INDUCTIVE LANGUAGE

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Abstract

It is only because Popper persists in arguing that words are not important in the formulation of problems that he can maintain that induction is a myth. But scientific hypotheses do not come into existence unless they are formulated in a well defined language. Popper's hypothetico-deductive method becomes possible only *after* we have been successful in defining our problem in a given language.

I

A major trouble with the problem of induction seems to be that it is a heterogeneous set of questions. We have become aware that the traditional oversimplification which took it for granted that every hypothesis is just a package of data, and that every hypothesis entails its own evidence, is met nowhere in science. The concepts of theory convergence, explanatory power, originality, and predictive performance are handled intuitively in the practice of scientific research and they are linked, also informally, to the basic concept of partial truth. Popper, on the other hand, will accept a hypothesis (tentatively, to be sure, until further notice) but will never make the assertion that it is probable. What is at issue here is the question of whether inductive logic is to have a rule of acceptance. The set of relevant answers is supposed to have a certain structure; Pierre Duhem, F.P. Ramsey and T. Kuhn regard the role of theories as essentially that of providing conceptual frameworks in which the inductive part of science is carried on. The empirical investigator never begins with a clean slate; he is typically selective and comparative, and the choice of the hypothesis partially determines the character of the subsequent inquiry. [1] The amount of support that acquired data yield normally depends strongly upon the method employed in finding the data. Thus, when talking about induction it seems more natural to speak of the learner than of the knower. The selection of language or the selection of random variables is the largest single decision determining how information will be processed. But the highly selective principles of attention that must necessarly be at work do not seem to be characterizable in any direct way from the concept of conditional probability. J.G. Kemeny [2] has pointed out that the principle of simplicity is not a presupposition concerning the simplicity of nature, but that it may be regarded as a consequence of requirements set up by methodological considerations. Scientific hypotheses do not come into existence unless they are formulated in a well defined language, and scientific languages therefore play a decisive role in scientific thinking. Each inductive method based on a certain language gives a different picture of the world.

The central problem of epistemology is often taken to be that of explaining how we can know what we do, but the content of that problem changes from age to age with the scope of what we take ourselves to know. Ramsey had construed probability as the measure of the subject's willingness to act on his belief. However, because logical relations hold between statements, but not between events and statements, the relationship between a perceptual experience (an event of a certain sort) and a basic statement cannot be a logical one, and therefore, Popper contends, cannot be of a sort that would justify the statement. One must ask what would be involved is *not* trusting one's beliefs, and one way of mistrusting a belief is declining to act upon it. Coming to have suit-

(1) Max Black, «Notes on the Paradoxes of Confirmation,» in Jaakko Hintikka, Patrick Suppes (eds.), *Aspects of Inductive Logic*, North Holland Publishing Company, Amsterdam 1966, p. 183, note.

(2) «The Uses of Simplicity in Induction,» *Philosophical Review*, vol. 62, 1953, pp. 391-408.

able degrees of belief in response to experience is a matter of training — a skill which we begin acquiring in early childhood, and are never quite done polishing. Clearly, the borderline between factual and linguistic error becomes cloudy here, for it is not clear what proportion of rational information can be verbalized. (3) There is a body of background knowledge that must be accepted before a statement makes sense at all.

Some philosophers have considered Hume's problem a pseudoproblem to be deposed of by roundly declaring that induction just is rational. But we lack agreed upon criteria for «rational», and Feyerabend indeed denies that they are possible in science. In the seventeenth and eighteenth centuries there was no clear distinction between «induction» and «deduction.» The history of logic (i.e. of the theory of truth value channels) from Descartes till today is essentially the history of criticizing and improving the deductive channels and destroying the inductive channels by making logic «formal.» (4) The main feature of classical empiricism was the preference of the logic of justification over the logic of discovery. The logical empiricist had no interest in the logic of discovery, for neoclassical empiricism had replaced the old idol of certainty by the new ideal of exactness. But one cannot describe the growth of knowledge, the logic of discovery, in «exact terms,» one cannot put it in formulae. The deepest explanations are «fact-correcting» explanations, and for that reason Lakatos (5) rejects the notion of degrees of belief, namely that their best touchstone is how much one is willing to bet on them. In scientific predictions we are not playing against a malvolent opponent but against nature, and nature does not exploit incoherencies. Carnap tried to avoid any language dependence of inductive logic, but he nevertheless assumed that the growth of science is cumulative. While in some betting situa-

(3) P. Suppes in *The Problem of Inductive Logic,* Imre Lakatos (ed.) North Holland Publishing Company, Amsterdam 1968, p. 187.

