A brief summary is contained in the *History of the Second World War Medical Research* (H.M.S.O., 1953).

Collaboration between the scientists of the two countries up to the end of 1943 was informal and far from complete. Both groups made great progress in examination of the degradation products of penicillin. American workers seem to have been responsible for at least one of the most useful discoveries, namely, the crystallization of sodium benzyl penicillin by McPhillamy, Wintersteiner and Alicino of the Squibb Laboratories. Two other achievements may be mentioned in this connexion: (1) The discovery that the penicillin, obtained by surface culture, investigated by the British chemists is not chemically identical with that investigated by the Americans, obtained from deep fermentations. Analytical results from Merck laboratories, and the examination of crystalline compounds made by treatment of penicillin with benzylamine (Peoria laboratories) were factors in this discovery. This led to the designations Penicillins *F* and *G* (U.S.); I and II (Great Britain). (2) The discovery in the Peoria laboratory that phenyl acetic acid is obtained on hydrolysis of penicillin and that the addition of phenyl acetic acid to the culture medium increases the yield of penicillin. Eli Lilly and Co. adopted the practice of adding derivatives of phenyl acetic acid to culture media in their production plant.

In the second half of 1943, encouraged by progress toward understanding of the chemistry of penicillin as well as by the spectacular results of therapeutic trials, stimulated also by the fear that natural fermentation could not supply the future need for penicillin and hence that a synthetic method must be devised if possible, officials of the two Governments, United States and Great Britain, began plans for the establishment of formal intergovernmental collaboration. The director of O.S.R.D., Dr. Vannevar Bush, appointed a committee of three chemists, Hans T. Clarke, Roger Adams and R. D. Coghill, to survey and report on chemical personnel and organizations within the United States fitted by skill and facilities to advance the chemical problem. He proposed to Sir Edward Mellanby, secretary of the British Medical Research Council, that a similar investigation and report be formulated in Great Britain and that a system of prompt and full exchange of information be adopted by the two Governments. The resulting plan became effective early in 1944 and continued until the end of the War. It contained the extraordinary provision that the determination of ownership of patent rights, originating from inventions in the United States, should be made by the director of O.S.R.D. Included in this international effort were four British and five American universities; five British and ten American commercial firms; one British and four American Government agencies; two British and two American research foundations. The number of participants was more than 300; the number of reports exchanged was about 700. The usual legal difficulties which included the drafting of contracts acceptable to all parties were successfully solved by the general counsel to O.S.R.D., Mr. John T. Connor, and his successor, Mr. Oscar M. Ruebhausen.

The outcome of this tremendous joint effort can be summarized by the statements that: (1) an encyclopædia of information had been assembled concerning the chemical constitution and behaviour of a new group of compounds—penicillins—not hitherto found in Nature; (2) minute amounts of a substance had been synthesized by both the American and British investigators which proved to be identical with natural penicillin both with respect to antibacterial activity and destructibility by the penicillin-destroying enzyme, penicillinase; (3) by the isotope dilution method, identity of the synthetic and the natural substance was made certain.

These scientific achievements did not, however, bring with them change in commercial production of penicillin. Fermentation processes had become so productive and economical that it can be said without gross exaggeration that the cost of manufacture of 100,000 units of penicillin is scarcely more than the cost of material and labour required to put it into an ampoule and that the scientific results gave no prospect that a competitive synthetic process of commercial production of penicillin would be devised.

Fig. 1 shows the progress of production and supply of penicillin by commercial organizations from February 1942 until the end of the War. What began as a trickle from a few companies became a flood of billions of units as better media and more productive strains were discovered and a greater number of industrial units engaged in production. The following quotation is taken from Volume 2 (p. 651) of the book *Antibiotics*, assembled by Florey and the Oxford group:

". . . too high a tribute cannot be paid to the enterprise and energy with which the American manufacturing firms tackled the large-scale production of the drug. Had it not been for their efforts there would certainly not have been sufficient penicillin by D-day in Normandy in 1944 to treat all severe casualties, both British and American."

