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INDUCTION AND HYPOTHESIS

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Induction and Hypothesis

Proceedings of the Aristotelian Society supplementary vol. 16 (1937), 63–102. This was the one published philosophical paper excluded from *Concepts and Categories*, to Berlin's mild regret, oddly enough, given that he was very uncertain about the whole volume. The main basis for excluding it was that it was too parasitic on Margaret MacDonald's paper, but as can be seen IB summarises that paper quite fully at the outset.

With much of Miss MacDonald's paper¹ I find myself in agreement; and in particular with the objections which she brings against the arguments of G. F. Stout and A. C. Ewing, which seem to me conclusive. I shall therefore confine myself to the consideration of those among her views which I find I cannot accept, and, in stating the reasons which lead me to reject them, I hope to make my own position clear.

Miss MacDonald's argument appears to proceed roughly as follows:

The word 'knowledge' is used in two main senses indicated by the expressions 'deductive knowledge' and 'inductive knowledge'. The only common characteristic which the word denotes in both cases is that of being concerned with propositions: the first activity is concerned with propositions whose truth, which in this case is equivalent to validity, entirely depends on the consistent use of the conventions in accordance with which they are constructed, so that to deny any one of them would involve contradiction of the conventions, that is, self-contradiction. The second is concerned with propositions about the world, and these, since their truth does not depend on conventions, can be denied with no fear of disastrous logical consequences. The fallacy of rationalism consists in supposing that because the word 'knowledge' is used in both connections, the logical nature of the two activities is identical or similar; that the second can in some way be reduced to the first; so that just as in the case of the first, that is, deduction, the truth of a proposition is discoverable by examining the denotation of its constituent terms and the logical character of their connection, and a logical guarantee can be demanded for each step in the argument, it can equally be demanded in the case [64] of the second, or inductive, reasoning. For, so it is said,

¹ Margaret MacDonald, 'Induction and Hypothesis', *Proceedings of the Aristotelian Society* supplementary volume 16 (1937), 20–35.

only such a guarantee could 'justify' scientific and common-sense beliefs about the world, since this is what the word 'justify' means; and since it does not seem at all clear how this guarantee is to be found, or where it is to be looked for, or what it could possibly be, there is here an unsolved problem which has haunted philosophers for many generations. Had they however realised (as they might have done by paying more attention to the different ways in which common forms of speech occur in ordinary non-philosophical language) that the two senses of the word 'knowledge' are entirely distinct, they would have ceased to demand for one what, by definition, can belong only to the other; for if the demand could in principle be satisfied, it would be possible to obtain information about particular past, present or future states of affairs in the world by sufficiently close attention to the meanings of words. But the suggestion that such could ever be the case is obviously senseless, and can be the result only of incorrect analysis of some concept, of a failure to realise that the word 'knowledge' is equivocal, a homonym for two entirely different concepts. No sooner is this perceived than the problem is seen to be a pseudo-problem, a verbal confusion due to the ambiguity of language. Yet there are philosophers even among the empiricists who perceive only half this truth; for, starting from the two propositions that knowledge, properly so called, is knowledge of propositions whose truth is logically guaranteed, and that no proposition about the world can be so guaranteed, they conclude that these latter cannot be known, and are, consequently, never more than hypotheses. But this conclusion does not follow: it depends on the confining of the term 'knowledge' to only one of its senses, which is contrary to ordinary usage and is indeed precisely the old fallacy committed by the rationalists. As for hypotheses, the sense in which it would be natural to say that we do not know them is a sense totally different from that in which it is maintained that all empirical propositions are hypotheses; it is therefore highly misleading to suggest that they are hypotheses, [65] for this would entail that (as we normally use words) they cannot be known, but at best only believed; and this, in the accepted sense of the verb 'to know', is simply not true. That we do know some can, moreover, also be shown by the fact that it is senseless to assert that there are propositions which can be believed, but can, in principle, never be known.

I hope that this brief summary correctly represents at least the gist of Miss MacDonald's argument: for since I disagree with much of it, it is particularly important to state it as accurately as possible.

I shall maintain in the first place that although the substance of Miss MacDonald's contention against the rationalists in question is correct – there is and there can be no 'guarantee' of inductive

reasoning – yet her victory is gained too easily, by an oversimplification of her opponents' position, whose fallacies deserve more attentive treatment than she accords them, since they are partly due to a view of knowledge whose existence Miss MacDonald ignores, but which, nevertheless, seems to me to be not only correct but alone relevant to this issue, although some conclusions which have frequently been drawn from it are erroneous.

In the second place I shall maintain that her charge against the empiricists of fatally confusing hypotheses and other kinds of empirical propositions, if it is valid, entails the falsity of at least one of her premisses; alternatively, if her premisses are true, the charge is either invalid or trivial.

I shall argue, finally, that the problem of induction is one not of knowledge but of probable reasoning, or rational belief; and that this is left by Miss MacDonald where it has always been, foremost among the unsolved problems of philosophy. Like her, I do not pretend to be able to answer it; but I differ from her in supposing that, while it is a genuine problem, whose final solution cannot be found until a correct analysis has been given of the import of all general propositions, it is possible that consideration of what we mean by speaking of beliefs reached by induction as rational may indicate at least what kind of answer is likely to be right.

