Philip Kitcher and Wesley Salmon (eds.), *Scientific Explanation.* Minneapolis: University of Minnesota Press, 1989.

Nine distinguished philosophers of science have contributed to the 13th volume of the Minnesota Studies in the Philosophy of Science series. Though, of course, scientific explanation is the main topic of all the essays in the volume, the approaches are divergent. The contributions of Paul Humphreys and Philip Kitcher are the most 'classical' ones: both try to develop criteria of adequacy for explanations. Humphreys' essay will be discussed in section I below, the Kitcher's contribution in section II. Section 3 contains a short overview of the other essays of the volume.

I

In his 'Scientific Explanation: The Causes, Some of the Causes and Nothing But the Causes', Paul Humphreys discusses the nature of singular causal explanations (causal explanations of singular events). According to H., the term "explanation" is used in two different ways. The complex of factors, structures and mechanisms that cause an event may be called the causal explanation of the event. On the other hand, certain linguistic entitities (viz. answers to explanation requests) may also be called causal explanations. H. refers to explanations of the second kind as *linguistic explanations*. No specific name for explanations of the first kind is suggested. I will refer to them as *objective explanations*. Humphreys' main aim is to determine the canonical form of linguistic causal explanations for singular events. His conclusion with respect to this topic is the following:

(CF) An appropriate (linguistic) explanation has the form "Y in S at t occurred because of Φ, despite"

'Y', 'S' and 't' are terms referring to, respectively, a property or change in property, a system , and a time; Φ is a nonempty list of terms referring to contributing (positive) causes of Y, is a (possibly empty) list of terms referring to counteracting (negative) causes of Y. Linguistic explanation of the form laid down in (CF) are called *aleatory explanations*.

Humphreys' defense of thesis (CF) is based on a conception of the

way science and scientists function in our society. In H.'s view, explanation requests (which have the form "What is the (objective) explanation of Y in S at *t*?") are the means by which laymen ask scientists for information they need in order to solve a problem connected with the event mentioned in the request (e.g. the problem of understanding why the event occurred). A linguistic explanation is the way in which a scientist, provides the information we need to solve the problem. According to H., there are three reasons why linguistic explanations as defined in (CF) are the appropriate vehicles for transmitting information from scientist to questioner:

(1) Events usually have different, independently acting causes; aleatory explanations can capture this multiplicity of causes.

(2) Most events have both positive and negative causes; in aleatory explanations, this diversity of causal influence can be represented.

(3) Scientists usually don't know the complete objective explanation of an event; because we can add elements to the sets Φ and Ψ of an explanation without denying that the original explanation is correct, aleatory explanations are approriate for transmitting incomplete information.

Though I think the general ideas behind Humphreys' defense (linguistic explanations as the instruments by means of which scientific information is conveyed beyond the point of discovery) is very valuable, I don't share H.'s point of view concerning the structure of singular causal explanations. In the objections I put forward in the next two paragraphs, I start from H's general ideas and show that they may lead to conlusions that contradict (CF).

There are at least two kinds of problems that may lead to an explanation request: practical problems (connected with decision problems about actions) and theoretical problems (connected with our desire to understand the events we observe). When an explanation request is motivated by a theoretical problem (i.e. when the question is asked in order to obtain the information we need to understand an event), the following desideratum is to be fulfilled by the linguistic explanation:

(D_1) A linguistic explanation of an event has to contain all available information that is relevant for understanding the event under consideration.

I claim that singular causal explanations as defined in (CF) fail to meet

this requirement. In my view, complete causal understanding of an event has been reached when we have found a set of causal factors which jointly constitute a sufficient cause for the event, i.e. when we have shown that the occurrence event could have been predicted by determining whether certain causal factors were present or absent. In general, the degree of causal understanding we have reached for an event depends on the degree of causal predicatability (the degree to which it could have been predicted invoking only its causes) we may attach to it. The aim of a causal explanation is to increase the degree of causal predictability of an event. In order to increase the degree of causal predictablity that we may attribute to an event, we need information about the causal efficacy of the different combinations of causal factors. Though this information is often available to scientists, it cannot be transmitted by means of an aleatory explanation. Therefore, these explanations often violate (D_1).