It might be added that the efforts of American manufacturing firms could not have been so promptly and successfully put forth had not the agencies of the United States Government and the National Research Council mentioned in this account supplied courageous understanding and essential support.

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THE BRITISH MUSEUM (NATURAL HISTORY)—UNIVERSITY OF LONDON JOINT PALÆONTOLOGICAL EXPEDITION TO NORTHERN RHODESIA AND TANGANYIKA, 1963

By J. ATTRIDGE, Dr. H. W. BALL, Dr. A. J. CHARIG and Dr. C. B. COX

The nineteenth century was a time of exploration and colonization. Many Europeans in newly explored territories throughout the world—mainly soldiers, doctors, missionaries and engineers—were interested in fossils; they collected what they found, and, if British themselves, they usually sent their material to the British Museum for appraisal and description. The collections of Permian and Triassic reptiles thus obtained from the Karoo rocks of southern Africa include the types of many new genera and species, and are of great historical and scientific value. Yet they often consist only of skulls, the collectors having ignored any post-cranial material, and are often poorly preserved and prepared. Moreover, they frequently lack precise geographical and geological

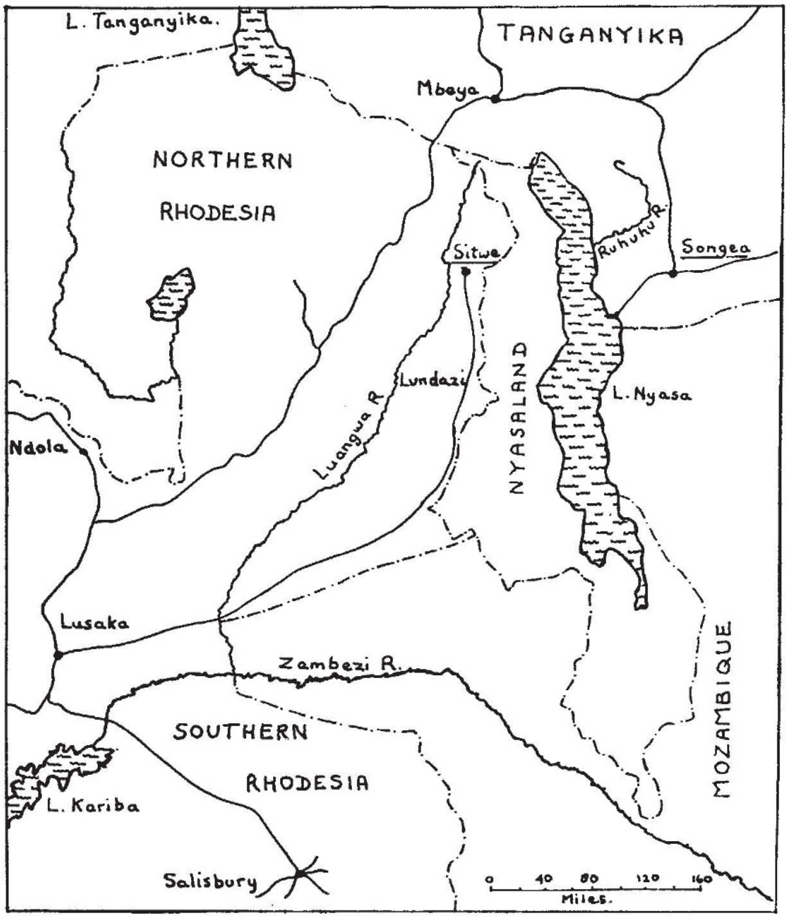

Fig. 1

It was decided to visit two parts of Africa which appeared to be of especial interest (Fig. 1). The upper Luangwa Valley of Northern Rhodesia had been surveyed in 1928 and 1935 by Dixey[1,2], whose collection of vertebrate fossils, deposited in the South African Museum (Cape Town), was described by Boonstra[3]; but the inaccessibility of the region had for long prevented any further investigation. During 1960–61, however, James Kitching, of the Bernard Price Institute for Palæontological Research, University of the Witwatersrand, visited the area with Alan Drysdall, of the Northern Rhodesia Geological Survey[4]; they found vertebrate fossils both in the Upper Madumabisa Mudstone of the Permian, where they were extremely abundant, and in the Triassic Ntawere Formation and Red Marl. This material is at present in Johannesburg.

