LETTERS

Malaria Research

It is good to note that *Science* will be reporting on recent developments in parasitology. Gina Kolota's article "The search for a malaria vaccine" (Research News, 9 Nov., p. 679) does not, however, tell the full story of malaria research in recent years.

The seminal work of Cohen, McGregor, and Carrington in 1961 (*1*) demonstrated protective antibody to human malaria and provided a basis for believing an effective vaccine to malaria might be possible. But a vaccine cannot be made unless one has a source of antigenic material. Yellow fever and flu virus vaccines are grown in chick embryos, and polio vaccines are grown in tissue culture. In 1975, when the World Health Organization embarked on its Programme of Research on Tropical Diseases, there was no way of producing any amount of human malaria parasites. No stage of the parasite could be grown in culture, and there were no suitable experimental animals. Cultivation of the parasites was the first priority. This was achieved in 1976, when a relatively simple method for continuous culture of the erythrocytic stages of *Plasmodium falciparum* was reported (*2*). This work sparked the revival of hope for a malaria vaccine. For the first time a way was available to produce quantities of human malaria parasites in any reasonably equipped laboratory. This meant that antigens could be purified from such cultures and tested for immunization. At this time there was no way to produce sporozoites in adequate amounts. This was the real reason why a sporozoite vaccine did not seem feasible. Then came the methods for monoclonal antibodies and recombinant DNA, and these have been exploited very effectively by Ruth and Victor Nussenzweig.

The work on a merozoite vaccine discussed in Kolata's article depends on the culture method, yet cultures are not mentioned. Nor does Kolata mention one of the most significant results published so far—the report by Perrin *et al.* (*3*) showing effective immunization of laboratory-bred squirrel monkeys to *P. falciparum* with very small amounts of a highly purified surface component prepared from cultures of erythrocytic stages. It is important and encouraging that the protein was prepared from one isolate of *P. falciparum*, whereas the challenge infection was derived from an entirely different isolate highly adapted to the squirrel monkey.

The work on a gamete vaccine likewise rests squarely on cultivation of the erythrocytic stages. In these cultures we can produce gametocytes infective to mosquitoes, thus providing a source of sporozoites. The cultures are also being widely used to screen for new drugs and to study the mode of drug action and the remarkable physiological relationships between the parasite and its host erythrocyte.

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3. L. H. Perrin *et al.*, *J. Exp. Med.* **160**, 441 (1984).

Reported Laboratory Frauds in Biomedical Sciences

In recent years, we appear to have been hit by a wave of accounts in journals and newspapers of fraudulent reporting of scientific data. Many factors may have contributed to this, including an increase in the number of persons devoting substantially full time to research; an increase in the competition for available support dollars; an increase in the pressure to publish abundantly; possible changes in the nature of the training process that leads to the Ph.D. degree; and possibly, just possibly, a deterioration in the morality of our scientists. Assignment of weights to each of these and other factors is, at this time, not possible. However, review of reported cases indicates that certain generalities may be noted.

The frauds appear to occur most frequently in our most prestigious research and teaching institutions. A young man enters the laboratory of a very successful investigator, one who has an unusually large bibliography and who has, therefore, secured generous grant support and abundant laboratory space. The young man (there is a paucity of cases in which women are involved in fraud) inspects his new environment to ascertain what it takes to succeed there, and he soon concludes that, since his preceptor, who is obviously successful, has published an unusually large number of papers, this is the route to success. He therefore tries to follow this example and may publish ten or more papers in a year. Those of us experienced in the production of biomedical research know that to generate novel research results sufficient to fill that number of papers in the allotted time is not easy. Our young candidate, therefore, is forced by circumstances to consider the routes he may follow to achieve his ambition. On the one hand he may choose to plagiarize from the results of others. On the other hand he may choose to fabricate results and experiments. By these means, he hopes to diminish the time normally consumed in honest research, which entails the planning and design of experiments, the acquisition of the necessary technical skills, consideration of the relevant literature, and finally the preparation of his own research report. All of these steps consume time and energy.

One of the consequences of the selection of a very successful investigator as preceptor is that he will have attracted the attention of other pre- and postdoctoral fellows. He is likely to have a large number of trainees at some level of training who are accountable to him. Sometimes this number exceeds 20, and this, together with the fact that successful preceptors are likely to spend much time on the road giving lectures and participating in various committees and editorial board functions, reduces the time the preceptor may spend with each trainee. There are cases in which the trainee meets with his preceptor for 1/2 hour every 6 weeks. This is simply not enough if the preceptor is to take his teaching responsibility seriously. He should review with each trainee experiments done yesterday, and he should outline with the trainee the experiments planned for tomorrow. He should guide the trainee through the maze of the literature, and he should assist the trainee in the acquisition of the necessary experimental skills.

In addition, both by example and by precept, he has an obligation to make certain that each of his trainees is fully sensitized to the absolute requirement of total honesty in the reporting of scientific results. Many professions recognize unacceptable deviations from strict honesty. The banker cannot tolerate the embezzler. The military person cannot tolerate the deserter. And the intelligence services cannot tolerate the mole. Science cannot tolerate the man who takes lightly his moral obligation to report strictly what is true.

In light of the foregoing, it is suggested that research training groups under a single preceptor be kept small in size, permitting abundant contact between preceptor and trainee. The preceptor, if he is to fulfill his moral obligation, will undertake to spend significant periods of time at frequent intervals with each of his trainees. The candidate trainee will be well advised to select a preceptor who is not excessively encumbered with large numbers of trainees. He should recognize that a preceptor with an excessively lengthy bibliography may set quantity of publication above quality of research and may thus be a poor role model. In several of the recently publicized instances of laboratory fraud, the trainee has been the prime target of criticism, while the preceptor has been treated sympathetically and with commiseration. There may be instances in which this distribution of blame is not appropriate. Frequently, when one member of a group produces many more publications than do his contemporaries, this is taken as an indication of unusual ability. It may be appropriate to view such exceptions as a basis for suspicion and an indication for scrutiny.

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