

Heine have considered a model d band metal in which the only scattering phase shift is for  $l=2$ , being of a resonance form. One advantage of this approach is that the energy of the surface states is deduced relative to that in well known band structure calculations. The mathematics comes in matching the wave-function and its derivative inside the metal, composed of evanescent Bloch waves from all the bands, with that pertaining outside. They considered specifically the (100) surface of a face-centred cubic metal.

The result is a narrow band of surface states close to the lower end of the band gap formed by hybridization of the sp band and the d band. This seems to occur at between 4 and 5 eV below the Fermi energy in nickel and between 5 and 6 eV below the Fermi energy in copper, coinciding with the energies at which photoemission spectra show peaks in the density of states.

The exact interpretation of photoemission spectra is not always clear. The possibility that the alleged surface effects may be caused by impurities cannot be ruled out, but the idea that surface states should contribute to the spectra is entirely reasonable. Although optical absorption occurs to a depth of several hundred Ångströms in the solid the electrons excited near the surface have a much higher probability of escaping and being observed. Moreover, absorbed contamination has been found to affect the peak in nickel (T. A. Callcott and A. U. MacRae, *Phys. Rev.*, **178**, 966; 1969) and this is consistent with the surface states being important.

The mystifying existence of one or two non-magnetic layers on the surface of iron may also be explained on this picture (see *Nature*, **221**, 1193; 1969). Forstmann and Heine point out that the contribution to the surface states from the 3d electrons must be subtracted from the bulk bands, and this means that the Bloch states would be diminished in amplitude over the two outer layers. This in turn implies a possible reduction in the exchange energy and a consequent drop in the magnetic moment. In the original experiment with iron films, it was not established clearly whether the demagnetized layers were caused by interaction with the copper substrate or by a modification of the exchange energy at the open surface of the iron. But on this latest evidence, it seems that the importance of surface states has not been overestimated.

#### FUNGAL VIRUSES

### Infectivity Achieved

from our Virology Correspondent

THERE has been doubt as to whether the particles found in various species of the fungus *Penicillium* are in fact viruses, because no infectivity has so far been reported. Now, however, workers in this field can hope to feel justified in using the term. Dr P. Lhoas (Imperial College, London), in his contribution to the symposium of the Society of Chemical Industry held at Imperial College on June 23, claimed that he has obtained infection into a virus-free strain of *Aspergillus niger*. Virus particles, containing double stranded RNA like those found in *Penicillium*, have recently been found in certain species of *Aspergillus* by G. T. Banks *et al.* One of the main difficulties in this work on infectivity is that the infected fungi show practically no morphological differences from the non-infected ones, and therefore detection of whether virus is present has to depend on exam-

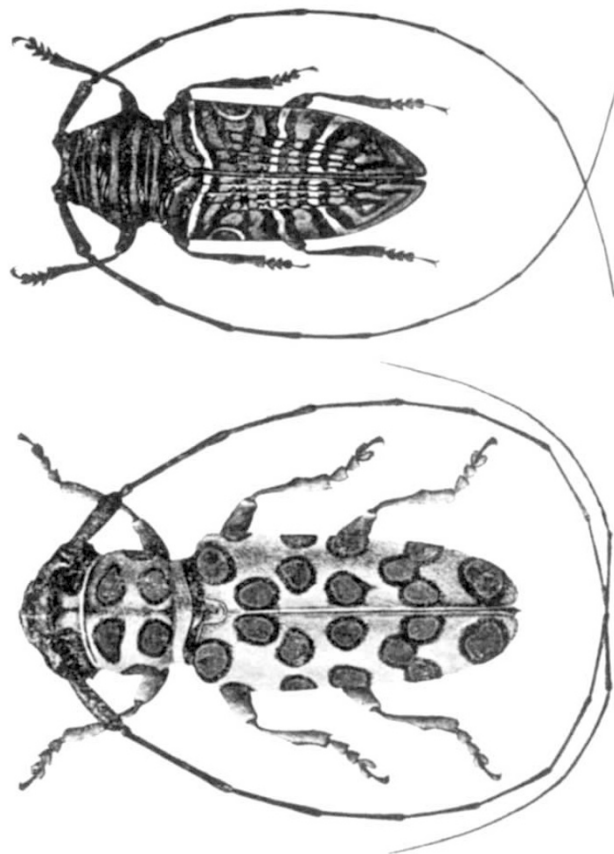
ination of preparations under the electron microscope.

Approaches to the problem of infectivity have included attempts at curing the infected strain and then trying to reinfect it. This poses the questions, first, has the strain mutated during curing, and second, is the virus preparation used still capable of infection?

Dr Lhoas achieved his infectivity by a method in which these doubts were eliminated and which coped with the absence of selective methods for the newly infected strain—that is, by the formation of heterokaryons between infected and virus-free strains. (A heterokaryon is a strain derived from the two parents and contains nuclei and cytoplasmic material from both.) By first obtaining mutants of the two strains with visible markers, so that they could be easily distinguished and also to show that no contamination had occurred, it was then possible to separate the two strains derived from the heterokaryons and to look for the presence of virus.

He was able to observe virus particles in what had been the virus free strain even after repeated sub-culture. He pointed out, however, that the degree of infection was low because only a small number of particles were observed, and these were surrounded by other particulate matter. He went on to say that his future work will include investigation of this to see if it has any relation to the virus, and also further infection studies using the newly infected strain.

### Mozambique Longhorns



Two members of the Lamiinae subfamily, *Zographus hieroglyphicus* (above) and *Dinocephalus ornatus* (below). From G. da Veiga Ferreira, *Revista de Entomologia de Moçambique*, 9, Nos. 1 and 2, 1966.