(4) I. Lakatos, «Infinite Regress and the Foundations of Mathematics,» *Aristotelian Society Supplementary Volume 36,* 1962, p. 162.

(5) In *Aspects of Inductive Logic, op. cit.* p. 358.

tions the basic beliefs may be specified as the «rules of the game», science is an open game, and there is no Turing machine to decide either on the truth of our conjectures or on the rationality of our preference. For both Lakatos and Popper methodology is a rational reconstruction of the history of science, of the growth of knowledge. We can only judge the reliability of eliminated theories from the vantage point of our present theories, and games are consequently poor models of science. While inductivism postulates the primacy of «facts,» according to Popper's logic of discovery, even in science we can never know and we always have to guess.

II

Empirical concepts are held to be ideas that have been «abstracted» by the mind from what is «given» in experience. Thus, the distinction between a priori and a posteriori rests upon a crude and outdated psychological theory about «abstraction» — a quasi mechanical process which the mind supposedly can perform upon what is «given» in experience. Up to the nineteenth century, Euclid's *Elements* served not only as the textbook of geometry but also as a model of what scientific thinking should be. (6) Euclid's geometry was accepted as a body of scientific knowledge about the nature of space, knowledge of which is perfectly true and firm. The development of the geometries of Lobachevsky and of Riemann came therefore as something of revolutionary intellectual significance. There is little doubt that the first and oldest problems in any branch of mathematics spring from experience. The definitions and theories af mathematics are indeed applicable to its concepts and objects, but this is only true because these concepts and objects are ready-made beforehand. Thus arithmetic considers only one single property of things, namely their indi-

(6) Stephen F. Barker, *Philosophy of Mathematics,* Prentice Hall Inc. Englewood Cliffs, N.J. 1965, p. 16.

viduality, that is to say, their identity with themselves and their distinction from each other. On the other hand, a projection by analogy of the finite into the infinite is accepted by most mathematicians. Indeed, an essential purpose of modern metamathematical activity is to devise methods by which infinity can be fandled by a finite intellect. It is now known that the truth or falsity of the continuum hypothesis and other related conjectures cannot be determined by set theory as we know it today. If we examine Peano's axioms for integers, we find that they are not capable of being transcribed in a form acceptable to a computing machine. This is so because the crucial axiom of induction speaks about «sets» of integers, but the axioms do not give rules for forming sets nor other basic properties of sets. Our intuition of sets comes from our belief in the natural, almost physical model of the mathematical universe.

Nevertheless, these structures are not altogether inevitable. There is simply no clear grounding of the view that logical principles express the limiting and necessary structures of the world. Mathematical evidence is acquired, and the mathematician understands his arguments only in a certain context. Sets are not privileged by some superior form of mathematical existence, even though they have proven an easy hold on our intuition, and in spite of the fact that the set theoretic style has found widespread application, including set theoretic or Tarskian semantics F.W. Lawyere (7) has reduced sets to categories, and intuitively speaking, set theory is biased towards substance, whereas category theory is biased towards structure. Model theory can be characterized as the study of the interactions of a language — usually a precise logical symbolism — and the «reality» this language represents. The «old-fashioned» idea is that one obtains rules and definitions by analyzing intuitive notions and putting down their properties.

(7) «The Category of Categories as a Function of Mathematics,» in *Proceedings of the Conference on Categorical Algebra*, La Jolla 1965, New York, Springer 1966, pp. 1-20.