My second objection to (CF) is related to the other class of problems that may provoke an explanation request. When we have to make a choice between two or more alternative actions, the first step in our decision process usually consists in structuring the decision problem: we ascertain which are the possible consequences of the alternatives and by which circumstantial factors the outcome of the possible actions are co-determined. In this first fase, all we need is knowledge about causal relationships. Information about the efficacy of a cause or a cluster of causes is not useful. In a second phase of our decision process, we calculate the expected utility of the alternatives. Here we use information about the efficacy of clusters of causes (each cluster consisting of one of the possible actions and the circumstantial factors that influence the outcome of this action). Taking these considerations into account, it is clear that aleatory explanations fail to meet the following desideratum:

(D_2) A linguistic explanation of an event has to contain all available information that is relevant for chosing a way to bring about similar events (events belonging to the same type).

Aleatory explanation contain only information that is useful in the first phase of the decision problem. Information that is valuable in calculation phase of the decision process will not be found in an aleatory explanation, though it is often available to scientists.

The objections I have put forward are motivated by the idea that a

linguistic explanation, because it is an instrument a scientist uses to transmit information, must (1) be appropriate for representing the kind of information that scientists possess, and (2) be appropriate for transmitting information that is relevant for the questioner. Humphreys' thesis (CF) is, in my opinion, the result of neglecting the second principle.

II

In his essay 'Explanatory Unification and the Causal Structure of the World', Philip Kitcher develops a model of explanation based on the idea of unification. K.'s central concept is the explanatory store over K, abbreviated E(K). K is the knowledge accepted as true by the scientific community. Suppose we try to provide a DN-explanation for every singular fact or law the scientific community accepts. The result will be a set of derivations, the premisses and conclusions of which belong to K. We can imagine many systematizations of K, but only one of them will be called the explanatory store over K: E(K) is the systematization of K that best unifies K. The degree of unification a systamatization bestows on K is a function of the number and stringency of the arguments patterns needed to generate the arguments contained in the systematization, and of the number of events and laws that appear as conclusion in at least one of the derivations of the systematization. According to Kitcher, explanations are arguments that belong to E(K).

I will not criticize the model itself. Instead, I will direct my attention a thesis which is closely connected to it, viz. the thesis that there is no sense to the notion of causal relevance independent of that of explanatory relevance. Kitcher claims that our causal beliefs are determined by the patterns we use to explain phenomena: derivations that belong to E(K) become accepted as explanatory, and the phenomena described in their conclusions are viewed as objectively dependent on the phenomena described in their premises. I have two comments on Kitcher's thesis: (1) it is untenable, and (2) Kitchers discussion of the well-known problems of irrelevance and asymmetry suggests a viable alternative.

Why is the thesis untenable? Our causal beliefs have a practical function: our decisions depend on them. Our causal beliefs are based on rules of acceptance that have proved to be pragmatically adequate in the past. These rules constitute sources of causal beliefs that are independent of

our explanatory efforts, and ensure that the notion of causal dependence has a sense independent of the notion of explanatory dependence.

To show that Kitchers discussion of the irrelevance problem and asymmetry problem yields an alternative for his thesis about the relation between causal and explanatory dependence, we have to examine the function of the thesis in Kitchers' theory. Kitcher (following Hempel on this issue) claims we understand a phenomenon (particular event or law) if and only if we have shown that this phenomenon was to be expected. In addition to this, both Hempel and Kitcher maintain that a means-end relationship exists between explanation and understanding: explanations are the instruments we use to demonstrate that a phenomenon was to be expected. These two theses lead Hempel to the conclusion that the construction of a deductive-nomological or inductive-statistical explanation is the proper reaction if we are confronted with a phenomenon we don't understand: each DN- or IS-explanation is an argument which shows that its conclusion was to be expected. Kitcher reaches the same conclusion, but adds the condition that (in order to keep the global system of arguments we use to understand phenomena simple and coherent) the argument we construct should belong to E(K). An obvious objection against this view of what understanding of the world consists in, is that people very often construct causal explanations. The frequency of causal explanation suggests that understanding has a causal aspect.