[66] The questions posed by Miss MacDonald are: Can we ever be said to *know* any inductive generalisations? If so, under what circumstances? And in what sense of the word 'know'?

Miss MacDonald in the course of her argument distinguishes three senses of the word 'knowledge':

1. The sense in which we are said to know analytic propositions, that is, propositions whose contradictories are self-contradictory, for instance definitions and whatever follows from them in accordance with the law of contradiction. The attempt to reduce empirical propositions to these leads, as Miss MacDonald rightly points out, to complete absurdity; but the assertion that this is what rationalists have attempted to do is much more dubious.

2. The sense in which we are said to know rules, instructions and so on, for instance how to play a game, how to speak a language, how to drive a car. This is relevant because Ramsey suggested that knowledge of causal laws could be interpreted as

knowledge of certain rules. To this Miss MacDonald objects that causal propositions cannot be rules, since whereas it is quite usual to speak of believing causal propositions, it is impossible to say that one believes a rule. This objection does not seem to me conclusive, since a more elaborate transformation rule than one which simply substitutes 'believe' wherever 'know' can legitimately occur might produce intelligible sentences. A consistent follower of Ramsey would say, perhaps, that while what he meant by 'X knows p ' is equivalent to 'X unhesitatingly relies on the applicability of method Q in certain circumstances', 'X believes p ' is equivalent to 'X relies on Q, but without complete confidence' or the like.

3. The sense in which we are said to know that Jones is angry; which is regarded as the same sense as that in which we are said to know such propositions as 'Jones is at this moment sitting on a chair', and also the same as that in which we are said to know that the combination of H_2 and O produces water, or the laws of Avogadro, Gay-Lussac and so on, but do not know that the nebular hypothesis, or the theory of natural selection, is true.

[67] These three senses are treated as radically distinct; in themselves, it is claimed, they offer no problems; perplexities arise only when we confuse them, when we ask of one of these objects of knowledge, of an accusative governed by the verb 'to know' in one of its senses, in what way it is governed by it in one of its other senses, or even fuse the senses into one, which is ultimately a linguistic or grammatical blunder, although it may disguise itself as a logical or epistemological crux; whereas if (like unsophisticated persons who do not philosophise) we remember that these senses are distinct we shall see there is no genuine problem. All alternatives to this position are eliminated not because they are false but because they are nonsensical.

Against this I propose to argue:

(a) that if Miss MacDonald is right then there is no distinction of kind between knowledge in sense 3 and what is commonly called belief or opinion; that this does not accord with common usage; and that the assertion that this is the only sense in which any empirical propositions are ever known entails conclusions at least as absurd as those from which Miss MacDonald's analysis is intended to protect us.

(*b*) that there are at least two further ways in which it is customary to use the verb ‘to know’, in terms of which alone the question at issue is intelligible; these senses being either identical or cognate, but in any case not related to each other or to the senses cited above merely by the sharing of a common name.

(*c*) that the first of these (sense 4) is the sense in which we are said to know whatever is immediately given to the senses, to introspection, possibly to memory; such states of direct acquaintance being expressed by singular propositions; while the second (sense 5) is the sense in which we are said to know that which is asserted by certain general propositions which are not analytic in sense 1 nor inductive in sense 3.

[68] (*d*) that knowledge in sense 1 reduces to something very similar to, if not completely identical with, knowledge in sense 2.

(*e*) that the mistake of rationalists such as Aristotle or Kant consists of confusing 3 with neither 1 nor 2 but, if anything, with 5.

(*f*) that while A. J. Ayer and other empiricists are mistaken in supposing that all empirical propositions are hypotheses, their case is not altered by accepting Miss MacDonald’s remedy of regarding some of these as not indeed hypotheses, but simply general; since the objections which hold against the view that they are hypotheses are no less fatal to the view that they are general, for the difference, on her view, if there is a difference, is not one of kind, but at most of degree: the sense in which hypotheses, since they are not known a priori, are said not to be known at all, is precisely the same as that in which general empirical propositions can be said not to be known, which is no more than the empiricists in question have maintained. This is not affected by defining (as Miss MacDonald does) knowledge itself as fallible, for in this odd sense of knowledge hypotheses too could be said to be ‘known’; so that the question becomes at most one of precise verbal expression, and confusion between the two (that is, hypotheses and generalisations) could not possibly lead to any philosophical errors.

(*g*) that ‘A believes p ’ does not, as Miss MacDonald appears to think, entail “‘A knows p ’ may be true”, and further that ‘It is possible to believe that p ’ (which is equivalent to ‘ p is a

proposition' or ' p is either true or false') is compatible with, but does not entail, although it may be entailed by 'It is possible to know that p '; from which it follows that the question 'Do we know any inductive generalisations?' and the question 'Do we regard any as probable, or hold rational beliefs concerning them?' are two distinct and irreducible questions, neither of which has been satisfactorily answered, neither being either obscure or meaningless.

