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ON DEDUCTIVE NON-NOMOLOGICAL EXPLANATION

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Among the recent attacks directed at the D-N model of explanation is that it excludes perfectly adequate deductive explanations which warrant no nomological statements in the explanans. In the following essay I analyze one such counter-example and argue that while the given case appears to be deductively complete careful scrutiny reveals it fails unless we introduce an assumption of universal scope. While such an analysis cannot show that all adequate deductive explanations necessitate a nomological statement, it can expose a class of pseudo counter-instances to the D-N model. Frequently, explanation sketches omit universal propositions or covering laws because they are too commonplace to cite. A satisfactory explanation for ordinary discourse which is not in the form of the D-N model is not in itself an argument against the model. The explanation as provided must resist the D-N schema when deductive completeness is aimed at. Similarly, acceptable arguments in ordinary discourse which do not follow the strict forms of validity are not to be considered counter-instances to those forms. In the particular problem discussed, the question of whether the D-N model applies reduces to a question of which generalized assertions shall be accepted as part of our class of empirical laws.

I

The following example has been offered as an argument that some perfectly adequate explanations of a deductive type contain no covering law.[1]

(1) All the balls in the urn were red.
(2) Seymour drew a ball from the urn.

(3) Seymour drew a red ball.

Proposition (1) is an accidental restricted universal and consequently not a nomological statement. It is argued that propositions (1) and (2) logically entail proposition (3) and, furthermore, that proposition (3) is adequately explained by propositions (1) and (2). Consequently, the argument goes, we have a deductive non-nomological explanation of the proposition 'Seymour drew a red ball'.

If proposition (3) is deducible from propositions (1) and (2) the conjunction of (1) and (2) with the negation of (3) would be a contradiction. However, there is no contradiction in holding simultaneously the statements 'All the balls in the urn were red', 'Seymour drew a ball from the urn', and 'Seymour drew a non-red ball'. One only has to recognize that a ball may change color after being drawn from the urn. Let us see how a formalization of the explanation contributes to its pseudo-deductive character. 'Bx' means 'x is a ball'; 'Ux' means 'x is in the urn'; 'Rx' means 'x is red'; 'Dxy' means 'x drew y'; 's' means 'Seymour'.

(a) $(x)(Bx \cdot Ux \supset Rx)$
(b) $(\exists x)(Bx \cdot Ux \cdot Dsx)$

(c) $(\exists x)(Bx \cdot Rx \cdot Dsx)$

Formal proposition (c) is logically entailed by formal propositions (a) and (b). However, the formalization collapses certain temporal distinctions implicit in the original argument. Premise (1) describes a static condition (red balls in urn). Premise (2) describes the result of some action taken (withdrew a ball from the urn). Formal proposition (b) asserts more than is asserted in the original argument. It says that a ball is both in the urn and is drawn from the urn. Since our formalized propositions contain no temporal terms, these two states of affairs are taken to be compatible in general and subsequently, simultaneously compatible.

But the simplest intuitive understanding of the original argument tells us that it is contradictory to simultaneously hold 'x is in the urn' and 'x was drawn from the urn'.

II

In order to avoid the previous mistake in formalization, it is a simple task to introduce a new triadic predicate with time as a predicate constant ('Dsxt' means 'Seymour drew x at time t').

(d) $(x)(Bx \cdot Uxt_1 \supset Rxt_1)$
(e) $(\exists x)(Bx \cdot Uxt_1 \cdot Dsxt_2)$

(f) $(\exists x)(Bx \cdot Dsxt_2 \cdot Rxt_2)$

It should be evident that formal proposition (f) is not logically entailed by propositions (d) and (e). (Simply use the model: 'Ba' is true; 'Uat_1' is true; 'Rat_1' is true; '$Dsat_2$' is true; 'Rat_2' is false; 'a' is the only ball drawn at t_2.)

We may transform the previous argument into one with a valid deductive form by introducing the following universal proposition. If any red ball is in an urn at time t_1 and is drawn from the urn at time t_2 (where it is understood that t_2 is greater than t_1) then it will be red at time t_2. It can be formalized as follows:

(g) $(x)(Bx \cdot Uxt_1 \cdot Rxt_1 \supset (y)(Dyxt_2 \supset Rxt_2))$

We could easily further generalize the proposition by introducing a universal quantifier over time and substituting for Rxt the predicate Cxyt ('Cxyt' means 'x has color y at time t'). For the purpose of our argument the simplified form is sufficient. Formalized proposition (g) expresses a universal result since it is true that drawing a ball from an urn does not alter its color except perhaps under extraordinary conditions.

