IMPERIAL COLLEGE

OF SCIENCE & TECHNOLOGY

GHANA

1958

THE EXPLORATION BOARD

IMPERIAL COLLEGE

BIOLOGICAL EXPEDITION TO GHANA

1958

FINAL REPORT

Imperial College
Exploration Board

N O T E

Some years have passed since the members of this expedition were at College and it has been left to others to assemble the threads of their report. We apologise for any errors, omissions or inconsistencies in its presentation.

The report B(i) - "Physical Factors affecting pests in ships' holds during a voyage from temperate to tropical waters" by A.C. Neville has been bound previously in a separate volume entitled "Imperial College Ghana Expedition 1958 - Cargo Section".

Unfortunately, Section A(i) has been mislaid altogether.

August, 1965.

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SECTION I

GENERAL REPORT

INTRODUCTION

In 1957, the first of a series of Expeditions planned by the Royal College of Science Natural History Society and sponsored by the Imperial College Exploration Board, visited Ghana. The first expedition was followed by another in 1958. The aim of the Expeditions was threefold:

1. To carry out scientific work on problems connected with agriculture in Ghana, and with the transport of agricultural products by ship from Ghana.
2. To give the student members experience of working in tropical conditions and of organising such a trip.
3. To foster goodwill between the countries concerned.

In preparation for the second Expedition in 1958, two training expeditions were held in 1957. A party of botanists spent two weeks in North Wales whilst a Zoological party visited Oronsay in the Inner Hebrides, for about five weeks.

PREPARATIONS

In June 1957 R.F. Sturrock was invited by the Natural History Society Committee to lead the 1958 Ghana Expedition. This was confirmed by the committee on October 10th and finally endorsed by the Society at the A.G.M. on 16th October 1957. The immediate tasks were to raise funds, re-establish contact with various people in Ghana, and to

select a suitable party. To assist in these tasks a committee was formed consisting of the leader, two third year and two second year students. Second year students were included in the committee to gain experience in organising expeditions of this kind which they might be able to put to use on a future occasion.

By the middle of November 1957, letters had been sent to the Froestry Dept. of Ghana, the West African Timber Borer Research Unit (W.A.T.B.R.U.) and Messrs. African Woods Ltd., asking for assistance during the Expedition's stay in Ghana. All of these bodies agreed to help and by March 1958 were able to confirm that accommodation would be available in the Bobiri Forest Reserve, near Kumasi. Further arrangements had been made with the Dept. of Agriculture (Ghana), Soil and Land Use Survey Division (S.L.U.S.) for the provision of transport.

The size of the party was governed by financial considerations. Originally we had hoped to know what our funds would be well before Christmas 1957, thus enabling us to make a final selection of the party at an early date. However, it became necessary to choose a provisional party before the end of the Autumn Term when it was still not clear what money would be available. Application forms were circulated in the first week of December and there were eighteen replies. A short list was approved by the Natural History Society General Committee and later by the Imperial College Exploration Board.

Three main criteria governed the selection. First, the party should have balanced scientific interests; second, third year students

should have preference over lower years as this was their last chance of taking part in an Imperial College expedition; third, the maximum number of women should be two since the transport costs for a woman would be greater than for a man. (The reasons for this are explained later). Account was also taken of previous experience, extra qualifications and personality.

The short list was as follows:

A. Main Party

*	Keith Loach	- Botanist (Secretary)
	Janet Stevens	- Botanist (Quartermaster - food)
	Charles Neville	- Entomologist (In charge of ship's cargo problem)
	Jan Taylor	- Entomologist (Quartermaster - scientific stores)
*	Bob Sturrock	- Parasitologist (Leader)
*	John Webster	- Parasitologist (Treasurer and medical officer)

* Members of original committee.

B. Reserves

(i) To come if enough money raised:

John Jones	- Parasitologist (Cameraman)
Joyce Farmer	- Botanist (Quartermaster - domestic stores)

(ii) To replace any of the above should they drop out at the last minute:

Ann Holm	- Botanist
John Parnell	- Entomologist
Christopher Vyle	- Botanist

In the end, only the first seven persons listed above were able to go. This had two serious repercussions. First, we lost the valuable experience of Miss Farmer, who was the only member of the 1957 party

to apply. She had been placed lower on the list than the only other woman member, Miss Stevens, because it was considered that persons who had not already been on one Imperial College Expedition should be given first opportunity on this occasion. Secondly, Miss Stevens would consequently be the only girl, and this would undoubtedly throw some 'social' strain on the party as a whole and on her in particular. She had been warned of this possibility before applying but had nevertheless decided that she would be prepared to go.

The most exacting of the original tasks was that of raising money. An application for the adoption of the Expedition was made to the Imperial College Exploration Board in early November 1957. At a meeting on November 21st the Board approved the proposals and offered financial aid up to £500, later raised to £550. It was also agreed that members should pay a contribution, finally fixed at £30 per person. As the original estimate for the trip was £1,500, this left another £700 odd to be raised.

Early in November, support was sought from nine firms with interests in Ghana but only £5 was raised in this way. The absence of a report of the previous Expedition, lack of details of work which it was proposed to undertake in 1958, uncertainties about the composition of the party, and above all, asking for far too much money (£100) all contributed to this failure.

Since the major expenses would be the shipping fare by normal passenger liner to and from Ghana, an attempt was made to economise on this item. A contact in a private company which chartered cargo ships on the West African run offered to try to arrange passages for the men

in the party; the only charges would be for victualling. Unfortunately, the owners were unwilling to ship women in this way, so whatever happened the women members of the party would have to travel as fare-paying passengers, on the normal liner service. A recession in trade and shipping ultimately made it impossible to do more than bring four men back from Ghana by this method. Even so, this represented a saving of about £200.

Further attempt to raise money for the original programme, for extra work on Schistosomiasis and for a cine-film, all proved abortive for various reasons. It was not until March that the importance of work related to the transport of Agricultural products on ships became apparent. A report on such work undertaken by the 1957 expedition, although controversial, proved of great interest to a number of commercial organisations. In view of this interest, Neville was asked to continue the work on this Expedition. A programme was drawn up in conjunction with several authorities and negotiations began with the interested bodies. These resulted in a further £325 being offered, together with a free return passage (equivalent to about £140) for Neville.

These negotiations were not completed until the end of June when our funds stood at about £1,200. Thus we were still about £100 short of our original estimate and it was obviously necessary to limit the party to seven persons.

Despite the precarious financial situation at the time, other preparations were put in hand the moment the short list for the party was drawn up in December. Jobs were allotted to each member as

indicated above. Lists of supplies were drawn up, criticised, and amended. Various firms were contacted, mainly through the Supplies section of the College Administration, about supplying items not readily available from within the College.

The Expedition's scientific programme was arranged to satisfy the individual interests of the party. A great deal of advice was received from people with experience of conditions in Ghana, including the members of the 1957 expedition. On the whole, we limited our problems far more than the 1957 expedition, since we hoped to achieve the most useful results by concentrating our resources on particular problems. The Ministry of Agriculture, Fisheries and Food, Infestation Division, gave three members of the Expedition (Neville, Sturrock and Webster) a short course on stored product pests at Tolworth in late June. The course included a routine inspection of two ships newly arrived at London from West Africa.

The members of the party began the series of medical injections required round about Easter so as to have plenty of time to fit them all in. Jones unfortunately missed the recommended poliomyelitis injections because by the time that it was clear that he could come, there was no longer sufficient time available.

Equipment and supplies began accumulating from about the middle of May and were stored until the end of term; no stores were packed until the sailing date was known and then everyone assisted where possible and the bulk of the goods was sent by road to Liverpool, a

week before we were due to sail. Neville accompanied some special equipment which was sent by van to Liverpool on July 14th, for his work on the ship

The party assembled at Liverpool on July 16th and embarked on the M.V. Sangara which was due to sail the following morning. All the immediate difficulties had been overcome (even a dock strike had not stopped us), and we were able to relax during the voyage out to Ghana where the real work of the Expedition would begin.

MOVEMENTS OF THE VARIOUS PARTIES

When on the 16th July 1958, the members of the Expedition embarked on M.V. Sangara at South Brunswick Docks, Liverpool, Neville was already aboard preparing for his work on insect infestation in the ship's holds. We sailed at 10.30 a.m. the following morning. It was one of Liverpool's brighter days with a calm sea and clear sun. By the afternoon, we had unpacked the scientific equipment needed for the work aboard ship and established ourselves in a small room on the upper deck, which was to serve as our laboratory. Neville directed operations in the ship's holds from this room and we soon had temperature and humidity recording apparatus set up in four of the holds. The next few days were spent in coaxing the instruments into proper working order, playing deck games, sunbathing, and on the stormier days being sea-sick.

Our immediate call at Las Palmas for bunkers and Spanish onions was preceded by the celebration of Neville's 21st birthday in the appropriate fashion. We spent four hours ashore at Las Palmas on 23rd July and the party split up to tour the town and parts of the island. Back aboard and on our way again, we continued with work in the holds, making counts of insect pests present in the waste left from previous cargoes and becoming more familiar with the use of the instruments. At the end of the outward voyage we had collected data of the physical conditions in the holds and Neville was ready to begin the bulk of this work on the return trip.

On July 31st we disembarked at Takoradi and were met by Mr. J. Wheelan, Chief Conservator of forests i/c Western Region. Passage through Customs proved to be a lengthy process but we eventually came out quite well as regards payment of duty. After a pleasant two days' stay in Takoradi Government Transit Quarters we were able to travel north by train from Sekondi to Kumasi. Here we were met by Mr. G. Ellis and Mr. H. Brammer who organised our transport out to the Bobiri Forest Reserve three days later on July 5th. We were soon unpacked and settled in the two huts, one belonging to the Forestry Department and the other to African Woods Ltd.

Mr. Tecwyn Jones of W.A.T.B.R.U. and Mr. Dinning, silviculturalist in the Forestry Department, came to the Reserve to see us, bringing with them Awuni, a steward, who, together with

Gambilla, the cook already with us, and Adongo our 'small boy' - engaged later, made up our complement of local labour.

Work on the Reserve began by finding the transect marked out by last year's Expedition and many of our subsequent studies were carried out on or near this area. The Entomologists, who had been collecting literally since stepping off the "Sangara", soon amassed a large and varied collection of insects. Jones began to make his film of the Expedition, and his fellow parasitologists busied themselves examining the insides of bats, rats, mice, snakes, gigantic frogs, lizards and two pangolins. The botanists made frequent trips to the laboratories at Kwadaso to plate out micro-organisms from soil samples. (A fuller account of the work carried out is given elsewhere in this report.) On August 9th, Webster and Sturrock travelled down to the West African Cocoa Research Institute (W.A.C.R.I.) at Tafo and met Dr. Johnson with whom they arranged to perform an experiment on Nematode populations in covered and partly covered soils. On Tuesday 19th August, Miss Stevens visited the Forestry School at Sunyani while Sturrock and Webster collected snails at Kumasi Reservoir, where they were also shown over the complex filter system. The weekend beginning 23rd August was spent in Kumasi and the party split into four groups to stay at the homes of Messrs. Ellis, Brammer, Jones and Dinning. On the Sunday, Neville, Sturrock and Loach were taken by Mr. Brammer on a trip up north through Mampong, Ejura, Kintampo

and Wenchai into the Savannah, whilst the others visited Kumasi Zoo.