[69] (a), (b), (c) Miss MacDonal asserts with considerable emphasis that when on certain occasions we say that we know a general inductive proposition to be true, we are using the word 'knowledge' in a recognisably correct sense; and that it is a sense in which knowledge is contrasted with belief or supposal: for whereas we know certain empirical propositions to be true, we believe some and suppose others. Nevertheless such knowledge is not to be defined as immune from error: we can, according to Miss MacDonal, be said to know a proposition which later turns out to be false; the indubitability of what is in this sense known cannot thus be determined either by inspecting the logical character of the proposition so known, or by any epistemological criterion, nor by the definition of knowledge as infallible. How, then, are we to distinguish knowing from other cognitive attitudes, or indeed to discover what the term denotes? The only criterion left is psychological. Knowledge of a general empirical proposition is defined as an attitude towards it such that, after we have carried out certain tests, we do not trouble to look for further evidence of its truth, and would think it odd in others to do so. Nevertheless, the proposition may be false. Knowledge is therefore, on this view, equivalent to subjective certainty, a state of intense conviction, in which all the logical alternatives or contraries of the proposition in question are, or would be, unhesitatingly rejected if they offer themselves for inspection. It is the kind of state of mind which would cause a man, if asked whether he was quite sure that England was still an island, to reply that he was.

This is the attitude which Miss MacDonal (rightly in my opinion) implies that scientists adopt towards the well-established generalisations in their sciences, and ordinary persons towards the existence of many physical objects within and beyond their perceptual field. That the existence of such a state of mind is

indicated and presupposed by many of our everyday statements is indubitable. But if to Miss MacDonald it seems strange not to call it knowledge, to me it seems strange to call it so. Many propositions have been held by individuals with this overwhelming degree of conviction, yet, however vehemently [70] they were asserted, we should not ordinarily say that they were known. Men have believed that the earth is flat, that the sky is a solid ceiling studded with stars, that the sun is sometimes swallowed by a dragon, that words have magical properties, that the existence of God can be proved a priori. If they had been asked whether they *knew* all these propositions to be true, it seems highly probable that they would have answered that they did. And if they had then been required to produce evidence for this, and had provided what to them might have seemed (what they 'knew') to be adequate proofs, they would, on Miss MacDonald's criterion, be fully within their rights in claiming knowledge. Yet we do not now say 'They certainly knew all this, and yet they happened to be wrong' or 'Their knowledge is more fascinating than ours, but unfortunately it is quite false.' We should normally say that they thought they knew (although some philosophers, rightly perhaps, take exception to this usage), but they were mistaken: they did not know; what they wrongly called knowledge turns out to have been mere belief. And we should say this not only when and because these propositions were, in fact, false (although this puts the matter logically beyond doubt), but because we presuppose, in assuming that we apply the word correctly, some criterion by which we can directly distinguish at any rate some kinds of knowing from intense belief, such that the propositions expressing such knowledge are incorrigible by any previous or subsequent experience.

If an example of this is required we need go no further than the previous paragraph. In saying that it is indubitable that this state of mind (that is, of unhesitating acceptance of a proposition as true, whether after suitable tests or not) exists and is different from other states of mind, 'indubitable' is used in a sense which is other than psychological, that is, not equivalent to strong conviction. Knowledge of the distinctions between certainty, doubt, wonder and so on is founded on direct acquaintance, and is not itself a case of something intensely believed to be true. Two propositions are involved: one asserts that what we [71] mean by certainty differs in a statable manner from doubt or wonder; the other that

we have at least once had an experience which consisted of acquaintance with this difference. The first states a general proposition about the defining characteristics of certain events or states; the other is singular and existential and asserts that an instance of such an event has on at least one occasion occurred in our experience, but for which fact we should not have become acquainted with the characteristics in question. Neither of these propositions can be verified either by attending to their logical structure, or by problematic induction. If they are seen to be true they are seen to be so by some sort of direct inspection: what they symbolise are irreducible and indefinable ultimate data of consciousness; the instancial propositions are basic or primary, need no 'justification', but on the contrary verify or render probable other propositions, which in relation to them are secondary or tertiary or belong to some higher order, and logically depend on the primary propositions for their veridicity.

The sense of 'knowledge' in which we know some event to be of a certain kind, an instance of a certain universal or determinate, is a primary one, and classifies those states of mind which include direct apprehension of a datum, such that, in cases where the determinate predicate is absolutely specific, no error can arise; that there are such states of mind is presupposed by the possibility of any significant symbolism – that is, meaning. This may be shown by the fact that if we ask what a given word or expression means, we may at first be offered other words or expressions into which the former are translatable according to the conventional rules of the language; but if these are either not precise enough or themselves as yet convey nothing (as when a language is taught to a child), the only method of exhibiting the meaning is by pointing to some experience which must be of at least the kind of fact to which the original symbols were intended to refer. Unless it is possible to say truly on at least one occasion 'Here is something scarlet' and point, the word 'scarlet' (as opposed to the behaviour of a symbol in a formal, linguistic system, when [72] it ceases to be a word or to have meaning) signifies nothing.

Acquaintance with the empirical illustrations of specific determinates is the most elementary and ultimate form of knowledge, and there must, in any individual's experience, have occurred as many of these acts of acquaintance with specific determinates (or simple universals) as there are irreducible general

terms in his language. All this is obvious enough. It is referred to here only in order to show that unless knowledge exists which is at once not verbal (that is, about words in sense 1), and not corrigible (that is, neither 2 nor 3), but such that it alone verifies or probabilifies general or any other propositions, no meaning can be attached to Miss MacDonald's distinction between knowledge and belief (according to which Avogadro's law is known, but not the hypotheses which account for it); for unless such knowledge exists, nothing can be meant by such words as 'verification' or 'appeal to experience', and nothing, therefore, by the distinction between empirical and other propositions. If this absurd conclusion is to be avoided, we must allow this fundamental sense to the word 'knowledge'.

