory to the Jamaica Government.

On behalf of the Institute, Dr. M. G. Smith contributed a paper on Ethnic and Cultural Pluralism in the British Caribbean to the 30th Study Session of the International Institute of Differing Civilisations which met at Lisbon in April, 1957.



During the course of her field studies Dr. C. O'Loughlin conducted a number of classes and seminars on general economics and economic development for Extra-Mural groups in British Guiana. In Jamaica Mr. G. E. Cumper conducted Extra-Mural classes in economics.

At the request of the Institute, Prof. Margaret Read, visiting consultant to the Department of Education, U.C.W.I. gave a public lecture on "Education and Cultural Tradition".

Dr. H. D. Huggins, Mr. G. E. Cumper, Mr. L. E. Braithwaite, Dr. M. G. Smith and Dr. R. T. Smith attended a Study Conference on Plantation Systems of the New World held by the Pan-American Union at San Juan, Puerto Rico, 17th to 24th November, 1957. Dr. Huggins acted as Chairman of certain sessions, Dr. R. T. Smith presented a paper on "Family Structure and Plantation Systems in the New World", Mr. Cumper led the discussion on "socio-cultural aspects of labour, land and capital", Mr. Braithwaite discussed a working paper on "Colour and Social Class" and Dr. M. G. Smith discussed a paper on the development of creole cultures in plantation societies of the New World.

The Institute's staff played a major part in preparing the documentation presented by the British section to the Caribbean Commission's Conference on Demographic Problems in Trinidad, July, 1957, and helped to organize, and took part in, the Economic Development Conference held at University College of the West Indies in August, 1957.

#### Staff Publications in 1957

The Institute's Journal, Social & Economic Studies continued to increase its circulation and volume of published materials. A sales promotion drive has been organized to raise the subscriptions from the current figure of approximately 900.

During the period under review the Institute issued a double number of the Journal devoted to the subject of West Indian Federation under the editorship of Prof. Paul Knaplund, and a monograph on the financing of Jamaican peasant farms. The Institute also prepared a volume on Caribbean Studies for joint publication with Columbia University.

Publications by members of the staff during the year 1957-1958 were:

##### Braithwaite, L. E.

Progress Toward Federation, 1938-1957. Social and Economic Studies, Vol. 6, No. 2, June, 1957, pp. 133-184.

"Federal" Associations and Institutions in the British West Indies. Social and Economic Studies, Vol. 6, No. 2, June, 1957, pp. 286-328.

The Present Status of the Social Sciences in the British Caribbean. Caribbean Studies: A Symposium, November, 1957, pp. 99-109.

Sociology and Demographic Research in the British Caribbean. Social and Economic Studies, Vol. 6, No. 4.

The Development of Higher Education in the British West Indies. Social and Economic Studies, March, 1958, Vol. 7, No. 1.

##### Cumper, G. E.

Estimates of Jamaican Commodity Trade, 1850-1949. Social and Economic Studies, Vol. 6, No. 3, September, 1957, pp. 425-431.

Economic Development in the West Indies in the Nineteenth Century. Extra-Mural Reporter, Vol. 4, No. 2, April, 1957, pp. 6-14.

Review of Steward "The People of Puerto Rico". American Sociological Review, Vol. 22, No. 4, August, 1957, pp. 480-481.

The Jamaican Family: Village and Estate. Social and Economic Studies, March, 1958, Vol. 7, No. 1.

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O'Loughlin, C.

Agricultural Sector Statistics in National Accounting, Social and Economic Studies, September, 1957, Vol. 6, No. 3.

Smith, M. G.

Ethnic and Cultural Pluralism in the British Caribbean in Ethnic and Cultural Pluralism in Inter-Tropical Communities. INCIDI, Brussels, April, 1957.

Review of "Developments towards Self-Government in the Caribbean". *Man*, Vol. 57, Article 70, April, 1957.

Smith, M. G.

Family Patterns in Rural Jamaica. *The Welfare Reporter*, Vol. 16, No. 3, June 1957.

On Segmentary Lineage Systems, Curl Bequest Prize Essay, 1955.

*Journal of the Royal Anthropological Institute*, Vol. 86, Part 2, June 1957.

(with G. J. Kruijer) *A Sociological Manual for Extension Workers in the Caribbean*. Caribbean Affairs Series, Extra-Mural Department, August 1957.

Dark Puritan. Part I. *Caribbean Quarterly*, Vol. 5, No. 1. Extra-Mural Department, June 1957.

Dark Puritan. Part II. *Caribbean Quarterly*, Vol. 5, No. 2. Extra-Mural Department, February 1958.

Review of Proudfoot, "Britain and the U.S.A. in the Caribbean", *Caribbean Quarterly*, Vol. 5, No. 1. Extra-Mural Department, June 1957.

The African Heritage in the Caribbean. *Caribbean Studies: A Symposium*, November 1957.

Review Article: The Political Past and Future, Social and Economic Studies. Vol. 6, No. 4.

Smith, R. T.

Review of Salz, "The Human Element in Industrialization: A Hypothetical Case Study of Ecuadorian Indians." *Man*, Vol. 57, Article 71, April 1957.

Economic Aspects of Rice Production in an East Indian Community in British Guiana. *Social and Economic Studies*, Vol. 6, No. 4.

The Family in the Caribbean. *Caribbean Studies: A Symposium*, November 1957.

McMorris, C. S.

*Small-Farm Financing in Jamaica*. Supplement to *Social and Economic Studies*, Vol. 6, No. 3, September 1957.

#### APPENDIX IV

#### THE RHODES-LIVINGSTONE INSTITUTE FOR SOCIAL RESEARCH

#### DIRECTOR'S REPORT FOR THE YEAR ENDING 31st MARCH, 1958

##### *Introduction:*

The feature of the year was undoubtedly the greater impact of the Institute in particular and social research in general on Governments, commercial enterprise and private individuals throughout Central Africa. In the days when the greater proportion of the funds came from Colonial Development and Welfare there was, it is felt, a tendency amongst the local people to regard social research as something outside their orbit which they neither paid nor cared for. The commencement of the new attitude can, I think, be traced to Sir Arthur Benson's appeal which was so successful in obtaining local funds and stimulating local interest in social research. Another event of the first importance in this connection was the establishment of the University College of Rhodesia and Nyasaland, with which the Institute's relations are close and cordial. This awakening interest has been stimulated by the large number of talks given by the Institute's staff to meetings and over the radio, and to the courses and groups detailed below who have visited the Institute during the year.

The growing realisation of the existence of the Institute and the value of its work has led to a greater demand for its services, and, what is more, a willingness to pay for these. Details of such commissioned research appear in the appropriate section of the report.

On the debit side recruitment during the period under report has proved slow: even where candidates were forthcoming it was apparent that our recruiting mechanism required streamlining. As a first step towards this end a successful approach was made by the Secretary of State on our behalf to the Inter University Council for Higher Education Overseas who will, from now on, undertake advertisement, preliminary checking of candidates, interview in U.K. etc. on behalf of the Board of Trustees. When this mechanism is inaugurated it will be necessary to see whether procedure in Central Africa requires overhaul.

#### *Board of Trustees:*

Several changes occurred during the year. The Board as constituted at the 31st March, 1958 was as under:—

His Excellency Sir Arthur Edward Trevor Benson, K.C.M.G. (President).	Governor of Northern Rhodesia.
* H. Franklin, Esq., O.B.E., M.L.C., (Vice President).	Member for Education and Social Services, Northern Rhodesia.
* The Financial Secretary, R. A. Nicholson, Esq., C.B.E.	Northern Rhodesia.
* The Acting Secretary for Native Affairs, G. S. Jones, Esq., C.M.G., M.B.E.	Northern Rhodesia.
O. B. Bennett, Esq., O.B.E. ... ..	Rhokana Corporation, Kitwe, N. Rhodesia.
R. H. C. Boys, Esq. ... ..	British South Africa Company, Lusaka, Northern Rhodesia.
Professor B. A. Fletcher, M.A., B.Sc. ...	Vice-Principal, University College of Rhodesia and Nyasaland.
C. D. P. T. Haskard, Esq. ... ..	Acting Secretary for African Affairs, Nyasaland Protectorate.
R. Howman, Esq., B. A. ... ..	Under Secretary for Native Affairs, Southern Rhodesia.
* W. C. Little, Esq., O.B.E. ... ..	Director-Designate of African Education, Northern Rhodesia.
John Mwanakatwe, Esq., B.A. ... ..	Headmaster, Kasama Junior Secondary School, Northern Rhodesia.
H. N. Parry, Esq., C.M.G. ... ..	Secretary to the Prime Minister and Cabinet Office, Federation of Rhodesia and Nyasaland.
F. M. Thomas, Esq., B.A. ... ..	Provincial Commissioner, Central Province, Northern Rhodesia.
L. Tucker, Esq., M.L.C. ... ..	Northern Rhodesia.

\* Indicates Member of Standing Committee.

#### *Committees:*

The formal rules required by statute establishing the Committees and laying down their procedure were not in fact promulgated when the Committees themselves were established. A run of a year or more has enabled the most appropriate

form of such rules to be decided. These have been accepted by the Board of Trustees, approved in principle by the Governor and their final form is now being considered by a legal draughtsman. The membership of the Committees as set out in this report shows their future composition.

*Research Committee :*

Professor B. A. Fletcher, M.A., B.Sc. (Chairman).	Vice-Principal, University College of Rhodesia and Nyasaland.
Desmond Clark, Esq., Ph.D., O.B.E. ... ..	Curator, Rhodes-Living- stone Museum.
* H. A. Fosbrooke, Esq., M.A. ... ..	Director, Rhodes-Living- stone Institute.
G. S. Jones, Esq., C.M.G., M.B.E., Act. Sec. for Native Affairs.	Northern Rhodesia.
W. C. Little, Esq., O.B.E. ... ..	Director - Designate of African Education Dept., Northern Rhodesia.
* Professor J. Clyde Mitchell, B.A., D.Phil. ...	Professor of African Studies, University Col- lege of Rhodesia and Nyasaland.
C. A. L. Myburg, Esq., M.Com., Ph.D. ...	Acting Director, Central African Statistical Office, Salisbury.
Roger Summers, Esq. ... ..	Keeper of Antiquities, The National Museum, Southern Rhodesia.

*Consultants :*

* Professor Elizabeth Colson, Ph.D. ... ..	Associate Professor, African Studies Program, Boston University, U.S.A.
* Professor Max Gluckman, D.Phil. ... ..	Professor of Social Anthro- pology, University of Manchester.

\* Indicates Member of Editorial Board.

*External Relations*

One of the most important developments in the research picture in Central Africa since the establishment of Federation was the appointment in 1957 by the Federal Prime Minister of Mr. D. G. Kingwill, Chief Liaison Officer, South African Council for Scientific and Industrial Research, to enquire into the organization of research in the Federation. It is understood that Mr. Kingwill examined three main aspects of the problem. Firstly, the possibility of co-ordinating research under some body with Federal-wide powers, secondly the development of scientific library services and the interchange of information in the scientific field, and thirdly the representation of the Federation in scientific matters at international level. It is understood that Mr. Kingwill's report is presently being studied by the Governments concerned. The Institute assisted him in his enquiries by submitting memoranda, both factual and as proposals for research. The Director and Dr. Bettison attended a conference called in Salisbury to consider Mr. Kingwill's terms of enquiry in relation to the social sciences. It might not be inappropriate to mention at this juncture that Mr. Kingwill found the administrative framework of this Institute a model, considering our system of Boards and Committees an ideal means for bringing together all those interested in the problems under review.

The Institute and its members continued to play their parts in Lusaka public life. In addition to the offices mentioned last year—member of the Monuments Commission, of the Council of Munali Secondary School, of the Editorial Board

of the Northern Rhodesian Journal and of the Geographical Place Names Committee—the Director accepted the chairmanship of the Northern Rhodesia Council of Social Services and also of the Lusaka branch of the Rhodesia and Nyasaland University Association. He was also co-opted as a member of the Committee of the United Northern Rhodesia Association. It is felt that this type of work, although time consuming, is valuable in making the Institute and its works better known amongst those who can profit from a study of its results.

The Director was in the United Kingdom from July to early October. During his sojourn he visited six Universities and attended the conference on African History organized by the School of Oriental and African Studies in London, the meeting of the Association of Social Anthropologists at Edinburgh and the Colonial Office Summer Conference at Cambridge. He then proceeded to Madagascar where he was one of the Federal delegation attending the C.C.T.A. Conference on Rural Welfare. In Northern Rhodesia he presided at a two day conference organized by the Northern Rhodesia Council of Social Services, attended a conference on Alcoholism at Kitwe and joined in the deliberations of the Christian Council who are engaged on organizing a social survey. Both the Director and Dr. Bettison attended the Colonial Office Conference on Urbanisation held at Ndola in February. En route to U.K. the Director also appeared before the Serengetti Committee of Enquiry at Arusha at the request of the Tanganyika Government.

Many requests were received for talks and broadcasts. The Institute's staff was heard on the local radio at least once a month, appearing in such features as Postscript to the News, Forum, Your Questions Answered etc. Dr. Bettison gave talks to an African Trade Union Officials' course, to the Chalimbana Cadets Course, to Lusaka Round Table and to the Council of Social Services Conference mentioned above. The Director addressed Munali Secondary School, the Gilbert Rennie School Scientific Association, Capricorn Society, the Lusaka Natural History Club and a conference of officers on rural development organized by the Northern Rhodesia Government.

Dr. Apthorpe will act as rapporteur for Central Africa at the 31st Conference of the International Institute of Differing Civilizations, Brussels, and is now preparing his survey.

*Conferences*

Two Institute conferences were held during the year, the 10th and 11th in the series which staff movements and other unavoidable circumstances had caused to fall into abeyance for a couple of years. The April 1957 conference was well attended and covered a broad field as the following list of Papers reveals:—

- The Blantyre-Limbe Peri-Urban Problem by Dr. Bettison (R.L.I).
- The Meadowlands Housing Scheme by L. Vincent, Manager, N.R. Housing Board.
- The Lusaka Market Boycott by A. Nyirenda (R.L.I).
- Local Implications of Matrilineal Descent in a Changing Africa, a discussion introduced by H. A. Fosbrooke (R.L.I).
- Ila Witchcraft by A. Tuden, Ford Foundation Fellow affiliated to the Institute.
- The Valley Tonga by Dr. Elizabeth Colson (R.L.I).
- The Pastoral Problems of Northern Rhodesia by M. Halcrow, Deputy Director of Agriculture.
- African Agricultural Adaptability by H. A. Fosbrooke (R.L.I).
- African Farming Improvement Amongst the Plateau Tonga by C. E. Johnson, Chief Agricultural Officer.
- African Land Tenure in Northern Rhodesia by C. M. N. White, Land Tenure Officer.
- Problems of African Budget Enquiries, a discussion introduced by officers of the Central African Department of Census and Statistics.

The eleventh conference in January 1958 was honoured by the attendance of four professors. The last minute cancellation of the visit of a fifth professor—Professor Fortes of Cambridge—was a matter of great regret. Having representatives of the social sciences from all the surrounding areas the opportunity was taken to present a review of the study of sociology in Southern Africa, Professor Maquet of the University of Elizabethville describing the situation in the Belgian Congo, Professor Irving informing the conference of the position in South Africa and Professor Mitchell performing a similar function in relation to the Federation. Thereafter the conference proceeded to consider its main theme “Interrelations in Central African Rural and Urban Life” under the following heads and with contributions from those listed below:—

*Rural-Urban Migration*

The reasons for migration from rural areas, Professor Mitchell, University College of Rhodesia and Nyasaland

Migrancy and social structure in peri-urban communities in Nyasaland, Dr. D. G. Bettison, (R.L.I.)

Rural development as a corrective to excessive migration, by H. A. Fosbrooke, (R.L.I.), C. E. W. Coleman, (Rural Development, Northern Rhodesia Government), and W. J. Argyle, (R.L.I.)

*Urban Ecology and Society*

Ecology of city growth in the African context, Professor Irving, Rhodes University.

African town planning in relation to the neighbourhood concept, P. O. Coltman, A.R.I.B.A.

Types of urban social relationship, Professor Mitchell.

Can labour be stabilised without permanent urbanisation and concomitant social security measures?, H. A. Fosbrooke.

*Urban Economic Activities*

Factors inimical to African production, Professor Irving.

The current employment situation in Northern Rhodesia, C. E. Cousins, Commissioner for Labour, N. Rhodesia.

The Blantyre-Limbe Market, A. A. Nyirenda, (R.L.I.)

Distilling and Brewing in Nyasaland, H. D. Ng'wane, (R.L.I.)

*An Hypothesis.*

The interrelation of tribal and urban social structures, Dr. R. J. Apthorpe. (R.L.I.)

Proceedings closed with a most useful discussion on the proposed lines of future research.

In addition to these two conferences the Institute played its part in assisting in the organisation of a Seminar at the Roan Antelope Mine to consider and discuss Bemba matters in both the rural and mining context. Dr. Audrey Richards was the guest speaker whilst Dr. Apthorpe represented the Institute.

The opportunity presented by Father Fortune's presence in Central Africa was taken to organise a linguistic week-end at the Institute attended by Father Fortune, Lecturer in Bantu languages at Cape Town University and at present working at Salisbury, Mr. C. M. N. White, the Land Tenure Officer of the Northern Rhodesia Government, well known for his linguistic ability and Mrs. Carter, the wife of an Education Officer now posted in Tonga country and previous research worker of the School of Oriental and African Studies. Mr. Gerald Wilson of the Publications Bureau also joined in these discussions as a result of which the proposed approach to linguistic research in this area was worked out.

