DEMONSTRATIVE INDUCTION

Most of the arguments encountered in scientific literature are supported by reference to (a) general empirical premises, and (b) particular statements of empirical evidence. The reasoning which proceeds from (a) and (b) to the inductive conclusion is often demonstrative. Below I should like to consider, first, whether or not such demonstrative inductive arguments can ever lead to a complete justification or elucidation of induction, and, second, the forms of demonstrative inductive inference which have been discussed by a number of writers on induction, in particular, J. M. Keynes, J. Nicod, C. D. Broad, and G. H. von Wright.

1. I shall first of all show that these demonstrative inductive arguments cannot lead by themselves to a justification of induction. It is possible to do this by showing that no genuinely inductive conclusion can be logically certain, and that therefore it cannot occur as the conclusion in a demonstrative arguments.

G. H. von Wright presents an interesting argument against the possibility of knowledge which is both empirical and necessary. He begins with what purports to be a tautological reformulation of Hume's analysis of "necessary connection." Hume's argument is that if B is not logically entailed by A, then we cannot know that there is a necessary connection between A and B. Von Wright's reformulation is: "If the causal relation is synthetical, i.e., if the effect is not a logically necessary consequence of the cause, then the relation cannot be analytically valid." [1] This reformulation seems to be trivially valid, the problem is to show that it is equivalent to Hume's thesis.

This equivalence obviously rests on the possibility of showing that a connection that can be known to be necessary is one that is analytically valid; or showing, more generally, that a necessary statement is one that is analytic. Von Wright attempts to show this by the ingenious technique of asking how a partisan of synthetic necessity would treat an alleged counter-instance. Consider the generalization, "All S's are T's." Suppose that someone maintains that this statement, call it G, is both necessary and synthetic. Since G is not analytic, it is perfectly possible that someone could claim to have observed an S which was not a T. There are only two

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[1] von Wright, G. H., *The Logical Problem of Induction*, Helsingfors, 1941, p. 23.

ways to save the generalization without impugning the honesty of the report. One is by saying that the entity in question was not *really* an S; the other is by saying that it must have been *really* a T, even though it appeared not to be one. In order to maintain that G is certain, we must be able to maintain that it is certain that one or the other of these alternatives is true.

According to von Wright, we can only be certain that one of the alternatives is true if we accept G as analytic. If we say, "It may have *looked* like an S, but if it was not a T, then it is a violation of the rules of the language to call it an S," then we are abandoning the alleged synthetic nature of the law. On the other hand, if we admit the possibility that there might be an S which is not a T, then we must allow for the possibility that the law may be false, and hence must admit that it is only probable. The argument may be presented in more general terms: It is always meaningful to deny a synthetic statement. If it is logically possible for the denial to be true, then the original statement is not necessary; if it is not logically possible for the denial to be true, the original statement is analytic, and not synthetic.

As it stands, this argument begs the question. The person who upholds G as synthetic and *a priori* need not deny the *logical* possibility of a refuting instance; he may say that he is certain that the alleged counter-instance can be explained away simply because he *is* certain that the law is true. This certainty need not be *logical* certainty, but may simply be described as *a priori* certainty.

There is, however, a somewhat weaker version of this argument which does not beg the question. It does not show, as von Wright's argument was intended to show, that the doctrine of the synthetic *a priori* is totally untenable, but merely that it cannot be called upon to bestow certainty upon inductive arguments. Let us suppose that the generalization G is inferred from experimental evidence E (which includes the statement "b is S and b is T,") in accordance with the synthetic *a priori* principle P, and that it cannot be asserted on *a priori* grounds alone. Let the alleged refuting evidence E* be, "a is S and a is not T." Neither E nor E* is impossible *a priori* (much less, logically impossible), for the impossibility of E would refute the generalization *a priori*, or would render it trivial, and the impossibility of E* would make it possible to deduce the generalization from general considerations alone: we would not require the evidence E, contrary to our hypothesis. Given P, either E or E* may be true, but not both.

