would deprive the micro-organisms of a factor essential for their growth and/or metabolism. It may even be that pining and other wasting diseases are due to cobalt deficiency of the bacteria, the animal requiring not cobalt but the bacterial products which have thereby become deficient. If cobalt is an essential metabolite for the host alone, then its concentration in micro-organisms may reduce its availability for the host. In this connexion it is of great interest that cobalt has been found to occur to the extent of 4·0 per cent of the crystals (dried *in vacuo*) of the naturally occurring anti-pernicious anæmia factor[19]. It is possible that both the host and the microbial population of its alimentary canal require cobalt for their respective metabolic activities. On a low cobalt diet these competitive relations may assume some importance in the etiology of cobalt-deficiency diseases. How far cobalt found in rumen micro-organisms, after leaving the rumen, can be made available for absorption by the host or for intake by its microbial population in the lower parts of the alimentary canal, and with what result, remains to be shown experimentally, together with the points raised earlier.

Full details of this work involving a study of several trace elements in rumen micro-organisms, and certain pure cultures of bacteria and yeasts, will be published elsewhere.

[1] Lines, E. W., *J. Coun. Sci. and Indust. Res.* (Aust.), **8**, 117 (1935).
[2] Underwood, E. J., and Filmer, J. F., *Austral. Vet. J.*, **11**, 84 (1935).
[3] Askew, H. O., and Dixon, J. K., *N.Z. J. Sci. Tech.*, **18**, 73 (1936).
[4] Stewart, J., Mitchell, R. L., and Stewart, A. B., *Empire J. Exp. Agric.*, **9**, 145 (1941); **10**, 57 (1942).
[5] Stewart, J., *Biochem. J.*, **41**, Proc. xlii (1947).
[6] Marston, H. R., "Ann. Rev. Biochem.", **8**, 557 (1939).
[7] Underwood, E. J., *Nut. Abstr. Rev.*, **9**, 515 (1939–40).
[8] Russell, F. C., Imp. Bur. of Animal Nut., Tech. Comm., No. 15 (1944).
[9] Maynard, L. A., and Smith, S. E., "Ann. Rev. Biochem.", **16**, 273 (1947).
[10] Houk, A. E. H., Thomas, A. W., and Sherman, H. C., *J. Nutrition*, **31**, 609 (1946).
[11] Thompson, J. F., and Ellis, G. H., quoted by Maynard, L. A., and Smith, S. E., in "Ann. Rev. Biochem.", **16**, 280 (1947).
[12] Comar, C. L., David, G. K., Taylor, R. F., Huffman, C. F., and Ely, R. E., *J. Nutrition*, **32**, 61 (1946).
[13] Comar, C. L., and Davis, G. K., *Arch. Biochem.*, **12**, 257 (1947).
[14] Askew, H. O., and Dixon, J. K., *N.Z. J. Sci. Tech.*, **18**, 707 (1937).
[15] Tosic, J. (to be published).
[16] Mitchell, R. L., and Scott, R. O., *J. Soc. Chem. Ind.*, **66**, 330 (1947).
[17] Mitchell, R. L., Commonwealth Bur. of Soil Sci., Tech. Comm., 44 (1948).
[18] Phillipson, A. R., and Innes, J. R. M., *Quart. J. Exp. Physiol.*, **29**, 333 (1939).
[19] Smith, E. L., *Nature*, **162**, 144 (1948).

LARDER OF THE RED-BACKED SHRIKE

MR. J. H. OWEN has given some interesting information about a bird the habits of which are little known to present generations because the bird has become so scarce (*British Birds*, **41**, No. 7; July, 1948). From observations it would appear that all red-backed shrikes (*Lanius c. collurio*) make larders provided they do not need the catch when it is taken. The male bird seems much more given to 'lardering' than the hen, and as many as six larders may be used by one pair of birds. Usually the larders are not far from the nest, but some have been reported 150 yards away. Often the number of larders is one or two. Shrikes prefer to nest in one of a number of isolated bushes, provided one of them is suitable, rather than in a hedge. Hedgerow larders are usually not at all easy to find. The favourite bushes are hawthorn or blackthorn, especially a part that has been killed by fire or some other means. The large thorns on rough briars and brambles are frequently used as larders, and occasionally barbed wire is also used. Larders often have a considerable number of humble-bees (*Bombus*) in them, often a small bird and, occasionally, a house-mouse (*Mus domesticus*) is found.

Queen humble-bees figure prominently in the larders. The birds usually devour workers and males, carder bees and honey bees (*Apis*) as they catch them. Sometimes wasps (*Vespa*) are taken and the remains found in pellets; but it is rare to find a wasp in a larder. Dor-beetles (*Geotrupes*) and cockchafers (*Melolontha*) are seen pinned up. Insects are usually pinned through the underside of the thorax, back uppermost; but occasionally some are pinned through sideways or through the back. The victims are often found alive. Larders are more likely to contain food at night than in the morning, and on cold misty mornings the larder that was well stocked at night is often empty. Among the young birds which were found were willow-wrens (*Phylloscopus trochilus*), whitethroats (*Sylvia communis*), linnets (*Carduelis cannabina*), and pipits (*Anthus*), while common lizards (*Lacerta vivipara*), field-voles and wood mice (*Apodemus sylvaticus*) are also taken.

The larder is used for other purposes than feeding. Often the old birds will carry sacs of excrement from the nest and place them on the tips of thorns in a regular larder. This always occurs when pellets are thrown up by the young. Attempts have been made to pin up dead small birds and mammals in the larders. Observations have shown that these have never been pinned up to the satisfaction of the shrikes, and usually a cock bird pulls the bodies free and fixes them elsewhere. There is a certain amount of evidence to show that the hen fetches food from the larder much more than the cock, although he alone may provision it. Both may use it to cram the young before a thunderstorm, for example, or if they have been kept away from the nest for some time.

T. H. HAWKINS

WAVE MECHANICS IN SCIENTIFIC RESEARCH

PROF. C. A. COULSON'S inaugural lecture as the first professor of theoretical physics at King's College, London, which he delivered on March 2, 1948, is printed in full in the July issue of *Science Progress* (**36**, 436; 1948). Taking as his subject, "Wave Mechanics in Physics, Chemistry and Biology", Dr. Coulson shows, by several well-chosen examples, that wave mechanics, in spite of its early successes, does not provide neat, complete solutions to all physical and chemical problems, thus obviating experimental research; but, as a branch of theoretical physics, is most useful in correlating different pieces of information and in bringing out the essential underlying character of what is observed and measured.

From de Broglie's concept of a particle as a wave, enunciated in 1924, Schrödinger in 1926 treated the simple case of the non-relativistic and unperturbed hydrogen atom and introduced the wave equation, that equation which replaces the ordinary Newtonian