These problems are social and religious rather than purely technical, and their solution depends on the informed education of the agricultural student and adviser, and through them of the farmer himself. For this purpose the present book is an admirable source of balanced and reliable information, and may well serve as a standard text-book on Indian grassland husbandry.

The standard of production, though not high, is serviceable and the price reasonable. Many of the illustrations of grassland types leave much to the imagination, and the legends on the map of soil types require a strong magnifying glass, but these are minor blemishes on a most timely and useful publication.

J. P. Cooper

PHYSIOLOGICAL ECOLOGY

The Water Relations of Terrestrial Arthropods

By Prof. E. B. Edney. (Cambridge Monographs in Experimental Biology, No. 5.) Pp. vi+109. (Cambridge: At the University Press, 1957.) 15*s*. net.

NATURALISTS have for a long time been aware that insects and many other arthropods live under conditions which often expose them to the danger of considerable desiccation. Physiologists have, in the laboratory, studied the effects of temperature and humidity on these animals, and have discovered mechanisms which enable them to survive under what would appear to be unfavourable conditions. In this book Prof. Edney has brought together the results of these laboratory investigations in such a way that ecologists will be able to find many explanations of their field observations.

Insects, and some other arthropods, are the only 'small' animals which are not either aquatic or restricted to an environment where the air is normally saturated. They are able to live under these conditions because they have a more-or-less waterproof cuticle, and because they have respiratory mechanisms which enable them to take in sufficient oxygen and lose a corresponding amount of carbon dioxide without also losing an excessive quantity of water. There are, of course, limits to the efficiency of these processes, and it is probably the need to respire which finally limits the distribution of many insects. We have known for twenty-five years that, of the water which is evaporated from insects, particularly those adapted to dry environments, practically all is lost through the respiratory spiracles, and scarcely any through the general surface of the cuticle, but a full elucidation of the nature of this cuticle, and the reasons for its remarkable properties, has taken a long time, and work is still proceeding. Prof. Edney devotes nearly a third of his text to an admirable account of our present knowledge of this subject, and he makes it as easy to understand as is possible when dealing with such an essentially complicated subject.

The second way in which these animals withstand dry conditions is by having developed excretory mechanisms which function with the minimum loss of water. Not only have they evolved means of eliminating waste nitrogen in insoluble forms (uric acid, guanine) which can be voided without any substantial loss of water, so that the urine is often practically solid, but also many have complicated mechanisms which cause the fæces also to be bone-dry. These mechanisms cannot, however, prevent considerable fluctuations in water content and in the concentration of salts and other substances in insect tissues. The ability of the insects to function normally while these changes are taking place is a further important reason for the success of the group in colonizing such a wide range of habitats. It may seem surprising to find that five pages of this short book of only 93 pages of text on terrestrial arthropods are devoted to osmotic regulation in aquatic forms, but the work described here is clearly relevant to the main argument and its inclusion is fully justified.

The ways in which arthropods gain water is also discussed. Considerable space is devoted to the interesting, and still unsolved, problem, of how some arthropods take up moisture from unsaturated air. This problem, though interesting to the physiologists, is of only minor importance in ecology, and it would perhaps have been better to have devoted more attention to the commoner methods by which water is gained. It is surprising, for example, to read that "drinking of liquid water—is confined to adults; larvæ obtaining their water with the food". The naturalists who preceded the present generation of ecologists were familiar with the way in which caterpillars would drink, and one species, the drinker caterpillar, was particularly well known in this connexion. This is, however, only a minor point, and it is very satisfactory to find the sometimes controversial question of metabolic water so clearly dealt with.

The body temperature of small animals is normally very close to that of the atmosphere, but may be higher due to insolation, and lower due to evaporation. Such cooling is relatively uncommon as it leads to desiccation, but Prof. Edney himself has shown that in woodlice it may not be unimportant. As a whole these animals supplement the physiological mechanisms by their behaviour; they can not only withstand some exposure to unfavourable conditions, they are also able to react in such a way as to find the least unfavourable positions within their environment.

Kenneth Mellanby

THERMO-ELECTRIC POWER

Semiconductor Thermoelements and Thermoelectric Cooling

By A. F. Ioffe. (Translated from the Russian.) Pp. vii+184. (London: Infosearch, Ltd., 1957.) 42*s*.; 6 dollars.

IN the early years of this century the possibility of using the thermo-electric effect to produce electrical power was explored. The idea was abandoned because of the relatively small thermo-electric powers of metal junctions. The more recent development of semiconductors with controlled constitution and physical characteristics has caused a revival of interest in the thermo-electric generator and also in the use of the Peltier effect to provide a refrigeration unit, since semi-conductor junctions provide relatively large thermo-electric powers. In the present book Prof. A. F. Ioffe has combined two other works, one on the basic theory of thermojunctions and the other on application of thermojunctions to refrigeration. In his Institute for Semiconductors of the Soviet Academy of Sciences considerable effort has been given to the development of efficient semi-conductor thermo-elements, both for power generation and for refrigeration. It is clear from the text that the Institute is fully aware of the basic problems involved