The other area concerned was the Ruhuhu Valley in south-western Tanganyika, where vertebrate fossils had first been found in 1930 (ref. 5). Good collections made in 1933–35 (now in Cambridge, Tübingen and Munich) had shown the presence of both Permian and Triassic terrestrial vertebrate faunas, just as in Northern Rhodesia. There was already an extensive literature on the many new forms found. It was evident, however, that there were many other new forms represented by tantalizingly incomplete material; that further knowledge of all these creatures was highly desirable; and, further, that the Triassic fauna in particular was likely to be of great importance in investigations of evolution, stratigraphical correlation and palæogeography.

information, so that a typical label may even read "From the Karoo of Cape Colony".

Twentieth-century collecting practice has become more methodical, with greatly improved excavation techniques and accurate recording of all relevant details. It is difficult for any but the professional palæontologist, adequately supplied with money and resources, to collect large fossils in this way in comparatively remote country; and the quantity of such material submitted to the British Museum (Natural History) by amateurs, for this reason and for others, has declined. Even professional geologists, conducting routine surveys, can usually do no more than pick up chance discoveries of weathered surface material. It is therefore not surprising that, until now, the Museum had received practically no further reptile material from the Karoo, either from the well-known deposits of South Africa or from the other fossiliferous areas discovered further north; its collections of such material could therefore no longer be compared in either quality or quantity with those of institutions in South Africa itself.

The afore-named Expedition, which returned to England recently, has now remedied this situation to some extent with large collections of good material for both display and research. It was conceived and organized by four London palæontologists: Alan Charig and H. W. Ball, of the British Museum (Natural History), and John Attridge and Barry Cox, both lecturers in zoology in the University of London (at Birkbeck and King's Colleges, respectively). Dr. Ball unfortunately suffered a recurrence of an injury to his back and was obliged to return home after only one month, but the others remained in Africa from June until October. Several other workers helped them for shorter periods.

The party set out in two Land-Rovers from Salisbury, Southern Rhodesia; they were joined in Lusaka by James Kitching, whose uncanny ability as a field collector is almost legendary. Kitching stayed with the Expedition for four weeks in the Luangwa, showed them the known fossiliferous areas, and himself discovered a large proportion of the material collected there.

Camp was set up near Sitwe, a small village in Northern Rhodesia on a tributary of the Luangwa, 125 miles north of the District headquarters at Lundazi and close to the Nyasaland border. As the dirt road ended at Sitwe, and as the fossils were scattered over some 400 square miles of almost uninhabited mopane scrub, it was necessary to make or reopen quite extensive stretches of track. One such track was 32 miles long and crossed 20 river-beds, which, though generally dry at this time of year, were mostly steep-walled; the construction of drifts to render them passable by Land-Rovers required a great deal of labour. The thick cover of grass and small bushes had then to be burned off before searching could begin. Local men were employed for all these jobs and for carrying the fossils back to the vehicles.

About 220 specimens, weighing (packed) some 2–3 tons, were collected in this area. Most of the material was from the more richly fossiliferous Permian beds, the Upper Madumabisa Mudstone, where the fossils usually occur in red or purple ferruginous nodules; though many specimens consist only of skulls (Fig. 2), some more or less complete skeletons were found (Fig. 3). As in the South African Karoo, the anomodonts or dicynodonts (herbivorous synapsid reptiles) account for about 90 per cent of the specimens from the Upper Permian. The rest of the fauna consists almost entirely of carnivorous synapsids (gorgonopsians and therocephalians), though

Fig. 2. Anomodont skull from the Permian Madumabisa Mudstone of Northern Rhodesia

Fig. 3. Anomodont skeleton from the Permian Madumabisa Mudstone of Northern Rhodesia, as found

pareiasaurid cotylosaurs are found occasionally. The genera and species identified indicate levels equivalent to the *Endothiodon* and *Kistecephalus* zones of South Africa.