It is not impossible (in any sense) that we should be confronted by both of the evidence statements E and E*, but if we are, we can be certain, *a priori*, (in virtue of P), that one of them is false. People do lie, and do make mistaken observations. But which evidence statement is false?

The matter is one which must be decided by the weight of the evidence in favor of one or the other, since neither one can be excluded *a priori*.

What has been proved here is merely that if an inductive conclusion is supported by some *a priori* principle, together with evidence E, and would be refuted by similar evidence E*, which is not *a priori* impossible, then this conclusion cannot be certain: it will be infected with the uncertainty of the evidence. The only way of escaping this conclusion is to assert *a priori* that the evidence reports are certain, i.e., that if E is the case, then no one will ever make the mistaken (or lying) report E*. This additional *a priori* premise stating the impossibility of false evidence reports hardly seems worth serious consideration.

This does not show that induction cannot be supported by reference to synthetic *a priori* principles like P, but it does show that even in this case the conclusion cannot be certain. Since the conclusion is uncertain anyway, there seems to be no reason for invoking the synthetic *a priori* when a well-confirmed generalization will do as well. Although such principles *may* be necessary (I don't think they are) to establish the cogency of some inductive arguments, they are clearly not sufficient. We must also develop a means of weighing evidential import. The analysis of demonstrative inductions, then, is not in itself a justification of induction, or an answer to all the problems of induction. The general premises which are discussed in the next two sections of this paper, at any rate, will have the character of well-established generalizations, even though they may, in Pap's [2] terminology, function analytically.

2. Although Bacon and Mill were revolting against the rationalistic traditions of the scholastics, they accepted the goal of induction as "certain" knowledge, and both, apparently, believed that a valid induction could not lead to a conclusion which might turn out to be false after all. Their inductive arguments were thus essentially demonstrative in form. Keynes' arguments by positive and negative analogy are very similar to the arguments examined by Bacon and Mill. For him these analogical arguments are fundamental in supporting inductive conclusions.

The property P is part of the positive analogy in a set of instances when all of the instances of the set have that property. The property Q is a part of the negative analogy in a set of instances, when at least one of the instances lacks that property. We may distinguish between known and unknown positive and negative analogies: two instances may have a property in common, or one may lack a property that another has, without our knowing it.

The simplest type of argument by analogy, called by Keynes *perfect analogy*, is based on instances which are completely known, and in which

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[2] Pap, Arthur, *The A Priori in Physical Theory*, New York, 1946.

the total analogy is covered by the generalization. To say that the instances are completely known is to say that we know *all* of the properties possessed by each instance. To say that the total analogy is covered by the generalization that P is constantly conjoined with Q, is to say that the instances have nothing in common but the presence of P and Q. We might use this form of argument to support the generalization that thunderstorms (T) cause the souring of cream (S) by citing two instances in which the only common properties are the souring of cream and the prior presence of a thunderstorm.

Perfect analogy is the fundamental form of inductive argument for Keynes; he provides an analysis of more complex arguments primarily to indicate the methods by which practical arguments can be made to *approximate* perfect analogy. It is absurd to say that we can have literally *complete* knowledge of an instance, for example; and if we do not, the total positive analogy (the logical product of all the properties which the instances have in common) may very well exceed the *known* positive analogy. We therefore are led to consider the negative analogy; the more exhaustive the known negative analogy, the less extensive is the unknown positive analogy likely to be. Even an instance which does not appear to differ in any way from previously observed instances will increase the probability of a generalization, for, "Every new instance *may* diminish the unessential resemblances between the instances and by introducing a new difference increase the Negative Analogy. For this reason, and for this reason only, new instances are valuable." [3]

