

waves, we observe in a direction perpendicular to the sun's rays but at a zenith distance of 70° to 80° , where the absolute intensity of the primarily scattered longer waves is greater and the greater part of the radiation comes from a comparatively thinner layer nearer the surface of the earth. Observations at Simla show that the polarisation for the red in these directions often reaches values so high as 30 per cent., which may be compared with 91.6 per cent., the value of the polarisation of the light transversely scattered by pure air. K. R. RAMANATHAN.

Colaba, Bombay, June 25.

Medical Entomology and the Tropical Field Worker.

WITH a wider enlightenment on matters of public health among all communities, east and west in the tropics and sub-tropics, nowadays the medical officer of health finds a more insistent demand on his attention to problems connected with medical entomology.

Before proceeding to his tropical or sub-tropical appointment the medical officer of health has doubtless had a training in medical entomology, and often has acquired an active interest in this important subject; so much so, that if his destination is to some locality, let us say, where malaria is rife, he takes up his appointment with an enthusiastic intention of improving conditions. To those of us who have seen the arrival of many a medical officer of health in the tropics that is but the beginning of the story. The remainder is less satisfactory, and sadly uniform in most instances: on arrival he can give a fairly excellent account of the systematic divisions of the Anophelini, and a poorer—often a decidedly bad account—of the Culicini, and can readily distinguish an anopheline from a culicine larva (when it is in the laboratory, or microscopically mounted). So he arms himself with a few tubes, and then usually wonders where on earth he can find the species of his locality. At the back of his mind is the recollection that 'old tin-cans, broken bottles, gutters, and water-tanks' have been mentioned as being dangerous mosquito-breeding places, and a search is therefore diligently made in these situations. His efforts are rewarded, maybe, by the capture of what ninety-nine times out of a hundred are culicine larvæ—which he distinguishes by the presence of the siphon. Ere long the capture of 'Culexes' becomes less exciting, and he possibly seeks in the foulest pond in the district for the more interesting anopheline larvæ. By great good luck he may find one or two, and with a feeling of just pride orders the abolition of that breeding-place; while some clearer, but, in reality, more pestilential pond in which he found no larvæ, yet where there are actually thousands, continues to breed its pests.

In the end, supported only by a meagre knowledge of the systematic divisions of the Culicidæ, upon the capture of a few larvæ which all look horribly alike and cannot be identified as anything particular, and perplexed by the unaccountable numbers of mosquitoes which continue to swarm, enthusiasm speedily dies with the feeling that "this mosquito business is a subject only for the expert."

The reason for all this is obvious: we might as well expect to produce competent surgeons by a training devoted to descriptions and the examination of excised pathological exhibits. At present, astonishing as it is, instruction in medical entomology follows an absurdly parallel course: academic teaching and laboratory exhibitions (decidedly essential as they are) are almost the sum total of what instruction

in medical entomology constitutes. The bionomics, the remarkable habits of some species, the practical methods of demonstrating the breeding-places in Nature, the varied methods of collection, the practical application of control measures in the field; all these matters of paramount importance in the training and successful work of the sanitarian receive no more attention than can be given in lectures. Consequently, once the sanitarian finds himself in the field, he discovers immediately that for all he has learnt he has no idea how to proceed.

I have merely taken the case of mosquitoes as an example. The same thing is true of the 'field' aspects of all other insect-enemies, and it is indeed time that the essential importance of proper field instruction should be taken into account so as to ensure that the men whom we send out from our schools are not so completely stranded when they meet the problems as Nature herself presents them. To avoid misapprehension, I should perhaps add that the Wellcome Field Laboratory is *not* a teaching centre where such practical instruction as that referred to can be obtained. MALCOLM E. MACGREGOR.

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Accurate Square Roots.

IN NATURE for June 19, Mr. John Wishart directs attention to certain inaccuracies of one unit in the last printed place in Barlow's Tables of the square roots of numbers. Such errors are very common in these tables, applying to approximately ten per cent. of all the square roots; and they also apply, apparently even more frequently, to the cube roots. The reciprocals in the same tables are much more accurate, but even these are occasionally in error by a unit of the last printed place.

Mr. Wishart says that "there are some who have need of all the figures that existing tables give them, who sometimes wish, indeed, that more were available." I gather from this and from other hints in his letter that he may not be acquainted with the very useful collection: Hülse's edition of Vega's Tables, published by Weidmann at Leipzig, 1849. On pages 476 to 575 are there given the square roots of all integers up to 10,000. They therefore have the same extent as Barlow's Tables but they give the roots to twelve decimals, five more than Barlow. The same table gives cube roots to seven decimals just as Barlow does, but they are carefully rounded off to the correct digit.

The best table of reciprocals is that by Oakes (published by Layton, London), which gives them to seven significant figures for all integers up to 100,000; care was taken to make the last printed digit correct. Hülse's and Oakes' tables together should replace Barlow's where great accuracy is needed. But Barlow's tables, as Mr. Wishart intimates, are very convenient indeed whenever an error of one part in 100,000,000 is not important, and this is almost always the case.

The following method for deriving or testing square roots to many places may be of interest. Let N be the number the root of which we wish to extract, and let a and b be two nearly equal numbers such that $ab = N$.

We have then

$$\begin{aligned}\sqrt{N} &= \sqrt{ab} = \frac{1}{2}\sqrt{(a+b)^2 - (a-b)^2} \\ &= \frac{a+b}{2} - \frac{(a-b)^2}{4(a+b)} + \dots\end{aligned}$$

If, therefore, b differs from a by one part in 10^7 say, $\frac{1}{2}(a+b)$ will differ from \sqrt{N} by only about one part