On 2nd September a dinner was organised in the Reserve to which we invited all those members of the Departments of Forestry and Agriculture who had been so helpful to us during our stay. It was a most satisfactory occasion from all points of view. We were all much relieved to hear from British Aluminium Company about return passages on their chartered ships and so on September 7th packing operations commenced and experiments were brought to a close. Two days later, Neville left so that he could check his apparatus on board the M.V. Sangara as she loaded for the return journey at Takoradi. In the afternoon the rest of the party went on their last ride in the lorry to Savannah country on the Ejura scarp.

On Thursday, September 11th, Miss Stevens, Jones, Taylor and Loach left for Takoradi. On the Friday, Taylor and Loach boarded the s.s. Katia Banck, a Swedish ship, which sailed for Burnt Island, Scotland the next morning, arriving 18 days later on October 1st. Miss Stevens, Jones and Neville embarked on the M.V. Sangara on September 13th, but did not sail until September 16th. After calling in at Freetown, Dakar and Bathurst, Miss Stevens and Jones left her at Avonmouth on October 5th, while Neville continued to Liverpool to supervise the unloading of his instruments.

The rest of the party safely on their way home, Webster and Sturrock returned to the Bobiri Forest where they finished packing the Expedition stores. On Saturday, September 13th, they moved into Kumasi, payed off the steward and small boy, and deposited all the equipment they would not need during the following week.

The next day, they and the cook moved 300 miles to Wa, in the Northern Territories, travelling in a S.L.U.S. 3 ton Bedford truck on its way to relieve a field unit in that area. During the short stay there they carried out a quick search for certain aquatic snails that might be potential schistosome carriers. In addition they were shown over a Medical Health Field Unit.

After spending the next weekend in Kumasi, they began moving down to Takoradi, staying two days on the way at Prestea where they were shown round the Ariston Gold Mines (1929) Ltd. On their arrival at Takoradi on September 25th it was found that the ship, another ore carrier, had been delayed. However, they were shown some new fumigation techniques and also taken to Accra by the Ghana Cocoa Marketing Board before finally embarking on the s.s. Tynemouth and sailing on October 1st. 18 days later they landed at Gravesene, after a very comfortable trip. Their arrival in London marked the end of the Expedition.

SCIENTIFIC REPORTS

The following lines of investigation were attempted. Where possible

the problems chosen were related to the main topic, the breakdown of leaf litter. Further details are given in Section II of this Report.

A. BOTANICAL WORK

The work, which was carried out by K. Loach and Miss J. Stevens, falls under three headings:

(i) An investigation of the moisture content of the wood of standing trees producing commercially valuable timber. This work, undertaken at the suggestion of Mr. Levy, consisted of taking a series of standard increment borings from the boles of trees and determining the moisture content of the wood cores thus obtained. Ten species were investigated.

(ii) This second line of work had two sub-divisions:

(a) A measurement of the rate of disappearnace of leaf litter from the forest floor in three contrasted sites using the method devised by Bocock and Gilbert, i.e. a weighed amount of leaf litter was placed in nylon hair nets which were distributed over the forest floor in each of the three

sites. At the end of our stay the nets were reweighed and thus a comparison of the rates of leaf litter disappearance in the three sites was obtained.

(b) Environment factors that have bearing on the rate of breakdown of leaf litter were investigated. These included measurement of the rate of leaf fall, soil pH, soil moisture content, temperature in the litter layers, and counts of soil fungi and bacteria done on three types of Oxoid nutrient media. Valuable assistance and facilities were obtained from S.L.U.S. and the Specialist Divisions of the Ghana Department of Agriculture. This work was a continuation and extension of that carried out by the 1957 Ghana Expedition.

(iii) A species list of an area completely cleared of vegetation by last year's expedition was prepared in connection with studies of forest regeneration.

B. ENTOMOLOGICAL WORK

The entomological work for which A.C. Neville and J. Taylor were responsible, consisted of two parts. First, a continuation of Matthew's investigation (Ghana Expedition, 1957), of the physical factors affecting

insect pests in ships' holds; this was carried out by Neville, assisted by the other members of the party, and has been published as a separate report.

On arrival in Ghana, entomologists made extensive collections comprising most orders of insects, especially butterflies and dragonflies. This material is being identified and lists compiled for the Bobiri Forest Reserve district. Scientific work also included studies of gregarious behaviour in ants and mound structure of termites.

C. PARASITOLOGICAL WORK

Between them, the parasitologists handled a considerable amount of the administration. Consequently they tended to work independently, co-operating only as time permitted.

J. Jones

Although undertaking some general collecting the principle task was to obtain a cine-film record of the Expedition. This was done using a 16 mm. Bell-Howell cine-camera and Kodachrome colour film. The almost continuous cover of cloud considerably limited the time for filming and created several technical problems.

R.F. Sturrock

(a) An attempt was made to find the effect of exposure to sunlight on the populations of nematodes in the soil. Varying degrees of exposure were obtained with aluminium screens over a denuded area of the clearing (see Botanical Work iii). Samples were collected daily and the nematodes extracted for preservation by the Baermann technique.

(b) Collection of aquatic snails for Dr. C.A. Wright of the British Museum to indicate the distribution of potential Bitharzia carriers.

(c) Collection of earthworms.

(d) General collecting of parasites from any animals that could be obtained.

J.M. Webster

(a) A quantitative examination was made of the leaf litter and soil for free-living nematodes. The same areas were investigated as those used by the botanists and so it is hoped that some correlation will be shown between the action of the fungi, bacteria and nematodes in the break-down of the leaf litter.

(b) Some time was spent assisting in making the collection of snails for the British Museum.

(c) A general collection of parasites was made from small mammals, reptiles and amphibia.

TREASURER'S REPORT

The Expedition Treasurer acted as a liaison officer between the Expedition and the Exploration Board Treasurer, Mr. F.W.G. Annas and also kept an account of the cash handled by the Expedition.

All major expenses incurred in England were paid directly by the Exploration Board from the Expedition funds, but an imprest of £10 was made available to cover petty expenses until our arrival in Ghana.

Before leaving for Ghana arrangements were made through the Exploration Board for the insurance of the members of the Expedition against accident and disease, and also for the insurance of equipment and certain personal baggage. Further, arrangements were made for the transference of £300 to the Bank of West Africa in Kumasi. Here a joint account was opened for the Expedition in the names of R.F. Sturrock and J.M. Webster.

There follows an abridged statement of the accounts.

INCOME	£	s.	d.	£	s.	d.
Exploration Board Grant				500	0	0
Personal Contributions 7 at £30				210	0	0
* Receipts from Organisations outside the College						
F. Hills and Sons	5	0	0			
L. Rose and Co.	10	10	0			
Ghana Cocoa Marketing Board	50	0	0			
Cocoa, Chocolate and Confectionary Alliance	150	0	0			
Unilever	50	0	0			
Nigerian Produce Marketing Co.	75	0	0	340	10	0
				£1,050	10	0

EXPENDITURE						
Transport	560	7	8			
Photography etc.,	23	7	4			
Food	66	5	2			
Expenses in Ghana and Transfer costs	271	0	5	921	0	7
Allowance for payment of return fares	95	0	0			
Allowance for cost of report and film	35	0	0	130	0	0
				£1,051	0	7
Cash in hand				2	0	0
				£1,049	0	7

	£	s.	d.
Receipts	1,050	10	0
Expenses	1,049	0	7
Balance	£1	9	5d.

*Elder Dempster Lines Ltd., provided one free return passage valued at £140.

HEALTH CONSIDERATIONS

Tropical conditions necessitate special precuations against disease, besides the normal medical supplies required by any expedition. The Ministry of Health informed us that vaccination against smallpox and innoculation against Yellow Fever were essential, and those against cholera, typhoid and tetanus were recommended though not compulsory.

In the light of present conditions in Ghana it was decided to have vaccinations against poliomyelitis. The London School of Hygiene and Tropical Medicine was approached and the vaccine eventually obtained through the Commonwealth Relations Office.

As prophylactic treatment for malaria, four members of the party used Paludrin and three Chloroquine Phosphate.

Our health in Ghana was quite satisfactory until the last fortnight in the forest. From then until the time of leaving, some members suffered from attacks of diarrhoea lasting from two or four days. Anti-acid and astringent tablets appeared to cure it. There was no real suggestion of dysentry, but in some cases a dose of Sulphurmethazine was taken as a precaution.

Taylor began to suffer from continual abdominal pains in the stomach region which did not respond to the above treatment. Eventually he visited Kumasi Central Hospital, but the diagnosis of worms or liverfluke was dubious. On arrival in England, he was found to have a Duodenal Ulcer. All members of the party were advised on their return, to have a thorough check-up at the London School of Hygiene and Tropical Medicine.

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ACKNOWLEDGEMENTS

The Expedition is indebted to the following for their help, without which the whole venture would have been impossible.

A. For Advice on all matters:

The Imperial College Exploration Board, especially Mr. E. Fairhurst, Prof. H.R. Hewer and Mr. P.F. Taylor.
The members of the 1957 Ghana Expedition.

B. For Special Advice, Assistance and Facilities:

Messrs Africa Woods Ltd.,
Mr. F.W.G. Annas of the Imperial College Finance Department.
The British Museum (Natural History) especially Dr. C.A. Wright.
The Forestry Dept. of Ghana, especially Mr. J.G. Ellis and Mr. J. Wheelan.
Miss Falkingham of the Imperial College Supplies Dept.
Imperial College Botany and Zoology Departments especially Dr. W.F. Jepson and Mr. J. Levy.
Dr. C.D. Johnson of the West African Cocoa Research Institute.
Mr. T. Jones of the West African Timber Borer Research Unit.
The Ministry of Agriculture, Fisheries and Food (Infestation Division) at Tolworth and Liverpool.
The Nature Conservancy.
The Pest Infestation Laboratory (Slough) D.S.I.R.
Mr. J. Rawnsley of the Ghana Cocoa Marketing Board.
The Agriculture Dept. Ghana (Soil and Land Use Survey Div.) especially Mr. H. Brammer.
Mr. Woodall of the London School of Hygiene and Tropical Medicine.