It is clear that even if we are dealing with a perfect analogy, the argument is incomplete. In order to obtain the general law that Q is invariably preceded by P, we need to be sure that there *is* some property X, possessed by the antecedent situation, which is always followed by the property Q in the subsequent situation. We might add the premise, for example, that every occurrence of Q is preceded by some occurrence X, such that X is always followed by Q. But this statement does not help us very much, since there is nothing to rule out the possibility that each occurrence of Q is preceded by a *different* X such that X is always followed by Q. It might be true that the first occurrence of Q is preceded by P_1, and that P_1 is always followed by Q; the second occurrence of Q is preceded by P_2, and P_2 is always followed by Q; and so on. In order to achieve certainty by Keynes' ideal method of perfect analogy, we must make the far stronger assumption that there is only *one* cause of the phenomenon under investigation. We must assume not only that there is some property P possessed by the antecedent situation such that Q always follows P, but that there is no other property P', such that Q always follows P'. If we do not make

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[3] Keynes, J. M., *A Treatise on Probability*, London, 1921, p. 233.

this assumption, then we may at any point run across two instances whose only positive analogy is Q itself.

In the example discussed earlier, we can be sure that the thunderstorm caused the souring of the cream, given our perfect analogy, only if we are sure that the souring of the cream does not admit of a plurality of causes. Suppose that our eveidence consists of a perfect analogy between two instances; the instances differ in every property except that of S and that of T. Every property, outside of these two, which is possessed by one instance, is not possessed by the other. Suppose that the cream in the first instance is in a pewter container, and in the second in a brass container. (This implies that the two instances do have a property in common: that of being in a container, or even that of being in a metal container. It is difficult to find plausible examples.) If we accept only the postulate of determinism suggested first above, it remains perfectly possible that the souring of the cream is caused by placing it in a pewter container in the first instance, and by placing it in a brass container in the second instance, and that it has nothing to do with thunderstorms at all.

On other hand, the second postulate suggested above, that there is not in a given case a plurality of causes, seems altogether too strong as a general principle. Nicod [4] proposes a compromise, in the form of a postulate concerning the probability of a plurality of causes. Suppose that we have n instances of S and T, among which no two instances have any other property in common. (This is only possible for n greater than two, because Keynes and Nicod do not treat the absence of a property as being itself a property.) If T is not the causes of S, then the real cause of S must consist of an alternation of at least n causes; i.e., there must be at least an n-fold plurality of causes. Nicod's postulate states that as n approaches infinity, the probability of an n-fold plurality of causes being at work approaches zero.

This postulate already removes the argument from the realm of demonstration to the realm of probability. Furthermore, since there cannot be more instances satisfying the conditions of perfect analogy two by two than there are properties other than S and T, we require a high number of properties in order to achieve a high probability: if there are only k properties other than S and T, then the probability that T causes S will be at most unity less the probability of a k-fold plurality of causes. Nicod himself goes on to show that when we consider incompletely known instances, even the postulate concerning the improbability of a large number of causes will not save us. We cannot achieve a high probability, according to his argument, even with an infinite number of instances before us.

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[4] Nicod, J., *Foundations of Geometry and Induction*, New York, 1950.

It is doubtful if the analogical argument which is based upon incompletely known instances can ever be used to elucidate inductive arguments which make use of material premises. If we do not have a list of relevant properties, we cannot be sure that any of the laws which we can formulate in terms of the properties we *do* know about will turn out to be true; we cannot formulate laws regarding unknown properties. The general condition under which an argument from analogy can be used to support an inductive conclusion explicitly seems to be that we have a finite list of relevant properties; this means that we must use as a premise what is tantamount to a generalization in which the occurrence under investigation is asserted to follow invariably *some* occurrence (or each of a group of alternative occurrences) which can be unambiguously described in terms of the properties on our finite list.

If this condition is met, it means that we know that one of a certain finite number of laws is true. Each instance examined may refute some of these laws. If we are lucky, all but one of the laws may be eliminated. The argument we employ need not be phrased in terms of positive and negative analogies; we may start right out from the consideration of the finite list of laws, of which we have assumed that one is true. The invalidation of one of these laws by an instance of the phenomenon under investigation is a straightforward matter of deductive logic. Keynes' arguments from analogy not only fail to provide a general justification of induction (which is to be expected) but contribute only moderately to its elucidation.