It now becomes relevant to ask (i) whether we know inductive generalisations in this sense; to which the answer is that we do not, since by knowledge in this sense we mean acquaintance with particular empirical facts; and if so, (ii) what the precise relation is between such singular propositions (sometimes called deictic), whose truth we know by acquaintance, and the general propositions which they verify or make probable. This I take to be the real problem of induction, the problem which F. P. Ramsey's statement that causal propositions are rules or imperatives is intended to answer. Miss MacDonald, rightly in my opinion, finds this view inadequate, for, as she says, one can believe inductive generalisations but one cannot believe rules; although it is important to point out that this is more than a statement about our use of the words 'believe' and 'rule', but a way of saying that it is absurd to deny that what we intend to express by means of general propositions can be true or false. Ramsey translates 'X causes Y' into 'If you want to get Y, produce X', but if anyone asks for a reason for [73] saying this, it obviously makes sense to add to this some such words as 'because I am sure that no one will ever obtain (or has ever obtained) Y without the previous occurrence of X', a statement which is either true or false, and would, therefore, be completely refuted by a single negative instance, whereas it is nonsense to say that a rule is refuted by anything. But then, not unnaturally, one goes on to ask: What would have to be the case for it to be true? How is it verified? What is meant by saying that it is so much as probable? To which Miss MacDonald's only answer seems to be that when we know it we know it, but sometimes we

do not; and even when we do, we may still be mistaken; of which one can say only that it is either tautological, or fallacious, and in either case extremely obscure.

(d) As for knowledge in senses 1 and 2, they are almost identical, and their relevance to the issue seems very distant. The first is knowledge of such propositions as ‘If φ is defined as “ $p \ \& \ q$ ” then “ φ entails q ” is true’, denial of which entails self-contradiction. It is clear that no expression is self-contradictory unless it is made so by the definition of the symbols which compose it. Whether the definition is explicitly made (as when a new symbol is defined for the first time), or is implicit in the verbal habits of a given individual or society, is clearly immaterial.

Definitions of symbols may be of two kinds: either they are verbal, that is, the expression is defined as equivalent to some other for which it is thus substitutable; or they are ostensive, in which case a symbolic expression is attached to a characteristic given in experience or to a combination of such characteristics whose instances it then classifies. The process in both cases is analogous: a new rule for using symbols is created, or an existent usage is established as a rule. Contradictions occur only if the rule is broken. This seems to me to be a perfectly normal sense of the word ‘rule’: we are said to ‘know’ algebra or a system of shorthand or how to play chess in the same sense as that in which we know how to swim, or what to do in the case of a fire. In either case what we mean when we say that we *know* is either that we understand the sentences which state [74] the rules (or could deduce or remember them if we tried), or that we believe that we could, if we chose, respond to the relevant situations by behaving in a certain fashion; and often both of these. Knowledge in sense 1 (that is, of what are traditionally called analytic propositions) refers in particular to the theoretical aspect of the situation, that is, to familiarity with the verbal conventions; knowledge in sense 2 is used as equivalent to belief that we could obey them if we chose; this belief is, of course, itself an ordinary inductively reached belief and not awareness of a rule. ‘I know Italian’ is an empirical statement about knowledge of rules, and not itself a rule in any sense.

Fundamentally, 1 and 2 are therefore logically almost indistinguishable, and the distinction drawn between them by Miss

MacDonald seems to me to be supported neither by common usage nor by the facts. This sense of knowledge does not seem relevant to the topic, since in neither case is this kind of knowledge knowledge of general propositions, nor indeed of any propositions properly so called. The question at issue is, however, whether this latter kind of knowledge exists, and if not, what is the proper description of our cognitive relation to such propositions.

Miss MacDonald says that 'knowledge' is a word which we frequently use to denote our attitude to propositions based on induction, which, being empirical, are liable to error. Whether this is so or not does seem to me to be important: it seems to me a conveniently ambiguous use of the word 'knowledge', which we are prepared to admit to be misleading, particularly when such knowledge is claimed by others. It is misleading here because it obscures a distinction between two states of mind with which we are clearly acquainted. Everyone has a right to attach to symbols whatever meaning he chooses: Miss MacDonald's point would have been less plausible if she had made it clear that, as she uses it, 'knowledge' is equivalent to 'strongly held conviction'. Do people hold inductive propositions with strong conviction? It is obviously plausible to say that they often do. With this her discussion of the subject, so far as I can see, ends. But the questions which [75] I should like to ask are: (i) If conviction is not the attitude commonly described by the word 'knowledge', what is it that is so described? (ii) What difference is there, if any, between rational and irrational conviction? These seem to be the questions which occupied the old philosophers. Miss MacDonald's answer to, at any rate, the first of these is that it is a pseudo-question due to confusion between sense 1 and sense 3 of knowledge. But this is too unplausible. Can anyone believe that even the stupidest and most dogmatic among rationalists believed that 'The moon is uninhabited' can be demonstrated in the same fashion as ' φ entails q ' when φ is (by arbitrary convention) defined as ' $p \ \& \ q$ '? Some philosophers may have thought it in principle as demonstrable as ' $2 + 2 = 4$ ', but that is because they held a non-conventionalist view of the logical structure of arithmetic.