The Triassic fossils, on the other hand, are generally almost free of matrix, occurring as dissociated elements which have weathered out of the soft dark red mudstones and grits of the Ntawere Formation and Red Marl. They are not normally abundant; yet at one locality the side of a small hill was found to be covered with 500–600 absolutely clean anomodont bones, mostly post-cranial, of which some were complete. Other, less common elements in the Ntawere fauna are the remains of large cynodonts, pseudosuchians, a large amphibian and the fresh-water bivalve *Unio karrooensis*. This faunal assemblage is later than that of the Lower Triassic *Cynognathus* zone of South Africa, and may therefore be of Middle Triassic age; and the discovery of pseudosuchians, not recorded by earlier expeditions, is of particular importance in this connexion.

After breaking camp at Sitwe, the Expedition was joined in Lundazi by three new members: A. W. Crompton, director of the South African Museum in Cape Town; Dr. Barney Hirschson, a Cape Town radiologist, who acted as medical officer; and A. R. I. Cruickshank, assistant lecturer in zoology in the University of Edinburgh. The whole party then drove around the northern end of Lake Nyasa to the Ruhuhu Valley in Tanganyika. Camp was set up near Litumba, a Benedictine mission fifty miles west of the Ruvuma Regional capital at Songea. As before, motor tracks to the fossil localities were constructed by local Africans; the total length of these was less than in Rhodesia (about 20 miles), but some of the watercourses still carried sufficient water to make it necessary to build bridges rather than drifts. The bridge over the Rutukira River was more than 100 ft. long.

Stockley[5] and Nowack[6] had indicated the general areas in which bone had been found, but their lack of accurate maps had made it impossible for them to indicate the precise localities. Each area, therefore, had now to be searched for exposures. These were usually found where the harder strata outcropped to form low ridges or hillocks, in the walls of dried-up streams, and, in particular, in the systems of small gulleys and eroded flats often to be found at the heads of streams. As the country is fairly level and much of it was covered by dense high grass, generally too green to burn, fossiliferous exposures were difficult to find. The local Africans, however, soon learned what the fossils looked like and the sort of place in which they might be found, and, being well acquainted with the area, they too discovered many new localities. Altogether the Expedition found thirty-five localities yielding good bone.

W. W. Bishop, curator of the Uganda Museum, Kampala, joined the Expedition in its final stages to map these localities and to study their stratigraphical relationships. His work was of immense help to the Expedition; it showed, among other things, that most of the Triassic localities are exposures of one comparatively rich fossiliferous level, though a few localities below and above this level were also found.

Twenty-seven fossil localities, scattered over an area of some 50 square miles, were in the Middle Triassic Manda Formation (K8). This Formation consists of fairly soft, pink and purple sandstones and green and purple marls. Though bones found in the sandstones are usually free of encrustation, those in the marls are often coated with a hard layer of variable thickness and composition. If they had not already been weathered out, the fossils were easily excavated from the soft rock, fragile and articulated specimens being strengthened and protected by a plaster-of-Paris jacket.

Four groups of reptiles were found in the Manda Formation, in approximately equal numbers: archosaurs, rhynchosaurs, anomodonts and cynodonts. The most important archosaur discovery was an incomplete skull and jaws 2 ft. long (Fig. 4) superficially similar to those of a large modern crocodile, with 4½-in. teeth; previous finds of archosaur skull material in Middle Triassic beds, except in Argentina, had consisted only of isolated fragments. Several small excellently preserved archosaur skeletons were collected, sometimes articulated, at least one with its skull. An unusual find was an isolated archo-

Fig. 4. Archosaur skull from the Triassic Manda Formation of Tanganyika, after excavation

saurian dorsal vertebra bearing a strong neural spine more than five times as high as the centrum. These finds are of the greatest importance, for, while no dinosaurs have yet been described from the Manda Formation or from beds of comparable age (unless these include the "Mesotriásico Superior" of Argentina), the Manda archosaurs collected by Parrington include pseudosuchians (*Mandasuchus*, *Teleocrater*), which are closer than any other known reptile to the primitive saurischians of the Upper Trias.