*Visitors*

More than 400 people signed the Visitors' Book during the year including all members of the Board of Trustees and of the Research Committee. This

figure indicates the growing use made by the public of the Institute's facilities ; it compares with a figure of 200 in the previous year and less than 100 the year before.

From overseas, we welcomed:—

- Mr. G. M. Roddan, C.M.G., Deputy Agricultural Adviser to the Secretary of State, Colonial Office, London, S.W.1.
- Professor and Mrs. M. J. Herskovists, Professor of Anthropology, Northwestern University, Evanston, Illinois, U.S.A.
- Mr. R. J. Honk, Geographer, St. Paul University, Chicago, Illinois, U.S.A.
- Mr. R. W. Walker, Ministry of Labour, London.
- Professor Thomas M. Frank, Professor of Law, Graduate School, New York University, Washington Square, New York 3, U.S.A.
- Professor and Mrs. Foster Flint, Professor of Geology, Yale University, New Haven, U.S.A.
- Dr. Lighthart, United Nations Secretariat (Africa Division), Manhattan, New York, U.S.A.
- Mr. Christopher Martin, Brasted Theological College, Kent, England.
- Mr. R. Soumaille, International Labour Office, Geneva, Switzerland.
- Mr. Wilfred Benson, United Nations, New York, U.S.A.
- Mr. Andre Springuel, Trade Unionist, 26, Ave. N.D. de Fatima, Berchein St. Agatje, Belgium.
- Professor Douglas V. Steere, Haverford College, Haverford, Pa., U.S.A.
- The Hon. Richard Wood, Mr. James Callaghan, Mr. Charles Fletcher-Cooke, Col. J. H. Harrison, Major Patrick, H. B. Wall, Mr. J. E. MacColl, Mr. G. A. Pargiter, being the delegation from United Kingdom Branch of the Commonwealth Parliamentary Association to the Federation of Rhodesia and Nyasaland.
- Dr. R. W. M. Johnson, Research Officer, Colonial Social Science Research Council, London.
- Professor Channing B. Richardson, Associate Professor of Political Science, Hamilton College, Chinton, New York State, U.S.A.
- Mr. John D. Durand, Demographer, Population Branch, United Nations, New York, U.S.A.
- Mr. Nigel Heseltine, Specialist for Near East and Africa, Food and Agriculture Organization of the United Nations, Rome, Italy.
- Mr. Murray McMullan, Colonial Office, London, S.W.1.
- Professor and Mrs. W. Lonsdale Tayler, Chairman, Department of Political Science, Dickinson College, Carlisle, Penns, U.S.A.
- Miss Thelma A. Dreis, Nutrition Liaison Officer, U.S. Department of Agriculture, Institute of Home Economics, Washington, D.C., U.S.A.
- Dr. and Mrs. Max Yergan, Sociologist and Physician, Pinebridge Road, Ossining, N.Y., U.S.A.
- Professor and Mrs. Franklin Parker, College of Education, University of Texas, Austin, U.S.A.
- Dr. Margery Perham, Fellow of Nuffield College, Oxford, England.
- Mr. Montague Yudelman, Economist, Rockefeller Foundation, New York.
- Mr. F. X. Sutton, Mr. Melvin J. Fox, Mr. Alfred C. Wolf, Ford Foundation, 477 Madison Avenue, New York, 22, U.S.A.
- Visits from neighbouring towns and territories in Africa were received from:—
- Professor H. H. Jacqmin, Elisabethville, Belgian Congo.
- Mr. F. A. Bennett and Dr. Irvine, Central African Statistical Office, Salisbury, Southern Rhodesia.

- Mr. and Mrs. M. R. Metcalf, United Kingdom High Commissioner, Federation of Rhodesia and Nyasaland, Salisbury, S. Rhodesia.
- Mr. Derek A. Clarke, Librarian, University College of Rhodesia and Nyasaland, Salisbury, Southern Rhodesia.
- Mr. R. P. Plewman, Chairman, S. Rhodesian Government's Urban Affairs Commission.
- Mr. L. C. Ross, Southern Rhodesian Native Affairs Chief Information Officer, and Secretary to the Plewman Commission.
- Dr. and Mrs. W. H. Whiteley, Linguistic Section, Makerere University College, Kampala, Uganda.
- Mr. Hugh Tracey, I.L.A.M. African Music, Roodeport, Nr. Johannesburg.
- Mr. G. H. Ferguson, and Mr. W. J. Morlan, Lecturers in History and Geography respectively, Royal Technical College, Nairobi.
- Mr. J. E. Mathewson, Director, non-European Affairs, Benoni, S.A.
- Mr. Mikombe Jean, B.C.K.C., Elisabethville, B. Congo.
- Mr. D. G. Kingwill, Consultant, Federal Prime Minister's Office, Salisbury, Southern Rhodesia.
- Mr. A. de Freitas, Portuguese Gov. Offreral, Lourenco Marques.
- Mr. J. H. van Dyh, Deputy-Director of Bantu Education, Pretoria.
- Mr. Tom Mboya, M.L.C., Kenya Legislative Council, Nairobi.
- Mr. Peter Odumosu, Dept. of Labour, Lagos, Nigeria.
- Mr. A. Pedroso de Lima, Member of Legislative Assembly, Lourenco Marques.
- Mr. F. D. Winslow, Personnel Officer, Cameroons Development Corporation, British Cameroons, Nigeria.
- Mr. Curtis C. Strong, American Consul, American Consulate General, Salisbury, Southern Rhodesia.
- Mr. John Ingham, Secretary for African Affairs, Zomba, Nyasaland.
- Dr. Walter Adams, Principal, University College of Rhodesia and Nyasaland, Salisbury, Southern Rhodesia.
- Mr. J. Angus, Registrar, University College of Rhodesia and Nyasaland, Salisbury, Southern Rhodesia.
- Professor N. H. MacKenzie, Professor of English, University College of Rhodesia and Nyasaland, Salisbury, Southern Rhodesia.
- Professor S. H. Harper, Professor of Chemistry, University College of Rhodesia and Nyasaland, Salisbury, S. Rhodesia.
- Mr. A. F. Rouse, C.M.G., Research Fellow, University College of Rhodesia and Nyasaland, Salisbury, Southern Rhodesia.
- Professor James Irving, Rhodes University, South Africa.
- Mr. J. W. Phillips, Chairman, African Administration Committee, Bulawayo, Southern Rhodesia.
- Professor Jacques J. Maquet, University of Elizabethville, Belgian Congo.
- Mr. N. R. K. Davies, Chamber of Mines, Box 134, Kitwe, Northern Rhodesia.
- Dr. B. F. Hansen, of the Health and Nutrition Scheme, Fort Rosebery, Rhodesia.
- Dr. S. Bieshuvel, Director, National Institute for Personnel Research, Johannesburg, South Africa.
- Professor A. W. Southall, Professor of Sociology and Social Anthropology, Makerere University College, Kampala, Uganda.
- Professor A. G. Davis, Professor of Agriculture, University College of Rhodesia and Nyasaland, Salisbury, S. Rhodesia.



- Mr. S. W. Fraser Smith, District Commissioner, Dar-es-salaam, Tanganyika.
- Mr. G. E. Stent, Labour Adviser, Government of Southern Rhodesia.
- Father G. Fortune, Lecturer, School of African Studies, Cape Town University, South Africa.
- Mr. R. W. Gill, Deputy Resident, Buganda.
- Mr. C. F. Atkins, Secretary for Social Development, Kenya.
- Mr. C. E. Hamshere, Headmaster, Arusha School, Tanganyika.
- Among numerous local residents who visit the Institute and take general interest in its activities, the following may in particular be recorded:—
- Mr. C. W. Lynn, Director, Department of Agriculture, Lusaka, Northern Rhodesia.
- Mr. C. E. Cousins, Labour Commissioner, Lusaka, Northern Rhodesia.
- Mr. S. McLellan, District Commissioner, Lusaka Urban, Northern Rhodesia.
- Mr. C. M. N. White, Land Tenure Officer, Lusaka, Northern Rhodesia.
- Colonel A. N. Millard, Superintendent of Technical Training, Department of African Education, Lusaka.
- Mr. L. G. Vincent, Northern Rhodesia Housing Board, Lusaka, Northern Rhodesia.
- Mr. Murray Armor, District Officer, Lusaka Urban, Northern Rhodesia.
- Mr. W. G. M. Lugton, Director, Department of Welfare and Probation Services, Lusaka, Northern Rhodesia.
- Mr. L. G. Butler, District Officer, Secretariat, Lusaka, Northern Rhodesia.
- Mr. G. M. Wilson, Director, Publications Bureau, Lusaka, Northern Rhodesia.
- Mr. C. E. Johnson, Deputy-Director, Department of Agriculture, Lusaka, Northern Rhodesia.
- Mr. J. J. Keigwin, Commissioner for Rural Development, Lusaka, Northern Rhodesia.
- Mr. C. E. W. Coleman, Assistant to Commissioner for Rural Development, Lusaka, Northern Rhodesia.
- Colonel J. P. I. Fforde, Commissioner of Police, Lusaka, Northern Rhodesia.
- Dr. Alexander Scott, Federal Member of Parliament for Lusaka, Federal Assembly, Salisbury, Southern Rhodesia.
- Rt. Rev. Adam Kozłowiescki, Roman Catholic Bishop of Lusaka.
- Mr. S. H. Chileshe, Member of Legislative Council, Lusaka.

In addition to such visits as recorded above, several lectures and meetings have been held in the Institute addressed by the Director (or Acting-Director).

Among these may be noted a talk to the thirty-five delegates to the Inter-African Labour Conference; a talk to seventeen African Trade Unionists; a discussion session with seven members of a delegation from the United Kingdom branch of the Commonwealth Parliamentary Association; lectures to three C.I.D. Police Officers training courses, and a Superior Police Officers' Course; a group of District Officers in training at Chalimbana Native Authority Development Centre; Senior African Civil Servants' course from Chalimbana Native Authority Development Centre, an Urban Courts Clerks' course also from Chalimbana and finally a talk to a group from the Jean Rennie School, accompanied by a number of school girls from Elisabethville to whom they were acting as hosts.

*RESEARCH IN PROGRESS AND PROJECTED*

During the year the following staff were employed:—

Director ... ..	H. A. Fosbrooke, M. A. (Cantab.)
Administrative Secretary ...	Miss M. Marsden.
Research Secretary ... ..	R. J. Apthorpe, D.Phil(Oxon), B.A.(Hons.), (from July).
Librarian ... ..	Mrs. U. K. N. Stevenson, B.A.(Cantab.), F.L.A. (on leave from July).
Assistant Librarian ... ..	R. M. S. Ng'ombe.
Statistical Assistant ... ..	E. A. Mbewe.
Research Officers ... ..	Elizabeth Colson, Ph.D.(Harvard), M.A.(Minnesota), departed for U.S.A. in September.
	T. Scudder, B.A.(Harvard), departed for U.S.A. in September.
	D. G. Bettison, Ph.D.(Rhodes), M.A.(Rhodes).
	W. J. Argyle, B.A., B.Litt.(Oxon), Dip. Soc. Anthropol. (from June).
	Miss V. Ellis, B.A.(Rhodes), Local Research Officer, Blantyre, Nyasaland.
	B. Clack, B.A.(Rand)B.Econ., (Natal) (in training at Institute of Personnel Research, Johannesburg, March).
	D. G. J. Matthews, M.A.(Chicago) (en route).
Senior Research Assistant	S. C. Katilungu, Diploma in Social Welfare.

In addition, 12 Research Assistants are distributed between Lusaka and Blantyre/Limbe, and half a dozen people employed on clerical and on maintenance duties at Headquarters.

Dr. Colson continued her study of the Valley Tonga people which she had inaugurated in the previous years. She was assisted by Mr. Scudder who concentrated on a study of the environment. These two workers left in September, 1957, for the United States where the material they have collected will be jointly written up. Thereafter it is hoped they will return some years hence to study the changes which have taken place in this group caused by their move in connection with the Kariba Hydro-Electric Scheme.

Dr. Bettison was resident in Nyasaland from January to June, 1957, in connection with the Blantyre-Limbe Peri-Urban Enquiry. Thereafter he took up residence at the Institute, leaving the team of Africans in the immediate charge of Miss Ellis, Local Research Officer. Although this work is designed to continue for a considerable time several interim reports were rendered to the Nyasaland Government, which is financing the project.

In this connection the Chief Secretary for Nyasaland writes to the Director that he is to express "the satisfaction of the Government at the results so far achieved by the Survey, and to ask you to convey to Dr. Bettison and his staff, the Government's congratulations on the progress made to date."

Whilst continuing supervision of the above Dr. Bettison instituted the Lusaka Housing Enquiry which the Northern Rhodesia Housing Board is financing. In addition, at the request of the Chairman of the Southern Rhodesia Enquiry into Urban matters, he spent a short time producing a Poverty Datum Line study in Salisbury.

Mr. Argyle arrived in June and after a short period at the Institute commenced work as a Field Anthropologist amongst the Soli.

The Board of Trustees favoured a strengthening of the Institute's work in the industrial sphere: as a result of this Mr. Matthews was appointed as Industrial Sociologist. He will leave his teaching post at Liverpool and join the Institute

in June, 1958. In addition, Mr. Clack was appointed to undertake a study of and the application of aptitude testing for Africans. He is at present in training under Dr. Biesheuvel at the Institute of Personnel Research at Johannesburg.

In relation to the Institute's research programme mention should be made of the value of the team of research assistants—African—some of whom have been in the employ of the Institute since 1949. Their work under successive research officers has done much to train them in the art of conducting social enquiries, in fact without such a *cadre* of workers a professional officer, however well trained, would be powerless. A large proportion of these workers are studying to better their qualifications: one was awarded a Federal bursary for three years University study in the United Kingdom, whilst others were successful in passing subjects at Advanced and School Certificate level, so getting nearer to the stage when they also can apply for University study. This facet of the Institute's work has been continuing quietly for a long time without perhaps sufficient realisation of its value, which is indeed great.

#### *Future Work*

In addition to our own programme detailed in last year's report, additional projects have been mooted, but no final decisions yet made. One is in association with the Northern Rhodesia Government's Scheme for Rural Development in the Northern Province to which the sum of £2,000,000 has been allocated. We have been approached by the Development Commissioner with a view to posting to the area a woman Agricultural Economist to ascertain to what degree the local economy is dependent on subsistence agriculture and to what degree it is supported by external remittances. The Provincial Commissioner of the newly formed Luapula Province has appealed for sociological or ecological enquiry in support of the Fort Riebeeck Health and Nutrition Scheme, and the Chief Information Officer of Northern Rhodesia would like research conducted on the impact of mass media on rural populations. Whilst the Institute is willing to organise and administer such research certain financial issues remain to be clarified before special staff can be recruited.

Further suggestions come from Southern Rhodesia where it is proposed to conduct an "enquiry in depth" as a follow-up to the C.C.T.A. survey published under the title of "The Human Factors of Productivity in Africa." The matter of finance is still under consideration, as also is the issue as to whether this work should be done through this Institute or the University College Salisbury, or both. There is also a proposal under consideration that a Unit under the joint control of the University College and the Institute should be established to provide an Advisory Service to Industry and Commerce in the field of Personnel Management.

#### *Finance*

Although various aspects of finance are mentioned under the headings of research, building, etc., for the record the overall financial position is summarized hereunder. The present arrangement is that Colonial Development and Welfare Funds carry the expenses of administration, provided local resources make a commensurate contribution to field research. As a result of changed circumstances the original scheme R.698 received supplementary grants of £18,731 bringing the total for the four years 1956-60 to £51,501. Local contributions to research from Governments, Trusts and Industry amount to approximately £18,000 per annum, whilst specifically commissioned research brought in a total of £7,320 from the Governments of Nyasaland and Southern Rhodesia and from the Northern Rhodesia African Housing Board. A further sum of £8,100 has been voted for a continuation of projects in hand by the first and last of these bodies. The total of the Colonial Development and Welfare grant mentioned above includes not only headquarters recurrent expenses, but grants of £4,000 for publications and £8,400 for buildings.

#### *Affiliates*

As in past years the Institute formed a base for several overseas workers. We were honoured by the presence of Dr. Audrey Richards in Northern Rhodesia

where she had studied the Bemba many years ago. She returned to Bemba country for a three months' visit: we look forward to publishing her impressions of the changes which had occurred since her previous visit.

Mr. Arthur Tuden, a Ford Foundation Fellow, completed his period of study of the Ila Tribe and returned to America in May, likewise Professor Coleman of the University of California wound up his short study of leadership in Lusaka and returned home in April. Barry N. Floyd, a British student of geography completing the requirements of Ph.D. degree at Syracuse University, U.S.A., has obtained employment as a temporary Land Development Officer in Southern Rhodesia to enable him to study the effects of the Native Land Husbandry Act at first hand. The Institute is assisting him with a grant towards travel expenses, and hopes to have him resident for a month or two at the conclusion of his contract whilst he reviews his material. This prolongation of his stay in Africa has been made possible by a grant from the Nuffield Foundation. Mrs. Carter, the Linguist, will be working in affiliation with the Institute: the degree of assistance required will depend on the success of her application for a C.S.S.R.C. grant. Further applications for affiliation are pending, particularly in conjunction with the Fulbright scheme.

The position of affiliates is being placed on a more formal basis to ensure that facilities are only made available to those likely to get the maximum advantage therefrom.