Taking knowledge, then, in its more usual philosophical sense, as being a cognitive relation to incorrigible propositions, we may ask: Are there *any* general propositions other than definitions, and the tautologies which follow from them, which we can in this

sense be said to know? For if there are none such, then it will follow analytically that inductive propositions, since they are general, and are neither definitions nor rules, cannot be known.

We may begin by asking whether there are any general propositions which can be known a priori, for some rationalists appear to have believed that at any rate the principles of induction were to be found amongst these. Miss MacDonald assumes that only nominal definitions and what analytically follows from them are a priori. This is a widespread view, but, if by 'a priori' all genuine propositions are meant save those which can be confirmed or refuted by experience, then it seems to me certainly incorrect. There plainly exists a class of general propositions which are certain in the sense that no empirical evidence could in principle refute them, but which are nevertheless not analytic in the above sense. These are propositions of the type reached by what W. E. Johnson [76] has called intuitive induction, which, he seems to imply, includes the law of contradiction itself. It asserts some relation between empirical characteristics or universals which is necessary, but not rendered so by definition: for instance, 'This pink [shade] is more like this vermilion than it is like this black', or 'If in the same sense-field a colour patch A looks smaller than a colour patch B, and B looks smaller than C, then A looks smaller than C', where 'pink', 'vermilion', 'black', 'A', 'B', 'C', 'more like', and 'looks smaller than' are or could be defined ostensively, that is, by pointing.

One perceived instance of such complexes suffices to demonstrate that all past or future instances of the constituent universals are related by the same relation as those in the given instance. The proposition is not tautological, because the words 'pink', 'vermilion' and so on are defined not in terms of the position of particular colour patches on a scale or colour map constructed in some conventional order, that is, in terms of each other (as Hume appears to have supposed), but can be defined directly, by sensible inspection. The logical relations of the colour names are determined by the order of the shades in a scale or series which is itself directly perceived or 'given'. The generating relation between the terms in this series is in this case the relation 'more similar than', which is as directly observed as the shades themselves. The contradictory of the proposition is therefore itself not formally self-contradictory, since the rules against which we

offend if we say 'Pink is more like black than like red' are not conventional: the use of words may be governed by rules, but not the truth which they express, or fail to express. Given the three singular propositions 'A is pink', 'B is red', 'C is black', the proposition 'Anything of the same shade as A resembles B more than it resembles C' does not follow analytically, but neither is it reached by ordinary induction. That it is not verbal may be shown by the fact that a man blind from birth, if he knew that colour words described sensible qualities, and that pink, red, black were names of colours, might know, since the sensible qualities in his own experience [77] occurred in a graduated series, whose generating relation was transitive and asymmetrical, that it was the case that of any given colours belonging to the same series, some two were more like each other than either was like a third; but he could not know of which of the shades this was true: for this, at least one act of acquaintance with all three is required, which *ex hypothesi* he cannot have had.

This seems to me conclusively to refute the view that the proposition is a tautology, that is, that 'Pink resembles red more than black' is a way of saying 'The words "pink", "red", "black" are so used that the word "resembles" would be appropriate between the first two, but not between the first and third.' The appropriateness is not a convention of what is sometimes called logical syntax, but is determined by the perceived relation between seen instances of the shades. This error may be due to a confusion of verbal with ostensive definitions: the latter are perhaps improperly called definitions, since by themselves they entail nothing at all. Either a definition is verbal or it is not; if it is not then nothing which offends against it does so because of misuse of an adopted syntax. The definitions of given shades of colour or of 'more like than' are not verbal, but ostensive (this is what is meant by calling the *definienda* indefinable); the contradictory can therefore never be, as in the case of tautologies, self-contradictory.

But if it is not a tautology, is it empirical? It cannot be this either, since it is never nonsense to say of a general empirical proposition that it is false; but a proposition of this type cannot be so contradicted. Invited to conceive of a world in which the shades we call pink, red, black occurred in some order other than that presented in ours, we must say that we cannot do so; not because of a failure of imagination, but because it is inconceivable: the

invitation is itself nonsensical. Whereas of course we can alter at will, or conceive as altered, relations between anything which we can manipulate – symbols, or chessmen, or tables and chairs.

But if the contradictories of these ostensive definitions are neither self-contradictory nor straightforwardly false, what are they? We can answer only that they seem meaningless. Meaningless not because they offend against [78] the rules of a particular language, for they conform to them; but because, while they appear to state something, what they state is, in fact, inconceivable: that is, they state nothing whatever.

(e) The fundamental properties of the qualities and relations met with in ordinary experience are what they are, a species of brute fact. The propositions which describe them cannot entail any existential propositions since they record not what occurs but only what can be conceived as occurring; they resemble ordinary empirical propositions in telling us what to expect when they have application, but differ from them in that nothing can be meant by speaking of their possible failure to have application; if propositions which are neither existential, nor formal, but nevertheless significant and known to be true are called metaphysical and a priori, then these are so. The sense in which they are known is sense 5 of the word 'knowledge', which is not recognised by Miss MacDonald.

