permit each author to indicate the present problems of his own speciality, on an extensive perimeter. In addition to the authors and the members of the Scientific Council of the Solvay Institute, a limited number of leading scientists concerned with this field were also invited to attend. On this rather exclusive basis, those present found it feasible to discuss and define their difficulties, as well as to communicate their progress, without undue pressure from other speakers more anxious to communicate, than to attempt in common any Socratic assessment of ignorance. As in the case of other recent meetings of the Solvay Institute, on inorganic structural chemistry (1956), on nucleoproteins (1959) and on energy transfer in gases (1962), the invited papers and considered discussion contributions resulting from the compact team-work of the present meeting will be published in full, as soon as possible.

At this meeting some highly suggestive theoretical considerations about photo-excited molecules attracted much discussion. Advances in theoretical chemistry indicate that interactions between excited molecules may differ markedly from the situation described by the more familiar force fields and potential energy surfaces for molecules in the ground state. Compared with those, even the analogues of van der Waals' forces are likely to be of considerably longer range between excited species. In a molecular encounter, at the stage near what would be the transition state for unexcited molecules, more intense interactions likewise call for profound modifications in their description when they refer to electronically excited species. A general enlargement of the 'molecule volume' may be anticipated, within which the distribution of electronic charge can affect the course of chemical reaction between excited species.

This general inference points to a number of novel directions for theoretical and experimental research. Quite generally, even when apparently non-bonded, the influence of neighbouring molecules on a specific molecular reaction can be much more profound, when this involves photo-excited species, than for molecules in the ground

state. A particular instance of the controlling influence of neighbours, which was extensively discussed at the meeting, but for which there still remains much to be clarified, refers to photo-chemical reactions in the crystalline state, or in solid solution.

Striking solvent effects on reactions between excited molecules may be closely related to this general principle, and several instances were discussed. Again, effects of pressure in determining the relative role of alternative chemical reactions should be much more prominent and distinctive, in favourable cases, than can normally be expected for reactions in the ground state.

The complexity of molecules the photo-chemical reactions of which can now be studied experimentally has increased in recent years to a notable extent, through the development of new methods of photo-excitation, and the use of various refined methods of chemical identification of the products. This has given new impetus to highly suggestive researches on problems such as the transmission of excitation energy within a polyatomic molecule, resulting from primary absorption of photons, or from irradiation by γ -rays or particles. Regions of a photo-excited molecule that may undergo quite diverse reaction can be examined on a selective basis. In addition to the great scientific interest of researches in this general direction, the technological mastery of economic production by photo-chemical means of quite complex molecules offers suggestive possibilities; though these were not discussed at any length at the meeting, they seem likely to attract more attention to this field in the future.

Calculations of the distribution of electron densities in molecules in their ground state can now be made with considerable confidence in favourable instances. However, there was some discussion about the extent to which such density distribution can guide assessments of reactivity of excited states. Novel ideas about charge transfer between excited molecules, put forward at the meeting by R. S. Mulliken, provided further fascinating glimpses of important future work in a field which promises to grow rapidly.

A. R. UBBELOHDE

SCHISTOSOMIASIS

MALARIA has been aptly called 'public enemy No. 1' and the title 'public enemy No. 2' might well be given to schistosomiasis, a lingering and often fatal disease of man and other animals including farm stock. The disease is caused by parasitic trematode flatworms belonging to the genus *Schistosoma* or *Bilharzia*. The latter name commemorates Dr. Bilharz, who first discovered the eggs of the parasite in Egypt and who was a pioneer in research on this trematode and on the disease it causes. Species of this genus, unlike other parasitic trematodes, are unisexual and live, not in the digestive tracts of their hosts as do many parasitic trematodes, but in the blood vessels; for this reason they are often called 'blood flukes'.