The abundant rhynchosaur material includes skeletons which are almost complete and which will therefore provide excellent museum exhibits. It should permit description of the internal anatomy, hitherto unknown, of the skull of *Stenaulorhynchus*.

There are also a number of nearly complete anomodont skeletons, some in articulation, of which one may belong to the genus *Kannemeyeria*. A large skull represents a new anomodont genus.

The cynodont material includes some excellent partial skulls, some with complete brain-cases and others with teeth. The fauna is of particular interest as it contains many small and relatively unspecialized forms which may throw some light on the origin of mammals.

The Manda fauna considered as a whole is similar to the Ntawere fauna of Northern Rhodesia; in particular, both faunas include *Unio karrooensis*. The Ntawere, however, differs in one striking respect—the apparent absence of rhynchosaurs. It is interesting to note that one Manda locality, below the richest level, yielded an anomodont provisionally identified as *Kannemeyeria*—a genus found hitherto only in the Lower Triassic *Cynognathus* zone of South Africa. If this specimen is indeed *Kannemeyeria*, it might indicate that the genus persisted into Middle Triassic times, the fauna of which is not well represented—if at all—in South Africa.

The collecting in the Ruhuhu Valley, in contrast to that in the Luangwa, was concentrated on the Triassic beds. The Expedition, however, also found a few Permian localities, which yielded a predominantly anomodont fauna, including some excellent specimens of the anomodont *Endothiodon*. It was at first assumed that the latter, like those already described from the same region, were from the Kawinga Formation[7] (*K*6, Lower Bone Bed, Lower bone-bearing series, etc., of earlier authors); but Dr. Bishop established that they were, in fact, from the underlying Ruhuhu Beds (*K*5), which had been thought to contain no vertebrate remains. These Ruhuhu Beds, and perhaps the lowest part of the Kawinga Formation, are therefore homotaxial with the *Endothiodon* zone of South Africa. The Permian vertebrates from Tanganyika, like those from Northern Rhodesia, usually occur as nodules in the mudstones of the Ruhuhu Beds and the Kawinga Formation, but they lack the heavy ferruginous covering characteristic of the Rhodesian specimens.

The weight of fossil material collected in Tanganyika, comprising some 230 specimens, was about 2–3 tons (almost exactly as in Rhodesia). Thus a total of 5 tons of Permian and Triassic fossil reptiles, represented by 450 entries in the field catalogue, has now arrived in England from the collecting areas of East and Central Africa. Its development in the laboratory (using both mechanical methods and acid techniques) will necessitate some years of work, but it is hoped that the more promising material may be described fairly quickly.

The general organization of the Expedition may be contrasted with that of the pioneers of the nineteen-thirties—Dixey, Stockley, Parrington and Nowack—who travelled about the country by 'porter safari'. It might seem paradoxical that the present Expedition, equipped with motor-vehicles, was far less mobile than its pedestrian predecessors. On 'porter safari' a camp was set up at the nearest convenient site to a promising fossil locality, so that virtually the whole of each working day could be spent at that locality and any others nearby; the comparatively small quantity of equipment and stores was carried to the next camp-site by a column of porters. As the porters could march without difficulty in any direction, crossing rivers such as the Ruhuhu or Rutukira where necessary by dug-out canoe, every part was accessible and an *ad hoc* itinerary could be followed.

The 1963 Expedition was organized on an entirely different basis. The professional and family commitments of its prospective members limited its duration to four months; the Long Vacation, June–October, fortunately coincides with the middle of the dry season, which is the most suitable and pleasant time for field work. But as the time to be spent in the field was thus restricted to twelve weeks, exclusive of travelling, it was considered necessary to have a larger party (of 4–7 persons). A party as large as this required so much equipment and stores that to move the base camp from one place to another in the same field area would have taken several days. Valuable time was spent in building tracks, operations were limited to areas accessible from those tracks, and the crossing of major rivers necessitated enormous detours. On the other hand, the size of the Expedition, together with the use of Land-Rovers, made it possible to explore an extensive area from each of the base camps and to work two or three scattered fossil localities simultaneously; and even quite distant sites could be visited by setting up a small temporary camp nearby. Such a party, moreover, could include specialists on several groups of reptiles, with various skills in collecting techniques and general Expedition duties.