Special mention must be made of Dr. W.F. Jepson, whose timely encouragement undoubtedly prevented the failure of the Expedition; and of Mr. Tecwyn Jones and his wife who looked after us so admirably during our stay in Ghana. There are obviously many other people whom we cannot mention by name, whose parts, though small, ensured the success of the Expedition and to whom we are extremely grateful.

C. For Financial Aid

F. Hills and Sons.
L. Rose and Co. Ltd.,
Ghana Marketing Cocoa Board.
Cocoa, Chocolate and Confectionary Alliance.
Unilever.
Nigerian Produce Marketing Co. Ltd.,

D. Transport

The Burnett Steamship Co. Ltd.,
Elder Dempster Lines Ltd.,
Mr. Kennedy of the British Aluminium Co. Ltd.,
The Liverpool Warehousing Co. Ltd.,

E. Supplies of Food:- (free of charge or at reduced prices)

Batchelors Peas Ltd.,
Carr and Co. Ltd.,
Cerebos Ltd.,
Chivers and Sons Ltd.,
Huntley and Palmer Ltd.,
Anglo-Swiss Food Products Ltd.,
Machonochie Bros. Ltd.,
Mazawattee Tea Co. Ltd.,
Mc.Dougalls Ltd.,
Ministry of Agriculture, Fisheries and Food (Aberdeen)
James Pascall Ltd.,
Quaker Oats Ltd.,
Scotts Porridge Oats Ltd.,
Tate and Lyle Ltd.,
A Wander Ltd.,

F. General Supplies:-

J. Bibby and Sons Ltd.,
British Visqueen Ltd.,
Cellon Ltd.,
Kodak Ltd.,
Marks and Spencer Ltd.,
Oxo Ltd.,
Paper Goods Manufacturing Co. Ltd.,
Rolex Paper Co. Ltd.,
Vidor Ltd.,
Windsor and Newton Ltd.,

G. Medical Supplies:-

Boots Pure Drug Co. Ltd.,)
Pharmaceutical Division I.C.I.) Medical Stores
Messrs Allen and Hanburys - anti-snakebite serum and syringes.

SECTION II

SCIENTIFIC REPORT

A. BOTANICAL WORK

K. Loach and Miss J.L. Stevens

A.(i) MOISTURE CONTENT OF STANDING TIMBER

This Section has unfortunately been mislaid.

A(ii) STUDIES ON THE DISAPPEARANCE OF LEAF LITTER IN A TROPICAL FOREST AND ITS RELATION TO ENVIRONMENT

Introduction

The Bobiri Forest Reserve, where these studies were made lies 26 miles to the east of Kumasi in the Ashanti region of Ghana. The forest has been described as being of the moist semi-deciduous type, the dominant trees of the upper storey being members of the Sterculiaceae (e.g. Tripolochiton scleroxylon, Mansonia altissima), Meliaceae (e.g. Entandophragma sp., Khaya ivorensis) and Celtis spp.

There are two main rainy seasons in the year, with peaks in May-June and September-October, separated usually by a dry spell. The time of our visit (5th July 1958 to 10th September 1958) coincided with the beginning of the second rainy season but the weather was abnormally dry and this should be borne in mind in considering our results.

Outline of the experiments

The investigation consisted of 2 main parts:- (a) The measurement of the rate of disappearance of leaf litter in three contrasted sites in the forest, and (b) The measurement of environmental factors which it was thought might have a bearing on the rate of disappearance of the leaf litter. These included:

(a) Counts of soil micro-organisms
(b) Soil temperature
(c) pH of the uppermost layers of the soil (top $1\frac{1}{2}$")
(d) Soil moisture content
(e) The rate of leaf fall.

Counts of the insect fauna of the soil were carried out by Miss Peterson of the 1957 Expedition. Mr. J. Webster extracted and made counts of the nematode population of the soil and leaf litter but his results are not available at the time of writing and will be given in a separate report. Earthworms are obvious contributory factors to the disappearance of leaf litter but unfortunately time did not permit a thorough investigation of their occurrence. Our few attempts to make counts will be mentioned briefly later.

The Experimental Areas

The sites chosen lay on a transect previously mapped by the 1957 Expedition and running from an area of Raphia Swamp alongside a stream passing through the Reserve, up the bank of the stream to an area of High forest at the top. Three areas, each approximately 16 sq.m. were marked out, one at the bottom of the slope in the Raphia swamp, another in the High forest at the top of the slope and the third halfway down the slope. The distance between the former two areas was just over 1,100 ft. The plants in each area were identified and maps made showing their distribution.

Experimental Procedure

(a) Measurement of the rate of disappearance of leaf litter

The method used was that devised by Bocock and Gilbert (of the Nature Conservancy). Newly fallen leaves were collected from each of the three chosen experimental areas and left to dry at room temperature. Their final moisture content was determined by drying a large weighed amount of each of the three lots of litter in an oven at 105°C, and then reweighing. Ten room dry samples of each of the 3 types of litter (30 samples in all) were weighed and placed separately in nylon hairnets. These room dry weights could be converted to oven dry weights by using a factor derived from the oven dried

samples. The nets were closed up with nylon thread and taken into the field where they were deposited at random in their appropriate areas, (8th August). They were fastened together with the thread to facilitate recovery, and were then left undisturbed until the last week of our stay. On September 5th the hairnet samples were collected and individually dried (in a 105°C oven) and reweighed. The amount of leaf litter that disappeared could then be expressed as a percentage of the approximate original dry weight. (see Table 1).

(b) Measurement of environmental factors

Soil micro-organism counts

The plate count technique was used. The original plan to use 3 types of nutrient agar medium, 3 dilutions of soil suspension and to separate the anaerobic organisms form the aerobic (by enclosing one set of plates in a sealed tin with alkaline pyrogallol), and the sporing bacteria from the non-sporers (by heating the suspension to 80°C for 10 mins. and then replating) had to be modified since the Laboratories were at an inconvenient distance from the Reserve. The simplified design was as follows:

3 types of agar were used:

Wort Agar; for Yeasts and Moulds
Czapek's Agar; for Moulds
Plate Count Agar; for Bacteria and Actinomycetes

2 dilutions of soil suspension:

0.5g. soil per litre Ringer's Solution
0.25g. " " " " "

and the counts made were simple aerobic counts, the plates being incubated at 22°C.

It should be pointed out here that the results shown in the tables were derived from only four separate experiments and in work of this nature many

more would be needed to establish truly representative counts. However the data do roughly serve to indicate the relative numbers of micro-organisms in each of the three areas.

Soil Temperature

Maximum - minimum thermometers, with their bulbs buried in the topmost layers of the soil, were used. Readings were taken twice daily (at 8.30 a.m. and 5.30 p.m.) and thus the temperature range during the day and the night was obtained.

Soil pH

Determined in the laboratory by pH meter.

Moisture content of soil

Determined by drying samples in a 105°C oven and finding their loss in weight.

Leaf fall

As part of a different experiment squares of wire netting supported at a height of 9" above the ground were set up in each of the 3 areas. The leaves falling on this netting were collected and weighed.

Results - See Table 1

Discussion

During the one month experimental period, the hairnets in the 3 areas had lost on average, approximately 23% of the initial dry weight of leaf litter they had contained. Bocock and Gilbert using the same hairnet technique in this country, but placing 5 different sorts of litter in 3 wooded areas over contrasted soil types, obtained similar figures on two of their sites,

i.e. on a mo.er and on a peat soil, the average loss in dry weight of the 5 different sorts of litter, was approximately 20-25%. Over the third soil type - a rich mull - the average loss in dry weight was just above 50%. Their experimental period however was six times as long as ours (almost 6 months). Direct comparisons of this kind, since there are so many different factors not taken into account, can be dangerous, but the figures quoted above illustrate sufficiently clearly the fact that the rate of disappearance of leaf litter in a Tropical forest such as the Bobiri forest Reserve is far greater than that in Temperate woodlands, such as those of this country. This has been long appreciated.

Counts of micro-organisms vary a great deal according to the experimental technique used and even in the same area using the same technique, there is considerable variation in numbers with time. Table 2, gives a selection of bacterial counts made in various places using plate count techniques.

TABLE 1

AREA	Disappearance of leaf litter (see footnote)	MICRO-ORGANISM COUNT (Per GM air dry soil)					SOIL pH
		BACTERIA x 10^6	MOULD FUNGI x 10		YEASTS x 10^3	ACTINO-MYCETES x 10^4	
			Wort Agar	Czapek's Agar			
TOP FOREST	23.7%	3.82	1.02	2.03	12.2	4.98	5.3
MIDDLE FOREST	26.9%	1.18	0.47	0.61	32.1	2.0	6.2
RAPHIA SWAMP	18.3%	1.20	0.25	0.52	16.9	1.5	5.0

The disappearance of leaf litter is given as the mean loss in dry weight over the experimental period (1 month) expressed as a percentage of the approximate initial over dry weight.

AREA	SOIL TEMPERATURE ($^\circ$F - MEANS)									SOIL MOISTURE CONTENT %	LEAF FALL PER SQUARE FT.	
	RANGE			MAXIMUM			MINIMUM				WEIGHT	NUMBER
	D.	N	O	D	N	O	D	N	O			
TOP FOREST	4.0	3.8	5.0	73.6	72.4	73.6	69.6	68.6	68.6	17.90	8.17g.	25.2
MIDDLE FOREST	3.5	3.3	5.1	72.9	7.18	73.2	69.4	68.5	68.1	17.66	11.17g.	66.5
RAPHIA SWAMP	5.6	4.6	6.8	75.1	73.2	75.1	69.5	68.6	68.3	23.15	4.49g.	39.7

Soil Temperature D = Daytime (8.0a.m. - 5.0.p.m.)
N = Night (5.0.p.m.-8.0. a.m.)
O = Overall (i.e. over 24 hours)

Range = Max - Min
e.g. Day (d) = Day Max. -Day. Min. etc.

TABLE 2

SITE	Bacteria per GM. soil (x 10^6)	Source of data
Average fertile agricultural soil in this country	15.0	Burges[3]
Rothamsted fields - Barnfield (treated with farmyard manure)	28.86	Russell[4]
Rothamsted fields - Park Grass (treated with farmyard manure)	2.25	
Dune Heath (Newburgh, Scotland)	0.13	Webley Eastwood and Gimmingham (from Russell[4])
Dune pasture " "	2.23	
Virgin tundra	2.0	Calculated from date of Mishutin given in Burge(3) (approx. only)
Virgin forest meadow	0.97	
Virgin Meadow steppe and Steppe	2.3	
Virgin Desert steppe and Desert	2.8	

Allowing for the variation mentioned above it remains apparent that contrary to what might be expected in view of the rapid rate of disappearance of leaf litter, our counts do not reveal unusually high numbers of bacteria in the top $1\frac{1}{2}$" of the soil. It must be borne in mind however that our bacterial counts were made on only one type of medium, (Plate count agar). Counts of fungi as revealed using Wort and Czapek Dox media, and of actinomycetes (plate count agar), again failed to show unusually high numbers of these organisms.