#### *The Sir Gilbert Rennie Library*

The membership of the Institute has been dealt with this year in the absence of the Librarian by the Assistant Librarian, supervised by the Research Secretary. The table set out below shows the changes in membership during the past year. In the categories of honorary members, exchange members and paying members, increases are recorded. The decrease in total membership is due to a decrease in the number of official members. This was caused by a need to limit the free distribution of the Institute's publications, and an unwillingness on the part of the overwhelming majority of those affected to rejoin as paying members:—

	1956-57	1957-58			+ or -
		Resigned	Joined	Total Membership	
Honorary ... ..	28	—	5	33	+ 5
Official ... ..	339	161 (withdrawn by R.L.I.)	20	196	-143
Exchange ... ..	85	—	6	91	+ 6
Paying ... ..	199	—	19	218	+19
Total ... ..	649			538	+28 -143

Of the total membership of the Institute, 171 are in Northern Rhodesia, 173 in the rest of Africa, 101 in Europe and 67 in America.

Considerable expansion has taken place in the library during the past year, possibly to a greater extent than in any previous year. 528 books and pamphlets have been added—this total representing 238 more than last year, about double last year's total acquisitions. This total of 528 excludes the reports and other publications of Government departments in Central and East African Territories. It includes, however, books obtained for review in the Rhodes-Livingstone Institute Journal, on exchange, and by gift. In this latter category special reference should be made to the gift of some 30 duplicate volumes from the Library of the University of Toronto. Most of these are in various fields of psychology and social psychology, subjects that at present are very little developed in the library.

Expansion is also to be reported in the periodicals and newspapers sections of the library. 225 periodicals are now taken regularly—an increase of 18 over last year's total. Four of these are gifts; eight are received on exchange. Nine more newspapers are now taken than during last year. Seven of these are published mainly for African readers, six of them being in all or part in one of the vernaculars of the Federation. The total number of newspapers taken now stands at fifteen. The vernacular section of the library reported in last year's report, also continues to expand. A microfilm section is in process of being opened, a microreader being en route from the United Kingdom, whilst microfilming apparatus has been obtained for the use of the Institute staff in Central Africa. It is hoped that in the future the out-of-print early Papers of the Institute which are still in great demand will be microfilmed, by contract in the United Kingdom. Another most useful addition to the Institute's equipment might also be mentioned here—a taperecorder. This is in great demand both at headquarters and in the field.

The bibliographing of all social anthropological and information that comes to the notice of the Librarian and other members of the Institute is continuing steadily. Many calls are made upon it not only in Lusaka but also by the many associate members of the Institute in different parts of the world.

### *Publications*

The list of publications appearing hereunder reveals the most commendable progress that past or present Institute workers have made in completing the analysis and write-up of their field material. At times social scientists are criticised for the time lag between research and publication, but in many cases preliminary results have been published as articles or papers prior to the appearance of the book: in this connection the revival of our Communications series is particularly valuable.

Nos. XXI and XXII of the Rhodes-Livingstone Institute's Journal: "*Human Problems in British Central Africa*";

No. XXVIII of the Rhodes-Livingstone Institute's Papers: *An Analysis of a Social Structure in modern Zululand* by Max Gluckman, with an introduction by J. C. Mitchell.

Full-length books have been published on behalf of the Institute by Manchester University Press based on the field research of two former officers of the Institute:

*Schism and Continuity in an African Society: a study of Ndembu Village, Mwinilunga District, Northern Rhodesia*, by V. W. Turner. (Appeared December, 1957.)

*Politics in an Urban African Community: a study of the social, administrative and political developments of Africans living on the Northern Rhodesia Copperbelt*, by A. L. Epstein. (Appeared January, 1958.)

Three more full-length books are in proof stage:

Gann, L. G.: *The Birth of a Plural Society*.

Colson, Elizabeth: *The Plateau Tonga of Northern Rhodesia*.

Watson, W.: *Tribal Cohesion in a Money Economy: a study of Mambwe People of Northern Rhodesia*.

Books by Dr. I. G. Cunnison, *Chieftainship among the Kazembe Lunda*, and Dr. J. van Velsen, *The Lakeside Tonga of Nyasaland*, are also in an advanced stage.

A reprint of *Seven Tribes of British Central Africa*, with a new introduction, is also well in hand.

After a long hiatus, much progress in publication has been made in the Institute's *Communications* series. Four issues have been made, thus nearly doubling the total number of Communications available. This series chiefly aims

to make available interim reports on current research so that full advantage may be taken of its topicality, by government officers and others. These are issued to the sponsors of the research concerned and others immediately interested in the results. Associate members receive notice of such publication by an announcement and summary of each Communication, published in the journal. They may then apply for free issue. This scheme obviates the wastage of bulky and detailed documents being circulated to those not immediately interested.

*The Rhodes-Livingstone Communications :—*

No. 7: *A Selected Bibliography of the Federation of Rhodesia and Nyasaland*, by R. M. S. Ng'ombe. (August, 1957.)

No. 8: *Historical Notes on the Bisa, Northern Rhodesia*, F. M. Thomas. (February, 1958).

No. 9: *Cash Wages and Occupational Structure, Blantyre-Limbe, Nyasaland*, by D. G. Bettison. (February, 1958).

No. 10: *The African Railway Workers Union, Ndola, Northern Rhodesia*, by P. B. Mwewa. (March, 1958).

Also available is an account of the transactions of the Institute's Eleventh Conference, both papers and discussions, *Interrelations in Central African rural and urban life*, edited with an introduction by R. J. Apthorpe. (March, 1958).

*Buildings*

The end of the year also saw the completion of the building programme financed jointly from the Institute's reserves and a C.D. & W. grant. All the new quarters are now in occupation and are much appreciated by European and African staff alike. The guest accommodation for both senior and junior research workers has been frequently in use and more than justifies the money spent on it, whilst the completed village for junior staff, with its central lawn and shade trees, fosters a sense of community amongst the twelve or more families living there.

Exceptional rains assisted the growth of the trees, hedges and shrubberies which in a few years should form a pleasing and spectacular feature of the grounds.

The problems of communication mentioned last year have now finally been solved. The telephone has enabled us to maintain close contact with the many Government and outside agencies in Lusaka with whom we have business. The approach road from the Great East Road to the Institute has been tarred. Finally, after considerable delay, the electricity link with the town supply was effected at the end of the year; this enabled us to construct the new houses on, and convert the old quarters to an all-electric basis.

*New Wing*

No sooner were the last of the builders off the site, than delivery of bricks commenced for the construction of a new wing to the main Institute Building. This extension, authorized by Trustees from untied local subscriptions, is necessitated by the expansion of the Institute work in the industrial field. It will contain three studies, store rooms, and a hall in which aptitude testing will be conducted. This hall will also be used for conferences and meetings, as the seating space in the Library will shortly be reduced by the erection of new stacks. The design is such that a larger hall can be added later and the smaller hall converted into a foyer for this.

*Conclusion*

It can be claimed with some justification that the year under review has been one of considerable progress; if shortage of staff has held up field research, much spade work has gone into the creation of conditions which will facilitate such research when it commences. This refers not only to the material conditions such as the new buildings, the build-up of the library and the installation of equipment, but, even more important, to the creation of a climate favourable to research. Amongst those in control of finance the response to our appeals

has been most generous. No less generous has been the response of the Africans who, even when the political atmosphere has not been free of tension, have answered our interviews and questionnaires in a remarkably co-operative manner.

My final tribute is to the staff past and present both from overseas and those locally recruited, without whose devotion to duty and many hours of extra work the year's turnout of research and publication would have been much less impressive.

H. A. FOSBROOKE,  
*Director.*

Lusaka.  
April, 1958.

## Tsetse Fly and Trypanosomiasis Committee Report for 1957-1958

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Colonial Office,  
Sanctuary Buildings,  
Great Smith Street,  
Westminster, S.W.1.  
27th October, 1958.

SIR,

I have the honour to transmit herewith the Report of the Tsetse Fly and Trypanosomiasis Committee for the year ended the 31st March, 1958.

I have the honour to be,

Sir,

Your obedient servant,

W. B. L. MONSON,

*Chairman.*

The Rt. Hon. Alan Lennox-Boyd, M.P.  
Secretary of State for the Colonies.



**TSETSE FLY AND TRYPANOSOMIASIS COMMITTEE****REPORT FOR 1957-58****Membership**

**MR. W. B. L. MONSON, C.M.G.**, Assistant Under-Secretary of State, Colonial Office (*Chairman*).

\***CAPTAIN K. F. T. CALDWELL**, formerly of the Kenya Game Department.

**DR. J. CARMICHAEL, C.M.G., M.R.C.V.S., Dip. Bact.**, formerly of the Colonial Veterinary Service.

**PROFESSOR T. H. DAVEY, O.B.E., M.D., D.T.M.**, Liverpool, School of Tropical Medicine.

**PROFESSOR P. C. C. GARNHAM, M.D., D.Sc.**, London School of Hygiene and Tropical Medicine.

**PROFESSOR R. M. GORDON, O.B.E., M.D., D.Sc., F.R.C.P.**, Liverpool School of Tropical Medicine.

**DR. F. HAWKING, D.M., M.R.C.P., D.T.M.**, National Institute for Medical Research.

**DR. C. A. HOARE, F.R.S.**, Wellcome Laboratories of Tropical Medicine.

**DR. E. A. LEWIS, M.Sc., F.R.E.S.**

**DR. L. HARRISON MATTHEWS, M.A., Sc.D., F.R.S.**, Scientific Director, Zoological Society of London.

**COLONEL H. W. MULLIGAN, C.M.G., D.Sc.**, The Wellcome Research Laboratories.

**MR. W. H. POTTS**, formerly of the East African Tsetse and Trypanosomiasis Research and Reclamation Organisation.

**MR. W. F. DAWSON, M.B.E.** (*Secretary*).

\*Died 3rd May, 1958.

**Ex-Officio Members**

The Directors of the East African Trypanosomiasis Research Organisation and the West African Institute for Trypanosomiasis Research. The Secretary of State's Deputy Chief Medical Officer, and Advisers on Agriculture and Animal Health. The Director of Colonial Medical Research. The Secretary of the Colonial Pesticides Research Committee.

It is the practice to invite the Scientific Liaison Officer for the Federation of Rhodesia and Nyasaland to attend meetings.

**Terms of Reference**

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

**TSETSE FLY AND TRYPANOSOMIASIS COMMITTEE**  
**REPORT FOR 1957-1958**

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## TSETSE FLY AND TRYPANOSOMIASIS COMMITTEE

### I. THE COMMITTEE

1. The Tsetse Fly and Trypanosomiasis Committee met twice during the period under review. Two meetings of the Chemotherapy Panel set up by the Committee were also held.

2. No changes occurred in the composition of the main Committee during the year under review. A second vacancy occurred in the Chemotherapy Panel on the resignation of Dr. J. Carmichael who had contributed greatly to the Panel's successful start. These vacancies were filled, on the invitation of the main Committee, by Professor D. L. Hughes of the Department of Veterinary Pathology, Liverpool University, and Mr. R. N. T. W. Fiennes, Pathologist, Zoological Society of London.

3. The topics on which the Committee was called upon for advice were as diverse as ever and included particularly the research programmes of the Regional Trypanosomiasis Research Organisations in East and West Africa. Its main preoccupation continued to be chemotherapy and chemoprophylaxis, particularly in relation to cattle trypanosomiasis, still a disease of major economic importance in Africa.

### II. FINANCE

4. The allocation of C.D. & W. money for tsetse and trypanosomiasis research over the five-year period ending 31st March, 1960, was increased during the year to £655,000 in order to meet estimated commitments of £626,000 and to provide an adequate reserve for contingencies and possible further new schemes. Expenditure against the allocation up to the 31st March, 1958, was estimated at £357,030.

### III. GENERAL

5. The results obtained with new drugs in extended laboratory and controlled field trials, under varying conditions in different parts of Africa, again emphasised the absolute necessity for such trials before new drugs can be accepted for general use in the field. The preliminary results obtained were in general satisfactory but in some instances local or systemic toxicity gave cause for concern; in others the protection did not come up to expectation on exposure to average challenge. Trials of the most promising drugs continue.

6. Although the main emphasis now centres on animal trypanosomiasis, the study of human sleeping sickness is still actively pursued. Pathological studies of *T. gambiense* and *T. rhodesiense* have continued. New drugs for the treatment of the disease in humans are also receiving attention. One of them promises to be of particular benefit in the treatment of *T. rhodesiense* sleeping sickness in cases hitherto resistant to Melarsen/BAL.

7. During the year Mr. W. H. Potts completed the writing up of his report on the biological experiment to ascertain whether tsetse flies are susceptible to sterilization at the puparial stage by the application of gamma rays. Acknowledgment is due to the Atomic Energy Commission and the Rothamsted Experimental Station for the valuable contributions which their experts made for the success of Mr. Potts' work.

8. The Committee sponsored visits to Africa by Professor O. W. Richards of the Imperial College of Science and Technology to study the insect

predator-prey relationship in respect of tsetse, and Professor R. M. Gordon in connection with his work on the deposition by tsetse flies of the infective forms of *T. rhodesiense*.

#### IV. EAST AFRICAN TRYPANOSOMIASIS RESEARCH ORGANIZATION

##### *General*

9. During 1957 the Organization lost by retirement several officers who had rendered long and valuable service: Mr. John Ford, M.A., B.Sc., was succeeded as Director by Dr. W. H. R. Lumsden, D.Sc., M.B., Ch.B., D.T.M., D.T.H., formerly Assistant Director of the East African Virus Research Institute, Major W. N. Scott, M.R.C.V.S., Assistant Director of Veterinary Services, Uganda, was appointed at a prior date as Deputy Director.

10. The year saw the first meetings of the Specialist Committees which have been set up to deal with three important aspects of trypanosomiasis in East Africa, human, animal and insect; the recommendations of these Committees were considered and endorsed by the East African Trypanosomiasis Research Coordinating Committee at its meeting in December.

11. With the change in the title, reclamation ceased to be a function of the Organization. Advice on such matters however, continued to be asked for and to be given, particularly with regard to the Ankole District, Uganda, where a study on the ecology of *G. morsitans*, of importance in relation to the reclamation technique of discriminative clearing, is being arranged.

##### *Human trypanosomiasis*

12. In the 15 months' existence of the E.A.T.R.O. hospital unit at Tororo 148 fresh and 11 relapse cases have been treated. About 75 per cent. of the cases are in the early stage of the disease, when treatment is comparatively easy, but the introduction of Melarsen/BAL for the treatment of late cases has greatly improved the chances of recovery. A high proportion of those late cases, hitherto considered incurable, may now be saved and relapses appear to be rare.

13. The convenience of the hospital unit has allowed important studies on the progress of the disease in man. Studies on the methods of estimation of, and changes in, the proteins of the cerebrospinal fluid have great importance in following the progress of the disease, to assess prognosis and control treatment. The infection has been discovered to interfere importantly and suddenly with some functions of the liver and this effect is being studied both in man and in monkeys, being correlated with searches for microscopical changes in liver tissue. The techniques described above have also been used in the study of cases of East African Kala-azar in collaboration with Kenya workers.

##### *Epidemiology*

14. The derivation of the cases treated in the hospital unit has given important information on the distribution and transmission of the disease. Practically all the cases seen were of *T. rhodesiense* sleeping sickness which appears thus practically to have replaced *T. gambiense* which was concerned in the same parts of the Lake Victoria littoral at the beginning of the century. Despite this change the relation of sleeping sickness to particular localities and occupations appears to be similar. This year's sharp increase in incidence is probably to be related to an increase in the use of "untreated" fishing camps. In the later stages of the epidemic the patients coming for treatment tended to be at an advanced stage of the disease. In these cases

the disease had been of insidious onset unnoticed by the patient in its early stages. Advanced cases of this sort are not only difficult to treat but, provide prior to treatment, a dangerous source of infection for flies.

#### *Animal trypanosomiasis*

15. A fundamental study in progress is related to the estimation of the degree to which animals are exposed to infection—the trypanosome challenge. The density of fly and their infection rates are two important factors. Studies to compare different methods of collecting flies have been made on *Glossina pallidipes* in southeast Uganda. Traps tend to catch the largest numbers about noon as do also fly boys moving through the bush. Catches on bait cattle on the other hand tend to yield the largest numbers soon after dawn and in the late evening. It has been found that the traps used do not lose significant numbers of flies over 24 hour periods so that for general purposes once daily emptying is sufficient.

16. Critical comparisons of the protective value of a considerable number of drugs have been made. In field trials in southeast Uganda, Ethidium, RD2902 and Prothidium (Boots Pure Drug Co.) and two formulations of Antrycide prosalt (Imperial Chemical (Pharmaceuticals) Ltd.) were compared with controls. Prothidium was considered worthy of more extensive field trials on the grounds of efficiency and low general and local toxicity. The effect of repeated artificial inoculation of cattle with *Trypanosoma congolense* concurrently with a drug regime is also under study. Four cattle so treated are all still resistant to challenge 10 months after completion of the regime while 2 out of 6 control cattle given the drug alone became infected.

17. Various alternative routes of injection of drugs, particularly of the surminate group, were investigated in cattle but severe reactions were noted in all cases. In horses ethidium bromide and Berenil (Farbwerke Hoechst a.g.), but not Antrycide methyl sulphate, produced severe local reactions.

18. Work on trypanosome immobilization and complement-fixation tests was continued. On the basis of the former some strains of *Trypanosoma brucei* appeared to be related to one strain of *T. congolense*. A satisfactory complement-fixation test has not yet been evolved. Haematological studies on normal and infected Zebu cattle are in progress as are also studies on serum protein; these studies are yet in an early stage, establishing normal ranges.

#### *Protozoology*

19. A valuable development in this field is a technique for maintaining alive the parasites in a deep-frozen state. Solid carbon dioxide is used as the cooling agent and *T. brucei*, *T. rhodésiense* and *T. congolense* have all been recovered in infective states after up to 7 months storage. Preliminary tests have indicated that such properties as drug sensitivity have remained stable during storage.