The whole discussion, as it is pursued by Keynes and by Nicod, is formulated with an eye to the justification of induction. If we consider only the matter of elucidation, then we can restrict the application of these arguments to situations in which quite strong information is at hand concerning causality, the plurality of causes, and so on. This information, in this context, may perfectly legitimately be based on inductive evidence.

C. D. Broad, and particularly G. H. von Wright, have examined in much greater detail than did either Nicod or Keynes, the conditions that must be satisfied for an inductive argument by analogy to be valid.

Before embarking on a discussion of their results, it will be useful to set down explanations of the terms "necessary condition" and "sufficient condition." To say that P is a sufficient condition of Q is to say that whenever P happens, Q will happen, or, for all x, if x is P, then x is (or will be) Q. To say that T is a necessary condition of S, on the other hand, is to say that S cannot occur unless T occurs, or that it T does not occur, then S will not have occurred, or, for all x if x is not T, then x is not S. By the principle of contraposition, this is the same as saying that for all x, if x is S, then x is (or was) T. Being burned in a fire is a sufficient condition for the destruction of a piece of paper, but not a necessary condition, since there are other ways in which it may be destroyed. A necessary condition

for its being burnt, is that it be brought into contact with intense heat; this is not a sufficient condition, however, since other conditions, e.g., the presence of oxygen, must also be met. If we add the requirements that oxygen be present and the paper dry, then we have a necessary and sufficient condition.

An immediate consequence of these conceptions of necessary and sufficient conditions is that if P is a necessary condition of Q, then P v R is a necessary condition of Q; and if S is a sufficient condition of T, then S. V is a sufficient condition of T. We may avoid these trivial complications by understanding a sufficient condition to be a smallest sufficient condition, so that if S is a sufficient condition of T, then S. V will not be one – i.e., will not be a smallest sufficient condition. In the same way, we may understand a necessary condition to be a smallest necessary condition – so that if P is a necessary condition of Q, and R is not, we will not count P v R as a necessary condition of Q in this narrow sense.

Broad and von Wright are partly interested in showing that the logic of necessary and sufficient conditions is not capable of justifying induction in general,[5] and partly in providing an explication or rational reconstruction of some of the arguments which are actually used to support inductions.[6] The goal of their approach is somewhat more modest than that of Keynes. I shall consider here only the significance of the logic of necessary and sufficient conditions as providing useful analyses of inductive arguments.

On the supposition that we must select our necessary condition from one set of properties, $R_1, R_2, \ldots R_n$, and our sufficient condition from another set, $P_1, P_2, \ldots P_m$, and also that the absence of a property is not to be causally efficacious except in producing the absence of another property, Broad and von Wright show that it is possible for elimination to proceed to the point where we have only one possible necessary condition and one possible sufficient condition left. The significance of this happy result is somewhat mitigated by the fact that we can predict which conditions will be those which fail to be eliminated: the necessary condition will be R_1 v R_2 v $\ldots R_n$, and the suficient condition will be $P_1 \cdot P_2. \ldots P_m$. This follows from the fact that the elimination of R_1 v R_2 v R_3 by an occurrence of the phenomenon lacking all three properties does not eliminate any necessary condition formed from the disjunction of more than three alternatives; it does not eliminate R_1 v R_2 v R_3 v R_4, for example. Similarly the elimination of $P_1 \cdot P_2 \cdot P_3$ as a sufficient condition

[5] von Wright, G. H., *op. cit.;* C. D. Broad, "On the Relation Between Induction and Probability (II)," *Mind*, n.s. Vol. 29, 1920; C. D. Broad, "Hr. von Wright on the Logic of Induction," *Mind*, n.s., Vol. 53, 1944.

[6] von Wright, G. H., *A Treatise on Induction and Probability*, New York, 1951; C. D. Broad, "The Principles of Demonstrative Induction," *Mind*, n.s. Vol. 39, 1930.

does not eliminate any sufficient condition with more than three components, e.g., $P_1 \cdot P_2 \cdot P_3 \cdot P_6$.