Mishutin has compared the proportions of fungi, bacteria and actinomycetes constituting the total micro-organism population in different soil types ranging in geographical position from the Arctic to the equator. The most striking feature of his results is the increase in number and proportion of actinomycetes as one passes from arctic soils southwards, e.g. from 1.4% of total micro-organism population (Tundra) to as much as 36.1% (Desert steppe and Desert) nearer the equator. In our counts on Plate count agar, the proportion of actinomycetes was small, never exceeding 2% of the bacterial population.

Comparing now the rates of disappearance of leaf litter in the three experimental areas, we see that the litter disappeared less quickly in the Raphia swamp area than in the other two, and micro-organism counts in this area were smallest. If the number of micro-organisms present were the dominant factor influencing the rate of disappearance of litter, we should expect the order of the counts to correspond to the order of the rapidity of disappearance of litter, (i.e. fastest rate with biggest count). It must be remembered however that not all micro-organisms present are concerned with litter breakdown and there is no such correspondence. The top forest area gave relatively large counts of micro-organisms but the rate of disappearance of litter in the middle forest area was greater. Other factors must be of importance. As previously mentioned, counts of the insect fauna of the soil were made by Miss J. Peterson of the 1957 Expedition but they proved to be surprisingly small and it seems likely that other litter feeding invertebrates play a large part. Earthworms are the obvious suggestion.

The soil in the middle and top forest areas was covered by worm casts but there was little evidence of any extensive earthworm activity in the Raphia swamp. We attempted to perform earthworm counts by sifting through soil dug up from 18" squares in the top and middle forest areas. Only a few very small earthworms were found in the top 18" of soil. It would seem that the majority of earthworms in the soil are deep burrowers. Time did not allow a thorough investigation of their population. Other invertebrates e.g. snails, may be active.

Bocock and Gilbert have shown that different types of leaf litter placed on the same site disappear at quite different rates. This is due in part to the different leaf sizes, the smaller leaves being more easily removed from the net, but also to the different composition of the leaves themselves e.g. leaves with a great deal of woody tissue are more resistant to breakdown than less woody leaves. When the number/weight ratio (see leaf fall column of Table 1) is large, leaf size is small. Hence average leaf sizes in the different areas are in the order top forest, middle forest, Raphia swamp. Since the leaves of the sqamp region are smallest, our figure for the rate of disappearance of litter in this region is most likely to be an over-estimate in relation to the figures for the other two areas. It is perhaps true to say that on the whole the larger leaves have a smaller proportion of woody tissue, (i.e. a greater proportion of the soft tissues of the lamina in comparison with the woody tissues of vein and petiole), than have small leaves. If this is so then we should expect the leaves in the top area to undergo breakdown more readily and it is tempting to suggest that this may account in part for the large numbers of micro-organisms in that area. Such reasoning however seems open to question.

Bocock and Gilbert investigated rates disappearance of litter on soils of widely different pH and found that it was very slow on soils of low pH and rapid on more alkaline soils. In our results the order of rapidity of disappearance follows that of increasing pH (see Table 1), but since differences in pH between the three areas are small this probably has little significance in relation to breakdown or the constituent members of the micro-organism population.

Soil moisture content is of importance as regards numbers of aerobic soil micro-organisms. These should be relatively less frequent in wet soils. The total number of micro-organisms is in fact at a minimum in the Raphia swamp area, though not so different from that in the middle forest area in spite of quite different soil moisture content. If we had been able to carry out our original plan to separate anerobic bacteria from aerobic the results might have been interesting from this point of view.

Soil temperature is very constant though day temperatures are nearly always a little higher than night temperatures. The areas with the most even temperatures (middle and top) had greatest numbers of micro-organisms but the significance of this is again doubtful.

ACKNOWLEDGEMENTS

We are very grateful to the Soil and Land Use Survey, and Plant Pathology (Specialist) Divisions of the Department of Agriculture, Ghana, without whose help none of this work would have been possible. We are also grateful to the Forestry Department, Herbarium, Kumasi, and to the Bobiri Forest Rangers for

their help with plant identifications; to the Oxoid Divisions of Oxo Ltd., who provided us with advice and the media for the micro-organism counts, and to numerous members of Imperial College staff and the Native Conservancy, Grange-over-Sands for advice and encouragement. The Imperial College Exploration Board gave immense support to our Expedition on all occasions.

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J.L. Stevens
K. Loach.

A(iii) LIST OF SPECIES FROM A CLEARED FOREST AREA

The 1957 Imperial College Ghana Expedition completely cleared an area in the forest (alongside the transect where our leaf litter studies were carried out), so that regeneration studies could be made by subsequent expeditions.

The list below includes the plants we found in the area after one year's growth. The list is not exhaustive and doubtful identifications are indicated by a question mark.

Aframomum sceptrum
Piper umbellatum
Triplochiton sclerozylon
Discoglypremna caloneura
Marantochloa flexuosa
Eulophia sp.
Microglossa volubilis
Solanum torvum
Tristemma coronatum
Pollia condensata
Urera cuneata
Mormodica charantia
Adenia lobata
Adenia cissampeloides
Leea guineensis
Imphalogonus nigritanus
Mikania carteri
Mormodica foetida
Leptaspis cochleata
Pteris acanthoneura
Nephrolepis sp ?
Tectaria angelicifolia
Dryopteris quadrangularis ?
Cyclosorus quadrangularis

The identifications were made with the help of the Forestry Department Herbarium, Kumasi.

B. ENTOMOLOGICAL WORK

B.(i) PHYSICAL FACTORS AFFECTING PESTS IN SHIPS' HOLDS DURING A VOYAGE FROM TEMPERATE TO TROPICAL WATERS

A.C. Neville.

This Report has been bound as a separate volumn entitled "Imperial College Ghana Expedition, 1958 - Cargo Section."

B(ii) COLLECTION OF INSECTS

(a) A.C. Neville. The dragonfly material was used as material for a Ph.D. project at Imperial College. The remainder of the collection is being held for identification purposes*

(b) J.C. Taylor. The entire collection was submitted to the British Museum where it was pooled with that of the 1959 Expedition. The two collections are being dealt with by the Museum experts.

* Dr. Neville may be contacted through the Royal Entomological Society.

C. PARASITOLOGICAL WORK

C(i)a. NOTES ON OCCURRENCE AND DISTRIBUTION OF SOME AQUATIC SNAILS

R.F. Sturrock

Introduction

The following work formed part of the 1958 Imperial College Biological Expedition to Ghana. It was undertaken at the suggestion of Dr. C. Wright of the British Museum (Natural History). The object was to collect aquatic snails, especially possible vectors of Bilharzia, in order to provide Dr. Wright with a representative collection from the area. It was also hoped to obtain some specimens of Bulinus senegalensis, but in fact none were found.

Methods

At the various sites visited, the mud, the vegetation, any sticks or stones, and the moist bases of the banks were all inspected for snails. These were taken back to base, washed and narcotised by placing them in a closed container, three-quarters full of water together with a few crystals of menthol. The degree of relaxation varied with the species of snail, being least successful in the larger operculates. Fixation was effected by dropping the narcotised snails in three times their volume of 70% alcohol, and changing this about 24 hours later before final storage.

Sites

During the seven weeks the expedition was active in Ghana, eight sites were visited. For the first six weeks the base was the Bobiri Forest Reserve near Kumasi in Ashanti, and local sites were examined in addition to one at -

nearby village, Kubeasi. Special trips were also made to Tafo in the Eastern Region, Owabi (Kumasi) Resevoir in Ashanti, and, whilst on a reconnaisance journey to the edge of the Northern Territories, to Fullers Falls (near Kintampo) and Bamboi, both being in Ashanti and just south of the Black Volta. In the seventh week a special trek was made to Wa in the North-western part of the Northern Territories, revisiting Bamboi and exploring two sites close to Wa, besides another at Buka near the Black Volta on the border with the Ivory Coast.

Individual Site Data

A. Kubeasi: The details of the site are shown in Fig. 1. It was visited on the 9th, 14th and 22nd August, and the 1st September. Snails were most abundant in the region B-E, less so in A-B and absent from the drinking-water pond except at the entrance. Four species were found: (a) Physa waterlotti (Germain), (b) Bulinus forskalii (Ehrenburg), (c) Lanistes libyous (Morelet), and (d) Potadorma freethi Gray.

P. waterlotti was the most common, moving actively on the water surface, and on vegetation. B. forskalii was only found once, on September 1st. when two specimens were taken from a submerged water lily stem. Both L.libyous and P.freethi were scattered over the mud all along the stream.

B. Bobiri Reserve: Fig. II shows the details of the site. A slow trickle draining a swamp, was culverted under a track and formed two small pools 3-6 feet across and up to 3 feet deep, containing very little vegetation. The site was visited on August 9th, when several snails subsequently identified as Lanistes libycus (Morelet) were collected from both pools. No snails were found in the swamp and further visits to the whole site failed to reveal any other species.

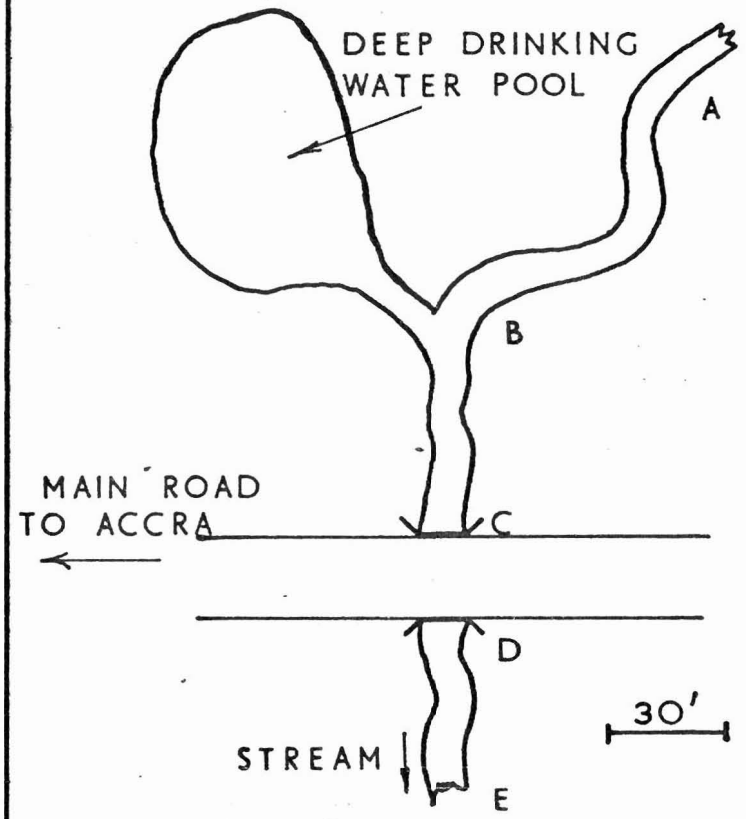

FIG.I. KUBEASI.