20. The culture of trypanosomes in artificial media has been studied as a possibly useful method for the diagnosis of scanty infections. Although the method is successful for the detection of scanty trypanosomes in the blood no attempt to culture trypanosomes from the cerebrospinal fluid has been successful even when parasites were numerous. Not even in the case of the blood was the method importantly more sensitive than microscopic examination.

21. Biochemical studies on trypanosomes have shown very wide differences in oxygen consumption from strain to strain of the parasite but it is not yet clear if these differences are sufficiently constant to be used to identify strains.

22. The possibility that a special stage of development of the trypanosome takes place in the mammal host—as in the case of the malaria parasite—has been investigated but the evidence is so far against the idea. The remarkable changes of form of the trypanosomes in the host's blood have been studied and are considered possibly to be related to the protective mechanism of the host.

23. Blood specimens from several hundred game animals from Uganda and Tanganyika have been examined. Several strains of trypanosomes infective to domestic animals have been recovered but so far no strains infective to man.

24. Work on the trypanosomes in the tsetse fly has shown that the infection does not reduce the length of life of the fly and may therefore be presumed to do it no damage.

### *Entomology*

25. Continuance of the studies of Jackson on methods of estimation of populations, by means of marking flies, and releasing them and recapturing them one or more times, has revealed some fallacies, one being that in some species flies were found not to be uniformly liable to capture. However, these difficulties have been largely overcome and the total population of *G. pallidipes* in the Lambwe Valley in Kenya is estimated to reach sometimes over 3 million per square mile, or about 1 fly per square yard.

26. The identification of the animal host of tsetse flies by the serological examination of fresh blood meals pursued in collaboration with the Lister Institute of Preventive Medicine since 1949, gave further important results. Of 2,500 blood meals from *G. swynnertoni* and *pallidipes* recently identified, 80-94 per cent. were from pigs, mainly warthogs. These proportions appear to exceed very considerably the proportions which wild pigs bear to the rest of the mammal fauna but it is not yet known if the result is indicative of an actual preference for pig on the part of the insect or if some special habit of the pigs brings them into closer contact with flies than is the case with other animals.

27. Studies on the water balance of puparia have uncovered differences which can be correlated with field data. The puparia of *G. morsitans*, *swynnertoni* and *longipennis* are so well waterproofed that they appear adapted to survive in sites drier than those in which they in fact occur. On the other hand restricted distributions of *G. brevipalpis*, *fuscipleuris*, *pallidipes* and *palpalis* are explicable on the basis of a less efficient water control mechanism. In the case of *G. pallidipes* the colour of the adult is affected by the climate experienced in the pupal stage. From this it may be deduced that at Shinyanga, sites are used which may be so dry as to cause 60 per cent. mortality. Shinyanga is at the dry end of the range of *G. pallidipes* and desiccation in the pupal stage may be there an important factor limiting its distribution.

28. Fat metabolism has been the subject of intensive study as the main food reserves of *Glossina* are stored in this form. In comparative studies of several different kinds of blood, it was found that more fat was synthesized from human blood than from pig blood despite the apparent predilection for pigs shown by tsetse flies in the field. In the pupal stage, fat metabolism is at an optimum at about 24° C., but it is seriously prejudiced at 18° and 30° C. The fat reserves of flies emerging from puparia kept at these temperatures is estimated to be less than the optimum by amounts representing 1½ days' survival at rest or 1 hour's flight activity, equivalent to 15 miles. The temperature limitations of this stage may be important in determining distributions of species in Southern Rhodesia and at the higher altitudes in East Africa.

*Other studies*

29. Studies of the distribution of resting flies and of the importance of predators in the control of tsetse numbers are in progress. Flies resting on the underside of branches appear to leave these sites at about sunset and to rest on leaves during the night—a few have been located by means of fluorescent marking and observation in ultra-violet light. All these studies, are expected to assist our understanding of discriminative clearing as a control method.

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## V. THE WEST AFRICAN INSTITUTE FOR TRYPANOSOMIASIS RESEARCH

### General

30. The year 1957 has probably been the best in the history of the Institute, the excellent staff position having resulted in an exceptional output in the volume of research.

### Human Trypanosomiasis

31. The greatest hindrance to the study of cyclically transmitted infections of *T. gambiense* has been the difficulty experienced in infecting *G. palpalis*; less than 1 per cent. of the flies fed in our laboratories on infected hosts have become infected. Recently it has been found that flies which can be persuaded to feed on the first day of life, are much more readily infected than those which feed on the second or third day. These results explain why in the field so few infected flies have been found in the vicinity of villages suffering from epidemic sleeping sickness. The chances are small of a fly taking its first meal, within 24 hours of emergence, off a man with transmissible, trypanosomes in his blood. On the other hand the flies so infected are those with the longest expectation of life.

32. Attempts to implicate the Congo Floor Maggot (*Auchmeromyia luteola*) as a transmitter of human sleeping sickness gave negative results.

33. The local reaction produced in man at the site of an infected tsetse bite has been studied. A volunteer was infected with *T. rhodesiense* *G. palpalis* which fed on his arm. It was not until the ninth day after the bite when a distinct nodule developed on the arm, that rats, inoculated with the patient's blood, subsequently became positive. On the tenth day the chancre was excised and prepared for sectioning and that evening the patient's temperature started to rise; next day a course of curative treatment was begun. Examination of the stained section of the chancre revealed that the trypanosomes were concentrated in the narrow upper layer of subcutaneous fat; it is suggestive that the cell mass of some trypanosomes is known to consist of a high proportion of fat, and that *T. rhodesiense* and *T. gambiense* utilize the large amount of lipid material present in tsetse saliva. Since the trypanosomes occupied a limited inflammatory area and were present in large numbers, it is a logical conclusion that the metacyclic forms had remained near the site of the bite, and that during the ten days incubation period they had changed into blood forms and multiplied in the subcutaneous tissue.

34. Daily observations have been made on the trypanosomes appearing in the blood of monkeys, which have been cyclically infected with *T. gambiense*. The number of trypanosomes show periodicity, periods of increase being followed by periods of decrease; such cycles follow each other regularly, each lasting on average about six days. Whilst making daily observations on the numbers of trypanosomes, records were also kept of the proportions of stumpy, intermediate and long-slender forms, the latter, under normal circumstances, being the only ones which divide. The highest proportion of slender forms is found at the beginning of a cycle, during the increase in numbers; but before the peak in total numbers is reached, the stumpy forms start to increase rapidly, reaching their highest proportion during the drop in total numbers. The result suggest that when the defence mechanism of the mammalian host becomes operative, the long-slender, dividing forms shrink into stumpy forms, until finally only a few stumpy forms survive; at the beginning of the next cycle, these elongate into



intermediate forms and thence into long-slender forms, which divide and give rise to a new increase in numbers. During the daily observations on the course of the infection in monkeys, a differential blood count was also made to detect any change in the white blood cell picture; it would appear that trypanosomiasis causes a marked activity of the lymphopictic system, while the function of the bone marrow seems to be repressed.

35. There is some evidence to suggest that the African may have developed some degree of partial immunity to *T. gambiense* sleeping sickness, as may a European who has been much in contact with tsetse. It seems possible that a partial immunity could be induced in man by frequent bites by tsetse flies infected with one of the species of trypanosome which are non-pathogenic to man. In the first part of this investigation prior challenge with *T. vivax* failed to protect monkeys and rats against subsequent challenge with *T. gambiense*, nor did immunological tests suggest that any cross immunity to *T. gambiense* had been produced.

#### Chemotherapy

36. In collaboration with the Sleeping Sickness Service of the Northern Region, a small field trial has been carried out with Berenil against *T. gambiense* in man. Seventeen patients received this drug, and a control group of 31 received a comparable course of pentamidine. For both groups patients in the blood-lymphatic stage were selected, having no evidence of cerebrospinal fluid involvement. Both courses were equally well tolerated. After one year, 14 out of the 17 Berenil cases were traced, and all except one appeared to have been cured. In the pentamidine control group, after one year 26 out of the 31 cases were traced, and of these 4 had relapsed; a further three cases looked as if they might relapse within the coming year. Such a very high incidence of relapse in the control group was most surprising as in Nigeria a course of pentamidine, used on such cases, normally results in a cure rate of about 95 per cent. It would seem from the result of this small trial that Berenil is better than pentamidine, but it would be wiser to consider it as possibly quite as good as pentamidine for use in the earlier stages of the disease.

#### Animal Trypanosomiasis

37. Previous attempts by this Institute to isolate field strains of *T. congolense* and transmit them regularly by tsetse have failed, because all the strains collected have produced very mild clinical symptoms in sheep and dogs, with trypanosomes appearing in the blood so scantily that regular cyclical transmission was impossible. However, more recently a *congolense*-like trypanosome has been isolated which behaved very differently, producing infections which are acute in dogs, goats and rats, and semi-acute in cattle and sheep; it was soon noted that this trypanosome appeared to be longer than the normal *T. congolense*. An intensive study of the morphology of this trypanosome and of its spectrum of infectivity is being made, and results to date suggest that it is *T. dimorphon*, a *congolense*-like species first described in 1904, and about whose identity much confusion has existed. The subject is important because of the conflicting views held in West Africa as to the importance of "*T. congolense*". It may well be that those who have claimed that *T. congolense* is of relatively little importance have been referring to the true *T. congolense*, whilst those who have claimed that this trypanosome causes heavy loss amongst cattle have been referring to *T. dimorphon* (?).

38. Initially, infection rates in *G. morsitans* of 5 or 6 per cent. were usual, but lately infection rates of up to 35 per cent. have been obtained.

Results await confirmation, but incubation of the pupae at 28° C. and the maintenance of the flies in a sheltered outdoor box, where diurnal temperature fluctuations occur, appear to be factors conducive to high infection rates. Preliminary results suggest that flies become infective about 21 days after feeding on the infected host. Among infected flies, trypanosomes have always been found in the proboscis and hypopharynx, and usually in the gut although sometimes much search is needed.

39. The immune response to trypanosomiasis has been studied in two animals of the Muturu breed, purchased from a herd which has been living on the tsetse-free Jos Plateau for at least 50 years. When challenged with fly-transmitted *T. vivax* both animals developed an intense parasitaemia; one died on the 19th day and the other on the 27th day after challenge. In both beasts the antibody index, as measured by the respiratory test, rose only slightly and then fell as death approached. The gamma-globulin content of the serum and the level of albumin decreased markedly as the disease progressed. Since the Muturu is considered to be a highly resistant breed, a similar study will be made with animals living in fly country.

40. A reed-buck was twice heavily challenged with fly-transmitted *T. vivax*, but trypanosomes were never, subsequently found in its blood. Antibody, as measured by the respiratory test, was not detected during the course of the experiment; but total protein rose rapidly after challenge, the rise being associated with the appearance and increase of an unusual gamma-globulin fraction.

41. The results outstanding from the original small pilot scheme on suramin complexes were for the groups of 3 beasts each of which had been given one subcutaneous injection, at a dose rate of 10 mg./kg., of the suramin complexes of ethidium-bromide, Prothidium and R.D.2902 respectively. The duration of prophylaxis afforded by each complex, as indicated by the interval between treatment and first break-through to regular challenge, was 13, 9½ and 9½ months respectively.

42. Since the ethidium bromide-suramin complex had given the greatest protection, attention has been concentrated on this complex. Three groups, each of 8 animals, were given the complex at dose rates of 5, 7½ and 10 mg./kg.; the drug was injected *subcutaneously*. Severe swellings occurred at the site of the injection; these usually developed a skin necrosis, followed by sloughing of the encapsulated drug, and a reduction of the minimal protective period to a mere 4½ months. Only two beasts failed to lose their drug depot and with these animals a duration of protection was achieved in keeping with the earlier results (para. 41). No cases of generalised toxicity were observed, and weight gains were normal, apart from a slight fall in the first month.

43. The premature closing down of the above experiment was followed by a series of intensive investigations. These suggested that to guard against the presence of any irritating free ethidium bromide in the complex, the suramin must first be dehydrated, and that local reactions were far less if the intramuscular route was followed; further, that to enable this route to be followed the injection volume could be greatly reduced, either by freeze-drying the complex and then reconstituting it with a small volume of water (a preparation referred to as F.D.R.) or by using ethidium chloride instead of bromide, the former salt being far more soluble in water.

44. A new experiment was started, consisting of the three following groups, treated *intramuscularly* at a dose rate of 5 mg./kg.:—

- (a) 6 beasts, ethidium chloride complex at half the volume used in the experiment described under paragraph 14.

- (b) 3 beasts, ethidium bromide complex (F.D.R.) at half the volume used before.
- (c) 3 beasts, ethidium bromide complex (F.D.R.) at less than one-fifth the volume used before.

There were also groups (d), (e) and (f), similar respectively to (a), (b) and (c) above, but the dose rate was 10 mg./kg. Although the local reactions were quite severe in some groups, neither skin necrosis nor sloughs occurred. Great hopes were raised when it was observed that the local reactions for groups (c) and (f), the freeze dried preparation in its most concentrated form, were far less than for the other groups; however, these hopes were short-lived, as it was found that the freeze drying process had robbed the complex of much of its prophylactic activity, both in groups (b) and (c), and (e) and (f). Another disturbing feature was that when using the intramuscular route, a dose rate of 10 mg./kg. was found to be too high; in groups (d), (e) and (f), there were definite signs of a delayed, generalised toxicity, as indicated by loss of weight in over half the 12 animals, and by the death of 6 beasts by the end of the sixth month: even at 5 mg./kg. there was a suggestion of generalised toxicity in one-third of the beasts. The prophylactic figures for group (a) approached expectation, but it is too early to pronounce on group (d).

45. Since local reactions only were observed when the subcutaneous route was originally followed, research has swung back to investigations aimed at reducing the local reactions by subcutaneous injections of the ethidium bromide complex. The prophylactic properties of this complex appear to be so outstanding that further research is undoubtedly justified.

#### The Insect Vector

46. Seasonal fluctuations in the population of *G. longipalpalis* appear to be related to the evaporation rate, as measured by a Livingstone white atmometer bulb. The fly population seems to thrive when the mean daily evaporation rate ranges between 6 and 16 c.c.; when the figure rises above 16 c.c. the population declines and the fly evacuates the savannah woodland in favour of the islands of forest which form the true habitat; when the rate falls below 6 c.c. the population remains steady or even falls, and evacuates the centre of the forest islands.

47. Pregnancy dissections of *G. palpalis* have revealed no wet season cessation of breeding, such as has been recorded from Freetown where the rainfall is much heavier.

48. Out of 131 observations on the resting positions adopted by tsetses of the fusca group, only 9 per cent. of the flies were resting in a horizontal position; the majority rest in the vertical plane with the head pointing downwards.

49. *G. tabaniformis* (and probably also *G. fusca*) prefers very old secondary forest in which the emergents are numerous and the middle storey forms a closed canopy, resulting in a great suppression of undergrowth.

50. A battery of 27 Morris-type traps were used in the forest, but were not attractive to *G. fusca* and *G. tabaniformis*, although they did catch *G. palpalis*.

51. During the rains a very successful marking experiment was undertaken in the forest, using a tethered ox as bait. Nearly 12,000 flies were caught, marked and liberated, about three-quarters of which were probably *G. tabaniformis* and about one-quarter *G. fusca*. N.B. Since we cannot differentiate between the females of these two species without dissection, the

proportions given are based on sampling. Activity is maximal between 6.30 and 9.00 a.m. ; it seems to decrease in the middle of the day, but to increase in the late afternoon. The proportion of males is just over 50 per cent. in the early mornings and late afternoons, but throughout the rest of the day it is around 30 per cent. One female was recaptured after 80 days, and 2.2 per cent. of the recaptures were taken 18 days or more after marking. Flies have been recaptured at distances ranging from 1,000 yards to 1½ miles from the site of marking.

52. We are now getting a better picture of the economic importance of the different species of fusca group tsetse from dissections, which indicate the normal infection rates with the organisms which cause animal trypanosomiasis:—

Out of 2,722 *G. tabaniformis* dissected, 3.5 per cent. infected.

Out of 717 *G. fusca* dissected, 13.9 per cent. infected.

Out of 103 *G. medicorum* dissected, 15.5 per cent. infected.

Out of 124 *G. nigrofusca* dissected, 26.3 per cent. infected.

With the exception of *G. nigrofusca*, females are about twice as heavily infected as males.

53. The first results from gorged, wild flies sent to the Lister Institute of Preventive Medicine for identification of the host's blood, suggest that *G. tabaniformis* relies mainly on Red River-hog and porcupine, whilst *G. longipalpis* favours bush-buck.

#### *The Entomology Section, Kaduna, Northern Nigeria*

54. Taking *G. palpalis* recaptured at a water hole 18 days or longer after marking, as being potentially infective, it has been found that in the dry season such flies are recaptured 9 times as frequently at a water hole near Kaduna as at a water hole near Ugbobigha ; even in the wet season, such flies are 7 times as frequent at Kaduna. The results suggest that the relative absence of human sleeping sickness in the south is due to the humid climate which permits *G. palpalis* to wander, whereas in the arid north, where this tsetse is strictly riverine in habit, there is a much closer contact between man and fly at the village water hole.

55. Preliminary data on host preferences, cf. paragraph 25 above, suggest that in the north *G. palpalis* takes about three quarters of its food from reptiles, man and his domestic animals. *G. morsitans* seems to take more than half its food from wart-hog.

56. Attempts are being made to rear *G. morsitans* under laboratory conditions. It has been found that a very high rate of fertilisation can be achieved if 4-day old females are mated with an equal or larger number of males, all at least 10 days old.

#### Publications

Reports and scientific papers published, or prepared for publication, during the year are listed below by Authors in alphabetical order.