Even this somewhat uninteresting result depends on two material assumptions. We must be able to assert that, "... under certain circumstance, it is possible to know when we possess complete knowledge of all the properties of the examined instances which are to be taken into account for the purpose of elimination of concurrent hypotheses,"[7] We must also be able to accept the deterministic assumption that there is, in any given instance, at least one necessary and one sufficient condition.

The status of the logic of conditions is made even clearer in von Wright's more recent book, in which his explicitly stated concern is to reconstruct scientific arguments. The arguments are worked out relative to a class Φ_0 of "logically totally independent properties." There are two postulates which are required. The first is that every property in Φ_0 is a "determined" property in Φ_0. "That A is a determined property in Φ_0 means that in every positive instance of A the Total Sufficient Condition of A in Φ_0 is present." [8] In addition to this deterministic postulate, another postulate, the Selection Postulate, is required. In one form, this states, "For any given conditioned property, a set with a known number of members can be known to include the set of actual conditioning properties." [9]

The supposition that these postulates are satisfied in a given inquiry is obviously tantamount to the supposition that one of a finite group of explicit laws is true. In the logic of conditions, as in the logic of positive and negative analogy, the arguments can all be recast in the form in which we have a finite number of causal laws, one of which must be true, and all but one of which are invalidated by the evidence. The situation is analogous to that in a detective story: either the butler did it or the elderly aunt did it, and as soon as one produces a valid alibi, or is otherwise eliminated, the blame falls on the other. The logic of conditions merely helps us to deal with a large number of suspects at once.

The interest of this approach is further vitiated by what I am inclined to call the confusion of ecxessive generalization. The common use of eliminative techniques of argument in supporting actual scientific inductions leads us to the consideration of the logic of conditions. In order to deal with very general forms of argument, we are forced to develop a complicated terminology. This process reaches its height in *A Treatise on Induction and Probability*. Logically we do not need this terminology; if we have a finite set Φ_0 of relevant properties, for which the two postulates

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[7] von Wright, G. H., *The Logical Problem of Induction*, p. 23.

[8] von Wright, G. H., *A Treatise on Induction and Probability*, p. 72.

[9] *Ibid.*, p. 136.

suggested by von Wright hold, then we can, if we are patient, enumerate all of the possible generalizations which make use of these properties, and employ ordinary deductive logic to eliminate them by means of our evidence-statements. The logic of conditions becomes interesting only when this set of properties contains a great many members, and we have no grounds, prior to consulting the evidence, for eliminating any of the possible generalizations based on properties belonging to Φ_0.

But this strikes me as a relatively rare situation. In the type of inquiry in which Φ_0 contains a great number of elements, e.g., in the search for the particular micro-organism that causes a particular disease, we generally have the further knowledge that exactly one of the elements of Φ_0 is the factor we are looking for: we can often exclude both a plurality and a (relevant) complexity of causes. It is doubtful if there are very many inductions in which the deterministic postulate and the selection postulate are satisfied, but in which we cannot narrow down the field of possible laws a great deal further than von Wright supposes in his treatment of general cases. Although his logic of conditions can be applied in the elucidation of some inductive arguments, we can always, by making a list of the alternatives and applying the simple method of direct elimination, get along without it, and it is questionable whether it is really worth all the terminology it requires for its general statement.

3. Some of the most useful forms of demonstrative induction (and those which are encountered most frequently in scientific literature), are those which employ some generalization which might be classified as pertaining to "the uniformity of nature" or "natural kinds." C. D. Broad has examined some of these arguments both from the point of view of a wholesale justification of induction [10] and from the point of view of providing a detailed elucidation of certain types of inductive argument.[11]

In the paper of 1920, he formulates a general "principle of the uniformity of nature," such that with it as an additional premise, inductions can attain a fairly high degree of probability on the basis of relatively few instances. The principle states roughly that the world consists of natural kinds, defined by specific properties. To say that Φ defines a kind, is to say that the group of things satisfying the propositional function $\Phi(x)$ also satisfies a "great number" of other propositional functions as well. If Φ defines a natural kind, and we observe that some Φ are Ψ, we can conclude with a fairly high degree of probability that all Φ are Ψ. One instance will not generally suffice: "We can also see now why common sense wants a number of observed instances before it will consent to be sure that there is

[10] Broad, C. D., "The Relation Between Induction and Probability (II)," *Mind.*, n.s. Vol. 29, 1920.