Now it would seem that some rationalists, notably Kant, and possibly Aristotle, sometimes speak as if they believed that such propositions as 'Nature is uniform' or 'Every event has a cause' are neither verbal nor empirical, but belong to a class of propositions similar to those reached by intuitive induction. This view is erroneous if, as it seems to do, it involves the deduction of existential propositions from a priori premisses: but it is a far more reputable error than that attributed to them by Miss MacDonald, who thinks they mistake tautologies for general propositions, since these are at least genuine propositions, and correctly described as general, whereas it may be doubted whether tautologies or verbal definitions are genuine propositions, unless they are taken to be empirical statements about current or intended usage. Kant, for instance, produces more than one argument intended to prove that causality is a relation which can be established a priori, by a species of intuition which seems similar to intuitive induction. If this were

true, scientific induction would acquire an a priori justification: it could be said that there *must* be *some* general propositions about the world which will never be falsified.

But all such arguments contain a fallacy akin to that of the [79] ontological argument, and particularly surprising, therefore, in a work which contains its classical refutation. It may be demonstrated thus: All that propositions of intuitive induction can establish is some relation between two or more universals. Whether any of the related universals have instances is clearly quite irrelevant to the truth of the proposition which asserts this relation: no proposition, for example, about the relative positions of colour shades in a scale entails that any of these have instances; nor does the proposition that one of them is instantiated entail that any other is. Causal propositions, on the other hand, assert that if characteristic F has an instance this must be followed by (or coexist with or be preceded by) an instance of characteristic G; in other words, that it is false a priori that when F is instantiated, G is not. This is a proposition asserting a connection not, as before, between two universals F and G, but between the *instantiation* of one and the *instantiation* of the other. If general propositions reached by intuitive induction are propositions asserting necessary connections between universals, then the universals here in question are 'being an instance of F' and 'being an instance of G'. But instantiation is only a synonym for existence: 'X is an instance of ...' and 'X exists' are equivalent expressions. The whole fallacy of the ontological argument consisted in taking existence to be a peculiar kind of universal, an abstractable property, and it is again repeated here: 'If there is an instance of F there *must be* an instance of G' attaches 'must' to 'being an instance of' or 'existing', which thus becomes an abstracted universal; this, as is now generally recognised, it cannot be, since if it were, then, just as it makes sense to say 'This round patch is not green', it would make sense to say 'This round patch is not an instance of anything', which is a self-contradiction.

This error is, however, fairly instructive, and not a crude blunder about our use of words, since its refutation establishes once for all that no causal proposition can obtain support from any kind of a priori truth; and consequently that there can in principle be no a priori justification of induction; and therefore no demonstration of intuitive knowledge of [80] inductive generalisa-

tions; and to this extent there is no problem. But what, in that case, are hypotheses, which, according to Miss MacDonald, account for such generalisations but, unlike them, cannot be known? And how, if these latter cannot themselves be known, do they differ from them? Her quotations from historians of science do not support her distinction, since (for example) the experimental discoveries claimed by Richards to be 'lasting addition[s]',² by Zimmer to be 'discoveries' which 'are immortal'³ and so on are taken by him, to judge by his expressions, to be propositions incapable of proving false. Since all Miss MacDonald's non-a-priori propositions, known and unknown, are equally liable to error, what is the difference between those known and hypotheses? This is important to her general argument, since she declares that certain empiricists confuse the two and draw illegitimate conclusions. At the same time what precisely this distinction in her view is, is far from clear. A consideration of some possible senses in which ' p is a hypothesis' might mean something different from ' p is an inductive generalisation' will, perhaps, elucidate the nature of Miss MacDonald's theory on this point.

(*f*) Her thesis would very definitely be proved if hypotheses were, as some phenomenologists have maintained, not propositions at all, but mechanical devices for successful prediction. The argument is, I think, of this kind:

No proposition is intelligible unless it is either such that all its terms refer to empirical data, that is, the data of the senses, introspection, memory and so on, or can be translated into those whose terms do so. Hypotheses in the commonest scientific sense of the word, since they appear to refer to such imperceptibles (and therefore inconceivables) as frequencies, atomic nuclei, quanta and so on, are not genuine propositions, but symbolic formulae which, when the symbols are connected by suitable conventions with the data of acquaintance, enable scientists to predict future data accurately and successfully. Some formulae have never failed to do so, and are highly trustworthy for that reason; some are less reliable; some cannot be relied upon at all; that this is so is a fact about the world and cannot be further explained. **[81]** These formulae are thus neither true nor false but, like calculating

² *ibid.*, 28: Theodore William Richards, letter, *Chemical News* 88 (1903), 70.

³ *ibid.*: E. Zimmer, *The Revolution in Physics* (New York, 1936), 68.

machines, differ only in efficiency; being meaningless, they do not describe. What we mean by saying that hypotheses 'interpret the facts' is that by means of such symbolic devices one can sometimes successfully pass from a description of certain phenomena at one time to a description of certain other phenomena at the same or another time; the discovery of such devices is a matter of luck, and that is all there is to it.

