matters arising

Immunopathy of parasitic infection

THE News and Views article 'Immunopathology of Parasitic Infection" by our correspondent F. E. G. C. (**246,** 187; 1973) has elicited several letters. He wrote "most parasites are capable of evoking immune responses in their hosts but these are seldom effective in eliminating the infection" and in conclusion that "as more information about immunity to parasitic diseases accumulates the possibilities of developing useful methods of immunisation fade further and further into the distance".

● Professor G. M. Urquhart of the University of Glasgow writes: "The first statement is inaccurate and the second is surely a personal opinion largely based on an erroneous extrapolation of the excellent work of Warren[1] who has shown that schistosome egg granulomata are the product of a delayed-type hypersensitivity reaction.

The development of a highly effective degree of acquired immunity both in the sense of the elimination of infection and in resistance to reinfection has been shown to occur in many experimental helminth infections and in domestic animals its natural acquisition plays an essential role in the survival and health of adult cattle, sheep and horses constantly exposed to heavy infection. Over the past 16 yr millions of calves in Europe have been successfully immunised with a vaccine prepared from X-irradiated larvae against *Dictyocaulus viviparus,* the lungworm of cattle.

The same situation applies to protozoal infections. Antigenic variation does present a problem in artificial immunisation but under natural conditions man and animals survive in large numbers in malarial and trypanosome endemic areas respectively, apparently through the development of an effective immunity. Leishmaniasis in experimental animals and man and coccidiosis in domestic animals also offer excellent examples in which acquired immunity is highly important in protection.

For many years immunological research on many of these important diseases was neglected and we should not be too dismayed if the present interest in parasitic immunology elicits some facts which, at least at first sight, appear disheartening from the viewpoint of the rapid development of a comprehensive range of vaccines."

● Dr D. G. Colley of Vanderbilt University, Tennessee writes: "The final paragraph draws a conclusion regarding immunisation potentials in parasitic infections which, although possibly correct, is based on what I consider to be erroneous reasoning. It reflects a misinterpretation of the basic tenets of either parasitology or immunology, or both. I do not argue with the possibility that the induction of a protective immune response in schistosomiasis may be difficult, or even impossible to achieve. As has recently been pointed out such immune resistance mechanisms have certainly not been convincingly demonstrated and may not even exist.

The article seems, however, to base this assumption upon the demonstrated immunopathogenic effects of an anti-egg response. This ignores both the uniqueness of the various intramammalian stages of the schistosomes (schistosomules, adult worms, eggs) and the fundamental concept of immunological specificity. Certainly to induce or increase anti-egg cell-mediated responses could be potentially disastrous (although the induction of enhancing antibodies might be beneficial). Responses against egg antigens have, however, long been seen as of little protective consequence. What the discipline needs, and many investigators are pursuing, is more attention to immune responses against specific antigens."

● Dr T. A. Miller, of the Jensen-Salsbery Laboratories, Kansas City, Missouri, writes: "The article should more appropriately have been entitled "Immunopathology of Schistosomiasis". The emphasis on this one host-parasite relationship excludes, for all practical purposes, consideration of the other 95% of parasitic infection. Moreover, the final statement represents only one aspect of the current international opinion, *viz-à-viz* schistosomiasis.

As a general statement applicable to the other 95% of parasitic infections, this is patently uninformed and misleading in view of the proven efficacy, safety and widespread use on two continents of irradiated nematode vaccines for lungworm disease of cattle and sheep and hookworm disease of the dog."

1 Warren, K. S., *Trans. R. Soc. trop. Med. Hyg.*, **66,** 417 (1972).

Population estimates from recapture studies

BELL[1] suggested that $P = ((N-a)!\,(N-n)!)/(N!\,(N-a-n)!)$ is the probability that a population is not larger than N in size, where a animals have been captured, marked, and released, and on a subsequent occasion n animals have been captured, all of which have been found to be unmarked. Though P is indeed the probability of the latter event given that the size of the population is N, Bell advances no reason why the probability that the population is not larger than N should be equated to it. Indeed, Fisher[2] has stressed it should not: 'The direct step from the test of significance to a probability distribution cannot be sustained, and this circumstance has been responsible for some misunderstanding, and confusion of the terminology.'

Were Bell's treatment valid we could find the probability that the population is of size N exactly by subtraction, yielding

$$p = an \times ((N-1-a)!(N-1-n)!)/(N!\,(N-a-n)!)$$

Suppose one marked animal were released ($a = 1$) and subsequently one animal captured and found to be unmarked ($n = 1$). Then $p = 1/N(N-1)$, indicating, for example, that $N = 10$ is 110 times more probable than $N = 100$. But most people, I suggest, would feel that they had learnt very little about N (except that it was at least 2), and they would be almost indifferent between $N = 10$ and $N = 100$.

This is reflected in the solution given by likelihood theory[3], in the context of which the problem is entirely standard. Since P is the probability of what was observed, given N, it is the likelihood of the hypothesis N given what was observed. It attaches a likelihood to each possible value of N, increasing from $n!a!/(n+a)!$ for $N = a+n$, to unity for N very large. For the case $a = n = 1$, $P = (N-1)/N$, indicating that 100 is only 1.1 times more likely than 10.