

staff doing a particular job in the Colonial Office would continue for a time to do the same job in the Commonwealth Relations Office with the longer-term option to join the Diplomatic Service or to be transferred to home departments of the Civil Service. Apart from Viscount Amory's endorsement of the importance attached to commercial work in the Report, the Lords debate added little of interest, and no one besides Lord Shackleton referred specifically to scientific work.

Nevertheless, the significance of the Committee's recommendations in regard to recruitment and training were widely recognized. It is true that the Plowden Committee is much more restrained in its recommendations for the use of scientists in such posts as scientific attachés than was Dr. Berkner. In regard to recruitment and training, however, it goes at least as far. The main criticism that could have been made is that the Report does not refer to the importance of educational policy generally. This could have a decisive influence, not so much on the availability of suitably qualified scientists and technologists as recruits to the new Service, but still more on the recruitment generally of administrative and other staff with some real appreciation of the significance of scientific factors in foreign affairs.

LIFE WITHOUT GERMS

Germfree Life and Gnotobiology

By Thomas D. Luckey. Pp. xii + 512. (New York and London: Academic Press, 1963.) 125s.

WE, like other multicellular organisms, are in effect convenient habitats for a host of bacteria, some viruses, often protozoa and worms. These are mostly harmless creatures inhabiting our mouths, throats and alimentary canals. Some may be not only harmless but also beneficial. How animals would get along without their internal fauna and flora is an intriguing question. The term 'germ-free life' conveys a clear meaning to most of us, but it is not satisfactory to the worker in this field. Having obtained his germ-free animals he often wants to introduce micro-organisms into them and then the subject of his study is no longer 'germ-free life'. So the word 'gnotobiology' is used, meaning "the study of organisms living by themselves or in association with other known species in the absence of all other living organisms".

This book by one of the pioneers in the field gives a comprehensive account of the present state of knowledge. The author begins with a philosophical approach to his subject, considering germ-free conditions in Nature and how far we are from attaining complete biological isolation in that killed, yet still antigenic, germs are likely to be present in the food of any germ-free animals. Dr. Luckey is evidently one of those who loves new words. Not content with gnotobiology, gnotobiotic and other derived words, he uses many other strange ones, most but not all of which are defined in a glossary. We read this sort of thing: "gnotophoric animals include mono-inoculated germ-free animals which have a monoflora and are therefore dibiotic". This is carrying jargon to extremes. And why has a dog carrying two species of worms to be called 'difaunated'? The opposite condition to germ-free is 'conventional' (the usual term), 'classic' or 'polycontaminated' (how he loves Latin-Greek hybrids!), and the process of restoring a germ-free animal to ordinary polycontaminated life is 'conventionalization'.

A full historical account of the subject begins with references to propagation of bacteria in pure culture (this is gnotobiology, but not germ-free life), and carries on to the point where germ-free kids, lambs and even

monkeys have been obtained. Hatching sterile chicks is fairly easy, but with mammals it is mostly necessary to start with Cæsarean section and laborious feeding with pipettes. Second generations of germ-free rodents have been obtained, so this complication need only be troublesome at earlier stages.

There are descriptions, with many photographs, of types of apparatus used to rear germ-free animals, from the very complicated to the relatively simple. Then there follows a chapter on nutrition; some diets are given in an appendix.

The heart of the book is Chapter 5, on the characteristics of germ-free animals; and there are numerous tables, some of them extending over several pages, giving details of chemical analyses of various viscera, intestinal contents and so forth, at different ages. Anatomical differences between conventional and germ-free animals are described; rather surprisingly the differences were in general not great. There were two exceptions to this: "organs in continuous intimate contact with micro-organisms were enlarged or more active in conventional than in germ-free animals"; this applied particularly to lymphoid tissue in the intestine and elsewhere. There was correspondingly a deficiency of lymphocytes and of globulins in the germ-free. More dramatic and serious was the great enlargement and distension of the cæcum in germ-free mammals, though not in birds. This interfered with reproduction and not infrequently caused premature death, sometimes following torsion. 'Conventionalization' quickly restored the cæcum to normal size. It is believed that the distension is caused by muscular atony, though how absence of germs could have that result is obscure.

The final chapter deals with gnotophoric animals, that is, germ-free animals inoculated with, or infected by, bacteria, viruses, protozoa or worms. Only too often, however, these obtained access by accidental contamination rather than design. Most attention is directed to the establishment of intestinal bacteria in germ-free chicks, rats and guinea pigs. It is scarcely surprising that some ordinarily harmless bacteria were lethal to previously germ-free animals, while others were not. The studies so far reported on viruses are disappointingly meagre. Indeed, the author grants that though germ-free animals are free from virus disease, it is hard to be sure that they are free from occult viruses.

There are more than 800 references, of which 47 are to papers by J. A. Reyniers, with whom the author was closely associated at the University of Notre Dame; 31 are from Dr. Luckey himself.

I cannot help feeling a little disappointed that despite the enormous amount of work carried out and despite the methodical uncovering of the basic facts of germ-free life, nothing spectacular or revolutionary in our notions of biology has come to light. Perhaps that was too much to hope or perhaps it is for the future.

CHRISTOPHER ANDREWEES

PROGRESS IN PLANT PATHOLOGY

Annual Review of Phytopathology

Vol. 1. Edited by James G. Horsfall, in association with Kenneth F. Baker. Pp. vii + 469. (Palo Alto, Calif.: Annual Reviews, Inc., 1963.) 8.50 dollars.

THE editorial committee of this new annual publication looks on it as a journal of synthesis, critical review and perspectives, in which the phytopathologists of the world can take the assembled facts from original publications and "meld them into an evocative and provocative intellectual structure", whatever that may mean. The contributors were asked for an integration of knowledge in addition to a critical evaluation and summary of the literature. In a brief opening chapter