But as a result of the paradoxes, we now believe that the intuitive notions of validity, set, natural number, or intuitively convincing proof, are problematical. Quine and Goodman argued that there are no such things as «sets»; and that there «really exist» nothing but concrete individuals. But to people who work in logic and mathematics it always looks as if what they learn is something they discovered and not something they invented. To the practicing mathematician it might indeed be a sound heuristic principle to suppose each arithmetic sentence determinate as to the truth. Such a supposition might well facilitate the discovery of proofs, for it is well known how quickly a proof or disproof can be found once one knows what to look for. To say that a possibility is queer or obscure is an implied argument against its existence. The objects of transfinite set theory do not belong to the physical world and even their indirect connection with physical experience is very loose (owing primarily to the fact that set theoretical concepts play only a minor role in the physical theories of today.(8) We maintain that the properties of logic and mathematics are independent of experience in the sense that they do not owe their validity to empirical verification. Analytic propositions give us new knowledge in that they call attention to linguistic usages of which we otherwise might not be conscious, and they reveal unsuspected implications in our assertions and beliefs. As Wittgenstein points out, our justification for holding that the world could not conceivably disobey the laws of logic is simply that we could not say of an unlogical world how it would look. (9) But it is perfectly conceivable that we should have employed different linguistic conventions from those which we actually employ. It is well known that some of the most interesting results of mathematics run counter to deeply ingrained intuitions and the customary feeling of self-evidence. Judgments as to what may

(8) Kurt Gödel, «What is Cantor's Continuum Problem ?» in *Philosophy of Mathematics*, edited by Paul Benacerraf and Hillary Putnam, Prentice Hall Inc. Englewood Cliffs New Jersey 1964 p. 271.

(9) *Tractatus*, 3.031.

be considered as self-evident are subjective; they vary from person to person and certainly cannot constitute an adequate basis for decisions as to the objective validity of mathematical propositions. Deductive mathematics was born when knowledge acquired by practice *alone* was no longer accepted as true.

The notion of set is much more complicated than was originally thought. Our inability to deal successfully with the continuum problem is certainly connected with the circumstance that our explicit knowledge of the continuum is very restricted. Quine shows that the various classifications of set theories into finitist, intuitionist, predictive, etc., cannot be regarded as exhibiting successive consistent extensions of a common logical or intuitive core. The nature of identification of exact mathematical and inexact empirical propositions is perhaps clearest in the case of the application of geometry. The identificatory statements which relate a geometrical to an empirical proposition are themselves empirical. ([10]) The one generally accepted arithmetic which is intuitively clear even to young children, is nothing but a set of empirical propositions. Domains of familiarity are used in judging theories, «previous knowledge» or familiarity with the inductive procedure can be used to delimit classical number theory and possibly a denumerable analysis. Mathematical investigation has so far an empirical character as we do not know the facts from the beginning, but have to learn them, and that surprising discoveries occur in mathematics. The methodology of a science strongly depends on whether it aims at a quasi-Euclidean or a quasi-empirical ideal. Lakatos shows that the present empiricist mood originates in the recent recognition that mathematics is not Euclidean or quasi-Euclidean — as had been expected, but quasi-empirical.

Carnap had argued that to accept the thing world means nothing more than to accept a certain form of language. The

([10]) Stephan KÖRNER, «On the Relevance of Post-Gödelian Mathematics to Philosophy,» in *Problems in the Philosophy of Mathematics,* Imre Lakatos (ed.), vol I, North-Holland Publishing Company 1967, p. 130.

purposes for which the language is introduced to be used will determine which factors are relevant to the decision, but the question *why* a certain terminology is, or is not, fruitful or expedient was not considered by Carnap. The nominalist rejects classes as incomprehensible, but may take anything whatever as an individual; yet Goodman admits that the line between what is ordinarily called «abstract» and what is ordinarily called «concrete» is vague and capricious. Sentences depend for their truth on the traits of their language in addition to the traits of their subject matter. We cannot know what something is without knowing how it is marked off from other things; scientific truth depends both upon language and upon experience. While philosophers have rightly despaired of translating everything into observational and logic-mathematical terms, the observation sentence is fundamental to the learning of meaning. Comparative similarity is all we need for that purpose, and Quine believes therefore that a standard of similarity is in some sense innate. For without some such prior spacing qualities we could never acquire a habit, and all stimuli would be equally alike and equally different. Every reasonable expectation depends on similarity and so does induction; even the ostensive learning of words is an implicit case of induction. We can consequently say that induction tells us more about our perceptual apparatus than about nature, in particular since we have different similarity standards and different systems of kinds for use in different contexts.