The formal explanation for why Seymour drew a red ball can be given by propositions (d), (e) and (g). Proposition (g) is the only one of the statements which could serve as an empirical law in the explanans. In contrast to a nomological proposition, (d) is a restricted universal and is reducible to a finite set of singular statements. It is more convenient, however, to leave formal proposition (d) in universal form while recognizing that it constitutes part of the initial conditions for the explanation. Initial conditions need not always take the form of singular statements. (Suppose we wished to solve the heat equation for a circular plate. One of the initial conditions, more appropriately called boundary conditions, might state 'All points on the circumference of the plate have a temperature of 70°C at time t_o'.)

III

The previous argument applies equally well to the following general form of the original explanation.

(4) All P are Q

(5) x is selected from P

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(6) x is a Q

The hidden universal proposition which suffices to make the explanation deductive states that the physical selection of x from the class of things which are P and Q does not alter a P from having a Q. (In other words, the property Q is conserved through the process of selection.) The above explanatory form is to be distinguished from the following deductive form which omits any reference to selectivity.

(7) All P are Q
(8) x is a P

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(9) x is a Q

In the case of drawing balls from the urn, the reason we are inclined to omit mentioning the process of selection in the explanation and commit it to our background information has to do with the fact that the condition is so commonly understood and so infrequently violated. Consequently, the thrust of the explanation is carried out by the proposition 'All the balls in the urn were red'.

By changing our example somewhat we can show how the selection process might become an important consideration. Consider the following explanation for why Bob caught a mutilated fish.

(10) No fish in this pond were mutilated.
(11) Bob caught a fish from this pond with a type x fish hook.
(12) Anyone who uses a type x fish hook to catch a fish in this pond will mutilate the fish.

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(13) Bob caught a mutilated fish.

In this example the thrust of the explanation is carried by premise (12) while premises (10) and (11) are more likely to be couched in the background information. 'Why-questions' are posed because something is perplexing. The explanation may be carried by a simple statement of antecedent conditions when certain physical assumptions or nomological statements in that context are trivially true. But for deductive completeness we must appeal to these generally-agreed-upon truths and establish them as part of the explanans.

There remains one question to be answered to complete the argument that the original explanation conforms to the D-N model. Remember, the original example purported to show that a complete and adequate explanation in deductive form need contain nothing more in the explanans than what amounts to statements of initial conditions. We have shown that a universal statement is tacitly assumed. But what are we to make of proposition (g) which states the color-conserving property of a physical selection process? Is (g) a law of nature? Surely, one can find no reference to it in any science text. If we restrict the class of general laws in the D-N schema to only those propositions stipulated as laws in one of the branches of science, then our reconstructed example fails to conform to the model. But that clearly was not the intent of the original architects of this model of explanation.[2] They were not in the least concerned with what laws are generated by the sciences. Rather the issue was: How to explicate a law-like sentence. A successful explanation requires at least one such proposition whether or not it has been certified by science.

The crucial point, then, for whether the D-N model is an adequate paradigm for the original example is found in the answer to the following query. Which of the true universal propositions or nomological types shall be taken as laws of nature? Proposition (g) with some slight modifications, i.e., quantifying over time, does seem to satisfy the generally acceptable criteria for law-like propositions (universal conditional form, generality of terms, supportive of a counterfactual).[3] So while there is no general agreement on the set of sufficient conditions for attributing law-like status to a proposition there are no obvious reasons for excluding proposition (g).

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NOTES

[1] Thomas Nickles, 'Covering Law Explanation', *Philosophy of Science*, Vol. 38 (Dec. 1971), pp. 548-549.

[2] See the classic essay on the D-N model 'Studies in the Logic of Explanation' by Carl G. Hempel and Paul Oppenheim, *Philosophy of Science*, Vol. 15 (April 1948) pp. 135-175, (reprinted in Carl G. Hempel, *Aspects of Scientific Explanation*, New York: The Free Press, 1965, pp. 245-290), especially part III on the logical analysis of law and explanation.

[3] For some representative views see: Ibid., pp. 152-157; Erenest Nagel's conditions on laws in *The Structure of Science*, New York: Harcourt, Brace and World, 1961, pp. 74-75; Hans Reichenbach treats the logic of nomological propositions in his *Elements of Symbolic Logic*, New York: The Macmillan Co., 1947, pp. 360-377; Arthur Pap's 'Lawlike Generalizations and Counterfactual Inference', in *An Introduction to the Philosophy of Science*, New York: The Free Press of Glencoe, 1967, pp. 289-305.