CHANDLER, R. L. Experiments with the Trypanocidal Compound "528" in West Africa. *Brit. J. Pharmacol.* Vol. 12, No. 1, pp. 44-46.

CHANDLER, R. L. Observations on the Cerebrospinal Fluid in Some Cases of Trypanosomiasis in Cattle and Sheep. *Brit. Vet. J.* Vol. 113, No. 11, pp. 482-483.

DESOWITZ, R. S. Suramin Complexes. Part II. Prophylactic Activity against *Trypanosoma vivax* in Cattle. *Ann. Trop. Med. Parasit.* Vol. 51, No. 4.

FAIRBAIRN, H. and GODFREY, D. G. The Local Reaction in Man at the Site of Infection with *Trypanosoma rhodesiense*. *Ann. Trop. Med. Parasit.*

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WIJERS, D. J. B. Polymorphism in Human Trypanosomiasis. *Nature.* Vol. 180, pp. 391-392.

WIJERS, D. J. B. Factors that may Influence the Infection Rate of *Trypanosoma gambiense* in *Glossina palpalis*. I. The Age of the Fly at the Time of the Infected Feed (going to press).

WILLIAMSON, J. Suramin Complexes. Part I: Prophylactic Activity against *Trypanosoma congolense* in Small Animals. *Ann. Trop. Med. Parasit.* Vol. 51, No. 4 (in press).

## VI. ACTIVITIES OF TERRITORIAL DEPARTMENTS

57. Much valuable work in the field of tsetse and trypanosomiasis research has been carried out during the year by the territorial departments of the African Administrations.

58. In Sierra Leone the Veterinary Department has undertaken trials with the new Antrycide Suramin complex prepared by the West African Institute for Trypanosomiasis Research for use against *T. simiae* infection in pigs.

59. The Veterinary Department, Northern Region of Nigeria continues to make a significant contribution towards the testing of new drugs and in collaboration with the Tsetse Control Section, trials have been conducted on the therapeutic and prophylactic properties of Prothidium Bromide (Boots Pure Drug Co. Ltd.), Tozocide (Messrs. Allen & Hanbury, Ltd.) and 4404 & 4427 (Messrs. May & Baker, Ltd.). Tozocide was found to have little value as a trypanocidal drug; observations on the other preparations are continuing.

60. In Central Africa the Nyasaland Tsetse Control Section is engaged in a tsetse eradication scheme in Karonga, based on discriminative bush clearing. This project has been undertaken for practical ends, but in so far as the techniques are being worked out empirically rather than simply applied on the basis of experience from other territories, it involves a considerable degree of investigation.

61. A tsetse survey of Northern Rhodesia has been completed and the report submitted for publication. It incorporates descriptions of the progress of the major tsetse control operations in the territory together with maps and graphs of the fly densities.

62. A fair measure of success has been obtained using insecticides as a means of tsetse control. Research into the various techniques and applications continues. At Mulungushi extremely light fly density persisted but there was no indication of a build-up in the population. The catches from regular fly rounds and inspections were so light that it was impossible to arrange an economical programme for the application of insecticides as a thermal aerosol. The method was therefore changed and a residual spray of 3 per cent. Dieldrin emulsion was applied by a 'Micron sprayer in any area where a fly was caught.

63. Since the beginning of the operations, investigations had been carried out to ensure that there was no reinfestation of the area by fly carried from the nearest *G. morsitans* concentrations in the Luano Valley. Until this year no indication had been found that this was taking place and as the more obvious access lines were investigated with negative results, the search was conducted further afield. Eventually a path was found leading from the Luano Valley and reaching the Luansemfwa road east of Mulungushi Dam and fly were taken from travellers along this path. Following on this discovery, a picket placed on the power line road in the vicinity of Mulungushi Dam caught 27 *G. morsitans* in a month and a half. It is possible therefore that original infection at Mulungushi has in fact been sterilised and that fly caught in the last two years have been carried in from the Luano Valley. Investigations will continue in the coming year.

64. No fly were caught during 1957 in the erstwhile area of infestation at Chingola. As horses, cattle and sheep are now kept in parts of the area it is assumed that eradication is complete and regular fly round inspections and the picket have been abandoned.

65. In conjunction with the tsetse control operations instituted to assist in the resettlement of Africans displaced by the inundation that will result from the Kariba Hydro-Electric Scheme, insecticides have been used in two areas in the Gwembe Valley during the year.

66. In the first instance at Kandabwé, a 1 per cent. gamma B.H.C. thermal aerosol was applied by two lightweight T.I.F.A.'s in an uninhabited valley following on discriminative clearing of the primary *G. morsitans* concentration areas. The applications were carried out after the manner of those at Mulungushi and Chingola and though coverage was good, results were disappointing. It is considered that the poor kill was due to the insecticide, as a new concentrate was used in formulating the solution. Samples have been sent for analysis, but the results are not to hand. When, towards the end of the applications, a return was made to the use of 30 per cent. gamma technical B.H.C. for formulation of the insecticide a 99 per cent. kill resulted.

67. At Mwezia, insecticides applied as a thermal aerosol were used in conjunction with discriminative clearing to reduce fly density in an area into which villages were being moved. The cumulative effect of all these measures has led to virtual elimination of resident fly in the resettlement area.

68. The Veterinary Department in an attempt to elucidate difficulties experienced in the field control of trypanosomiasis undertook studies of the susceptibilities of different strains of *T. congolense* to a variety of trypano-

cides at graduated dosage levels. The Sesheke strain proved resistant to Dimidium Novidium and Ethidium Bromide up to 7.5 mg/kilo, and to Antrycide at up to 4 mg/kilo. A strain of *T. simiae* from pigs in Chisamba also showed a high degree of Antrycide resistance.

69. As a result of field trials carried out by the Tanganyika Veterinary Department, Prothidium and Ethidium suraminates were shown to be satisfactory long term prophylactics under local conditions. When these drugs were used in an area of very heavy fly, infection first appeared 110 days after injection of Prothidium at 4 mg/kilo bodyweight and 113 days after Ethidium suramine at 5 mg/kilo bodyweight. In an area of light fly typical of large tracts of the territory, infection first appeared after 216 and 140 days respectively.

70. Throughout the year the Kenya Veterinary Department continued to test trypanocidal drugs, both in the laboratory and in the field and a large-scale experiment involving the treatment of native cattle with Berenil was conducted successfully in the Athi-Tiva Scheme of the Kitui district.

71. Two new May & Baker drugs were tested in the laboratory both for toxicity and their therapeutic value. One of these showed excellent curative properties with a wide ratio of toxic to therapeutic dosage, i.e. minimum curative doses range from 0.05 mg/Kg for *T. vivax* and 0.1 mg/Kg for *T. congolense* to 10 mg/Kg where delayed toxicity may occur after several weeks. Two experiments to test the value of the new pro-salt formulation against the old have been set in progress in the Athi-Tiva area and results so far indicate that the new formulation is as good as the old.

72. Insecticide (Dieldrex 15) sprayed over more than 300 miles of the Kuja and Migori river systems in South Nyanza against *G. palpalis* the vector of human sleeping sickness appears to have exterminated that fly from the sprayed part of this river system as no flies have been caught within the area since November, 1957. At the same time experiments have continued with insecticides against lake-side fly infestations with a view to exterminating *G. palpalis* from a large part of the Kavirondo Gulf in Lake Victoria.

73. Investigation into the natural hosts of tsetse flies by E.A.T.R.O. in Tanganyika and the Lambwe Valley, by serological identification of the gut contents of engorged flies, has shown that the family suidae (represented by two species, the warthog and bushpig) is the most important source of food for the tsetse flies of the morsitans group. However, recent work at Kiboko has shown that the rhinoceros is the preferred host of *G. longipennis*. Of 164 blood squashes tested 130 were rhinoceros blood. The remainder were buffalo (23), ostrich (4), giraffe (3), elephant (2), lion (1) and pig (1). No kongoni, impala or Grant's gazelle bloods were identified among those tested, although all of these animals were present in greater numbers than the others.

74. A number of substances received from the Colonial Pesticides Research Unit at Silwood Park, were tested as attractants to tsetse flies. The results of these tests showed that none of the compounds with the exception of Ethyl Caprate were attractive to *G. pallidipes*. Tests of other substances indicate that lanolin and shark extract merit further investigation.

75. Ecological investigations were made (a) on the natural hosts and resting places of *G. longipennis*, (b) the value of traps as a check in the estimation of *G. longipennis* populations and (c) to find a reliable method of estimating population density from evening catches made with fly boys starting about half an hour before sunset and finishing about half an hour after.

Report of the Director,  
Anti-Locust Research Centre,  
on Locust Research and Control  
1957-58

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Anti-Locust Research Centre,  
1, Princes Gate,  
Kensington,  
London, S.W.7.

23rd October, 1958.

SIR,

As Director of the Anti-Locust Research Centre, I have the honour to transmit to you a Report on Locust Research and Control for the year 1957-58.

I have the honour to be,

Sir,

Your obedient servant

B. P. UVAROV.

The Right Honourable Alan Lennox-Boyd, M.P.,  
Secretary of State for the Colonies.



## LOCUST RESEARCH AND CONTROL 1957-58

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## LOCUST RESEARCH AND CONTROL 1957-58

### ANTI-LOCUST RESEARCH CENTRE

#### *Personnel*

1. Mr. R. S. Ridgwell was appointed on 10th March, 1958, to the new post of Executive Officer, to take over some of the administrative responsibilities of the Secretary.

2. The following research workers from overseas locust organisations have been working at the Centre, on attachment or while on leave, for varying periods: Dr. R. C. Rainey, Dr. W. J. Stower, Messrs. G. B. Popov, J. Roffey and C. Ashall of the Desert Locust Survey; Mr. J. T. Davey and Dr. B. Nickerson of the International Migratory Locust Organisation; and Dr. R. F. Chapman of the International Red Locust Control Organisation.

#### *Locust information service*

3. In 1957 the heaviest Desert Locust infestations occurred in West and North-West Africa, in Arabia and in the Somali Peninsula, while Iran, Pakistan and India continued to remain clear. In the course of the year, 917 reports were received from 42 territories and monthly summaries and forecasts continued to be sent out regularly to all interested governments and organisations.

4. Special memoranda were prepared on the current Desert Locust plague developments for the FAO Eastern African and the FAO Technical Advisory and the Desert Locust Control Committees, and on the Red Locust infestations in Tanganyika Territory during the 1930-44 plague for the Colonial Office.

5. During the year 293 abstracts of current publications were issued, bringing the total since 1949 to 2,000. Indexing of old publications continued.

#### *Conferences, tours and lectures*

6. Dr. Uvarov attended meetings of the Executive Committee of the International African Migratory Locust Organisation in Paris in April; the FAO Technical Advisory Committee and Desert Locust Control Committee at Tangiers in June; and the Desert Locust Survey Advisory Committee in Nairobi in December. Dr. Taylor attended the annual session of the Council of the International African Migratory Locust Organisation at Kara, French Sudan, in June, and a meeting of the Executive Committee of the same organisation in Paris in December. Dr. R. C. Rainey took part in the first International Bio-Meteorology Congress in Vienna in September and read a paper on "Bio-Meteorology and the displacements of air-borne insects". During the year he also read papers to the Society for Experimental Biology, the Pesticides Group of the Society of Chemical Industry, and the Linnean Society of London. Dr. Ellis read a paper on "Social aggregation in two species of locusts" at an International Conference on social insects in Paris in July. Dr. Taylor and Dr. Haskell visited field research workers in Kenya, Somaliland Protectorate and Ethiopia during February. The Universities of Oxford, Cambridge, London, Reading, Leicester, Birmingham, Liverpool, Leeds and Nottingham were visited by Dr. Haskell during the year, and a lecture on "Acoustic communication in animals" was given at the Clarendon Laboratory, Oxford. He broadcast jointly with Dr. Rainey in the B.B.C. Overseas Programme on "The migration of birds and locusts" and made a contribution on locust physiology to the B.B.C. "Science Magazine" programme. Mr. A. T. Thompson gave a talk on locust migrations to the Bognor Regis Natural Science Society, and took part in two junior conferences on

"Food and People" organised by the Council for Education in World Citizenship.

#### *Students and Visitors*

7. Visitors to the Centre included specialists from Wurzburg, Warsaw, Tubingen, Manitoba, Central America, Australia, the United States, Madagascar and French Equatorial Africa.

#### *Locust research discussions*

8. The practice of holding afternoon discussion meetings at the Centre to enable staff and other laboratory and field research workers to exchange views on current investigations was continued. During the year under review, there were discussions on the behaviour of locust hoppers both in the laboratory and in the field; the nutrition, sexual maturation, fat and water content, and the visual responses of locusts; population dynamics; night flight in the Desert Locust; the efficiency of baiting operations against hoppers; the winter breeding areas of the Desert Locust on the Red Sea and Gulf of Aden coasts; and the Niger outbreak area of the African Migratory Locust.

#### *Locust laboratory*

9. The equipment of the laboratory in its present quarters is now complete with the exception of two small rooms for specially controlled cages, and this has made it possible to increase the volume of locust production. About three quarters of a million hatchlings were produced during the year as well as some 45,000 adult locusts. Cultures of several exotic grasshoppers (*Eyprepocnemis*, *Romalea*, *Gastrimargus*, *Pyrgomorpha*, *Caloptenopsis*, *Sherifuria* and *Acrida*) have been kept to satisfy demands for research material. About 40 laboratories in the United Kingdom and abroad made use of this service, and despite the vast numbers produced the demand continued to exceed the supply.

#### *Laboratory research*

10. Dr. P. E. Ellis continued her work at the University of Oxford, paying particular attention to social aggregation, which is the basis of swarming, in the first three hopper instars and in adult locusts, in comparison with that of certain African grasshoppers.

11. Dr. R. H. Dadd, working at the Imperial College of Science and Technology on locust nutrition, found that erratic results were obtained even with the best artificial diets, and directed his attention to the feeding stimuli provided by the various diets.

12. The research into sensory factors affecting locust behaviour in the field was continued and intensified. Dr. W. Loher at the Imperial College of Science and Technology, investigating the sense of smell, discovered a substance produced by mature male Desert Locusts which stimulates a response in young adults of the same species, and was able to concentrate this substance. Miss L. Goodman, at Queen Mary College, University of London, obtained valuable information on the effects of light on the flight performance of the Desert Locust. Dr. Haskell made oscillograph studies of the effects of stimulation of the aerodynamic sense organ on the head of the Desert Locust as the first stage of an investigation into the wind responses of this insect. Dr. J. S. Weir concluded his work on heat perception by locusts in October. Mr. G. K. Wallace commenced research at the University of Reading on the visual basis of behaviour in locust hoppers, with a grant from the Centre for equipment.

13. Professor A. Shulov of the Hebrew University, Jerusalem, commenced an investigation of the embryonic development of the Red Locust by making observations on the normal development of the eggs and on their water requirements.

#### *Taxonomic research*

14. Keys to the African Acridid genera are being prepared by Dr. V. M. Dirsh, but the work is somewhat impeded by the steady influx of undescribed genera. A revision of South African Pamphaginae has been completed. Miss J. Mason completed her survey of the tympanal organs in some 700 genera.

15. Mr. N. D. Jago commenced a critical revision of the genus *Calliptamus* which includes several economically important species which are often confused.

#### *Biogeographical research*

16. In the Geographical Section, under Miss Z. Waloff, the season-by-season analysis of the developments of the current Desert Locust plague was continued to include 1954 and most of 1955.

17. An examination of the rainfall characteristics of the Desert Locust breeding areas was started by Miss J. Magor, and the preparatory work involved a survey of the distribution and periods of operation of rainfall stations within the extensive total breeding area of this species, and a preliminary examination of rainfall variability in some selected breeding areas. The mean annual rainfall totals are plotted on a map of relative frequencies of breeding, and the relationship between rainfall and breeding in the East and North-East African and Arabian breeding areas is being studied.

18. Since movements of non-swarving populations of the Desert Locust occur mainly during nights with certain temperatures, a start was made by Miss P. R. Granter on an investigation of the distribution of night temperatures within the Desert Locust region with a view to delimiting areas which might be suitable for night flights at different times of the year. This work is expected to throw light on the dynamics of low-density locust populations, and their part in the development of locust plagues.

19. Miss E. Betts has followed her examination of the infestation frequencies of different territories during the 1928-42 plague of the African Migratory Locust by a review of the available information on the incidence of bands or swarms of this species during the period from 1871 to the present time. It was found that between about 1890 and 1904 the greater part of the African continent experienced a heavy infestation comparable in duration and extent with the 1928-42 plague, and that outside the main outbreak area there have been, more recently, apparently independent small-scale and localised outbreaks in Nigeria, the Sudan, Ethiopia and the Somaliland and Bechuanaland Protectorates, which have not led to plagues.

#### *Statistical investigations*

20. Statistical analyses were carried out by Mr. D. E. Davies on the biometrics of the Moroccan Locust (*Doclostaurus maroccanus*), activity, and percentage crowding, of *Locusta*, feeding, walking and percentage weight increase, and oxygen uptake, of adult *Schistocerca*, and field data on thermocouple temperatures, wind speeds and dew points, and soil moisture content.

*Control investigations*

21. Mr. MacCuaig and his unit at the Ministry of Supply Chemical Defence Experimental Establishment, Porton, continued investigations of the toxicity of various insecticides sprayed over locusts flying in a wind tunnel, and a summary of all available results of tests of contact toxicities of insecticides against locusts is to be published. During August and September Mr. MacCuaig visited the Airspray unit of the Desert Locust Survey in the Somaliland Protectorate, and the results of the field trials carried out were found to be in good correspondence with laboratory results.