[11] Broad, C. D., "The Principles of Demonstrative Induction," *Mind*, n.s. Vol. 39, 1930.

some law connecting Φ with Ψ. It wants these instances to persuade itself of the truth of the hypothesis that Φ defines a kind."[12]

Broad characterizes a natural kind in very general terms: "... a natural kind of state is a sort which has a predominately large number of instances in nature, and such that the number of instances of neighboring sorts of states falls quickly away in every direction." [13] If we gant the general truth of psychological theory, this seems to be an excellent description of the characteristics that a certain class must have if it is to be discriminated and given a general name. Furthermore it is certainly true that the world seems to be full of kinds which have these charactertisics. But it is clear that to assert that "swan" (say) denotes a natural kind is already to make an empirical generalization: it is to say (a) that there are a great many swans, and (b) that all things which are different from swans are very noticeably different. In addition we must also suppose that we have some empirical knowledge concerning the properties which are such that if one swan has it, all swans do. If we are to make the inference from "these swans are bad-tempered" to "all swans are bad tempered," we must suppose that having a bad temper is one of these properties.

The principle in its general form does not help in the general justification of induction – as we might expect – and in this form it is too vague to be of very much help in the reconstruction of actual inductive arguments. (The confusion of excessive generalization, again.) In his 1930 article, Broad discusses more specific forms of the principle, and demonstrates the power of a premise concerning natural kinds when it can be applied to a particular case. Suppose we wish to establish the law, "All S's are T's." We can do this on the basis of a single observation (or, to reduce the possibility of erroneous observations, on the basis of several), if we are entitled to use a major premise of one of the following forms:

(1) If this S is a T, all S's are T's.
(2) If at least one S is a T, then all S's are T's.

We can employ (1) or (2) as a premise if we can say that S is natural kind, and that T is one of those properties which is such that if one S has it, all have it. It is a well-confirmed hypothesis, or part of accepted theory, that if one member of a species is carnivorous, then all members of that species are. This provides us with a whole series of statments of the form (2): If one dog is carnivorous, then all dogs are carnivorous; if one cat is carnivorous, then all cats are carnivorous; if one rabbit is carnivorous, then all rabbits are carnivorous. But we must note that there is only a certain family of properties which can be referred to in a premise concerning

[12] Broad, C. D., "The Relation between Induction and Probability (II)," *Mind*, n.s. Vol. 29, 1920, p. 17.
[13] Broad, C. D., *op. cit.*, p. 26.

natural kinds. We cannot say, "If one dog is brown, then all dogs are brown."

As Broad points out, these arguments are demonstrative in the sense that the conclusion follows rigorously and logically from the premises; but the conclusion is nevertheless only probable, since the major premise is a synthetic universal generalization which must ultimately rest on a problematic, or nondemonstrative induction.[14]

Since the argument from natural kinds is a very common one in many branches of scientific inquiry, I shall present a more specific example than the above. This example also serves to point up the purely elucidatory nature of these premises about natural kinds, since there is here no possibility of confusing the major premise with an *a priori* truth.