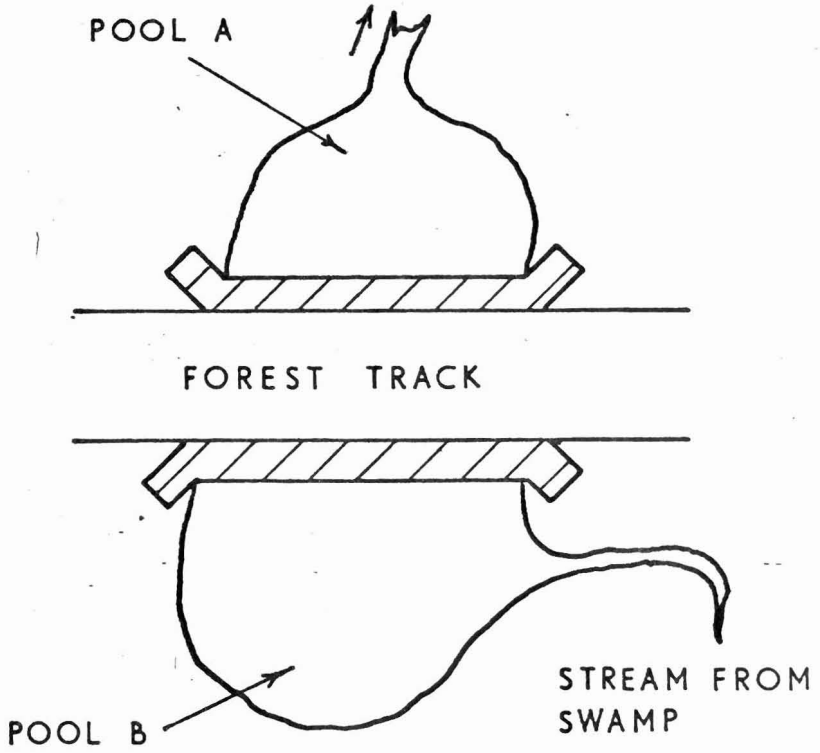

FIG.II. BOBIRI RESERVE

C. Tafo Reserve

Fig. III shows the details of the site. It was visited on August 9th, and snails collected from areas A, B and C. The feed stream was deep, slow moving, about 20 feet across, with steep earthen sides, containing little vegetation but with an algal scum on the surface. The piles of a wooden bridge and some stones near the bank yielded a few snails.

On the reservoir side of the dam the banks were of earth, shelving quite steeply. Snails were present on the mud and on large stones. Below the dam, the stream flowed rapidly over a rocky bottom. The rocks however provided many sheltered and almost stagnant pools. The following species were found: (a) P. waterlotti, (b) B. forskalii, (c) Pila africana (von Martens), (d) L. libyous.

While P. africana and L. libyous were present in all three areas, P. waterlotti and B. forskalii only occurred in area C), the snails being found in crevices in the rocks, bordering sheltered pools rather than in the fast-flowing mainstream.

D. Owabi (Kumasi) Reservoir:

Fig. IV shows the details of the site. It was visited on August 19th. and the whole day spent examining it. Collections were taken from three areas A. B and C.

Area A, the overspill stream, was fast flowing but as at Tafo, contained many boulders and rocks that gave sheltered, often almost stagnant pools. In these there was a detritus mud of rotting algae and other vegetation, which in some places formed banks above the water level. A few empty shells were present on this mud but the majority of the snails abundant on it and the rocks

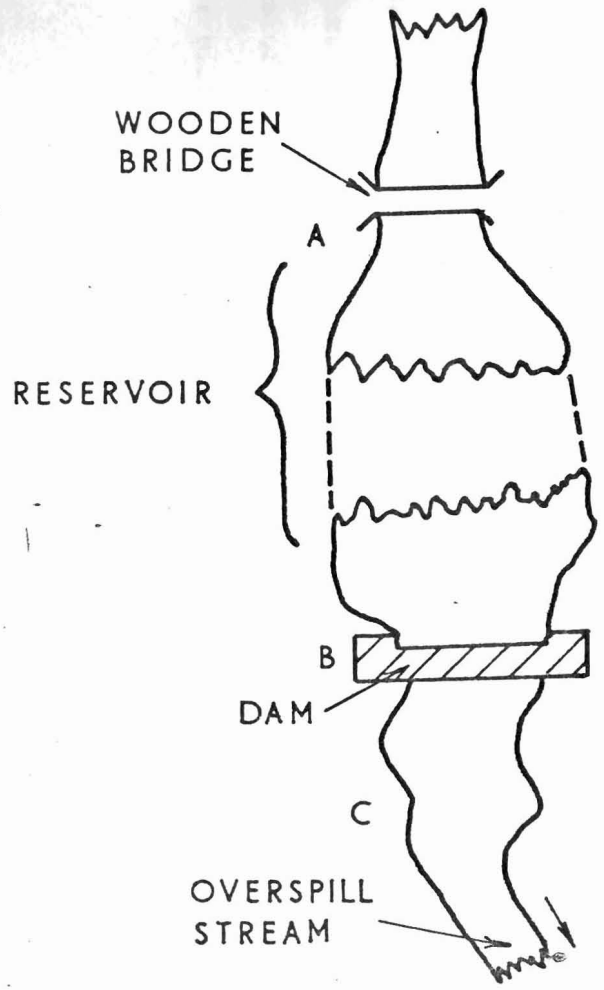

FIG. III. TAFO RESERVOIR

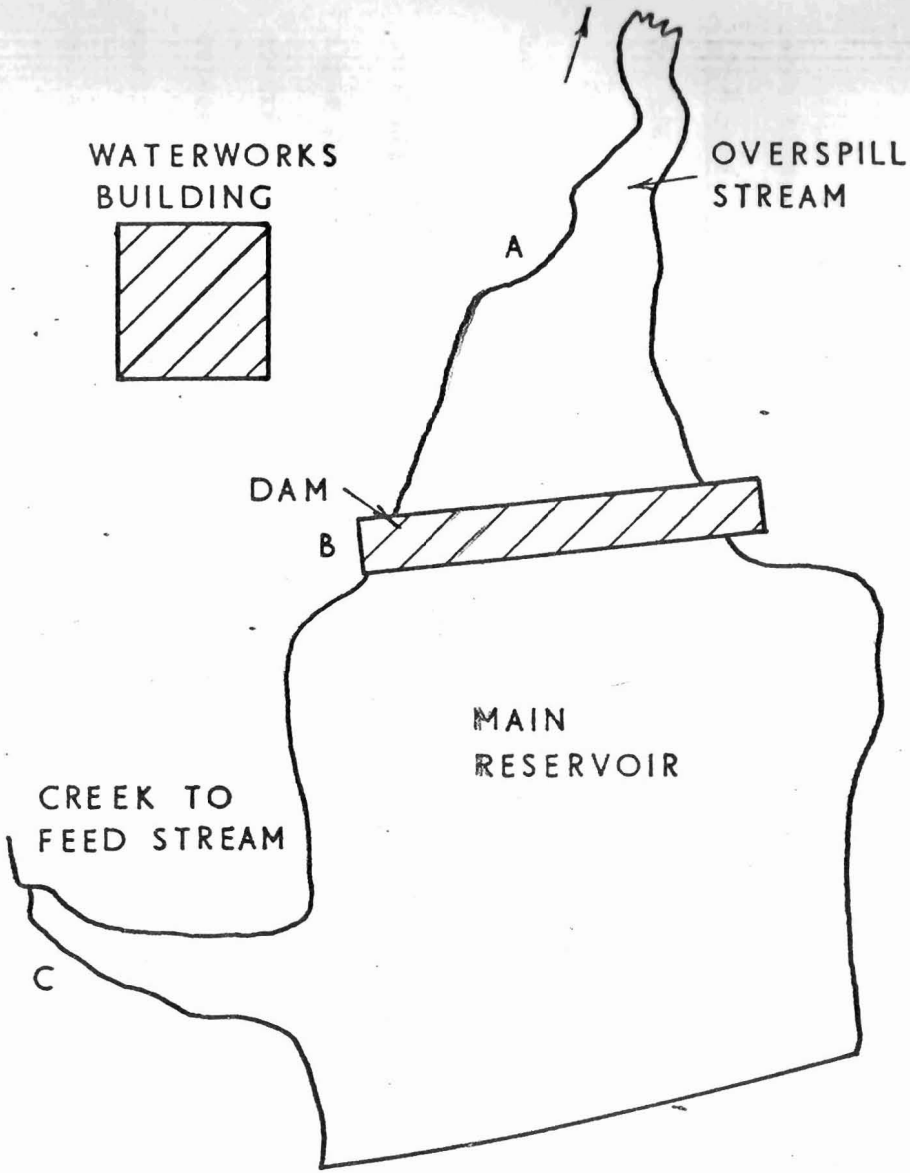

FIG. IV. KUMASI RESERVOIR

were alive. Three species were found; Lymnaea natalensis Kraus, Bulinus (Physopsis) globosus (Morelet), and B. forskalii, the first being by far the commonest.

Area B, consisted of the reservoir face of the dam and a region of the bank. The dam sloped steeply and was covered by a thick growth of algae; the banks were lined with small rocks to make a rough wall between the earthen bank and the gently sloping muddy bottom. Small-leaved water lilies and algae grew just off the shore. Snails were present in large numbers on the concrete slope, apparently feeding on the algae, in smaller numbers on and between the stones, and only rarely on the lilies. Besides the species mentioned above a few specimens of Biomphalaria pfeifferi gaudi (Ranson) were collected.

Area C, had steep earthen banks which were not lined with stones, and shelved below the surface. Two plants formed a band of vegetation along the edge, about three feet wide. This had an inner zone of small-leaved water lilies and an outer zone of large-leaved lilies. Despite the plentiful vegetation, snails were scarce and only a few L.natalensis were recovered.

Whilst at the reservoir, the records of the treatment of the water were examined. It is the practice to apply large doses of copper sulphate to the lake near the dam when the algal growth is excessive to prevent clogging of the sedimentation tank inlets. The dose is not stated but in January 1956, analysis of incoming water to these tanks records concentrations of up to one part per million of copper sulphate in the water, even 14 days after treatment

Although a molluscide, the large number of snails present indicates that at this level no appreciable control of the snails is given by copper sulphate.