22. Mr. R. D. Goodhue, working at the Imperial College of Science and Technology, determined the susceptibility to benzene hexachloride (BHC) as a stomach poison of each hopper instar of the Desert Locust. A decrease in susceptibility within the fifth instar was found, and as the fifth instar is stated to be the most difficult to destroy under field conditions, it has been used in most subsequent experiments.

23. Miss T. Kikal, working under Dr. J. N. Smith at St. Mary's Hospital Medical School on detoxication of insecticides in locusts, studied the metabolism of dinitro-*o*-cresol (DNC) in *Schistocerca* and *Locusta* together with that of two of its possible metabolites.

*Field research*

24. In the first part of the year Mr. D. J. Greathead was working at the Centre sorting out and studying his accumulated data and specimens and writing accounts for publication of his surveys of the natural enemies of the Desert Locust. After preparing papers dealing separately with four insect enemies, he returned to Eritrea in September to resume his investigations of the fly *Stomorphina lunata*, which is an important predator on Desert Locust eggs.

*Record of current research*

25. A major task during the year was compiling information on current research on Orthoptera from the replies received to the questionnaire referred to in last year's report. In all, 218 replies from research workers in 37 different countries were received and a mimeographed list was issued, with complete addresses of all workers, together with brief notes on their research and the species used. The first number was distributed in February and was greatly appreciated by research workers as a means of establishing contacts between scientists investigating similar problems.

**REGIONAL ORGANISATIONS***Desert Locust Survey*

26. The recession in the Desert Locust plague proved to be very short-lived and the personnel of the Survey was again almost entirely diverted to control operations. Substantial progress was made on further development of aircraft spraying, the tests of a new insecticide, Diazinon, having produced exceptionally good results. Large-scale tests of the method of controlling hoppers by the application of a residual insecticide to vegetation by means of an exhaust sprayer, carried out in Libya by invitation of the Libyan Government, proved to be a great success; the method is gradually replacing baiting in suitable conditions and it promises to result in considerable economy, due to the elimination of expenditure on the transport of large quantities of bait.

*International Red Locust Control Service*

27. The research work of this Service continued to be directed mainly to the investigation and testing of improved methods of enumerating locust

populations and studying their dynamics in relation to weather, flooding and vegetation changes. Studies on the behaviour of adults and hoppers were also continued. Operational research carried out during the last few years by Mr. J. H. Lloyd has produced valuable results in assessing the comparative effectiveness and economics of the various control methods.

#### *International African Migratory Locust Organisation*

28. Observations on locust movements within the outbreak area and outside it were continued with large-scale marking and recovery of adults. The data obtained by this method suggested the need for closer studies of locust behaviour, particularly of the night flight by which long-range movements appear to be accomplished. A programme of such studies was prepared during Dr. Nickerson's attachment to the Centre and field work commenced on his return. Detailed studies were carried out on the general Acridid fauna of the outbreak area. A general account of the topography and ecology of the area was prepared by Mr. Davey for publication.

### LOCUST CONTROL

29. The non-swarmling populations of the African Migratory and the Red Locust continued to be kept under survey and effective control by the respective international organisations.

30. The Desert Locust situation during 1957 became more serious than in 1956. Heavy breeding in summer occurred in Mauretania, Senegal, northern Ethiopia and in winter in the Somali peninsula. The spring invasion of the Arabian peninsula was a serious one, and the international campaign there, sponsored by FAO, proved to be inadequate to prevent the formation of new swarms.

### INTERNATIONAL CO-OPERATION

31. The recommendation of the FAO Panel of Experts on the Desert Locust which met in 1956 that the Anti-Locust Research Centre should undertake to establish an International Desert Locust Information Service is in process of being implemented. An agreement has been drawn up between the Food and Agriculture Organisation and the Anti-Locust Research Centre, and the final draft submitted for acceptance by the U.K. Government. The new Service, partly financed by the FAO, would form an integral part of the Geographical Section of the Centre.

32. Another recommendation of the Panel, that a special team consisting of an Acridologist and a Plant Ecologist should be charged with a general ecological survey of Desert Locust habitats throughout its distribution area is also approaching implementation. The Geographical Section of the Centre prepared the necessary background material for a special Working Group consisting of representatives of FAO, UNESCO, WMO and the Centre, which met at the Centre on 11-13th February to plan and initiate the survey, recommended two candidates for appointment, and drew up a plan of work with a view to the first field tour beginning in June, 1958.

33. Mr. C. I. H. Aspliden, meteorologist in charge of the World Meteorological Organisation's Technical Assistance Mission for Desert Locust Control continued his work in Nairobi on assembling and analysing synoptic data for the whole Desert Locust area, as a basis for the interpretation of the effects of weather dynamics on the seasonal movements and breeding of the locust.

## APPENDIX I

## ADVISORY COMMITTEE ON ANTI-LOCUST RESEARCH

**Membership**

- SIR GEOFFREY EVANS, C.I.E., M.A. (*Chairman*).
- DR. W. E. CHINA, M.A., Keeper of Entomology, British Museum (Natural History).
- DR. A. G. FORSDYKE, Assistant Director, Climatological Research, Meteorological Office, Air Ministry.
- DR. W. J. HALL, C.M.G., M.C., Director, Commonwealth Institute of Entomology.
- MR. I. C. JACKSON, Colonial Office.
- MR. C. LEA, Assistant Director, Arm. R.D.Air, Ministry of Supply.
- PROFESSOR O. E. LOWENSTEIN, D.Sc., F.R.S., Mason Professor of Zoology and Comparative Physiology, University of Birmingham.
- MR. G. W. NYE, C.M.G., O.B.E., Colonial Office.
- PROFESSOR O. W. RICHARDS, M.A., D.Sc., Professor of Zoology and Applied Entomology, Imperial College of Science and Technology.
- MR. K. F. SAWYER, B.Sc., Chemical Defence Experimental Establishment, Ministry of Supply.
- DR. T. H. C. TAYLOR, Deputy Director, Anti-Locust Research Centre.
- DR. B. P. UVAROV, C.M.G., F.R.S., Director, Anti-Locust Research Centre.
- PROFESSOR G. C. VARLEY, M.A., Ph.D., Hope Professor of Zoology (Entomology) University of Oxford.
- PROFESSOR V. B. WIGGLESWORTH, C.B.E., M.A., M.D., F.R.S., Director, Agricultural Research Council Unit of Insect Physiology; Quick Professor of Biology, University of Cambridge.
- DR. C. B. WILLIAMS, M.A., F.R.S., formerly Chief Entomologist, Rothamsted Experimental Station.
- MR. A. T. THOMPSON, B.Sc., Secretary, Anti-Locust Research Centre. (*Secretary*).

**Terms of reference**

1. To guide the work of the Anti-Locust Research Centre on its scientific side with the object of ensuring continuity and co-ordination of its research in all its aspects;
2. To advise the Director of the Centre in regard to the preparation of a programme and the means of ensuring the fullest co-operation of scientific bodies and Government departments in carrying it out
3. To consider the estimates of expenditure of the Centre.

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## APPENDIX II

## List of publications

## ANTI-LOCUST BULLETINS

DEMPSTER, J. P., 1957. The population dynamics of the Moroccan Locust (*Dociostaurus maroccanus* Thunberg) in Cyprus. *Anti-Locust Bull.*, London, No. 27: [4+] 60 pp., 3 pls., 21 figs.

HUNTER-JONES, P., 1958. Laboratory studies on the inheritance of phase characters in locusts. *Anti-Locust Bull.*, London, No. 29: [2+] 32 pp., 6 figs.

NORRIS, M. J., 1957. Factors affecting the rate of sexual maturation of the Desert Locust (*Schistocerca gregaria* Forskal) in the laboratory. *Anti-Locust Bull.*, London, No. 28: [2+] 26 pp., 2 figs.

RAINEY, R. C., WALOFF, Z. & BURNETT, G. F., 1957. The behaviour of the Red Locust (*Nomadacris septemfasciata* Serville) in relation to the topography, meteorology and vegetation of the Rukwa Rift Valley, Tanganyika. *Anti-Locust Bull.*, London, No. 26: [4+] 96 pp., 5 pls., 14 figs.

## JOURNAL PAPERS

AZIZ, S. A., 1957. The reactions of the Desert Locust, *Schistocerca gregaria* (Forsk.), (Orthoptera, Acrididae) to physical factors, with special reference to relative humidity. *Bull. ent. Res.*, London, 48: 515-531, 1 fig.

BUCHTHAL, F., WEIS-FÖGH, T. & ROSENFALCK, P., 1957. Twitch contractions of isolated flight muscle of locusts. *Acta physiol. scand.*, Stockholm, 39: 246-276, 19 figs.

CHAPMAN, R. F., 1957. Observations on the feeding of adults of the Red Locust. *Brit. J. Anim. Behav.*, Huntingdon, 5: 60-75, 14 figs.

CLARKE, K. U., 1957. The relationship of oxygen consumption to age and weight during the post-embryonic growth of *Locusta migratoria* L. *J. exp. Biol.*, London, 34: 29-41, 9 figs.

COUPLAND, R. E., 1957. Observations on the normal histology and histochemistry of the fat body of the locust (*Schistocerca gregaria*). *J. exp. Biol.*, London, 34: 290-296, 1 pl.

DIRSH, V. M., 1957. Review of the genus *Mecostibus* Karsch (Orthoptera, Acridoidea). *Publ. cult. Cia Diamant, Angola*, Lisbon, No. 34: 67-84, 60 figs.

DIRSH, V. M., 1957. The spermatheca as a taxonomic character in Acridoidea (Orthoptera). *Proc. R. ent. Soc. Lond.*, (A) 32: 107-114, 28 figs.

DIRSH, V. M., 1957. Two cases of gynandromorphism in Acrididae (Orthoptera). *Ent. mon. Mag.*, London, 93: 193-194, 2 figs.

DISSANAIKE, A. S. & CANNING, E. U., 1957. The mode of emergence of the sporoplasm in microsporidia and its relation to the structure of the spore. *Parasitology*, London, 47: 92-99, 7 figs.

GUNN, D. L., 1956. A history of Lake Rukwa and the Red Locust. *Tanganyika Notes*, Dar-es-Salaam, No. 42: 1-18, 1 map, 1 photo.

HASKELL, P. T., 1956. The locust problem. *Science News, Harmondsworth*, No. 42: 23-40, 1 map.

HASKELL, P. T., 1957. Stridulation and associated behaviour in certain Orthoptera. 1. Analysis of the stridulation of, and behaviour between, males. *Brit. J. Anim. Behav.*, Huntingdon, 5: 139-148, 1 pl., 1 fig.

HOYLE, G., 1958. The leap of the grasshopper. *Sci. Amer.*, Washington, 198: 30-35, 7 figs.

HUNTER-JONES, P., 1957. An albino strain of the Desert Locust, *Nature*, Lond., 180: 236-237.

KERLY, M. & LEABACK, D. H., 1957. The characteristics of hexokinase from *Locusta migratoria* muscle. *Biochem. J.*, Cambridge, 67: 245-250, 2 figs.



- KILBY, B. A. & NEVILLE, E., 1957. Amino-acid metabolism in locust tissues. *J. exp. Biol.*, London, **34**: 276-289, 5 figs.
- MACCUAIG, R. D., 1957. The cumulative toxicity of  $\gamma$ -BHC and diazinon applied in small doses to locusts. *Ann. appl. Biol.*, London, **42**: 114-121, 2 figs.
- MACCUAIG, R. D. & SAWYER, K. F., 1957. The cumulative toxicity of dinitro-*o*-cresol applied in small doses to locusts. *Bull. ent. Res.* London, **48**: 435-445, 6 figs.
- MALEK, S. R. A., 1957. Sclerotization and melanization: two independent processes in the cuticle of the Desert Locust. *Nature, Lond.*, **180**: 237.
- MORALES AGACINO, E., 1957. The abdominal morphology of a gynandromorph of *Schistocerca paranensis* (Burm.) (Orthoptera: Acrididae). *Proc. R. ent. Soc. Lond.*, (A) **32**: 169-170, 1 fig.
- NORRIS, M. J., 1958. Influence of photoperiod on imaginal diapause in Acridids. *Nature, Lond.*, **181**: 58.
- POPOV, G. B., 1957. The vegetation of Socotra. *J. Linn. Soc. (Bot.)*, London, **55**: 706-720, 1 map, 5 pls.
- RAINEY, R. C., 1957. Biometeorology and the displacements of airborne insects. *Int. J. Bioclim. Biomet.*, Oegstgeest, Leiden, 1 pt. III, sect. B: 5 pp., 2 figs.
- SHULOV, A., PENER, M. P., KUK-MEIRI, S. & LICHENSTEIN, N., 1957. Proteolytic enzymes in various embryonic stages of the eggs of *Locusta migratoria migratorioides* (R. and F.). *J. Insect Physiol.*, London, **1**: 279-285.
- TAYLOR, T. H. C., 1958. Progress in locust research. *World Crops*, London, **10**: 45-48, 6 photos.
- UVAROV, B. P. & JOHNSTON, H. B., 1957. A census of the African acridoid fauna. *Bull. Inst. franç. Afr. Noire*, Paris, (A) **19**: 511-519.
- UVAROV, B. P. & POPOV, G. B., 1957. The saltatorial Orthoptera of Socotra. *J. Linn. Soc. (Zool.)*, London, **43**: 359-389, 1 map, 38 figs.
- VESEY-FITZGERALD, D. F., 1957. The vegetation of central and eastern Arabia. *J. Ecol.*, Oxford, **45**: 779-798, 1 pl., 2 figs. (fldg.).
- VESEY-FITZGERALD, D. F., 1957. The vegetation of the Red Sea coast north of Jeddah, Saudi Arabia. *J. Ecol.*, Oxford, **45**: 547-562, 1 map, 4 pls.
- WEIS-FOGH, T., 1956. The flight of locusts. *Sci. Amer.*, New York, 194 No. **3**: 116-118, 120, 122, 124, 11 figs.

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

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## A. BUILDING AND HOUSING RESEARCH

### *Colonial Liaison Section, Building Research Station, Department of Scientific and Industrial Research*

1. Substantial progress has been possible on four matters of present interest to the Colonial Liaison Section, Building Research Station. They are: a study of housing densities; natural ventilation of buildings in low latitudes; behaviour of paints under tropical conditions; and, as an example of the use of local building materials, a study of the properties and behaviour of Maltese limestone. This work, and other activities, are described below.

2. Towards the end of the period under review, the Section was brought up to complement by the appointment of a civil engineer, Mr. A. F. Dalby, recently Director of Public Works, Sierra Leone. The appointment should help overseas governments to draw more effectively on the Building Research Station's wide experience in civil engineering and allied problems. Special attention is being given to earthquake- and hurricane-resistant construction, and to some aspects of water supply and drainage. Mr. P. H. M. Stevens, the town planner attached to the Section by the Colonial Office has been appointed head of a department of town and country planning recently established by the Government of Barbados. In October, 1957, the Colonial Liaison Section took over temporary but more commodious offices at Garston. Consequently, it has been possible to bring up to date and catalogue its extensive collection of photographs and lantern slides.

#### *Visits*

3. Mr. G. A. Atkinson, the Colonial Liaison Officer, who is also Housing Adviser to the Colonial Office, toured Aden, Somaliland Protectorate and the East African territories from April to July, 1957. Among the matters of special concern during his visit were the Nairobi African housing scheme, for which the Colonial Liaison Section had given advice on the use of local pumice as concrete aggregate; government staff housing in Uganda; school building in Somaliland; and air-conditioning practices at Aden and on the East African coast. From accounts of the cracking of buildings at Hargeisa, Somaliland Protectorate, it had been suspected that this was due to the heaving of unsaturated clay soils with changing moisture conditions, a problem met with in parts of East and South Africa and other places with marked seasonal variation in rainfall. The visit to Hargeisa confirmed this. Almost every major building was cracked, largely due to the heaving soil. Where, as in the case of the new Government House, large quantities of moisture were being supplied to the ground from drains and by garden watering, damage was most marked. Suggestions on how to reduce further damage were made.

4. Mr. P. Whiteley, the Tropical Paint Research Fellow, made a three month tour of East, Central, South and West Africa from August to November, 1957. During his tour, he visited paint exposure testing sites and government laboratories; he also discussed paint problems with works departments and others interested, including firms manufacturing and marketing paints. Further details of this tour are given in paragraphs 18 and 19.

5. Mr. C. G. Webb, the senior scientific officer working on environmental aspects of tropical building, made a short visit to Lagos, Nigeria, to attend a meeting of specialists on human behaviour in warm climates organised under the CCTA/CSA auspices. While in West Africa, he visited the West African Building Research Institute, Accra, the Meteorological Offices at Lagos and Accra, the University Colleges of Nigeria and Ghana, and the Health Department, Kano, Northern Nigeria. Systematic measurements of

long-wave radiation were made at four places lying roughly on a meridian and reaching the inter-tropical front. A number of valuable contacts were established with other workers studying thermal comfort in tropical climates.

6. Mr. W. H. Ransom, the officer responsible for work on materials and methods of construction, visited West and North Africa and Malta during October and November, 1957. Co-operative exposure trials of building materials were discussed at the West African Building Research Institute. It is probable that the Institute will continue to expose some of the samples now at the Ministry of Supply Tropical Testing Establishment, which is unfortunately closing down. In Sierra Leone, Ghana and Nigeria many buildings with flat concrete roofs were inspected as part of an investigation on the design and construction of flat roofs now in progress. Poor detailing, particularly at movement and construction joints, seemed to be responsible for most failures seen. In West Africa, attention was also given to the design and construction of cocoa stores, a matter on which the Section has been co-operating with the Pest Infestation Laboratory, Slough. Also at the request of the Laboratory, underground wheat fossae in Malta were inspected to see whether they could be waterproofed cheaply and efficiently. The main reason for the Malta visit was to assist the Admiralty, who met the extra cost of this part of the tour, on problems connected with the use of the local globigerina limestone, which also interest the Government of Malta and other Service Departments. Further details of this work are given in paragraphs 13 and 14.