We are so overwhelmingly impressed by the initial phase of our education that we continue to think of language generally as a secondary superimposed apparatus for talking about real things. As a result, the simpler of two theories is generally regarded not only as more desirable but also as more probable. However, belief in the simplicity and uniformity of nature is due to our perceptual mechanism which makes us tend to see the simple and miss the complex. Communication is possible only through a degree of novelty in a context of the familiar. Changes in interpretation are governed, at least to some extent, by the language in which the interpretation is being presented. We are unable to move from language to its referent without using language, and we would simply not take anything as a language unless it was potentially translatable into our forms. It is now current practice to compare the acquisition of a conceptual framework to learning to play a game. To learn a game is to become aware of a structure of demands and to become able to realize these demands and motivated to do so. It is worth noticing however that conceptual thinking is a unique game in that one cannot learn to play it by being told the rules. The term «theory» covers a wide variety of explanatory frameworks, and most, if not all, philosophically interesting concepts are caught up in more than one dimension of discourse. We always need a background language to regress into; indeed, one of the most important characteristics of human language is its unbounded character. Among the innately given of human cognitive abilities are the *Gestalt* like tendencies to establish perceptual entities. The concept of a sentence apparently reflects specific abilities, presumably innate to man which children posses as a necessary condition for the acquisition of language. (11) This ability is a precondition for the production of myths, hypotheses, and theories. Such concepts are not so much the product of man's cognition, rather this conceptualization is the cognitive process itself, a process which is never completed. Common to all mankind are the general biological characteristics of the species among which is the peculiar mode and capacity for conceptualization or categorization.

III

Induction is not undertaken aimlessly, without some theoretically determined objective, and generalizations are built on experience which is itself highly selective. Finding requires knowing what we look for; frameworks delineate our capacity to find *ranges* of plausible conjectures, and models sug-

(11) David McNEILL, «Are There Specifically Linguistic Universals ?» in *Semantics*, Danny D. Steinberg and Leon A. Jakobovits (eds.) Cambridge University Press 1971, p. 533.

gest to us such ranges as possible explanations. Hanson has pointed out that what one says about one of the notions of observation, description, fact, hypothesis or explanation will affect what one can say about the others. In science laws are not so much laws of nature as laws of our own methods of representing and reasoning about nature. Almost everything we usually call *seeing* inolves as fundamental to it what Wittgenstein calls «*seeing as*». New visual phenomena are noteworthy only against our accepted knowledge of the observable world. Language is not related to the world as a copy is related to its original; seeing and knowing are interdependent concepts, and that is why their idioms intermingle. Perception cannot take place without familiarity with previously encountered relevant situations. What is called interpretation is built by language into the very concept of seeing; crucial experiments are crucial only against some hypothesis in terms of a relatively stable set of assumptions which we do not wish to abandon. Necessity as well as probability have to do, not with the nature of things, but with the nature of arguments.

It is thus not nature which is uniform but scientific procedure. Different languages sustain alternative conceptual frameworks, and for that reason an argument which seems entirely convincing to one person may not even be comprehensible to another. Formal operations relying on one framework of interpretation cannot demonstrate a proposition to persons who rely on another framework. It is normal practice of scientists to ignore evidence which appears incompatible with the accepted system of scientific knowledge, in the hope that it will eventually prove false or irrelevant. All formal rules of scientific procedure must prove ambigious, for they will be interpreted quite differently according to the particular conception by which the scientist is guided. We should also remember that the rules of induction have lent their support throughout the ages to beliefs that are contrary to those of science. Astrollogy has been sustained for three thousand years by empirical evidence confirming the prediction of horoscopes. Conversely, the destruction of belief in witchcraft during the sixteenth and seventeenth centuries was achieved in the face of an overwhelming, and still rapidly growing, body of evidence for its reality. Those who denied that witches existed did not attempt to explain this evidence at all, but successfully argued that it be disregarded. Today, on the other hand, science stands supreme as the only belief that remains practically unchallenged.

