Symmetry, Foresight and Understanding

Extended Abstract

The problem of determining the logic of scientific explanation has become central in contemporary philosophy of science. Stephen Toulmin's contribution to this topic is included, to a large extent, in his 1961 book *Foresight and Understanding*. Though illuminating and well supported by historical cases, Toulmin's model of scientific explanation was soon expelled from the philosophical debate, since based on the highly controversial notion of 'ideal of natural order'. The aim of this paper is to revise Toulmin's model, by re-founding it on the less troublesome concept of symmetry.

According to Toulmin, the proper object of scientific explanations consists in phenomena. Phenomena are events, though not all events qualify as such: to be a phenomenon, an event should be 'highly unexpected'. Hence, phenomena are only defined negatively, as deviations from expected patterns of behavior. These patterns, in their turn, are established by what Toulmin labels *ideals of natural order*: paradigmatic cases, to which all natural events should be compared. Such paradigms represent at the same time the 'natural' or expected course of events, and a standard of intelligibility, for which no further explanation should be required. Scientific explanations are intended to make phenomena compatible with such ideals.

Toulmin's model overcomes most of the shortcomings affecting the traditional models of scientific explanation. Contrary to the deductive-nomological model, it offers good grounds to distinguish between scientific explanations and mere predictions or forecasts. Furthermore, it avoids the problem of justifying the explanatory asymmetry between *explanantes* and *explananda*, which also notoriously affects the deductive-nomological model: in fact, *explananda* (i.e. phenomena) are unambiguously individuated by being contrasted with ideals of natural order. Finally, Toulmin's account is superior to the so-called 'familiarity' model, according to which explaining consists in reducing complex or unfamiliar phenomena to simple and familiar ones: in fact, ideals of natural order offer a more objective and less relative basis for scientific explanations than the psychologically grounded notion of familiarity.

Toulmin's model, nonetheless, has been subjected to serious critiques, most of which focus on the significance and status of ideals of natural order.

Wilson (1969a,b) contests that, by relying on the concept of ideal of natural order, Toulmin is surreptitiously reintroducing an Aristotelian explanatory schema. In fact, ideals of natural order are supposed to denote 'natural' patterns of behavior which, precisely in virtue of their

supposed 'naturalness', serve as a basis for identifying and explaining deviating behaviors. Once it is applied to dynamics, however, the contrast between ideals of natural order and phenomena inevitably transform into the contrast between paradigmatic or 'natural' states of motion and 'forced' or 'unnatural' ones, which is typical of Aristotelian dynamics.

Friedman (1974), on the other hand, contested the historical variability of ideals of natural order, which entails the historical variability of what patterns of behavior count as rational or intelligible: in fact, how could criteria of rationality be substituted *rationally*? Changes in ideals of natural order depend on prejudicial and irrational choices, which can only be dictated by 'intellectual fashion'.

Much of the shortcomings of Toulmin's account, however, can easily be overcome by substituting his concept of ideals of natural order with the more widely accepted and less troublesome notion of symmetry.

Symmetries, understood as 'invariances under a group of transformations' (Weyl, 1952), are now considered the hallmark of the objective content of physical theories, since they determine the essential or structural features of their mathematical models (Suppes, 1957; Wigner, 1970; van Fraassen, 1989; Nozick-2001).

Under this interpretation, symmetries can replace the role of ideals of natural order in determining the object of scientific explanations: they establish what patterns of behavior should be expected in the light of the sole chosen theoretical context and, by contrast, what count as deviations. Under this light, phenomena consist in unexpected asymmetries, and the aim of scientific explanations is precisely that of pointing out what contingent causal factors lead to such violations of the expected symmetric behavior. Let us call the model so obtained the *symmetry-preserving* model of scientific explanation.

Replacing ideals of natural order with the notion of symmetry leaves the merits of Toulmin's model substantially unaltered, while easily overcoming its major drawbacks.

In the first place, contrary to ideals of natural order, symmetries do not convey any idea of 'naturalness': symmetric patterns of behavior are unproblematic and self-explanatory only in virtue of the role they play in delimiting the objective content of scientific theories; they are neither more 'natural' nor physically 'prior' to asymmetric ones. In consequence, the symmetry-preserving model is not exposed to any charge of disguised Aristotelianism.

Secondly, though traditionally associated with the ideas of harmony and order, the current acceptation of symmetry is independent of any paradigm of rationality or intelligibility. In consequence, historical changes in the basic symmetries of natural sciences do not involve any change in those paradigms; and therefore, they can be motivated by rational choices and procedures (Nozick-2001).

Finally, the symmetry-preserving model discloses the possibility of a unified account, under which the fundamental intuitions underlying all conflicting models of scientific explanation might possibly be recomposed.

For example, the intuition underlying the deductive-nomological model is that explaining natural phenomena is to show how they should be *expected* in the light of the assumed scientific theories. In the light of the model here proposed, explanations would make phenomena expectable by showing how their patterns of behavior diverged from the expected, symmetric ones.

Unifying account of explanation (Friedman, 1974; Kitcher, 1976), on the other hand, are based on the intuition that successful scientific explanations convey disparate phenomena under the same fundamental laws, or under the same explanatory schema, this way reducing the number of independent assumptions lying at the basis of scientific theories. The same intuition underlies the symmetry-preserving model, in the sense that showing the factors determining deviating patterns of behavior reduces the number of expected or self-explanatory, and hence independently accepted, patterns.

Finally, the causal-mechanical account of scientific explanation (Salmon, 1984) is based on the intuition that explaining phenomena is to find the causal mechanisms which are responsible for their production. The symmetry-preserving account can be made compatible with this intuition by arguing that causal mechanisms are determined by asymmetric initial or boundary conditions (Curie, 1894).

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