It is indeed good news that the Rockefeller Foundation, continuing its policy, so fruitful in the past, of giving financial aid to studies of the grave diseases that plague the world, has decided to undertake field investigations of schistosomiasis. The Foundation has been interested in schistosomiasis for 40 years. These investigations will be carried out on the small island of Santa Lucia in the Windward Islands; the Government of the Islands has also decided to give financial aid to these investigations. Schistosomiasis causes incalculable suffering and economic loss. It is estimated that some two hundred million people suffer from it in Egypt, Africa, South America, the Caribbean Islands, India and the Near and Far East. It has crippled large human populations and also agricultural progress, for some species of these trematodes infect farm stock. Egypt has been called the 'cradle' of the

disease, because formerly it was prevalent there (the eggs of these trematodes have been found in Egyptian mummies dating from 1,000 B.C.).

Schistosomiasis is a disease that especially affects agricultural peoples who work on irrigated land or irrigation systems. Man is infected by larval forms of the trematodes (cercariae) which develop in certain species of aquatic snails living in streams, ponds, lakes and irrigation systems in which he may work or bathe. The cercariae are able to penetrate human skin and enter the blood stream, which carries them to the blood vessels of the abdomen. Here they settle down and become sexually mature and lay spined eggs which work their way out of the infected person through the wall of the intestine or bladder into the faeces or urine. In so doing they cause bleeding from, and other forms of damage to, the walls of the bladder or intestine. Human faeces and urine contaminated with the eggs of the trematodes are frequently discharged into local waters. The eggs liberate larvae into the water which penetrate into snails living under water and develop inside the snails into cercarial larvae which leave the snails and can subsequently infect man.

It will be clear, therefore, that the disease is, in this sense, man-made.

Control of the disease aims at: (1) Protection of the human skin from the cercariae by wearing suitable clothing or by avoiding infected waters. (2) Destruction of the species of snails involved by means of chemical sub-

stances (molluscicides) and by measures which will make the environments of the snails unfavourable (clearing of vegetation, etc.). (3) Education of the people in the life-history of the parasite and the mode of infection, and in the need for better methods of disposal of their excreta.

Much research is needed on molluscicides and on methods of applying them, and on the habits and biology of the species of snail involved. Investigation of methods of treating infected people and on drugs suitable for this purpose is also necessary. Unfortunately the drugs so far discovered that will kill the adult trematodes in the blood vessels are compounds of arsenic or antimony, which may have serious effects on the patients treated

with them. The World Health Organization* is also sponsoring work on this disease, and Prof. George MacDonald has given up his directorship of the Ross Institute of the London School of Tropical Medicine and Hygiene to lead a team based at Makerere Medical School, Kampala, Nigeria, which will work on schistosomiasis. In 1961 the Rockefeller Foundation gave a grant of 142,500 dollars to aid this work. The team will work in co-operation with the staff of the East African Medical Research Council on the disease in Africans in the area of Lake Victoria.

G. LAPAGE

* WHO Technical Report Series, No. 299 (price 5s., from H.M.S.O., P.O. Box 569, London, S.E.1) and *Snail Control in the Prevention of Bilharziasis* (price 30s., from the same address).

HYDATID DISEASE

A NUMBER of publications recently issued by the National Hydatids Council of New Zealand will be of interest to anyone concerned with public health.

One of these, entitled *Hydatid Disease in New Zealand**, describes the events which led to the establishment of the National Hydatids Council. It gives statistics about the prevalence of the hydatid tapeworm in New Zealand dogs and the incidence of hydatid cysts, which are the larval (bladderworm) stages of this tapeworm, in cattle, sheep, pigs and man, together with figures of the incidence of the cysts of another tapeworm of the dog, *Taenia hydatigena*. It has been estimated that hydatid disease is more common in New Zealand than in any other country, and that as a cause of death it is three times more prevalent in New Zealand than in Australia and twenty times more than in England and Wales. It is five times more prevalent in Maoris than in Europeans, and at the present time more than 20,000 New Zealanders may be infected with hydatid cysts. This is ascribed to the fact that the range and degree of moisture in New Zealand favour the survival of the eggs of the tapeworm after they have been passed out of the dog in its excreta. Pertinent is the fact that New Zealand farmers feed their dogs on uncooked offal containing the hydatid cysts, from which the adult tapeworms develop in the food canal of the dog. The pamphlet also describes early and subsequent attempts at control of the infection in man. It discusses methods of educating the public in the ways in which infection with hydatid cysts may be acquired, spread of knowledge of this kind and its effects, the general awakening of public conscience about the disease, and the formation of the National Hydatids Council.

