

S.J. GREEN

In response to many published studies associating smoking with various diseases a great issue has been made of cause and effect relationships. Some might say that the cigarette industry has led the anti-smoking people 'up the garden path' by emphasising so much the issue of causality. Scientific proof of course, is not, should not be and never has been the proper basis for legal and political action on social issues. A demand for scientific proof is always a formula for inaction and delay and usually the first reaction of the guilty. The proper basis for such decisions is, of course, quite simply that which is reasonable in the circumstances. Nevertheless many have been misled into sincere concern with "scientific proof" and the issue of causality has been enlarged to engage a great deal of attention. The question is a good deal more general than that of smoking. For example "scientific proof" is sometimes demanded with respect to tetraethyl lead or to the ozone layer. It is therefore well worthwhile to examine further the smoking question.

Ironically the position of the tobacco companies is dominated by legal considerations. In the end companies wish to dispute that their products have caused injury to litigants. By repudiation of any causal role for cigarette smoking in general lawyers hope to cut off any claim for liability without further consideration of the specific cause in the particular case. It may be that this "belt and braces" approach is an unnecessary luxury for the tobacco companies nevertheless its adoption has led the industry into the position of rejecting in total any possibility of any causal relationship between smoking and disease. This makes it very difficult for ^{the} the industry to discuss safety evaluation, product safety, warnings and claims and even to collaborate in research. While vigorously trying to get their cigarettes endorsed as safer or seen to be safer or even to make them safer, companies strenuously deny the need to do so. The industry has publicly retreated behind impossible, perhaps ridiculous, demands for what in their public relations is called "scientific proof". The :

position of the industry might call for some sympathy, on the other hand there is a great deal more against smoking than the epidemiological evidence. However this note is concerned only with the epidemiological evidence and particularly with whether that evidence alone can say more to the scientist than merely to indicate a cause for concern.

In 1964 the first report of the U.S.A. Surgeon General's Advisory Committee dealt with the question of the causal significance of an association in some depth. It was suggested that this is a matter of judgment and that a number of criteria should be used no one alone of which would be sufficient in itself for such a judgment to be made. These criteria included the consistency, strength, specificity, coherence and temporal relationship of the association. The Committee made assessments of various associations and used various terms to characterise their assessments - "factor", "determinant", and "cause". By "factor" they meant a source of variation but not necessarily a cause. Further several factors may coexist but one may play a "determinant" role. The word "cause" was used to convey the notion of a significant, "effectual" relationship between an agent and an associated disorder in the host and it was specifically stated that no member used "cause" in an absolute sense. Of course, all the members accepted that biological processes involve multiple causes. But the end result is not particularly clear. They were obviously worried by some remote absolute meaning of cause which they felt is different from common usage. They chose to use the word cause in order "to affirm their conviction" that smoking cigarettes causes disease. In the massive authoritative Surgeon Generals Report on Smoking and Health, fifteen years later, in 1979 the question of causality is not mentioned and presumably has ceased to be an issue as far as the Surgeon General is concerned.

Clearly the 1964 committee had difficulty with the concept of causality. The difficulties many experience in this connection are probably due, whether we realise it or not, to the influence of various philosophers in the tests we almost instinctively apply. The tests bequeathed to us by J.S.Mill⁺ in particular must make him one of the most influential. Briefly these require both sufficiency and

necessity to demonstrate a cause and maybe this is what
the committee had in mind as "absolute" cause. Mill did not
claim his tests as proof but was concerned to establish
inductive methods to be used by scientists as an independent
check on observation. However the tests of sufficiency and
necessity can only apply to the very simplest of systems
mechanistic systems-whereas the complex systems with which
epidemiology is concerned require a probabilistic approach.
Mill was aware of multi-causal situations but was imprisoned
in the logical structure of the science of his time when it
was assumed that every effect must have a cause and that if
sufficient data were established for a system then the future
of that system could be predicted with certainty. Within
appropriate limits this concept is still valid and useful
and science and engineering demonstrate clearly the nature of
these limits. The trouble is that the mechanistic concept
appears to dominate both the popular and legal views without
any awareness of the limitations. Although in law the
extension of contributory negligence has increasingly
underlined the usualness of multiple causes nevertheless the
dominating concept is mechanistic - there is an underlying
assumption that given the facts of a situation the results
are predictable, calculable and legally apportionable. As
far as smokers are concerned the popular view allows the most
dependent to rationalise their inability to choose not to
smoke by invoking irrelevant tests for causality.

