suffered on joining a commercial firm; and, when the salary is high, the Inland Revenue takes the bulk of it. Because of this biologists, who are few in number, mostly prefer to stay in university posts. The direction of pharmaceutical research is therefore placed more and more in the hands of chemists, and it may be doubted whether the chemist always knows where the opportunity lies. This being so, the question arises whether more in the way of useful as distinct from academic research could be done in the universities. This might be arranged as a collaborative effort between the department of organic chemistry and the biological departments—biochemistry, microbiology, and pharmacology. Such collaboration, however, is rare, because the head of a department has his own research plans made without reference to those of other departments. If the plans concern the fundamental aspects of his work he is right to pursue them to the exclusion of others, for they are likely to prove of greater value to the nation and to the world. But it might be worth considering whether, without interruption of their own work, the heads of the departments concerned could form a committee to organize pharmaceutical research to be carried out by workers free from other duties. Such a suggestion would no doubt arouse opposition, for many would take the view that the field was an industrial one into which university workers should not enter. Nevertheless, with the concentration of talent in the science departments of some of our universities, such a scheme might achieve great results.

MALARIA CONTROL

The name of Sir Ronald Ross, who was born on May 13, 1857, will live for ever as one of the great benefactors of mankind. Though he was himself disappointed that his discovery of the transmission of malaria by the mosquito did not have the immediate practical results he hoped for, his work, as we recorded at the time of his death in 1932, "laid the foundation on which a truly scientific prophylaxis might be built, and [he] himself did much to build it." Since his death, and particularly in recent years, few subjects have been studied more thoroughly and more fruitfully than malaria. New methods of control and better drugs for prophylaxis and treatment have been discovered, and by the application of these discoveries the disease has been wellnigh overcome in some parts of the world. Quoting data gathered by the World Health Organization, Dr. Paul Russell[1] reports that eradication is practically complete in Barbados, Corsica, Chile, Cyprus, French Guiana, Italy, Mauritius, Puerto Rica, and the United States, while in another 15 countries the process is well under way. Yet the sober fact remains that malaria still ranks as one of the major diseases of the world, for in 1955 there were 200,000,000 cases of clinical malaria and over 2,000,000 deaths from it. The position may be summarized by saying that in well-populated and more advanced countries, if the necessary measures are adopted, the disease can be eradicated, but that in sparsely populated and underdeveloped regions only the fringe of the problem can be touched. There is much still to be done in working out the most efficient and economical way of applying these control measures, and many lessons to be learnt about the best way of maintaining control once eradication has been achieved. This is an expensive procedure and the need for it apt to be overlooked.

A recent issue of the *Bulletin of the World Health Organization*[2] brings together under one cover a series of papers on malaria control which were presented by international authorities at recent conferences. They give a comprehensive account of modern methods and modern trends of investigation, together with the results which have been achieved in certain countries. Emphasis throughout is on vector control, particularly by the use of the synthetic insecticides—D.D.T., gammexane, and dieldrin. The most important innovation of the last decade has been the development of residual spraying, a process which entails spraying the walls of huts and other dwellings with a suspension of one or other of these compounds so as to leave, after drying, a surface film of the insecticide. Under suitable conditions this remains active for some months (hence the term "residual"), and any susceptible mosquito which alights on the treated surface becomes contaminated and is killed by the poison. These compounds are equally effective as larvicides when scattered on the surface of or mixed with the water on which the mosquitoes lay their eggs, and thus can be used for killing the insects at every stage of their development.

Unfortunately the margin of effectiveness of residual spraying is not great, and mosquitoes, with the ebullient adaptability which characterizes most living

[1] Russell, P. F., reported in *Trop. Med. Hyg. News*, 1957, **6**, 9.
[2] *Bull. Wld Hlth Org.*, 1956, **15**, 361–862.
[3] Livadas, G. A., and Thymakis, K., ibid., 1956, **15**, 403.
[4] Chow, C. Y., and Soeparmo, H. T., ibid., 1956, **15**, 785.
[5] Gillies, M. T., ibid., 1956, **15**, 451.
[6] Bruce-Chwatt, L. J., ibid., 1956, **15**, 491.
[7] Frizzi, G., and Holstein, M., ibid., 1956, **15**, 425.
[8] Archibald, H. Munro, and Bruce-Chwatt, L. J., ibid., 1956, **15**, 775.
[9] Houel, G., ibid., 1956, **15**, 767.
[10] Ciuca, M., ibid., 1956, **15**, 725.
[11] Simic, C., ibid., 1956, **15**, 753.