E. Fullers Falls (Kintampo):

This site consisted of a pool two to three feet deep, in a fast-flowing stream just below a series of waterfalls. The snails were on the surface of the muddy bottom. The only species found during the visit on August 27th was P.freethii.

F. Bamboi:

Fiv. V shows the details of the site. It was a temporary pool in a depression with steeply sloping banks down to the water level. The mud bottom however was comparatively flat, being only $1\frac{1}{2}$ - 3 feet below the water surface in the centre. Two visits were made, on August 27th. during the reconnaissance trip and again on September 18th, whilst returning from the Northern Territories. The water level was very low on the first visit, but the onset of the rains raised it by the second. Living snails were found both times, but only in area A, on the submerged shoots of water lilies and reeds, and on twigs; though two empty shells were discovered on the mud at area B, during the first visit. The snails were all later identified as B.forskalii.

G. Buka:

This consisted of a culverted stream similar to Fig. III, but larger, the pools being about 12' across and containing some vegetation, mainly grass stems and a few lilies. The stream acted as a drainage/irrigation

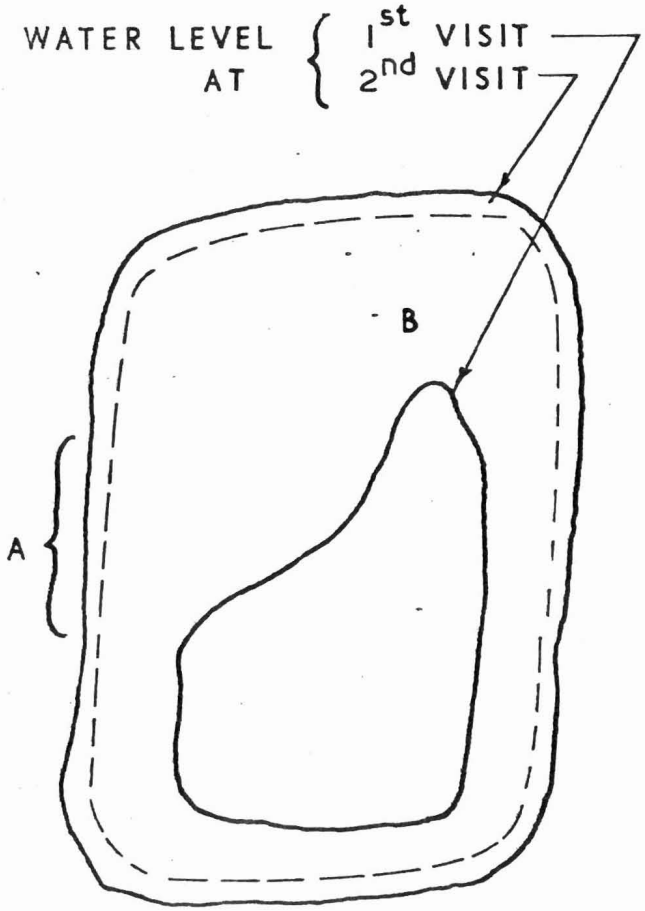

FIG V BAMBOI

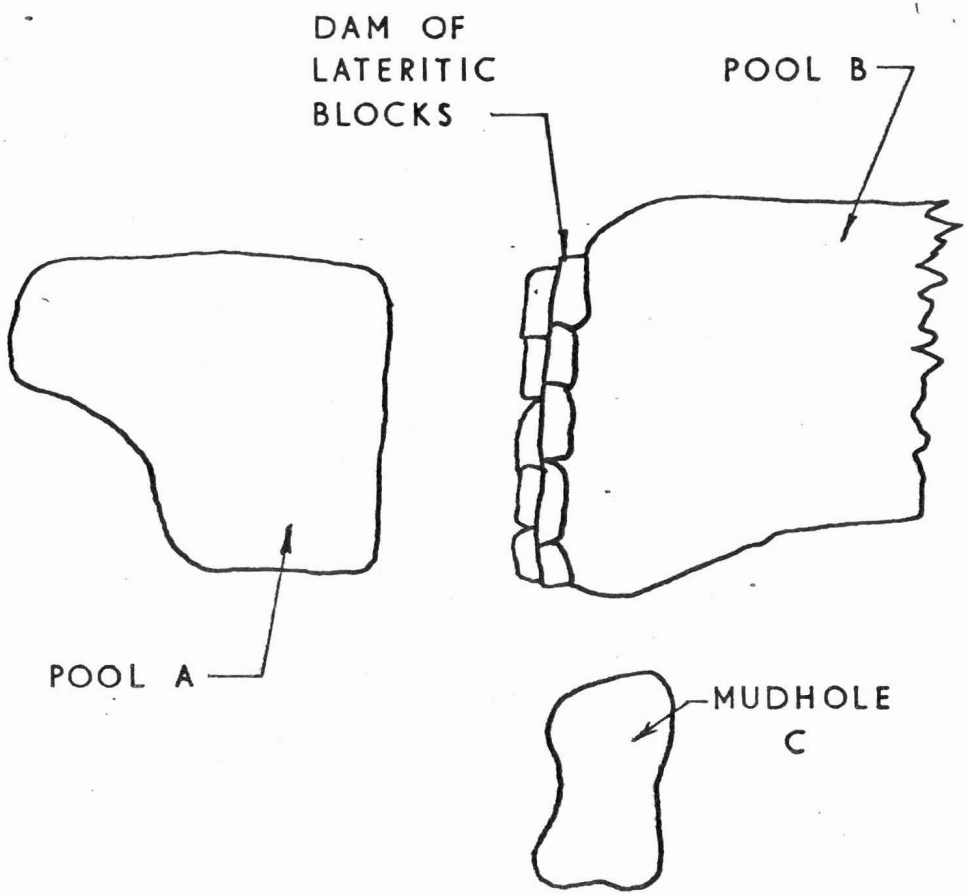

FIG VI WA (I)

channel for an area of agricultural land. The site was visited on September 15th, and after intensive search yielded three snails, all B.forskalii.

H. Wa I:

The site is shown in Fig. VI. Pools A, and B, formed the remains of a temporary water course some ten miles south of Wa Pool B, extended for about half a mile but pool A, was only some twenty yards across, and 2 - 3 feet deep in the centre. It was used by the local villagers for water and to wash crushed maize.

When visited on September 16th, pool A, contained large numbers of B.forskalii on submerged stems and pieces of wood. No snails were found in B or C.

I. Wa II:

This site was where a small stream flowed across a path in a marshy "water meadow". It was visited on September 16th, and again on September 17. Before the first visit there had been very little rain and the stream had almost dried up. Snails were abundant, though sluggish on the mud surface, especially in damp depressions including the footprints of a horse tethered on the spot. The snails were trapped on the muds above the water, under a layer of green filamentous algae in many places, and seemed in danger of dessication. However, the following day after heavy rains, the stream had filled up and the snails were moving actively over the mud surface, the algae and the greas stems. Subsequent examination showed them all to be B.forskalii.

SPECIES LIST AND NAMES[1]

Pulmonata

Family Planorbidae:	Biomphalaria pfeifferi gaudi (Ranson)
	Bulinus (Physopsis) globosus (Morelet)
	Bulinus forskalii (Ehrenberg)
Family Physidae:	Physa waterlotti Germain
Family Lymnaedae:	Lymnaea natalensis Kraus

PROSOBRANCHIATA

Family Ampullariidae:	Pila africana (von Martens)
	Lanistes libycus (Morelet)
Family Melariidae:	Potadoma freethi Gray

The three prosobranchs are widely distributed in West Africa Physa waterlotti is known only from Ghana and adjacent territories. This species and one other which has a closely confined distribution in Mozambique are the only representatives of the Physidae in the Ethiopean region. Lymnaea natalensis had a wide distribution throughout Africa and is known to act as an intermediate host for Fasciola gigantica. Biomphalaria pfeifferi and its subspecies are widely distributed thoughout Africa and are known to act as intermediate hosts for Schistosoma mansoni, but this parasite is not yet recorded in Ghana, although it has been identified in Togoland and the Ivory Coast. Bulinus globosus is one of the best known intermediate hosts for Schistosome haematobium in Ghana. B.forskalii is widely distributed throughout Africa and is a very variable species; it has never been shown to carry Schistosoma haematobium in nature, but under laboratory conditions it can be

infected and there is some epidemiological evidence from various areas that tends to incriminate this species.

(I) From data provided by Dr. Wright.

Summary

I. During the two month stay of the Imperial College Expedition in Ghana, a collection of aquatic snails was made from various localities. The work was undertaken at the request of Dr. C.A. Wright of the British Museum (Natural History).

II. An account is given of the methods used for collecting and preserving the snails.

III. A list of the localities visited is followed by a more detailed description of each site and the species of snails found there.

IV. A list of the species of snails collected is given together with notes on the helminthological role played by certain of them.

Acknowledgements

I wish to thank Dr. C.A. Wright for advice on the problem and for identifying the material collected; and J.M. Webster, another member of the expedition, for his assistance in the field.

C(i)b. EARTHWORM COLLECTION

This was passed on to B. Gerard of the 1959 expedition and was pooled with his collection.

C(i)c THE EFFECT OF SHADING ON POPULATION DENSITY OF FREE-LIVING NEMATODES IN TROPICAL SOILS

R.F. Sturrock

Experimental

An area of bush, 25' square, in the Bobiri Forest Reserve, near Kumasi, Ghana, was denuded of vegetation. Three plots, 12' x 3', were marked out. The first was covered by a sheet of aluminium, (perforated with nail holes to permit rain water to pass through it) which was supported by a wooden frame that held it about 9" off the ground surface. The second part was covered by a similar screen consisting of aluminium slats 2" wide, held 2" apart. The third plot was left exposed. Thus the three plots received full shade, half shade and no shade respectively.

Every day, a $1\frac{1}{2}$" deep soil core was taken from each plot with a 1" diameter soil borer. Each core was broken down in the laboratory and a 2g subsample taken. This was placed on a Baerman apparatus for 24 hours, to extract the nematodes. The first 10 ml. of suspension from each sample were run into a specimen tube and heated to kill any nematodes present. These were preserved by the addition of formaldghyde.

At a later date the nematodes were extracted from the dirty suspension by a Zinc Sulphate flotation technique for counting. in this technique, the suspension and saturated zinc sulphate solution were centrifuged cauging the nematode to float to the

IMPERIAL COLLEGE BIOLOGICAL EXPEDITION TO GHANA - 1958

Imperial College Exploration Board,
Imperial College, London, S.W.7.

Contents

the leader, two third year and two second year students. Second year students were included in the committee to gain experience in organising expeditions of this kind which they might be able to put to use on a future occasion.