The function of the Council is to exercise central control of measures used for the eradication of the tapeworm and of the disease caused by its hydatid cysts. It is now an offence to fail to register a dog or to bring it to one of the control centres for dosing with a drug that will kill the tapeworm. Furthermore, it is illegal to feed a dog on raw offal or to allow it to have access to such. As a result, the infection of dogs with the hydatid tapeworm has been reduced in about seven-eighths of New Zealand to 2 per cent, and in half the country to 1 per cent or less. Control of *T. hydatigena* has been less satisfactory, but there has been a considerable reduction of the rate of infection of dogs with this species. It is, however, hoped that it will be controlled by the measures taken to eradicate *E. granulosus*—the life histories of these two species being similar.

Further information about the work of the National Hydatids Council is given in the fifth annual report and statement of accounts of the Council for the year ended

March 31, 1965†. The Council has also issued a valuable pamphlet entitled *Hydatids Eradication in Iceland*‡, which describes the remarkable achievement of that country, in which, during 1860–70, some 15,000–20,000 dogs heavily infected with *E. granulosus* were kept by a total population of 70,000 people, most of whom were sheep farmers living under relatively primitive conditions. In 1840 the Chief Medical Officer estimated that one person in every seven was infected with hydatid cysts. Later evidence showed that one in every four or five was infected. Methods used to control the disease included: (1) education of the public in the life history of the tapeworm and the parts played in it by man, dog and sheep; (2) taxation of dogs in order to limit their numbers—at present there is a tax of £7 10s. on each pet dog and 15s. on each working dog, and in some towns the local authorities are empowered to forbid the keeping of dogs; (3) compulsory annual treatment of all dogs with an anti-tapeworm drug at special centres; (4) enforcement of the law of 1890 forbidding the feeding of dogs on any entrails of sheep or cattle and enacting the deep burial or burning of the internal organs of sheep infected with hydatids; (5) improvements in the general hygiene of the people and in certain farm practices likely to favour the infection of man with the cysts.

A table demonstrates the dramatic decline in the incidence of human infections with hydatid cysts that followed these energetic measures. In 1904 it was possible to conclude that hydatid disease was practically extinct in Iceland and there was a corresponding decrease in the incidence of the cysts in sheep and also of the tapeworm dogs. Although *E. granulosus* and its hydatid cysts thus appear to have been eradicated from man in Iceland, *T. hydatigena* and its cysts in sheep have not been eradicated; however, their incidence has been reduced.

For readers who are not parasitologists but who require a clear and accurate account of the structure and life history of the hydatid tapeworm *E. granulosus*, the National Hydatids Council has issued a publication entitled *Parasitic Animals, with Special Reference to Hydatid Disease*§. It is well illustrated and gives an excellent account of the characteristics and life history of *E. granulosus*. Also dealt with are the relationship of this parasite with other tapeworms and the epidemiology of hydatid disease, its incidence in New Zealand and the measures designed to prevent this disease. Another table gives a comparison of the appearance, lengths and hosts of the seven species of tapeworms found in dogs in New Zealand.

G. LAPAGE

† National Hydatids Council, Wellington, New Zealand. Fifth Annual Report and Statement of Accounts, year ended 31st March, 1965. Pp. 40. (Wellington: The National Hydatids Council, 1965.)

‡ Information Bulletin No. 15: *Hydatids Eradication in Iceland*. Pp. 11. (Wellington: The National Hydatids Council, 1965.)

§ *Parasitic Animals, with Special Reference to Hydatid Disease and its Prevention*. (Reprinted from *Biology for Sixth Forms*. Teach and Test Publications, Ltd., Otahuhu, New Zealand.) R. M. Miller and B. M. B. Harris. Pp. 36. (Wellington: The National Hydatids Council 1965.)

* *Hydatid Disease in New Zealand: An Account of the Events leading to the Establishment of the National Hydatids Council, and the Methods adopted to eradicate the Disease*. By F. S. Maclean. Pp. 48. (Wellington: The National Hydatids Council, 1965.)