But this cannot be what Miss MacDonald means by a hypothesis: for in that case hypotheses (which are not propositions at all) could not be said to turn into general propositions which are henceforward known, being established by the crucial experiments performed by scientists; which is incompatible with Miss MacDonald's assertion that certain hypotheses were so transformed by, for example, Lavoisier and Avogadro. Nor can she suppose that A. J. Ayer or any other sane person ever maintained that all empirical propositions can be reduced to useful but meaningless collections of symbols. Consequently she must mean by 'hypothesis' some kind of significant proposition or set of propositions.

(g) It might be maintained, more plausibly, that the difference is this:

Whereas general propositions are 'verified' or at any rate made probable by basic propositions which record real or possible acts of acquaintance, hypotheses are general propositions of the second or yet higher order, being assertions about other general propositions; when we say that they 'account for' them we mean no more than that they connect them, as the orders ascend, into wider and wider uniformities, each general proposition being a hypothesis about the next lowest order, which is relatively to it basic, that is, taken as true or known. If the phenomenalist analysis is correct all scientific and physical-object propositions are translatable into sets of general propositions of various orders. If phenomenism is false these propositions will be classified as entailing at least some singular or general propositions about imperceptibles; their logical relation to the ultimate [82] basic propositions which probabilify them, that is, to propositions verified by acquaintance, will, however, be the same whichever analysis is correct. If it is these propositions that Miss MacDonald calls hypotheses, it will follow that all general (or physical-object and scientific) propositions will be basic looked at from above, hypotheses looked at from below – all, that is, save the lowest row, which consists of generalisations whose predicates are the

absolutely specific characteristics with which we are acquainted; these, since they are themselves not 'about' any other general propositions, are to be called not hypotheses but general propositions simply; and confusion between the two [so it might be said] obscures the logical structure both of thought and of symbolism.

That some such distinction has been maintained by philosophers seems undeniable; but it cannot be the distinction which Miss MacDonald has in mind, for while not all, even of these general propositions, are in any sense known (many are doubted or believed to be false), it is equally true that many of the propositions belonging to the higher orders, whether or not they refer to imperceptibles, are in her sense of the word known. Once again we are confronted with the laws of Avogadro, Gay-Lussac and so on, this time as established hypotheses; for the fact that they are established does not affect their logical relations to other propositions, in virtue of which alone they were defined as hypotheses. Nor can it be that Ayer is guilty of this confusion either, for he uses 'hypothetical' as equivalent to 'corrigible', and 'corrigible' as equivalent to 'not known to be true'. Since Miss MacDonald's knowable propositions are also corrigible, they are still in Ayer's and perhaps ordinary usage unknowable; so that it appears that he simply uses 'hypothetical' where Miss MacDonald prefers 'general' or 'inductive', but that there is in any case no confusion, since the special sense of 'hypothetical', elucidated above, in which it means more widely general than the least general of propositions, is not employed by him; as is, indeed, natural enough, since the degree of generality does not affect the question with which he is concerned, namely the corrigibility of all empirical propositions whatever. If all empirical propositions are, as he maintains, hypothetical or general, then in the usual sense of the verb 'to know' they are not known. Miss MacDonald does not deny his premisses: she only observes that in her sense of 'know' some general propositions are known; yet they are not those he calls hypotheses. What then does Miss MacDonald mean by 'hypothesis'?

I can think of only one other possible answer. It is possible that the only property in virtue of which Miss MacDonald's hypotheses are to be distinguished from general propositions is not logical at all, but consists in the inferior degree of conviction felt about their

truth. Like other general propositions, they are reducible to propositions about characteristics instantiated in ordinary experience; like them, too, they cannot be known in the same sense as singular basic propositions, reporting direct acts of acquaintance, the infallibility of which is presupposed, as I have argued above, by the possibility of any consistent linguistic system. The sole difference lies in the subjective attitude of those who hold them. A proposition which I, who take it completely for granted, am for that very reason said to know, is for you, who happen to be only half convinced of its truth, a hypothesis; and as your conviction gradually grows, it alters from the second to the first; its logical character and its relation to the relevant facts remain the same in both cases. As a purely psychological proposition no one can quarrel with this: certainly it is true that most men believe some propositions more strongly than others, and that the degree of their belief alters frequently and for many causes; and if this is all that Miss MacDonald wishes to say, I agree with her, but so far as I can see nothing relevant to the problem of induction follows from this – nothing, for example, which throws any light on what we mean by saying that, when a belief alters as a result of observation or experiment used as evidence in an inductive argument, the process is rational; whereas conclusions reached as a result of prejudice or superstition or guesswork are not. This is the question the answer to which is at any rate part of the analysis of what we mean by inductive inference. [84] But before it is dealt with one further point must be noted.