By the middle of November 1957, letters had been sent to the Forestry Dept. of Ghana, the West African Timber Borer Research Unit,(W.A.T.B.R.U.) and Messrs. African Woods Ltd., asking for assistance during the Expedition's stay in Ghana. All of these bodies agreed to help and by March 1958 were able to confirm that accommodation would be available in the Bobiri Forest Reserve, near Kumasi. Further arrangements had been made with the Dept. of Agriculture (Ghana), Soil and Land Use Survey Division, (S.L.U.S.) for the provision of transport.

The size of the party was governed by financial considerations. Originally we had hoped to know what our funds would be well before Christmas 1957, thus enabling us to make a final selection of the party at an early date. However, it became necessary to choose a provisional party before the end of the Autumn term when it was still not clear what money would be available. Application forms were circulated in the first week of December and there were eighteen replies. A short list was drawn up by the third year members of the committee and this was approved by the Natural History Society General Committee and later by the Imperial College Exploration

Board.

Three main criteria governed the selection. First, the party should have balanced scientific interests; second, third year students should have preference over lower years as this was their last chance of taking part in an Imperial College expedition; third, the maximum number of women should be two since the transport costs for a woman would be greater than for a man. (The reasons for this are explained later.) Account was also taken of previous experience, extra qualifications and personality.

The short list was as follows:-

A) Main Party

*Keith Loach	-	Botanist (Secretary)
Janet Stevens	-	Botanist (Quartermaster - food)
Charles Neville	-	Entomologist (In charge of ship's cargo problem)
Jan Taylor	-	Entomologist (Quartermaster - scientific stores)
*Bob Sturrock	-	Parasitologist (Leader)
*John Webster	-	Parasitologist (Treasurer and medical officer)

*Members of Original Committee

B) Reserves

i) To come if enough money raised:-

John Jones	-	Parasitologist (Cameraman)
Joyce Farmer	-	Botanist (Quartermaster - Domestic Stores)

ii) To replace any of the above should they drop out at the last minute:-

Ann Holm	-	Botanist
John Parnell	-	Entomologist
Christopher Vyle	-	Botanist

In the end, only the first seven persons listed above were able to go. This had two serious repercussions. First, we lost the valuable experience of Miss Farmer, who was the only member of the 1957 party to apply. She had been placed lower on the list than the only other woman member, Miss Stevens, because it was considered that persons who had not already been on one Imperial College Expedition should be given first opportunity on this occasion. Secondly, Miss Stevens would consequently be the only girl, and this would undoubtedly throw some 'social' strain on the party as a whole and on her in particular. She had been warned of this possibility before applying but had nevertheless decided that she would be prepared to go.

The most exacting of the original tasks was that of raising money. An application for the adoption of the Expedition was made to the Imperial College Exploration Board in early November 1957. At a meeting on November 21st the Board approved the proposals and offered financial aid up to £500, later raised to £550. It was also agreed that members should pay a contribution, finally fixed at £30 per person. As the original estimate for the trip was £1500, this left another £700 odd to be raised.

Early in November, support was sought from nine firms with interests in Ghana but only £5 was raised in this way. The absence of a report of the previous Expedition, lack of details of work which it was proposed to undertake in 1958, uncertainties about the composition of the party, and above all, asking for far

too much money (£100) all contributed to this failure.

Since the major expense would be the shipping fare by normal passenger liner to and from Ghana, an attempt was made to economise on this item. A contact in a private company which chartered cargo ships on the West Africa run offered to try to arrange passages for the men in the party: the only charges would be for victualling. Unfortunately, the owners were unwilling to ship women in this way, so whatever happened the women members of the party would have to travel as fare-paying passengers on the normal liner service. A recession in trade and shipping ultimately made it impossible to do more than bring four men back from Ghana by this method. Even so, this represented a saving of about £200.

Further attempts to raise money for the original programme, for extra work on Schistosomiasis and for a cine-film, all proved abortive for various reasons. It was not until March that the importance of work related to the transport of Agricultural products on ships became apparent. A report on such work undertaken by the 1957 expedition, although controversial, proved of great interest to a number of commercial organisations. In view of this interest, Neville was asked to continue the work on this Expedition. A programme was drawn up in conjunction with several authorities and negotiations began with the interested bodies. These resulted in a further £325 being offered, together with a free return passage (equivalent to about £140) for Neville.

These negotiations were not completed until the end of June when our funds stood at about £1200. Thus we were still about £100 short of our original estimate and it was obviously necessary to limit the party to seven persons.

Despite the precarious financial situation at the time, other preparations were put in hand the moment the short list for the party was drawn up in December. Jobs were allotted to each member as indicated above. Lists of supplies were drawn up, criticised, and amended. Various firms were contacted, mainly through the Supplies section of the College Administration, about supplying items not readily available from within the College.

The Expedition's Scientific programme was arranged to satisfy the individual interests of the party. A great deal of advice was received from people with experience of conditions in Ghana, including the members of the 1957 expedition. On the whole we limited our problems far more than the 1957 expedition, since we hoped to achieve the most useful results by concentrating our resources on particular problems. The Ministry of Agriculture, Fisheries and Food, Infestation Division gave three members of the Expedition (Neville, Sturrock and Webster) a short course on stored product pests at Tolworth, in late June. The course included a routine inspection of two ships newly arrived at London from West Africa.

The members of the party began the series of medical injections required round about Easter so as to have plenty of time to fit them all in. Jones unfortunately missed the recommended poliomyelitis injections because by the time that it was clear that he could come, there was no longer sufficient time available.

Equipment and supplies began accumulating from about the middle of May and were stored until the end of term; no stores were packed until the sailing date was known and then everyone assisted where possible and the bulk of the goods was sent by road to Liverpool, a week before we were due to sail. Neville accompanied some special equipment which was sent by van to Liverpool on July 14th., for his work on the ship.

The party assembled at Liverpool on July 16th and embarked on the M.V. Sangara which was due to sail the following morning. All the immediate difficulties had been overcome (even a dock strike had not stopped us), and we were able to relax during the voyage out to Ghana where the real work of the Expedition would begin.

MOVEMENTS OF THE VARIOUS PARTIES

When on the 16th July 1958, the members of the Expedition embarked on M.V. Sangara at South Brunswick Docks, Liverpool,

Neville was already aboard preparing for his work on insect infestation in the ship's holds. We sailed at 10.30 a.m. the following morning. It was one of Liverpool's brighter days with a calm sea and clear sun. By the afternoon, we had unpacked the scientific equipment needed for the work aboard ship and established ourselves in a small room on the upper deck, which was to serve as our laboratory. Neville directed operations in the ship's holds from this room and we soon had temperature and humidity recording apparatus set up in four of the holds. The next few days were spent in coaxing the instruments into proper working order, playing deck games, sunbathing, and on the stormier days being sea-sick.

Our intermediate call at Las Palmas for bunkers and Spanish onions was preceded by the celebration of Neville's 21st birthday in the appropriate fashion. We spent four hours ashore at Las Palmas on 23rd July and the party split up to tour the town and parts of the island. Back aboard and on our way again, we continued with work in the holds, making counts of insect pests present in the waste left from previous cargoes and becoming more familiar with the use of the instruments. At the end of the outward voyage we had collected data of the physical conditions in the holds and Neville was ready to begin the bulk of this work on the return trip.

On July 31st we disembarked at Takoradi and were met

by Mr. J. Wheelan, Chief Conservator of forests i/c Western Region. Passage through Customs proved to be a lengthy process but we eventually came out quite well as regards payment of duty. After a pleasant two days stay in Takoradi Government Transit Quarters we were able to travel north by train from Sekondi to Kumasi. Here we were met by Mr. G. Ellis and Mr. H. Brammer who organised our transport out to the Bobiri Forest Reserve three days later on July 5th. We were soon unpacked and settled in the two huts, one belonging to the Forestry Department and the other to African Woods Ltd..

Mr. Tecwyn Jones of W.A.T.B.R.U. and Mr. Dinning, silviculturalist in the Forestry Department came to the Reserve to see us, bringing with them Awuni, a steward, who, together with Gambilla, the cook already with us, and Adongo our 'small boy' - engaged later, made up our complement of local labour.

Work on the Reserve began by finding the transect marked out by last year's Expedition and many of our subsequent studies were carried out on or near this area. The Entomologists, who had been collecting literally since stepping off the "Sangara" soon amassed a large and varied collection of insects. Jones began to make his film of the Expedition, and his fellow parasitologists busied themselves examining the insides of bats, rats, mice, snakes, gigantic frogs, lizards and two pangolins. The botanists made frequent trips to the laboratories at Kwadaso

to plate out micro-organisms from soil samples. (A fuller account of the work carried out is given elsewhere in this report). On August 9th, Webster and Sturrock travelled down to the West African Cocoa Research Institute (W.A.C.R.I.) at Tafo and met Dr. Johnson with whom they arranged to perform an experiment on Nematode populations in covered and partly covered soils. On Tuesday 19th August, Miss Stevens visited the Forestry School at Sunyani while Sturrock and Webster collected snails at Kumasi Reservoir, where they were also shown over the complex filter system. The weekend beginning 23rd August was spent in Kumasi and the party split into four groups to stay at the homes of Messrs. Ellis, Brammer, Jones and Dinning. On the Sunday, Neville, Sturrock and Loach were taken by Mr. Brammer on a trip up north through Mampong, Ejura, Kintampo and Wenchi into the Savannah, whilst the others visited Kumasi Zoo.

On 2nd September a dinner was organised in the Reserve to which we invited all those members of the Departments of Forestry and Agriculture who had been so helpful to us during our stay. It was a most satisfactory occasion from all points of view. We were all much relieved to hear from British Aluminium Company about return passages on their chartered ships and so on September 7th packing operations commenced and experiments were brought to a close. Two days later, Neville left so that he could check his apparatus on board the M.V. Sangara as she loaded for the return journey at Takoradi. In the afternoon the rest of the party went on

their last ride in the lorry to Savannah country on the Ejura scarp.

On Thursday September 11th, Miss Stevens, Jones, Taylor and Loach left for Takoradi. On the Friday, Taylor and Loach boarded the s.s. Katia Banck, a Swedish ship, which sailed for Burnt Island, Scotland the next morning, arriving 19 days later on October 1st. Miss Stevens, Jones and Neville embarked on the M.V. Sangara on September 13th, but did not sail until September 16th. After calling in at Freetown, Dakar and Bathurst, Miss Stevens and Jones left her at Avonmouth on October 5th, while Neville continued to Liverpool to supervise the unloading of his instruments.

The rest of the party safely on their way home, Webster and Sturrock returned to the Bobiri Forest where they finished packing the Expedition stores. On Saturday, September 13th, they moved into Kumasi, payed off the steward and small boy, and deposited all the equipment they would not need during the following week.