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or naive
part.*

In 1958 Julian Huxley wrote "The conclusion to be
drawn from the evidence is definite ; increased smoking
increases the probability of developing lung cancer.
Unfortunately the significance of such a statement is not
clear to many people. Obsessed by the naive idea of finding
a single cause for every effect, they shake their heads and
say that the evidence is only statistical, as if that
invalidated it. In point of fact every scientific law is
statistical, and all that physicists can tell us about
electrons is the probability of their occupying any particular
position". Thus he began to spell out a probabilistic view
of causality, a view based on twentieth century science and

and this is now being developed in several quarters. The laws of probability are about large numbers and for complex systems involving large numbers experimentally established relationships such as those established by epidemiological methods may be of use to predict the behaviour of a population with accuracy. Evidence about sufficiency or necessity with respect to individual members of the population is quite irrelevant to the measured behaviour of the population just as evidence about the population tells us nothing definite about a particular individual member.

There are many properties of systems which tell us nothing about individual members, for example temperature, entropy, disease statistics and "information" as used in communication theory. Temperature tells us something, say, about the mean free path for a gaseous system but it tells us nothing about predicting the behaviour of a particular molecule if we could catch one and tag it. Entropy measures the displacement of a system from thermodynamic equilibrium or, in communication theory, uncertainty associated with statistical descriptions of the system. Entropy and information are thus measures of the degree of organisation of systems - a gain in entropy is a loss of information. But these are characteristics of the system; questions about the degree of organisation of a system can be answered by reference to the relations or interactions of members or some such property of the system; reference to an isolated member would be irrelevant.

Thus the argument that since there are heavy smokers who do not have lung cancer (and, of course, the majority do not) and because there are some rare cases of non-smokers who do have lung cancer then smoking does not cause lung cancer, is totally fallacious. From all the evidence that smoking is a factor in multiple correlations and is strongly associated with some diseases then after meticulous experimentation by selecting otherwise comparable populations the claim that smoking causes some diseases (i.e. causes the incidence of the diseases in the population to increase) may well be proven. If it can be reliably predicted that if smoking is decreased in a population that the incidence of this or that disease will be decreased then the decrease demonstrates the causal relationship. Thus for

male smokers in the U.K., the U.S.A., and several other countries from the epidemiological evidence alone it can be concluded that smoking cigarettes causes lung cancer and some other respiratory diseases.

To reach a valid conclusion about a specific individual case the special circumstances would have to be taken into account. These would include sex, age, social background, genetic constitution, abnormal genotype or phenotype, exposure to other agents and possibly a host of other factors. Even for smoking where there has been a vast amount of expert investigation, at present epidemiology does not lead us to know or to calculate the probability that the habit will in fact cause any particular disease in any particular individual or whether by giving up the habit he or she will avoid smoking related diseases. However the case against smoking does not rest on epidemiology alone and if all the evidence is considered it must be concluded that smoking involves considerable risk (i.e. makes it much more probable that an individual will suffer from certain diseases) and it is up to the individual, if he is able, to make a value judgment whether to accept the risk. Likewise for social risks and on behalf of those unable to make judgments such as children and addicted smokers, the social apparatus must be used to exercise value judgments on the acceptability of the risks.

In general, with respect to practices which are suspected to involve risk of disease or any serious irreversible consequence the proper basis for decision either at the personal or social level is one of judgment of what is reasonable in the circumstances. Scientific 'proof' is unlikely to provide a satisfactory basis for decision - its establishment can usually be delayed until overtaken by events. As Karl Pearson put it "science is an intellectual résumé of past experience and a mental balancing of the probability of future experience : :+

Footnote:

+ J.S.Mill:

If two or more instances of the phenomenon under investigation have only one circumstance in common..... this is a cause. If an instance in which the phenomenon occurs and an instance in which it does not occur have every circumstance in common but one, that one only occurring in the former, this one differing circumstance is the cause.... (or an indispensable part of it).

If two or more instances in which the phenomenon occurs have only one circumstance in common, while two or more instances in which it does not occur have nothing in common (save the absence of that circumstance) the circumstance in which alone the two sets of instances differ is the cause.

++ Karl Pearson "Grammar of Science" Everyman Edition p. 99

Dr Green has been interested in smoking and disease for over thirty years and has recently retired from directing research for the last twenty years in the tobacco industry. He is now concerned with the general field of safety and risk. ~~XXXX~~
He has degrees in science and laws.