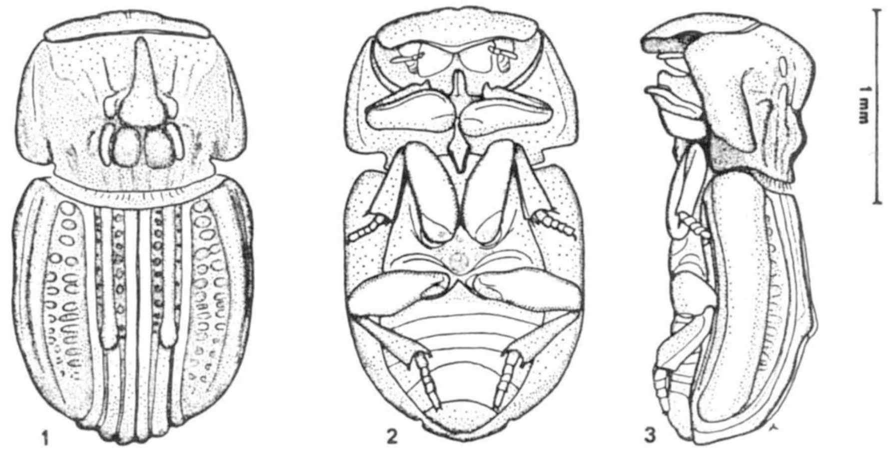
ENTOMOLOGY

Termitophilic Beetle



A bizarre, flightless and blind scarab beetle, only 2 mm long, has been found by J. Krikken in the Wasmann Collection in the Natuurhistorisch Museum at Maastricht. The beetle, shown here, had passed unnoticed in the museum since the beginning of this century when it was collected by N. Holmgren from a termite nest in the mountains of south-eastern Peru. Its affinities seem to be obscure, but Krikken (*Proc. K. Ned. Akad. Wet.*, C, **73**, 469; 1970) describes it as a new genus and species (*Termitaxis holmgreni*) in the aphodiid tribe Rhyparini. The illustration shows (1) dorsal, (2) ventral, and (3) lateral views.

BEHAVIOUR

Labour Rewarded

Experimental Psychology Correspondent

IT might be supposed that when an animal is offered the choice between working for food and being given it without working, other things being equal it would choose the latter. Indeed, the assumption it would choose the less laborious alternative underlies a good deal of theorizing about learning in animals. The appearance recently of two reports which indicate that animals seem to prefer to work for food may therefore be surprising.

In the first article (*Science*, **166**, 399; 1969), A. L. Neuringer had shown that pigeons would peck keys and rats would press levers to obtain food although exactly similar food was freely available in a food cup in the experimental chamber. D. Singh now shows that rats still prefer to work even when the amount of work is increased, and even when working provides food less quickly than when it is not worked for (*J. Comp. Physiol.*, **73**, 320; 1970).

In Singh's experiments rats accustomed to being fed for only 1 h per day were trained on alternate days either to work for food by pressing a lever, or to receive it free at the same average rate. In subsequent tests with the free food at one end of the experimental box, and the food to be worked for simultaneously present at the other end, rats showed high and consistent preferences for working. Ten rats which were required to make one lever press per pellet of food gained an average of between 78 and 94 per cent of their food by working on each of the four days of preference testing. Even when required to make eleven presses per pellet, rats' preferences for food gained by working did not fall below 67 per cent on any of four test days.

In a further similar experiment rats, instead of acquiring free food at the same mean rate as they had achieved in their previous working session, were put at a disadvantage by working, because they received food 12.5, 25 or 50 per cent faster by accepting it free. Only in the last of these conditions did the animals' preferences switch to free food.

Singh also presents an experiment in which children obtained marbles either free or by pressing a lever for them; and again working was preferred. He interprets his data as meaning that animals (including children) prefer to be in control of their environment. Though this argument has a certain force, particularly in relation to his own experiments in which rats not working for food had to wait for each pellet to arrive, a situation that may in itself be frustrating, his explanation seems less apt when Neuringer's results are considered. In that situation animals had a pile of free food available, and were perfectly in control of whether they ate it or not.

The sources of this motivation to work, or to do something which is instrumental to gaining access to food, thus still seem obscure, though it is obviously important for any theoretical analysis of motivation that they be recognized. This is, however, exactly the kind of experimental result which could appeal to the imagination of those persons who are becoming famous for their fanciful extrapolations from animal to human behaviour.

How a Virus Assembles

KLUG and his colleagues have three papers in next Wednesday's *Nature New Biology* (**229**, 37; 1971) in which they have gone no small way to defining the sequence of events in the assembly of tobacco mosaic virus. It is known that the protein alone can generate virus-like particles with helically arranged subunits. It can also under marginally different conditions form superficially similar rods, which are, however, made up of stacked disks, each containing seventeen protein subunits. The important new discovery is that a stable intermediate exists in the process of assembly to normal helical particles, and that this is a double disk, with two layers of seventeen subunits. In order to generate the helical particle these disks have to dislocate to a "lock washer" form. A transition between washer and lock washer evidently comes about in response to a change in *p*H, when two ionizing groups in each subunit become masked. These can be identified with the anomalous carboxyl groups recognized by Caspar in the intact virus.

The double disk is evidently the basic entity in the polymerization process, and its formation from smaller pieces is rate determining. This may be compared with the rate-determining formation of an oligomeric nucleus as the first step in many biological association processes, the ensuing polymerization on these "seeds" then being rapid. The growth of the TMV particle is greatly accelerated by the presence of its endogenous RNA, but only when the protein is already present as preformed double disks. When, on the other hand, the protein is in the "disaggregated" state, which in fact consists of small aggregates, and in particular a high proportion of trimers previously suspected to be the polymerizing unit the formation of helices remains very slow. With disks the growth of virus particles is complete in minutes. The RNA evidently recognizes the protein in the first disk, and thereafter disks are progressively added. The vital RNA recognition site is in the 5′ terminal region, for after treatment with spleen exonuclease, which degrades from the 5′ end, the rate of particle growth is greatly retarded. Degradation at the 3′ end with venom enzyme by contrast has little effect. It is important biologically, Klug *et al.* suggest, that the "relaxed" associated form of the protein is the disk. If the *p*H and salt concentration are not allowed to deviate greatly from the putative conditions prevailing in the cell, it is only in the presence of the RNA that the equilibrium is displaced towards the lock washer form as a step in the helical association.