In Hempels view, the popularity of causal explanations is the result of the fact that they contain the information we need to construct a DN-explanation: people often construct causal explanations because this is a way to obtain the information one needs to construct a DN-explanation, not because understanding of a phenomenon requires insight into its causes. This explanation of the popularity of causal epxlanation is based on Hempels ideas about causality. According to Hempel, the statement that *a* caused *b* implies the causal law "In circumstances X , an event of type A is always followed by an event of type B". Furthermore, we should not say that *a* caused *b* unless we have sufficient evidence to believe that the circumstances X are present, that both *a* and *b* happened and that *a* preceded *b*. As a consequence, trying to prove that some singular causal statement is true, implies gathering evidence for statements (singular and universal) which jointly constitute an DN-explanans for the explanandum event.

Two objections may be made to Hempels answer:

(1) The thesis that every causal explanation contains sufficient information to construct a DN-explanation is false. (2) Even if we accept the thesis about the information content of causal explanations, it is not clear why people would choose the more complicated way (first constructing a causal explanation) instead of immediately constructing a DN-explanation. Moreover, the complicated way may prevent us from finding an explanation because we direct our attention exclusively to causes and neglect the potential explanatory power of effects of the explanandum event.

Because of the objections that can be made to Hempels solution for the "popularity problem", Kitcher and other proponents of the epistemic conception of explanation and understanding had to find a new way out. Kitcher's solution is the subordination of causal dependence to explanatory dependence. I have argued that this is not an adequate solution. But the adherents of the epistemic tradition should not be pessimistic: as I already mentioned, Kitcher's discussion of the irrelevance and the asymmetry problem suggests a solution for the popularity problem.

We explain in order to understand the phenomena we observe. We try to develop a system of arguments that allows us to understand many phenomena and that is nevertheless coherent (measures of coherence are the paucity and stringency of the patterns used). Widening the area of explained events will always decrease the degree of coherence of our system of arguments. To counteract this tendency (i.e. to ensure that the degree of incoherence increases rather slowly), we can do two things:
(1) Scrutinize our system of arguments at definite times and try to explain the events we have explained till then in a more coherent way ; we aim at or comparative unification while keeping one of the variables (the number of events explained) constant.
(2) Use a coherence preserving strategy in all our efforts to explain events. A coherence preserving strategy is a strategy which makes the operation described in (1) to a certain extent superfluous. Systematically using argument patterns that lead to causal explanations is such a coherence preserving strategy, for two reasons:
(a) we avoid using arguments which by a subsequent scrutiny would be exposed as arguments that contain superfluous premisses (cfr. the irrelevance problem, e.g. the hexed salt example), and
(4) we avoid using arguments which by a subsequent scrutiny operation would be ruled out because they use a direction of explanation that is not

the optimal one (cfr. the asymmetry problem, e.g. the pendulum example).

III

As promised in the introduction, I will conclude my review with a short presentation of the contents of the other contributions to the volume. Wesley Salmon's historical essay 'Four Decades of Scientific Explanation' constitutes an excellent introduction to the literature on scientific explanation from 1948 till the publication of the volume. Peter Railton ('Explanation and Metaphysical Controversy') discusses the possibility of using the results of studies of explanation to construct arguments pro and contra theoretical realism and instrumentalism. In 'Explanation: In Search of a Rationale', Matti Sintonen investigates the motives scientists have when looking for explanations. The essays of David Papineau and Nancy Cartwright ('Pure, Mixed and Spurious Probabilities and Their Significance for a Reductionist Theory of Causation' and 'Capacities and Abstractions') deal with causality, a topic closely related to explanation. A critical analysis of Wesley Salmon's causal-mechanical model is offered by James Woodward ('The Causal Mechanical Model of Explanation'). Finallly, Merrilee Salmon discusses some objections against the thesis that there are no significant differences between explanations of human behaviour and explanations in te area of the natural sciences ('Explanation in the Social Sciences').

Erik WEBER
Research Assistant
Belgian National Fund for Scientific Research