#### *Enquiries and Technical Investigations*

7. *Environmental aspects of tropical building.* Bibliographies on low-latitude indoor climates, and on solar water heaters have been prepared. Stereographic solar charts have been drawn for latitudes  $0^{\circ}$  to  $18^{\circ}$  to provide, with those published by building research institutes in South Africa, India, and Australia, coverage for the low latitudes from  $0^{\circ}$  to  $34^{\circ}$  at  $2^{\circ}$  intervals. A note reproducing these charts and explaining their use in building design has been sent to Correspondents; it is available to others interested. A more comprehensive note, describing the construction and uses of solar charts for handling problems of insolation and shading in building design, has also been prepared and is being circulated for comment.

8. A note has been prepared on the thermal design of bedrooms for tropical low-cost housing. The lower bedroom temperatures that result from a reduction in the overcrowding of tropical dwellings may be objectionable to the occupants, but unavoidable if ventilation is not to be reduced to undue or even dangerous extent. This is especially the case where, in order to reduce capital cost, poorly insulated thin-wall construction is adopted. There appears to be a definite value of the conduction loss from a thin-walled dwelling which should not be exceeded. Under tropical conditions, this value is related to the number of occupants. The note describes the mechanism graphically; a table of maximum permissible values of the thermal transmittance is given.

9. Work has been started on the statistical examination of thermal comfort observations taken indoors in Singapore with a view to deriving a thermal comfort scale for low latitudes.

10. *Natural ventilation.* A paper suggesting a practical index of natural ventilation for design purposes in low-latitude buildings has been published in the Journal of the Royal Institute of British Architects. A further paper, discussing the fundamentals of natural ventilation in low-latitude climates, has also been prepared and is being circulated for comment. The surface climate in these latitudes is characterised by an ambient tempera-

ture of  $80 \pm 5^\circ$  F., a vanishingly small wind velocity, and an excess of moisture. Indoor climates are generally above the comfort range, buildings are unheated, and it is the function of ventilation to remove metabolic and other heat from a building. Very large quantities of fresh air are required for this purpose. The ventilation problem is most serious in the evening and at night when, on the one hand, buildings are warm and dry and normally no benefit is to be derived from absorption of heat by the fabric; while, on the other hand, wind is usually absent and natural ventilation is dependent on stack effect. On the basis of established principles, the effects of wind and non-metabolic heat on natural ventilation have been set out in graphical form, and a ventilation index and scale of ventilation suitable for low-latitude use proposed. These have been related to data on wind speeds and calculated values for ventilation indices in actual buildings, mainly from Singapore, with a subjective assessment of the resulting comfort conditions.

11. *Air conditioning.* During the Colonial Liaison Officer's visit to Aden and places on the East African coast, special attention was given to air-conditioning practices. As expected, there had been a rapid increase in the use of air-conditioning equipment, especially in Aden where many new buildings, including the general hospital, were being air-conditioned. The Aden Government had decided to provide a 1-ton unit in each senior officer's quarter. Of outstanding interest were the rapid deterioration of the casings and other metal parts of many of the small unit air-conditioners, and the problem of disposing of the large quantities of condensate water extracted by these units from the humid Aden air. Subsequently, the Colonial Liaison Officer attended a series of meetings with the Crown Agents and the Service Departments concerned at which common problems and experience were discussed. During the tour, much information was collected but, through pressure of other work, it has not been possible yet to analyse and publish it.

12. *Cooking facilities in low-cost housing.* The provision of facilities for cooking in low-cost housing was a second subject of special study during the Colonial Liaison Officer's tour. In Aden, where kerosene is being increasingly used instead of firewood, and bottled gas for cooking has recently been introduced, the Labour Commissioner had been carrying out experiments on the cost of alternative forms of cooking. In East Africa generally, more urban workers are turning either to charcoal or kerosene for cooking and many of the often elaborate and relatively costly brick or concrete fireplaces were not being used. In Tanganyika and Uganda, the government housing authorities are experimenting with improved cooking stoves. Much interest has been shown in Colonial Building Notes No. 45, "Cooking and Fuel Economy in Low-cost Tropical Housing"; many requests for additional copies of the Notes were received, particularly from East and West Africa. On his return from East Africa, the Colonial Liaison Officer discussed with one of the manufacturers of a wood-burning stove for low-cost housing in Africa the possibility of a similar stove using kerosene.

13. *Use of local materials for building: Maltese limestone.* For many centuries, limestone has been the traditional building material of the Maltese Islands. Since 1930, the Building Research Station has, from time to time, been consulted on its properties and behaviour. During a visit to Malta in 1955, the Colonial Liaison Officer was shown many buildings of different ages, in some of which the stone was sound after 200 or more years of exposure while in others recently built there were signs of severe deterioration. The Civil Engineer-in-Chief's Department, Admiralty, who is responsible for the maintenance of many of Malta's older buildings as well as the construction of new buildings in the Dockyard and elsewhere, was particularly interested in the problem. It was, therefore, agreed to examine at the Building Research

Station samples of globigerina limestone from Malta to determine whether stone which would weather well could be distinguished, prior to use, from stone which would quickly deteriorate. Such an examination was undertaken. The sodium sulphate crystallisation test, which has been found useful in distinguishing limestones of good and bad quality, was applied to the specimens. Results were sufficiently in agreement with the behaviour of similar stone in practice to make it worth while recommending its tentative use for quality control. The test is a comparative one and, consequently, concurrent tests on specimens of known good and poor weathering qualities need to be made.

14. Discussion with the Admiralty and the Maltese Public Works Department showed that it would be useful for a survey to be made of the comparative durability of stone from different local sources, and for exposure trials in Malta to be organised. Arrangements were therefore made for Mr. W. H. Ransom to visit Malta and Gozo in November, 1957. During his visit, talks were held with Service and Malta Government works departments, private architects, contractors, masons and quarry operators. Thirty-six selected structures were inspected in detail, very many other buildings being examined more cursorily. Exposure facilities were organised at three sites: Fort Ricasoli, facing the sea in a very exposed condition; Qrendi, facing the sea but about a mile from it; Imtarfa, an inland exposure, not severe. Exposure of samples obtained from a number of quarries followed the Building Research Station pattern; similar samples were sent to the Station.

15. An illustrated Note describing the work has been prepared and circulated. It summarises earlier work on Maltese limestone and discusses the nature and cause of deterioration, the repair and preservation of buildings, and the selection of better quality stone. Some changes in existing building practices are suggested.

16. *Other materials.* During the Colonial Liaison Officer's visit to the Somaliland Protectorate, the site of gypsum deposits about ten miles inland from Berbera was inspected. Advice was given on the possible uses of gypsum for building. Owing to the comparative inaccessibility of the site and the relatively small and scattered amount of building taking place in the Protectorate, the Berbera deposits seemed unlikely to be of any practical value for local works. There are other more favourably sited deposits.

17. Liaison was established with the consulting engineers responsible for the new deep-water harbour in Barbados with the object of obtaining more information on the behaviour of local coral rock as a concrete aggregate, and the possible use of pozzolana from the nearby island of St. Vincent.

18. *Tropical paint research.* The main object of the Tropical Paint Research Fellow's three-month tour of Africa was to acquire a knowledge of local climatic conditions and painting practices. Topics studied included the effects of a hot maritime climate on paints in Aden, the paint testing work of the Materials Laboratory, Kenya Ministry of Works, the work of the South African National Building and Paint Industries Research Institute, and the exposure testing work of the West African Building Research Institute, Accra, and the Ministry of Supply's Tropical Testing Establishment, Nigeria. In South Africa, a visit was also paid to the Bureau of Standards which, unlike the British Standards Institution, awards certificates for laboratory testing, with subsequent control by the testing of purchased samples. In connection with the tour, the Research Fellow has been in contact with the Export Group of the Paint Industry and with the City and Guilds Institute (on the training of painters overseas). A comprehensive report on the African tour was presented in draft to the Advisory Panel on Tropical Paint Research at its second

meeting in March, 1958. It has since been circulated for comment prior to publication.

19. The Research Fellow has been able to advise a number of overseas works departments on the specification and exposure testing of paint. In co-operation with the Crown Agents, and their paint consultant, and the Paint Research Station, he has been devoting special attention to an examination of emulsion paints now being used increasingly overseas. Arrangements are being made for their exposure testing at the West African Building Research Institute. On the Institute's behalf, arrangements are also being made with manufacturers for a series of exposure tests of gloss paints in West Africa. The Research Fellow will probably return to West Africa in the autumn to initiate these tests.

20. *Architectural, housing and town planning matters.* Following discussion on residential densities at the Overseas Section, Town and Country Planning Summer School, Oxford University, 1957, Mr. P. H. M. Stevens initiated a study into the factors determining housing densities, which may range from under 10 persons to an acre in the suburbs of some African towns to over 2,000 in Hong Kong's new housing schemes. A complementary study of space standards in tropical housing was made for a paper by Mr. G. A. Atkinson to the Sixth International Congresses of Tropical Medicine and Malaria, Lisbon. This paper, among other matters, compared the occupancy rates (floor area per person) of recent tropical housing schemes and housing in other parts of the world. Rates range from 140-180 sq. ft. per person in post-war social (municipal) housing in Western Europe, 90-110 sq. ft. in housing in Eastern Europe and some parts of Latin America, 45-100 sq. ft. commonly provided in mass housing in Africa, the Caribbean and similar tropical areas, to 30-55 sq. ft. in some densely populated Asian cities like Hong Kong. The high occupancy rates (low floor areas per person) reflect both lower levels of income and the greater use of outdoor living space. To give a more accurate expression of housing conditions, especially in warmer climates where many household activities can take place outdoors, reference must also be made to the total living space per person, which has been defined for the studies as the total space available on all floors indoors and outdoors within the housing plot. Figures for total living space are found to range from 40-60 sq. ft. per person in Hong Kong, through 140-150 sq. ft. in high density African housing in Kenya, to 300-400 sq. ft. in areas in Uganda towns where grade II building rules are being applied and 400-800 sq. ft. in smallholder resettlement schemes recommended in Singapore.

21. Account is being taken of this factor in the densities study. Tables have been prepared by means of which the effect on housing density of changes in the total living space standards, occupancy rates, number of floors built and the provision for access and open space can be compared. The tables provide for a range of total living space standards from 1,000 sq. ft. to 25 sq. ft. per person with occupancy rates ranging from 200 sq. ft. to 20 sq. ft. Corresponding densities range from about 20 persons to 5,000 persons an acre. No attempt is made to specify actual standards, the determination of which must be related to particular local conditions; different factors influencing choice of density are, however, reviewed. The study will be published with illustrations of housing developments at different densities in different parts of the world.

22. In connection with the forthcoming Inter-African Conference on Housing and Urbanisation, to be held in Nairobi under the auspices of the Commission for Technical Co-operation in Africa South of the Sahara in

January, 1959, the Colonial Liaison Section is preparing a bibliography on housing and urbanisation in Africa. Papers for the Conference are being prepared on a number of subjects. The Colonial Liaison Officer is conference liaison officer for the United Kingdom territories.

*Dissemination of Technical Information*

23. *Courses and visitors.* The seventh course for architects and civil engineers in H.M. Oversea Civil Service was held at the Building Research Station in September, 1957. It was attended by some twenty officers. Technical officers from the Crown Agents also attended, as did architects from the War Office and a commercial firm with interests in Central Africa. Members of the Colonial Liaison Section again assisted with lectures at the London School of Hygiene and Tropical Medicine, the Architectural Association School's Department of Tropical Architecture and elsewhere. Visitors to the Building Research Station have included the Permanent Secretary, Kenya Ministry of Works, the Director, West African Building Research Institute, and the Chief of the Housing and Building Materials Unit, Economic Commission for Asia and the Far East.

24. *Publications.* In April, 1958, the fiftieth issue of Colonial Building Notes was published. The issue which followed was retitled: "*Overseas Building Notes. Notes on Building, Housing and Planning in Tropical and Sub-Tropical Countries*". Minor changes were also made in layout. Since the last Report eight issues of *Colonial Building Notes* and two of *Overseas Building Notes* were published:

- No. 43. Tests for building materials. The burnt-clay brick. Pitch-fibre pipes.
- No. 44. Durability of building materials in low latitudes. Durability of reinforced concrete in buildings; a recent survey.
- No. 45. Cooking and fuel economy in low-cost tropical housing.
- No. 46. Bamboo as a building material.
- No. 47. Limestone and lime for building purposes. Movement joints.
- No. 48. Low-cost housing in Barbados.
- No. 49. A school for village planning in Ghana. Town planning in Malaya. Housing progress in a number of territories.
- No. 50. Index to Colonial Building Notes No. 1-49.
- No. 51. Town and country planning in tropical and sub-tropical areas; a bibliography.
- No. 52. Climate and town planning; with special reference to tropical and sub-tropical climates.

During the year, a review of the mailing list for these Notes was made. Questionnaires were sent to recipients. Some dead wood was eliminated but the list was not shortened as several replies asked for further copies to be sent to other addresses, i.e. district offices. A number of constructive suggestions and appropriate comments were received.

25. *Other publications:*

*Atkinson, G. A.* Housing and Building in the Commonwealth. Int.R.Soc.Arts., May, 1957.

*Stevens, P. H. M.* Planning in the West Indies. Town and Country Planning, vol. 25, no. 12.

*Webb, C. G.* Natural Ventilation in Low Latitude Buildings. A Practical Index for Design Purposes. Jnl.R.Inst. British Architects, November, 1957.



## West African Building Research Institute

### *General*

26. During the early part of the year, the installation of equipment in the four buildings erected in 1956 under the Interim Scheme was completed. In May the interim establishment for the Institute was completed by the recruitment of Mr. B. G. White, A.R.I.B.A., to the post of Principal Scientific Officer.

27. Further expansion was delayed pending the outcome of negotiations on the reorganisation of Inter-territorial Research. On the attainment of independence by Ghana, the administration of the Institute was assumed by the Chief Secretary, West African Inter-Territorial Secretariat.

### *Advisory Service*

28. Government Departments, Statutory Corporations, Consultants, Contractors and Manufacturers continued to seek help from the Institute and during the year approximately 300 enquiries were dealt with. These ranged over all aspects of building and civil engineering design and construction.

29. Further work on Building Regulations was started. The Director and Principal Scientific Officer visited the regions and territories and lectures were delivered to professional Societies.

### *Liaison and International Co-operation*

30. Exchange of information has continued with 25 research organisations in all parts of the world; particularly the Colonial Liaison Section of the Building Research Station in the United Kingdom. The Director was appointed a West African Correspondent of the Inter-African Committee on Housing Research of C.C.T.A. and in this capacity represented the Institute at a meeting held at Bukavu, Belgian Congo. He also attended the joint C.C.T.A./C.S.A. meeting in Lagos held to consider "Environmental Factors Affecting Man in Africa", and the annual conference of West African Directors of Public Works at Kaduna.

### *Visitors*

31. The Institute was honoured with a visit of Mr. J. Arthur, M.P., Parliamentary Secretary, Ministry of Housing, Ghana, on 5th October, 1957. Other distinguished visitors included Dr. A. G. Forsdyke, Assistant Director, Meteorological Office, London; and Mr. J. W. Drysdale, Assistant Director, Commonwealth Experimental Building Station, Australia.

32. Five visiting scientists from the Building Research Station, Section des Recherches, Dakar, and the Colonial Termite Research Unit, spent periods at the Institute working on problems of mutual interest.

### *Research*

33. Investigations have been directed towards determining the durability of materials and the functional efficiency of buildings designed and constructed by present methods.

34. In a co-operative project with 33 manufacturers, samples of alkyd type gloss paints have been exposed at Accra for almost 12 months. The test results are being analysed by the Tropical Paint Research Fellow at the Building Research Station in the United Kingdom.

35. The resistance of West African timbers to attack by subterranean termites is being assessed by means of stake tests at Accra, Takoradi and Kumasi.

36. Work continues on the stabilisation of soils by Portland cement and has been extended to cover silicone and cationic waterproofers.

37. The factors affecting the stability of buildings founded on soils which are subject to seasonal volume change are under examination.

38. With regard to the functional efficiency of buildings, a study of the relation between indices such as dry and wet bulb temperatures, radiation, air movement, etc., and the subjective reactions of African occupants is in hand. The results for the warm dry season, October, 1956-April, 1957 indicate the following values for the Accra area :—

<i>Index</i>	<i>Lower Comfort Limit</i>	<i>Optimum</i>	<i>Upper Comfort Limit</i>
Dry Bulb Temp. °F ...	75	80	85
Corrected Effective Temp. °F ... ..	74	77.5	81

Work is also in hand on the measurement of illumination levels in local buildings.

#### B. FALKLAND ISLANDS DEPENDENCIES SURVEY

39. The number of bases operated by the Survey has remained at eleven, as although the Anvers Island base was closed on completion of the field work in that locality, Base E in Marguerite Bay has been re-opened.

40. Antarctica was one of the six areas selected for special study during the International Geophysical Year, and nine of the FIDS bases have contributed to the I.G.Y. programme. Eight of these nine bases are meteorological stations, one of them including upper air, radiation and ozone measurements in its programme.

41. Base F in the Argentine Islands has continued its work as a general geophysical station and reports satisfactory progress, although few of its detailed I.G.Y. records have yet been received in the United Kingdom. Geomagnetic elements D, H, and Z have been continuously recorded, and solar radiation measurements maintained. The seismographs and the sea level and long wave recorders are also functioning satisfactorily.