At this point it is fitting to pay tribute to the pioneers of the 'thirties, who not only endured uncomfortable living conditions but also risked their health—which, in some cases, was permanently impaired. The 1963 party enjoyed the convenience of refrigerators, regular supplies of fresh food, newspapers and mail, and effective equipment for the sterilization of water; modern drugs and anti-snake serum were available, a qualified medical practitioner was with them for part of the time, and, had it been necessary, their Land-Rovers could have transported them to hospital in a matter of hours.

Experience shows that the following points are important. First, it is better to seek new localities rather than those of previous collectors, which are generally difficult to find and often worked out. Secondly, all temptations to make other sorts of natural history collections—plants, insects, etc.—should be resisted; time does not allow. Thirdly, it is essential that an expedition of this nature should include an expert cartographer and stratigrapher, supplied with all available large-scale maps and aerial photographs. At the same time, experience has modified the rather critical attitude adopted by members of the Expedition towards those early collectors from the South African Karoo who so often ignored post-cranial material; when limitations of time impose a choice between collecting one skull, together with every tiny fragment of its not particularly informative skeleton, and, alternatively, collecting several superb skulls and leaving the associated skeletons behind, there is *sometimes* a good case for choosing the latter.

The Expedition was financed by the Department of Scientific and Industrial Research, the Royal Society, the Percy Sladen Memorial Fund, the Godman Exploration Fund and Shell Research, Ltd. Free heavy transport, free services of many kinds, advice on various topics and the necessary collecting and export licences were generously given by Government and university departments, museums, other institutions and individuals far too numerous to mention here; and many companies in Britain and southern Africa kindly supplied food and drugs either free or at reduced cost. So much help made it possible to plan the Expedition with a minimum of financial worry.

The four 'full-time' members of the Expedition also thank the five 'part-time' members mentioned here for their invaluable co-operation and help; the Bernard

Price Institute, the South African Museum and the Uganda Museum for releasing such senior members of their staffs; and, last but not least, the many friendly, helpful and cheerful Africans who worked so hard on the Expedition's behalf in both Northern Rhodesia and Tanganyika.

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NEWS and VIEWS

Physics at the University of Lancaster: Prof. E. R. Dobbs

Dr. E. R. Dobbs has been appointed to the chair of physics at the new University of Lancaster. Dr. Dobbs graduated at University College, London, in 1943, where he began research under Prof. E. N. da C. Andrade on the viscosity of liquid metals. He was appointed to the academic staff of Queen Mary College in 1949 and worked in low-temperature physics on properties of the solidified inert gases, utilizing X-ray crystallography and ultrasonic techniques. After two years' leave of absence in the United States at Brown University, where he worked on micro-wave acoustics, he went to the Royal Society Mond Laboratory, Cambridge, as an Associated Electrical Industries Fellow, continuing to work in the field of microwave acoustics applied to solid-state problems. He has recently been visiting physicist at the Argonne National Laboratory, Chicago. Dr. Dobbs has a wide experience of the experimental methods of solid-state physics and teaching experience gained in several different university traditions which will serve him in good stead in the new University of Lancaster.