It is a well-confirmed statement that all samples of a given chemical compound have the same physical properties under the same specifiable physical conditions. I shall suppose that chemical compounds are defined in terms of their chemical properties alone. If we denote the class of chemical compounds by K, I am supposing that we can tell when something is a sample of a member of K without investigating its physical properties. Let us denote the class of physical properties covered by the generalization by F. F will include density, conductivity, melting point, boiling point, and the like, *under standard conditions*, but not location or velocity or mass. To make the symbolism simpler, we shall construe a chemical compound as the class of all samples of that compound, and a physical property in the same way. We can now write out our generalization about F and K as follows:

$$(3) \quad \rightarrow (P)(Q)[P \; \varepsilon \; K . Q \; \varepsilon \; F . \supset . \; (\exists x)(x \; \varepsilon \; P . x \; \varepsilon \; Q) \supset (x)(x \; \varepsilon \; P \supset x \; \varepsilon \; Q)]$$

(We may read this, "Whatever P and Q may be, if P is a member of the class of chemical compounds, and Q a member of the family of related physical properties, then, if there is a sample of P which belongs to the class Q of objects having the physical property in question, then all samples of that compound will have that property.")

Suppose now we discover a brand new chemical compound, A. With the aid of (3) we can determine its melting point, conductivity, and so on, with a high degree of probability in a very few experiments. We can substitute "the class of samples of compound A" for "P," and "the class of things melting at $93 \pm \delta°C$" for "Q" in (3). Since the former is a member of K and the latter a member of F, we can assert the second part of the statement by detachment. A few experiments can make it practically certain

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[14] Broad discusses more complicated arguments in the second part of his 1930 paper. They are due essentially to W. E. Johnson and concern the problem of deriving laws of variation (e.g., Boyle's Law) from instantial evidence.

that some samples of A melt at this temperature under standard conditions, and hence to make it highly probable that all samples of this compound will melt at this temperature.

There are a number of kinds of argument which can make use of statements like (3) or like those discussed by Broad in his article. It is also possible to have, instead of a universal generalization, a statistical generalization asserting that in a large proportion of the kinds belonging to the class K*, it is true that if one member of the kind has a property belonging to the class P*, then all members of that kind have that property. In this form, the premise might be used in zoology or psychology.

4. As far as the ultimate justification of induction is concerned, the same comments apply to all of the suggestions I have considered above. They all require, for the justification of a given inductive conclusion, reference to more general matters of fact. This is perfectly all right, so long as we are only interested in the elucidation of particular inductive arguments in concrete cases, since in advanced inquiries we usually do employ previously confirmed hypotheses in supporting a new induction. All of these methods are essentially methods of justifying an induction by reference to (a) a finite amount of evidence, and (b) one or more general synthetic statements, which are not open to question in that particular context of inquiry. These general statements, as Pap has pointed out, may function analytically in that particular context, but cannot be considered analytic in *every* context. None of these methods, however, provides any way of arriving at inductive conclusions by means of particular premises alone, and hence (since we do not want to have general empirical premises which are *never* open to question) none of them can provide a general or ultimate justification of induction.

The arguments by analogy discussed by Keynes and Nicod, as well as the logic of necessary and sufficient conditions discussed by Broad and von Wright, can be construed as taking for a general premise a disjunction of a finite number of laws. The evidence acquired in the inquiry then serves only to eliminate some of these possible laws. The generalization of this process leads to difficulties: we are led to wonder how we can know (except inductively) that a general premise of the kind described is true, and how this premise can ever be expressed in such a form that it is both applicable and fruitful in all contexts of inquiry. It seems reasonable to expect that in any real situation in which an argument can be reconstructed according to these patterns, it will also be possible and generally easier to reconstruct it in less general terms, making use of well-confirmed hypotheses that are explicitly applicable to that situation, from which we can infer that one of a number of definite hypotheses is true. The argument can then proceed by elimination.

The most fruitful of these analyses of demonstrative induction is that provided by Broad of the argument from natural kinds. In advanced sciences, this sort of argument is often employed explicitly, and with great plausibility. It is a well-confirmed and often employed generalization, for example, that each chemical element is a natural kind in the sense that there is a large family of properties, in addition to the defining properties of the kind, which are such that if one sample of an element has one of these properties, then all samples of that element have it. Although it is difficult to see any conceivable way in which such an hypothesis could be used in every inductive argument, or even how it could be used in all scientific disciplines, it is clear that many important forms of inductive argument can be reconstructed in this way.

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