The next day, they and the cook moved 300 miles to Wa, in the Northern Territories, travelling in a S.L.U.S. 3 ton Bedford truck on its way to relieve a field unit in that area. During the short stay there they carried out a quick search for certain aquatic snails that might be potential schistosome carriers. In addition they were shown over a Medical Health Field Unit.

After spending the next weekend in Kumasi, they began moving down to Takoradi, staying two days on the way at Prestea where they were shown round the Ariston Gold Mines (1929) Ltd.. On their arrival at Takoradi on September 25th it was found that the ship, another ore carrier had been delayed. However they were shown some new fumigation techniques and also taken to Accra by the Ghana Cocoa Marketing Board before finally embarking on the s.s. Tynemouth and sailing on October 1st. 18 days later they landed at Gravesend, after a very comfortable trip. Their arrival in London marked the end of the Expedition.

SCIENTIFIC REPORTS

It is impossible to give a full account of the scientific work at this stage and the following are intended merely to indicate what lines of investigation were attempted.

Where possible, problems were chosen related to the main topic, the breakdown of leaf litter.

A. BOTANICAL WORK

The work, which was carried out by K. Loach and Miss J. Stevens, falls under three headings:-

i) An investigation of the moisture content of the wood of standing trees producing commercially valuable timber.

This work, undertaken at the suggestion of Mr. Levy, consisted

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of taking a series of standard increment borings from the boles of trees and determining the moisture content of the wood cores thus obtained. Ten species were investigated.

ii) This second line of work had two sub-divisions:-

a) A measurement of the rate of disappearance of leaf litter from the forest floor in three contrasted sites using the method devised by Bocock and Gilbert i.e. a weighed amount of leaf litter was placed in nylon hair nets which were distributed over the forest floor in each of the three sites. At the end of our stay the nets were reweighed and thus a comparison of the rates of leaf litter disappearance in the three sites was obtained.

b) Environmental factors that have bearing on the rate of breakdown of leaf litter were investigated. These included measurement of the rate of leaf fall, soil pH, soil moisture content, temperature in the litter layers, and counts of soil fungi and bacteria done on three types of Oxoid nutrient media. Valuable assistance and facilities were obtained from S.L.U.S. and the Specialist Divisions of the Ghana Department of Agriculture. This work was

a continuation and extension of that carried out by the 1957 Ghana Expedition.

iii) A species list of an area completely cleared of vegetation by last year's expedition was prepared in connection with studies of forest regeneration.

B. ENTOMOLOGICAL WORK

The entomological work for which A.C. Neville and J. Taylor were responsible, consisted of two parts. Firstly, a continuation of Matthews' investigation (Ghana Expedition, 1957), of the physical factors affecting insect pests in ships' holds; this was carried out by Neville, assisted by the other members of the party, and will be published as a separate report.

On arrival in Ghana, entomologists made extensive collections comprising most orders of insects, especially butterflies and dragonflies. This material is being identified and lists compiled for the Bobiri Forest Reserve district. Scientific work also included studies of gregarious behaviour in ants and mound structure of termites.

C. PARASITOLOGICAL WORK

Between them, the parasitologists handled a considerable amount of the administration. Consequently they tended to work independently, cooperating only as time permitted.

J. Jones

Although undertaking some general collecting the principle task was to obtain a cine-film record of the Expedition. This was done using a 16mm. Bell-Howell cine-camera and Kodachrome colour film. The almost continuous cover of cloud considerably limited the time for filming and created several technical problems.

R.F. Sturrock

a) An attempt was made to find the effect of exposure to sunlight on the populations of nematodes in the soil. Varying degrees of exposure were obtained with aluminium screens over a denuded area of the clearing (see Botanical Work iii). Samples were collected daily and the nematodes extracted for preservation by the Baermann technique.

b) Collection of aquatic snails for Dr. C.A. Wright of the British Museum to indicate the distribution of potential Bitharzia carriers.

c) Collection of earthworms.

d) General collecting of parasites from any animals that could be obtained.

J.J. Webster

a) A quantitative examination was made of the leaf litter and soil for free-living nematodes. The same areas were investigated as those used by the botanists and so it is hoped that some

correlation will be shown between the action of the fungi, bacteria and nematodes in the break-down of the leaf litter.

b) Some time was spent assisting in making the collection of snails for the British Museum.

c) A general collection of parasites was made from small mammals, reptiles and amphibia.

TREASURER'S REPORT

The Expedition Treasurer acted as a liaison officer between the Expedition and the Exploration Board Treasurer, Mr. F.W.G. Annas and also kept an account of the cash handled by the Expedition.

All major expenses incurred in England were paid directly by the Exploration Board from the Expedition funds, but an imprest of £10 was made available to cover petty expenses until our arrival in Ghana.

Before leaving for Ghana arrangements were made through the Exploration Board for the insurance of the members of the Expedition against accident and disease, and also for the insurance of the equipment and certain personal baggage. Further, arrangements were made for the transference of £300 to the Bank of West Africa in Kumasi. Here a joint account was opened for the Expedition in the names of R.F. Sturrock and J.M. Webster.

There follows an abridged statement of the accounts.

INCOME	£	s	d	£	s	d
Exploration Board Grant				500	0	0
Personal Contributions, 7 @ £30				210	0	0
* Receipts from Organisations outside the College						
F. Hills & Sons	5	0	0			
L. Rose & Co.	10	10	0			
Ghana Cocoa Marketing Board	50	0	0			
Cocoa, Chocolate & Confectionary Alliance	150	0	0			
Unilever	50	0	0			
Nigerian Produce Marketing Co.	75	0	0			
				340	10	0
				£1,050	10	0

EXPENDITURE						
Transport	560	7	8			
Photography etc.	23	7	4			
Food	66	5	2			
Expenses in Ghana & Transfer costs	271	0	5			
				921	0	7
Allowance for payment of return fares	95	0	0			
Allowance for cost of report & film	35	0	0			
				130	0	0
				£1,051	0	7
Cash in hand				2	0	0
				£1,049	0	7

	£	s	d
Receipts	1,050	10	0
Expenses	1,049	0	7
Balance	£1	9	5

* Elder Dempster Lines Ltd., provided one free return passage valued at £140.

HEALTH CONSIDERATIONS

Tropical conditions necessitate special precautions against disease, besides the normal medical supplies required by any expedition. The Ministry of Health informed us that vaccination against smallpox and innoculation against Yellow Fever were essential, and those against cholera, typhoid and tetanus were recommended though not compulsory.

In the light of present conditions in Ghana it was decided to have vaccinations against poliomyelitis. The London School of Hygiene and Tropical Medicine was approached and the vaccine eventually obtained through the Commonwealth Relations Office.

As prophylactic treatment for malaria, four members of the party used Paludrin and three Chloroquine Phosphate.

Our health in Ghana was quite satisfactory until the last fortnight in the forest. From then until the time of leaving, some members suffered from attacks of diarrhoea lasting from two to four days. Anti-acid and astringent tablets appeared to cure it. There was no real suggestion of dysentry, but in some cases a dose of Sulphurmethazine was taken as a precaution.

Taylor began to suffer from continual abdominal pains in the stomach region which did not respond to the above treatment. Eventually he visited Kumasi Central Hospital, but the diagnosis of worms or liverfluke was dubious. On arrival in England, he was found to have a Duodenal ulcer. All members of the party were advised, on their return, to have a thorough check-up at the London School of Hygiene and Tropical Medicine.

ACKNOWLEDGEMENTS

The Expedition is indebted to the following for their help, without which the whole venture would have been impossible.

A. For Advice on all matters:-

The Imperial College Exploration Board, especially Mr. E. Fairhurst, Prof. H.R. Hewer and Mr. P.F. Taylor.
The members of the 1957 Ghana Expedition.

B. For Special Advice, Assistance and Facilities:-

Messrs. Africa Woods Ltd.
Mr. F.W.G. Annas of the Imperial College Finance Department.
The British Museum (Natural History) especially Dr. C.A. Wright.
The Forestry Dept. of Ghana, especially Mr. J.G. Ellis and Mr. J. Wheelan.
Miss Falkingham of the Imperial College Supplies Dept.
Imperial College Botany and Zoology Departments especially Dr. W.F. Jepson and Mr. J. Levy.
Dr. C.D. Johnson of the West African Cocoa Research Institute.
Mr. T. Jones of the West African Timber Borer Research Unit.
The Ministry of Agriculture, Fisheries and Food (Infestation Division) at Tolworth and Liverpool.
The Nature Conservancy.
The Pest Infestation Laboratory (Slough) D.S.I.R.
Mr. J. Rawnsley of the Ghana Cocoa Marketing Board.
The Agriculture Dept., Ghana (Soil and Land Use Survey Div.) especially Mr. H. Brammer.
Mr. Woodall of the London School of Hygiene and Tropical Medicine.

Special mention must be made of Dr. W.F. Jepson, whose timely encouragement undoubtedly prevented the failure of the Expedition; and of Mr. Tecwyn Jones and his wife who looked after us so admirably during our stay in Ghana. There are obviously many other people whom we cannot mention by name, whose parts, though small, ensured the success of the Expedition and to whom we are extremely grateful.

C. For Financial Aid

F. Hills & Sons
L. Rose & Co. Ltd.
Ghana Cocoa Marketing Board.
Cocoa, Chocolate & Confectionary Alliance.
Unilever.
Nigerian Produce Marketing Co. Ltd.

D. Transport

The Burnett Steamship Co. Ltd.
Elder Dempster Lines Ltd.
Mr. Kennedy of the British Aluminium Co. Ltd.
The Liverpool Warehousing Co. Ltd.

E. Supplies of Food:- (free of charge or at reduced prices)

Batchelors Peas Ltd.
Carr & Co. Ltd.
Cerebos Ltd.
Chivers and Sons Ltd.
Huntley & Palmer Ltd.
Anglo-Swiss Food Products Ltd.
Machonochie Bros. Ltd.
Mazawattee Tea Co. Ltd.
McDougalls Ltd.
Ministry of Agriculture, Fisheries and Food (Aberdeen)
James Pascall Ltd.
Quaker Oats Ltd.
Scotts Porridge Oats Ltd.
Tate and Lyle Ltd.
A Wander Ltd.

F. General Supplies:-

J. Bibby & Sons Ltd.
British Visqueen Ltd.
Cellon Ltd.
Kodak Ltd.
Marks and Spencer Ltd.
Oxo Ltd.
Paper Goods Manufacturing Co. Ltd.
Rolex Paper Co. Ltd.
Vidor Ltd.
Winsor and Newton Ltd.

G. Medical Supplies:-

Boots Pure Drug Co. Ltd.)
Pharmaceutical Division I.C.I.) Medical Stores
Messrs. Allen and Hanburys - anti-snakebite serum and syringes.

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