The difficulty is that the demand for a theory of scientific thinking cannot be satisfied. Popper has argued that the association psychology of Locke, Berkeley, and Hume was merely a translation of Aristotelian logic into psychological terms. (12) But Popper himself postulates a «principle of transference» according to which what is valid in logic is valid in psychology. He complains that such subject-predicate logic is a very primitive thing because in it there can be no real distinction between judging and arguing. In this way the mistaken theory of science which had ruled since Bacon — that the natural sciences were inductive sciences, and that induction was a process of establishing or justifying theories by repeated observation became deeply entrenched. Popper believes that on the prelinguistic level we often will solve problems without being fully aware that we have a problem, by «playing around» and «hitting accidentally on a solution.» But the hypothetico-deductive method becomes possible only *after* we have been successful in defining our problem in a given language. A «problem situation» crucially depends upon the language it is described in, and what will be a problem according to one set of assumptions or goals, will not be a problem in a different context. Popper holds that a deductive inference is valid if no counterexample exists, (13) but what will count as a counterexample depends on our scheme of classification. It is only because he persists in arguing that words are not important in the formulation of problems that he can maintain that induction is a myth.

(12) K. Popper in *The Philosophy of Karl Popper*, Paul Arthur Schilpp (ed), La Salle, Open Court 1974, p. 60.

(13) *ibid.* p. 115.

Popper holds that what looks like induction is really hypothetical reasoning. Corroboration is merely an evaluating report on past performance; it says nothing about the future, for it is just a report about the state of critical discussion at the time. To be «critical» means to look for logical contradictions and to eliminate them, but this crucially depends on the knowledge at our disposal and on the language we use. While truth and falsity are regarded by Popper (following Tarski) as properties or classes of statements, that is, of theories or properties of some language, the same does not hold for problems in his view. A problem is considered by Popper as essentially independent of the language in which it is formulated. Thus he can postulate objective, «third-world» knowledge without a knower — a philosophical extension of modern mathematical Platonism. He correspondingly rejects as «naive» the subjectivist theory of probability which assumes that we can measure the degrees of our belief in a proposition by the odds we should be prepared to accept in betting. Popper believes that if I like to bet and if the stakes are not high, I might accept any odds. He rejects betting as an indication of rationality since he prefers to «look at» (i.e. describe) an organism as a problem solving rather than an end pursuing entity, and he considers animals and even plants as «problem solvers.» Nevertheless, to say that life has problems is to describe it as a consciously driven teleological process, while to be «critical» or «imaginative» are extremely complex and sophisticated states of mind. When Popper therefore says that both ourselves and the world grow through mental struggle and selection, he is using a highly metaphorical language. The stated analogy between cultural and biological evolution is quasi-Hegelian: in *The Oopen Society* Popper started out attacking both Plato and Hegel but in his later philosphy he reverted to a modified Platonism as well as Hegelianism. In Popper's view the critical or rational method consists in letting our hypotheses die in our stead — this is a new version of the scapegoat myth.

The weakness of the hypothetico-deductive method lies in its disclaiming any power to explain how hypotheses come into being. In the end it is therefore not possible to dispense altogether with inductive reasoning. One can commit an error only if one is conscious of following a rule. A sort of conceptual rationality is contained in our «background knowledge» which already contains conceptual distinctions of kinds and objects. But if we do not know what the true theory is, there is no way to assess that we are approaching it. In Popper's view, it is falsifiability that is the mark of scientific value, and accepting false theories will often serve as well as accepting true ones for attaining our ends. However, Levi [14] agrees with Levinson, Lakatos and Salmon that unless truth were a desiratum, there would be no problem, and the risk of error would be unimportant. Originally people had hoped that a «logic of discovery» would provide them with a mechanical book of rules for solving problems. This hope had to be given up when it was recognized that the logic of discovery or «methodology» consists merely of a set of tentative rules of appraisal of ready articulated theories. Popper's methodology rests on the contention that there exist (relatively) singular statements on whose truth value scientists can reach unanimous agreement. But such «crucial experiments» do not exist; they are merely honorific titles conferred on certain anomalies long after the event, when one program has been defeated by another. Until now all the «laws» proposed by the philosophers of science have turned out to be false generalizing interpretations of the verdicts of the best scientists.

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[14] Isaac LEVI, *Gambling with Truth*, Alfred A. Knopf, New York, Routledge & Kegan Paul 1967.

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