Biochemistry at the University of Canterbury, New Zealand: Prof. B. H. Howard

Dr. B. H. Howard, who has been appointed to the newly created chair of biochemistry at Lincoln College, University of Canterbury, New Zealand, is a graduate of the University of Manchester. Owing to war-time conditions he was not immediately able to take up a post in the field of biochemistry, which was his main interest, but was employed for some time in commercial and Government laboratories. In 1947 he moved to the London School of Hygiene and Tropical Medicine as personal assistant to Prof. H. Raistrick where he carried out work on the metabolic products, especially the colouring matters, of *Penicillium* and *Aspergillus* species. This work was incorporated in a number of papers in the *Biochemical Journal*, and during this period Howard obtained a Ph.D. degree of the University of London. His work in London also included some teaching of biochemistry and microbiology. In early 1954 he joined the staff of the Rowett Research Institute in the Microbiology Department where he started an investigation into the biochemistry of the rumen protozoa, a field which at that time was virtually unexplored. Since then he has published alone, or in collaboration with Dr. Abou Akkada, a visiting worker at the Institute, some ten papers on this subject. His work in this field has greatly extended knowledge of the metabolism of the anaerobic rumen protozoa and has laid a foundation on which future workers can build. Dr. Howard was elected a Fellow of the Royal Institute of Chemistry in 1958. In 1961 he spent a year in New Zealand as a Department of Scientific and Industrial Research Senior Fellow at the Plant Chemistry Laboratories, Palmerston North.

Agricultural Chemistry at the University of Leeds: Prof. D. Lewis

Dr. D. Lewis has been appointed to the chair of agricultural chemistry in the Department of Agriculture, University of Leeds, from a date to be arranged. Dr. Lewis graduated with honours in agricultural chemistry at the University College of Wales, Aberystwyth, in 1946, and was awarded the degree of M.Sc. in 1947. He then entered the School of Biochemistry at the University of Cambridge and, a year later, he obtained honours in Part II of the Natural Science Tripos (biochemistry). He was elected senior scholar of St. John's College. He joined the staff of the Department of Microbiology in the University of Sheffield in 1949 and was awarded a Ph.D. degree by that University in 1951. He was a member of the staff of the Agricultural Research Council Institute of Animal Physiology, Cambridge, from 1952 until 1958; his research was mainly concerned with certain aspects of protein nutrition of sheep and their thyroid function. He was appointed lecturer in agricultural chemistry at the University of Nottingham in 1958 and promoted to a readership in agricultural chemistry in 1961.

Medical Microbiology at St. Thomas's Hospital Medical School: Prof. A. P. Waterson

Dr. A. P. Waterson has been appointed to the chair of medical microbiology at St. Thomas's Hospital Medical School. Dr. Waterson, who is forty years of age, was educated at Epsom College, Emmanuel College, Cambridge, and the London Hospital Medical College, where he qualified in medicine in 1947. At Cambridge, Waterson was placed in Class 1 both in the Natural Sciences Tripos, Part I, and in Part II (biochemistry). After house appointments at the London Hospital and service in the Royal Air Force in Germany, he took the M.R.C.P. (London) in 1950 and returned to Cambridge as house physician at Addenbrooke's Hospital, where he afterwards worked for two years in the clinical laboratories. He was appointed University demonstrator in pathology in 1953. He took the M.D. (Cambridge) in 1954. Since 1958 he has been University lecturer in pathology. He is a Fellow of Emmanuel College, and a tutor and director of studies in medicine at the College. Following some work on the titration of viruses by plaque formation in tissue culture, his research has been concerned principally with an investigation of the structure of the viruses of man and other vertebrates, and of the biological significance of the components of the viral particle. This has involved particularly the viruses of the influenza and parainfluenza groups, and also the measles group. He is the author of *Introduction to Animal Virology* (1961).

British Technical Co-operation Overseas

In reply to questions in the House of Commons on January 14, the Secretary for Technical Co-operation, Mr. R. Carr, said Britain was spending nearly £1 million in the present financial year on supporting research in Britain for the benefit of developing countries. He instanced the Anti-locust Research Centre, the Tropical Products Institute and the Tsetse Fly Laboratory, opened at Bristol in December. Grants were also made by his Department for research at universities and other institutions. On the advice of the Colonial University Grants Advisory Committee, he had allocated £325,000 to the new University of Basutoland, the Bechuanaland Protectorate and Swaziland from funds available under the Commonwealth Development Act, 1963, for the three