creatures of a lower order (and especially those which can be classified as pests), are beginning to develop resistance to these insecticides, a circumstance which arouses some anxiety for the future. It is true that they have not yet reached the carefree level of immunity acquired in certain localities by the housefly, and that resistance to one of the insecticides does not necessarily mean resistance to all, but the danger is nevertheless there. It is causing particular concern in Greece, and G. A. Livadas and K. Thymakis[3] give an account of the position in that country, while C. Y. Chow and H. T. Soeparmo[4] report a somewhat similar state of affairs in Java.

Resistance of this kind is not the only reason why residual spraying sometimes fails to do all that is expected. Certain species of mosquito have a tendency to rest outside rather than inside man-made shelters—a characteristic which has been called exophily—and thus may fly into a sprayed hut, bite their victim, and fly out again without alighting on the poisoned surface. Such behaviour may be a natural or instinctive habit, but this is not always the case. *Anopheles gambiae*, the most important vector in Central Africa, acts in this way for a different reason; it is irritated by the insecticide, and, if it alights on a treated surface, quickly flies off again before it has picked up a lethal dose. Clearly it is important to know the exact habits of each vector species, not only in general terms but in each particular area, for there is considerable local variation in their behaviour, and new ways of studying mosquito ecology are now being used. It is important to be able to estimate the age of the female mosquitoes, and information on this point can be gleaned from the stage of development of the ovaries. M. T. Gillies[5] now describes a mating-plug found in the common oviduct which persists for 12 hours after mating, and is finally absorbed within 36 hours. This provides an objective feature for recognizing one section of the nulliparous population, and, taken in conjunction with other characteristics, is of value in assessing the age composition of different mosquito catches, say before and after spraying. Again, some mosquitoes feed on domestic animals as well as on human beings, and in certain circumstances it is necessary to know the source of the blood in an engorged insect. For this purpose a delicate precipitin test devised by B. Weitz has been used, by means of which the species of the animal "donor" can usually be recognized with certainty. L. J. Bruce-Chwatt[6] discusses the use of radioisotopes for labelling insects to be used for experimental purposes, while G. Frizzi and M. Holstein[7] describe variations in the chromosome structure of *A. gambiae* which they believe may be related to differences in the behaviour of that versatile insect in different localities. By these and other perhaps more commonplace methods a store of useful knowledge is rapidly being accumulated.

In general, it can be said that chemoprophylaxis plays a relatively minor part in modern control schemes, and there are only scanty references to it in this *Bulletin*. H. Munro Archibald and L. J. Bruce-Chwatt[8] successfully suppressed malaria in Nigerian schoolchildren with pyrimethamine; and in Morocco, where vector eradication is well advanced, G. Houel[9] has obtained satisfactory results by mass treatment with widely spaced doses of chloroquine, amodiaquine, and pyrimethamine. In Rumania[10] and Yugoslavia[11] chemoprophylaxis has been used as an adjuvant to insect control, mainly with a view to eliminating gametocyte carriers, and this indeed is the policy generally recommended. Those who had experience of the striking successes achieved by chemoprophylaxis in the second world war in circumstances where vector control was impossible may wonder if this very effective method of attacking the problem is receiving as much attention as it deserves.

It would be unrealistic to imply that there is any likelihood that research now in progress will provide a short cut to the eradication of malaria throughout the world. It is mainly designed to allow existing methods to be used with more effect. Given the necessary funds and the necessary manpower, there is no reason to doubt that world-wide eradication could in time be achieved, but this is at present economically impracticable. The first and fundamental requirement in backward countries where the disease is now rife is steady progress in education and an accompanying increase in material prosperity. Only when these have undergone a substantial improvement can it be hoped to apply with the necessary intensity and determination the methods of malaria control which are proving successful in more developed countries.

MEDICAL SERVICES IN NORWAY

Norway seems to have solved the insoluble. It has provided a comprehensive medical service for the whole population in a way that meets with the approval of everyone concerned—public, profession, and Government. Our Norwegian colleagues explained the system to the Council of the World Medical Association when it met in Oslo last week. They laid great stress on the fact that their system of organized medical care had evolved slowly, and that in this way they had escaped the manifest disadvantages of sudden revolu-