42. Auroral observations have been carried out at three bases, and "whistler" recordings have supplemented the normal ionospheric soundings at Port Lockroy.

43. Glaciology at South Georgia and on King George Island has also formed part of the United Kingdom contribution to the I.G.Y. At South Georgia, field work has shown that there is a general recession of the ice cover, and the colonisation of new ground by vegetation was investigated. Moraines indicate that this recession dates only from 30-60 years ago. Biological and geological evidence of earlier climatic fluctuations is scarce but it is probable that the last glacial maximum, which occurred at the beginning of the century, was the greatest advance for several thousand years. A collection of flowering plants and soil samples was also made during the year by the chief glaciologist.

44. It has been decided that FIDS, as the organisation responsible for British activities in the Antarctic, should now assume responsibility for the Halley Bay base which was set up by the Royal Society for operation during the I.G.Y. only. The programme of work which is similar to that at FIDS Base F, will remain substantially as at present.

45. Apart from these I.G.Y. activities, survey and geological work have been continued by sledge parties from all bases. A new departure this year, which has proved very successful, has been the use of the Survey's relief ship to transport summer field parties to localities of particular interest away from the bases. Three such parties carried out useful work on Livingston Island and Greenwich Island in the South Shetlands and on Powell Island in the South Orkneys. Further south, a Naval Hydrographic Survey party assisted by FIDS personnel worked along the coast between Port Lockroy, the Argentine Islands and Base J on the Graham Coast.

46. Research into cold acclimatisation has been continued under the direction of the Medical Research Council, and new items in the sledge ration have been tested. Field tests on a new dog pemmican have also been continued, and the data collected is now being analysed.

47. *Publications* during the year have included several sheets in the new 1/200,000 series of maps produced by the Directorate of Overseas Surveys, and the following FIDS Scientific Reports :

- No. 16. Notes on Weather Analysis in the F.I.D. Antarctica. By A. W. Mansfield and S. D. Glassey.
- No. 18 The Breeding Behaviour and Reproductive Cycle of the Weddell Seal. By A. W. Mansfield, M.A.
- No. 20. The Petrology of Graham Land, III. Metamorphic Rocks of the Trinity Peninsula Series ; by R. J. Adie, B.Sc., Ph.D.
- No. 21. Upper Jurassic and Cretaceous Amonite Faunas of Alexander Land and Graham Land. By M. K. Howarth, B.Sc., Ph.D.
- No. 22. The Introduced Reindeer of South Georgia. By W. N. Bonner.

### C. GEODETIC AND TOPOGRAPHICAL SURVEYS

#### *Staff*

48. Recruitment of qualified surveyors remained difficult but the intake of cartographic draughtsmen continued to show a big improvement. The total staff in post on 31st March, 1958, was 437, including twelve Officers and Senior Other Ranks seconded from the Royal Engineers (Survey).

#### *Geodetic Surveys*

49. The first order chain of triangulation in south-eastern Tanganyika was completed, apart from observations at three stations, and the connection across Lake Nyasa to the Nyasaland chain was observed. A first order chain to the south of Lake Victoria, linking the Arc of the 30th Meridian to the chain running along the east side of the lake, was reconnoitred and observed.

50. In Kenya, measurement of the Isiolo base line was completed and the Kenya-Tanganyika border triangulation, with the link northwards to Isiolo, was observed ; from the Isiolo base a chain westward to Kitale was reconnoitred. A first order tellurometer traverse of some four hundred miles was run along the Tana River valley between the Malindi and Isiolo bases.

51. The Uganda chain north of Lake Victoria was completed and a connection north-westwards to the Arc of the 30th Meridian was reconnoitred and partly observed.

52. A primary triangulation network was reconnoitred in the Copperbelt of Northern Rhodesia, observations being completed for the eastern part of the area.

53. In the Southern Cameroons a primary chain with connecting links to triangulation in the Eastern and Northern Regions of Nigeria was reconnoitred. Some side lengths of this triangulation have been measured by tellurometer.

54. Work continued and some progress was made in North Borneo.

#### *Minor Triangulation and Photo Control*

55. In Tanganyika control was completed for the Kilombero Valley and the area between Dar es Salaam and the Kenya border in addition to continued work in the Kilosa-Dodoma area.

56. Control was fixed by tellurometer traverses for a block of mapping in the Malindi-Lamu area of Kenya.

57. Secondary triangulation was reconnoitred and partly observed and height control was supplied for mapping the West Nile area of Uganda.

58. The establishment of secondary and height control was continued for Nyasaland between 13°S and 15°S and extended into the adjoining area of Northern Rhodesia. Control was also supplied for mapping two smaller areas further north.

59. The observation of astro-fixes in Bechuanaland and the survey of height control in Basutoland continued.

60. The establishment of minor triangulation and height control in Somaliland continued.

61. The triangulation of Dominica and St. Christopher and Nevis was completed and work was started in Montserrat.

62. Reconnaissance for triangulation of the Falkland Islands was commenced.

#### *Air Photography*

63. In the Caribbean almost complete air photo cover was obtained for Trinidad and a small amount of large scale photography was flown in British Guiana. Flying was in progress at the end of the year over the islands of New Providence, Eleuthera and Cat in the Bahama Islands.

64. Air photography received for northern Tanganyika totalled about 10,000 square miles but, of two areas planned for Kenya, only 11,000 square miles were photographed.

65. In Bechuanaland 25,000 square miles of air photography was obtained.

66. From flying which was still in progress at the end of the year 13,000 square miles of air photography of the Cameroons and 6,000 square miles of Sierra Leone have so far been received.

67. Complete air photo cover was obtained for the islands of Malta and Cyprus.

68. Sorties were flown by the Royal Air Force over Aden, North Borneo and Tanganyika.

#### *Mapping*

69. Despite an increased proportion of inexperienced personnel, mapping output has been maintained. In addition extensive use of half tone printing based on two or three colours has allowed for the maximum differentiation of detail on the face of the maps. A system for showing detail of the relief by means of a photo-mosaic has been evolved for 1:100,000 mapping of the sparsely developed Aden Protectorate.

70. Extensive blocks of mapping at 1:50,000, including many contoured sheets, were in preparation for areas of western Uganda, central Tanganyika, south-eastern Kenya and Northern Nigeria. Planimetric mapping of Sarawak and Vanua Levu (Fiji) continued, together with the preparation of contoured editions for Basutoland and Northern Rhodesia and a formlined edition for Viti Levu (Fiji). Mapping at 1:50,000 was commenced for further areas of Northern Rhodesia and Nyasaland.

71. Continued progress was made with 1:25,000 contoured maps for Malta, Mauritius, the Leeward Islands and the Windward Islands, while mapping of Cyprus reached a preparatory stage. Production of a revised edition of the Malta 1:2,500 series was commenced.

72. Mapping at 1:125,000 for eastern Bechuanaland advanced steadily and further sheets were published at 1:200,000 for the Falkland Islands Dependencies.

73. Rapid progress was made with the fully coloured Gambia Land Use series at 1:25,000, for which detailed information was prepared by the Land Use Officer.

74. Special productions included maps prepared to illustrate reports, fully coloured geological maps and a hill shaded map of Mount Kenya.

75. There was a continuing demand for print laydowns (uncontrolled mosaics of air photographs) from specialists working in unmapped areas.

76. (A full account of this work is given in the Directorate of Overseas (Geodetic and Topographical) Surveys Annual Report for the year ended 31st March, 1958.)

#### D. GEOLOGICAL SURVEYS

77. The year saw the advance to independence of Malaya and Ghana. Both territories however indicated that they would probably seek specialist assistance from the Directorate in the future. At the beginning of the year a team of geophysicists from headquarters completed a very successful survey, in association with an UNTAA engineer, of the Malayan coastal alluvium deposits in order to assist in the development of underground water supplies.

78. The number of geologists, geophysicists and chemists in the overseas territories (excluding Malaya and Ghana) was 207. About 20 vacancies still exist, most of which should be filled by recruitment at the end of the present academic year. The present numbers on the various surveys have assured a considerable expansion in geological mapping. Nor should the extremely important contribution of Geological Departments to the development of water supplies be forgotten. Assistance was also rendered in various territorial engineering schemes.

79. Several new discoveries of carbonatites have been made in the African countries. These rocks are associated with a variety of minerals of economic importance and at two localities. Sukulu (Uganda) and Mbeya (Tanganyika), companies have completed the estimation of reserves and have installed pilot plants for separation of the various fractions. The prevailing low levels of prices in the non-ferrous market however is imposing considerable difficulties on the development of these and other deposits in the Overseas Territories.

80. Very important seams of coal including semi-anthracites have been proved in Swaziland. The year was also notable for the signing of two agreements to work deposits originally discovered by Overseas Geological Surveys; the first concerned the manganese of British Guiana and the second the bauxite of Sarawak.

81. The Geological Survey of Jamaica was responsible for an investigation into the serious earthquake which occurred there on 1st March, 1957. It is hoped that it will be possible to set up a network of three seismograph stations in Jamaica which, together with those of the Windward and Leeward Islands operated from Trinidad, will give considerable coverage of earthquake and volcanic activity in the British Caribbean.

82. Two successful holes were recorded in the drilling for petroleum in the Niger delta area by commercial interests and arrangements were put in hand for the export of the supplies. It should be pointed out that some £27 million has been spent on this venture, which is a figure worth noting when the cost of Geological Surveys in the Overseas Territories is related to the discoveries they have made.

83. The Mineral Resources Division carried out extensive laboratory investigations on cement materials from Tanganyika, coal from Northern Rhodesia, phosphates from the Solomons and gypsum from Somaliland, as well as on many other rocks and minerals. An X-ray set has been installed to assist in the work.

84. Photogeological interpretation of the geology of Nigeria, Tanganyika, Borneo and Somaliland has been carried out at the section housed at Tolworth.

85. Exploration geochemistry has been increasingly applied in the various territories during the year with the co-operation and guidance of the Geochemical Research Centre at the Imperial College of Science and Technology.

86. The Director of Overseas Geological Surveys and members of his staff visited East and West African territories, the Far East, Western Pacific, Washington and Canada, in order to keep abreast of developments, give specialist help, and attend Conferences.

87. Many of the territories too were visited by members of the geological staffs of various universities, carrying out research; these countries included Sierra Leone, Uganda, the Solomons, Fiji, British Guiana, Tanganyika, Nyasaland and Northern Rhodesia.

#### *Vulcanological Research in the Caribbean*

88. The seven seismograph stations maintained by the Seismological Unit at the Imperial College of Tropical Agriculture, Trinidad, recorded 822 earthquakes during the year; 415 originated in the Eastern Caribbean and epicentres were determined for 85 of these. More than 2,000 seismograms were examined in the course of the year.

89. The pattern of seismic and volcanic activity has been normal except for a period during which an unusually large number of earthquakes occurred in the sea to the east of Guadeloupe, Dominica and Martinique.

### **E. INDUSTRIAL AND ENGINEERING RESEARCH**

#### *East Africa*

90. The new Headquarters of the East African Industrial Research Organisation were occupied in July, 1957, and the metallurgical laboratory was being completed during the year.

91. Experimental work on the mechanical drying of coffee continued. Most of this was carried out on estates, though latterly it was possible to do laboratory trials designed to elucidate how loss of quality arises when mechanical drying is used.

92. Work on ceramics was divided between glazed pottery, bricks and tiles, refractories and utilisation of meerschaum. Vitreous white ware bodies

were made from raw materials found in both Uganda and Kenya, and techniques developed for forming, firing, decorating and glazing the ware.

93. A number of chemical analyses were carried out during the year but fuel technology and chemical engineering research was delayed due to the absence of a Fuel Technologist, and metallurgical work awaited completion of the laboratory at Entebbe.

#### *Hong Kong*

94. In the Department of Civil Engineering the research programme continued on the solution of field problems by electrical analogy and using the electrolytic tank designed and built by the staff in 1956. Results of research on fields near bundle conductors, seepage of water in soils and torsion of rectangular beams have been published. Experimental work is proceeding on the behaviour of encased steel frames in the plastic range of stress and on the load-carrying capacity of pre-stressed concrete frames. Large scale frames are being manufactured in the Department and tested to destruction. During testing operations accurate strain and deflexion measurements are being recorded with a view to applying the results of these tests to the economic design of multi-storey building frames in Hong Kong.

#### *Crown Agents for Oversea Governments and Administrations*

95. The Crown Agents Engineering Advisory Service continued to give advice and assistance to oversea officers in technical matters and many visits to works have been arranged. The demand for study and training courses of up to a year or more duration has been met.

96. The Engineer-in-Chief of the Crown Agents is the Colonial Office representative on the Road, Building, Water Pollution and Hydraulic Research Boards of the Department of Scientific and Industrial Research. In addition, another senior member of the Crown Agents' staff represents the Colonial Office on the Mechanical Engineering Research Board. Although primarily for more general purposes, there is much of specifically colonial interest in the research being undertaken at the laboratories concerned.

97. The Crown Agents were represented at the World Power Conference held at Belgrade in 1957 and two members of the Crown Agents' staff attended nuclear power courses at Harwell. This is being followed up with more practical training at Calder Hall.

98. The Crown Agents manage the biannual Conferences on Standardisation of Mechanical Equipment on Overseas Railways which are attended by the Chief or Deputy Chief Mechanical Engineers of the railways concerned, and play a part in similar conferences on Standardisation of Overseas Police Equipment. They are also represented on numerous committees of the British Standards Institution which play an important part in the preparation and revision of the British Standard Specifications. The Crown Agents' own specifications for overseas engineering requirements are being revised.

### F. METEOROLOGY

99. Dr. A. G. Forsdyke followed his visit to West Africa in November, 1956, by visits to the Caribbean in May-June, 1957, and to East Africa in July, 1957. These visits were made in the course of a survey which he is conducting of the research requirements for tropical meteorology with special reference to Colonial territories. Preliminary reports on all three visits have been prepared by Dr. Forsdyke and it is expected that his comprehensive report will be available during 1958-59. The project is being undertaken in pursuance of a resolution of the 1955 Conference of Commonwealth

Meteorologists and is financed mainly from Colonial Development and Welfare funds.

100. Shortage of staff continued to hamper research work by Colonial meteorological departments and this year extra demands on available staffs were caused by participation in International Geophysical Year activities.

101. Work has continued in East Africa on the use of cetyl alcohol to reduce evaporation losses from reservoirs and lakes. The Observatory Department in Mauritius has commenced research of a similar nature.

102. An analysis of the results of experiments in artificial rainfall stimulation with rockets, conducted by the East African Meteorological Department at Tabora, Tanganyika during November-December, 1956, shows that the rockets used, modified two-inch naval flare rockets, are an efficient and accurate method of cloud-seeding and confirms that sodium chloride is a successful seeding-agent in East Africa. It appears that cumulus clouds may be induced to rain earlier and more heavily by seeding than they would do naturally and there is evidence that clouds at a certain stage of development can be induced to rain even though they are unlikely to do so without interference. A major disadvantage, apart from the expense, of these rockets is that they are not self-destructive which means they can be used only in uninhabited country or in very restricted arcs of fire. Efforts are being made to find a more practical and self-destructive rocket. The East African authorities are also investigating an allied rocket technique of hail prevention developed in Italy: hail can cause considerable damage to crops in higher farming districts in East Africa.

103. Research continued into the application of meteorology to the desert locust problem and is now being conducted by two United Nations Technical Assistance Administration Meteorologists working in collaboration with the East African Meteorological Department and the East African Desert Locust Survey. This complicated and extensive task began in 1955 and involves a detailed analysis of weather conditions covering a particularly marked period of locust activity in East and North Africa.

104. The West African Meteorological Services are examining a theory of rather fast-moving upper troughs in the atmosphere to account for short-term variations in high-level winds previously thought to be random.

105. Investigations by the Mauritius Observatory Department continued, in co-operation with the Sugar Research Institute, into the effect of rainfall on sugar production and of wind damage to sugar-cane. A paper was published by the Department on the effect of tropical cyclones on the sugar crop of the island.

106. In Hong Kong, evapotranspiration studies continued as did a long-term project to determine the effect of afforestation on the run-off of surface water by increasing condensation in foggy conditions. A re-analysis of tracks of typhoons and tropical depressions for the period 1884-1953 was completed and publication commenced.

107. The British Caribbean Meteorological Service continued to participate in the hurricane research project organised by the United States Weather Bureau. The service provides the staff for two rawinsonde stations (equipped by the Bureau) at Kingston, Jamaica, and on Grand Cayman Island which form links in an extensive international chain of such stations in the Caribbean. The programme continues into 1959.

108. A considerable number of papers were published during the year by the East African Meteorological Department on such various subjects as rainfall, rainmaking, precipitation, the reduction of evaporation and climatic



zones. Papers on wind statistics and analysis were prepared by a member of the staff of the Malayan Meteorological Service and on rainfall and tropical cyclones by staff of the Royal Observatory, Hong Kong.

109. The Falkland Islands and Dependencies Meteorological Service continued the research into the generation of electricity from wind-power referred to in the 1955-56 Report. Three years' continuous wind records for Sapper Hill, Stanley, were completed and analysed during the year and a brief report on the work sent to the British Electrical and Allied Industries Research Organisation.

### G. WATER POLLUTION RESEARCH

110. The only practical work carried out for the Colonies during the year 1957-58 was the chemical examination of a sample of water from the Falkland Islands to determine whether it was suitable for a domestic supply.

111. Advice was sent by letter to Tanganyika on equipment and methods suitable for recording the quality of river waters, and as in previous years information on the progress of work at the Laboratory was sent to a large number of Colonial correspondents. Visitors to the Laboratory included some from Malaya and Uganda.

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