become infinite but only about 0.03 F m^2. Mead attributed this deviation to the penetration of the electric field into the metal, giving rise to an effective capacitance at each metal-insulator interface. Ku and Ullman (*J. Appl. Phys.*, **35**, 265; 1964) supposed that the electronic charge terminated abruptly at the metal surface, and they obtained reasonable agreement with Mead's results. Mott and Watts-Tobin (*Electrochim. Acta*, **4**, 79; 1961) assumed, however, an exponential decay of the electric field into the metal surface and found that although field penetration adds about 0.05 nm to the electrode spacing, it does not contribute a capacitance to the interface.

Recently other workers have joined the debate, working with a metal-vacuum rather than a metal-insulator interface. Tsong and Müller (*Phys. Rev.*, **181**, 530; 1969) assumed an abrupt termination of electronic charge in the same way as Ku and Ullman, and came to a similar conclusion that the metal-vacuum interface has a capacitance which significantly affects a parallel plate capacitor. Now Theophilou and Modinos have found that the capacitance at the interface can be ignored. If they are right, it is not possible to explain Mead's results in terms of field penetration. Clearly what is really being discussed is not the capacitance of a parallel plate capacitor, which is involved only as an interesting result of the authors' theories, but rather the abruptness or otherwise of the change in electric field at the surface of the metal. While the theoreticians sharpen their pencils in readiness for the next round, it is interesting to consider what effects the outcome of the debate may have.

The most important application, apart from the study of thin film capacitors, is in field ion microscopy. The specimen in a field ion microscope is subject to an intense electric field ($\sim 10^{10}$ V m^{-1}), and field penetration, together with the related effect of surface atom polarization, can change the binding energy of a surface metal atom or of a foreign atom adsorbed on the surface. When operating a field ion microscope it is sometimes necessary to evaporate the surface atoms by means of an electric field, that is to raise the electric field sufficiently to overcome the binding energy so that the surface atoms are evaporated in a controlled manner. When an alloy is field evaporated, it is usual for one element to evaporate more easily than the other, and this effect—selective evaporation—is of crucial importance in the interpretation of alloy images. If the binding energy of a surface atom is altered by field penetration, the field evaporation behaviour is also altered, and it is important to know the magnitude of this change. Fortunately for field ion microscopists, the results of both Tsong and Müller and of Theophilou and Modinos are qualitatively similar, so whatever the outcome of their debate, the resulting corrections to field ion theory should be fairly small.

EPIDEMIOLOGY

Hepatitis and Flying-pins

from a Correspondent

THE epidemiological concepts of hepatitis B infection (serum hepatitis) have recently undergone a significant change (see a review by Zuckerman, *Hepatitis-associated Antigen and Viruses*, North Holland; 1972). The demonstration that type B hepatitis virus was infective by mouth and the finding that the infection was endemic in closed institutions, the prevalence of infection in adults in urban communities, the carrier rate and age distribution of hepatitis B antigen (Australia antigen) in different geographical regions and the relatively high incidence in poor socio-economic environments, have altered the epidemiological dogma that type B hepatitis was spread exclusively by blood and blood products through the parenteral route. There is also some evidence for the transmission of type B hepatitis by intimate personal contact and possibly by the sexual route. Although the modes of transmission of this infection in the tropics are similar to those in other parts of the world, other factors may be of importance. These include traditional tattooing and scarification, ritual circumcision and repeated biting by blood-sucking arthropod vectors.

Preliminary results of investigations into the role which biting insects may play in the spread of type B hepatitis are conflicting. No consistent association could be found between the notification of hepatitis and the months of high or low rainfall or with the period immediately after the rains in eight countries in Africa and Latin America (Cockburn, *Amer. J. Dis. Child.*, **123**, 346; 1972). Although this does not exclude the possibility that biting insects may play a role in the spread of hepatitis, these observations imply that those mosquitoes which multiply with the rains may not be involved.

In another study, in New Guinea, the incidence of hepatitis B antigen was compared, in the same population, with that of antibody to several arboviruses of groups A and B (Hawkes *et al.*, *Amer. J. Epidem.*, **95**, 228; 1972). The incidence of arbovirus antibodies correlated strongly with that of mosquito activity, and it was inversely related to altitude. On the other hand, the incidence of detectable hepatitis B antigen was not related to either mosquito activity or to altitude. The prevalence of arbovirus antibodies in the population also increased cumulatively with age, whereas the incidence of hepatitis B antigen did not increase significantly with age. Moreover the different prevalence rates of antigen among ethnic groups living in the same geographical areas are inconsistent with vector-borne infection.

There is one report, however, which is yet to be confirmed, that some species of mosquitoes may serve as biological vectors for type B hepatitis infection (Smith *et al.*, *Nature*, **237**, 231; 1972). Colonies of *Anopheles gambiae*, *Culex pipiens fatigans* and *Aedes aegypti* were maintained from the egg to the adult stage. Newly emerged mosquitoes were starved for two days and later fed experimentally on blood with and without hepatitis B antigen. Surprisingly, the *Anopheles* and *Aedes* species refused to feed on such blood and died of starvation, although the controls did feed on blood without the antigen. Hepatitis B antigen was found by the immunofluorescent antibody technique in the lumen of the gut of the mosquitoes immediately after feeding on antigen-positive blood, and the antigen persisted in the lumen of the gut for ten days. Antigen reappeared in the salivary glands after three weeks. The antigen was also detected in the lumen of the gut and the salivary glands of infected culicine mosquitoes that died after eight weeks. More recently, 187 pools of mosquitoes caught in the wild in Kenya and Uganda were tested for hepatitis B antigen using the solid-phase radioimmunoassay technique (Prince *et al.*, *Lancet*, ii, 247; 1972). The antigen was detected in twenty-eight pools of mosquitoes representing eight different species. The trapped mosquitoes were from human bait collection and would therefore be likely to feed on human hosts. *A. aegypti* mosquitoes were also fed experimentally on a human chronic carrier of hepatitis B antigen and on a healthy subject, and the rate of disappearance of detectable antigen was investigated in the mosquitoes, which were subsequently maintained at 30° C. The antigen disappeared in parallel with blood meal digestion.

Mosquitoes in the tropics feed every two or three days and, if feeding on man, mosquitoes in certain tropical zones have at least a one in ten chance of feeding on blood containing hepatitis B antigen, because of the high prevalence of this antigen in the indigenous human population. It is considered possible, therefore, that mosquitoes may play a mechanical or a passive role in the spread of hepatitis B infection. As a corollary, other orders and families of blood-sucking arthropods may play a similar role and further studies are required. A new dimension has thus been added to the epidemiology of hepatitis B infection in man.