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DISCUSSION: COLIN WHITE*

Dr. MacMahon made a general remark at the very outset of his paper that caught my attention. It has often been said, with pride, by epidemiologists that John Snow made important contributions to the understanding of the etiology of cholera long before the cholera vibrio had been isolated. Dr. MacMahon now puts forward the interesting point of view that this timing of the epidemiologic contribution is in the very nature of things. The epidemiologist can work productively at some intermediate stage of knowledge when the disease is well-defined, but ideas as to etiology are immature. I think we can agree that the study of cancer is in this category.

We may inquire as to the special technique that the epidemiologist has, to cope with these problems. It is simply the method of coming to terms with

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the issue of variability by making comparisons between groups. Most heavy smokers do not develop cancer of the lung, and some patients who develop cancer of the lung have never smoked; but if the findings on the appropriate groups are examined in terms of probability, one can reach conclusions that are both firm and useful.

An epidemiologist working in this way can demonstrate the advantage of having competence without the limitation of being an expert. He must, however, expect some criticism from people who are experts in various aspects of the problems he studies. A person well-versed in the detailed biochemistry or clinical manifestations of a particular condition may find it difficult at first to accept findings that are based on a comparison of the rates in two groups, when he observes substantial fluctuations in some variable that is of interest to him. The criticisms of such experts have to be carefully considered but may not be overriding if the objections are based on an incomplete view of the problem.

Dr. MacMahon has not only recommended the epidemiologic search for etiological factors but has outlined practical methods of carrying out the studies. His experience is second to none in these matters and it is very useful to have his observations on record. This type of study, however, does not exhaust the possibilities of epidemiologic work and I would like to refer briefly to another class of problem.

It may be illustrated first by a reference to the infectious diseases. After the causative organism has been isolated, there still remain the problems which may be described as ecological. The solution of these problems may depend heavily on the laboratory worker, but their special feature is the study made within the field rather than within four walls. In this sense, there is no choice about the methods that must be followed: these are uniquely epidemiologic problems.

There are two general methods of attempting to solve them. The oldest is the method of the natural historian. There are few rules: you must be observant, intelligent, well-informed, enthusiastic, and somewhat lucky. More formal techniques have scarcely yet been developed though a few important results are available from the study of epidemic models. The important elements are the use of stochastic processes and the construction of biomathematical models. The processing of the data that arise will often be possible only with the aid of computers.

What is the counterpart of this type of problem in work on the epidemiology of cancer? We shall have to try to do what we have often advertised ourselves as interested in doing, namely, to study the interrelationship of various etiological factors. At the present time, the possibility of successful
analysis of etiological factors is determined largely by whether the factors are independent of one another or, at any rate, interact only in simple ways. The next step will be to build models of chronic diseases, and a basic tool once again will be the use of stochastic processes. A start has been made on such important topics as the problem of competing risks from various diseases, but much more work is needed. Epidemiology is still a young subject. Our great affection for it, as it is, should not deter us from inquiring what it will look like when it grows up. My feeling that biomathematical methods will soon become important in the study of chronic diseases has prompted me to add this point to the discussion of Dr. MacMahon's excellent paper.