In the course of proving that all propositions reached by ordinary induction are in principle capable of being known, Miss MacDonald observes: ‘In the commonest sense of “believe”, to believe a proposition which you could never conceivably know to be true would be nonsensical.’⁴ If this means no more than that any expression to which the words ‘I believe that’ could be prefixed is such that it is never self-contradictory to prefix ‘I know that’ instead, then it is a proposition about what the term ‘proposition’ means, and is very likely true. But there is another sense of it, which alone seems relevant, and in which I therefore believe it to be used by Miss MacDonald, in which it seems to me quite plainly false. I can believe whatever is expressed by a

⁴ op. cit. (35 n), 26.

propositional phrase, that is, whatever may be true or false: to say this is to utter an analytic proposition. But I cannot *know* whatever is so expressed; and this is no longer analytic in the same sense. I can, for instance, be acquainted with my headache and in that sense know that it exists; but your headache, a phenomenon of the same order as mine, verified, as mine is, by introspection, cannot be an object of my acquaintance. It is *not* self-contradictory to say 'I know that you have a [I am acquainted with your] headache', since if your headache is a historical event, I can believe that it is now occurring, and can, so far as logical or grammatical syntax is concerned, proceed to substitute 'know' for 'believe'; but it is certainly meaningless, because propositions of the type of which 'X has a headache' is an instance not only are not, but cannot be, known to be true by more than one observer: 'cannot' in the sense in which hypothetical propositions cannot be reduced to categorical ones, or pink be more like black than it is like vermilion. I can believe that a given patch in my sense field will presently turn from blue to purple; and I can then conclusively verify this and thus know, that is, be acquainted, with the fact. I can in a precisely similar sense believe that a given patch in your sense field will behave in this way; but it is meaningless to suggest that I verify this [85] by acquaintance with your experience: at best I have only sensible data of your behaviour, or telepathic experiences which I interpret as (that is, have inductive reasons for believing to be) evidence of the fact that you exist and are having the described experience. Both beliefs belong to the same logical type. The complete verifiability of the one, and the in principle incomplete verifiability of the other, make no difference to the fact that both are beliefs that certain acquaintance events will occur. These either do or do not occur: I can know precisely what situation, if it occurred, would completely verify the proposition believed (this is what is meant by knowing precisely what the sentence means, or understanding the proposition which it symbolises), and at the same time know (in the sense of 'know' in which we know general propositions reached by intuitive induction) that I cannot be acquainted with such a situation, that is, verify the proposition conclusively.

It may be objected that, even if I cannot, there is or there might be some observer at least who can in principle be acquainted with the situation symbolised by any genuine singular proposition; but

even if this were a true statement, it would not be valid as an objection, since all that requires to be shown is that 'X believes p ' does not entail 'X can in principle know p '; and this is seen to be so for any given X, even if 'X believes p ' did entail 'There can be some Y such that Y can in principle know p .' But in fact even this modified version cannot survive, since 'X believes p ' would be significant where, let us suppose, p describes a hypothetical situation: 'I believe that the red patch extended before me now would have looked bigger (that is, that there would in my sense field have been occurring a bigger patch) if I had moved forward.' I cannot verify this conclusively because I am in fact standing where I am and not in the required place. The fact that I may have been there before, and that I can move there now, may indeed provide inductive *evidence* for the proposition about what would have been occurring now, but is not even part of its *meaning*. Nor must the occurrence of the symbol 'if' lead anyone to suppose that we are dealing directly with [86] a general proposition. The hypothetical case is indeed an instance (although only a possible one) of a general proposition which the evidence is intended to support. It is entailed by it but, so far from being equivalent to it, does not even entail it: it cannot be false and the general proposition true; but it may be true and the general proposition false, and it is not itself general but singular. It is hypothetical and therefore not deictic; it entails that there is some deictic proposition of the same logical type as itself (that is, one entailed by the same general proposition) which is true, that is, states what is the actual case; but while it is not itself general, it is liable to be thought so because, if it is unfulfilled, it shares with the general proposition by which it is entailed the property of not being conclusively verifiable by anyone, that is, is in principle unknowable.

The mistake of supposing it to be general may also be due to our tendency to analyse all propositions beginning with 'if' intentionally, whereas in fact we frequently use them extensionally: phenomenalists, for example, attach so much weight to propositions of the type 'If you look up you will see a red patch' as involved in the analysis of propositions concerning physical objects precisely because, being taken in extension, they are held to be directly and conclusively verifiable, at any rate in principle, in which case they certainly cannot be general, and yet are as certainly

hypothetical. But because only singular propositions are conclusively verifiable it does not follow that the converse is true, that is, that all singular propositions are conclusively verifiable, even in principle, or that singular propositions cannot be hypothetical: all categorical, and some hypothetical, singular propositions can plainly be conclusively verified; others, for example the unfulfilled, cannot. But they do not for that reason cease to be singular.

As a last example (in case singular hypotheticals are still regarded as dubious instances of empirical propositions), let us take the categorical proposition 'My headache is at this moment more violent than yours.' I am acquainted with my sensation and you with yours; I can form a rational belief, on the general inductive evidence provided by your appearance, statements [87] and so on, plus the laws of physiology, as to the kind of sensation which you are experiencing; and I can conceive of what I should be experiencing if I were having a headache absolutely similar to (qualitatively identical with) yours. If this last seems to me less violent than the one I am in fact enduring, I make the above statement. You, by a similar process, can reach a conclusion which may or may not agree, that is, be compatible, with mine. We are uttering singular judgements which are true or false about an actual state of affairs occurring at a given date, and not merely comparing our verbal usage with regard to such words as 'violent' or 'headache'. Indeed, the proposition that the same sentences indicate more or less similar states of affairs in our respective experiences must itself be taken for granted to make it plausible to say that we understand each other. But although the above proposition is singular and empirical, and refers to an actual situation at a given date, it is in principle unverifiable: two occurrences are known by acquaintance, but the actual relation between the two groups of experienced characteristics (the intensities of the headaches) cannot in principle be known. Yet it is as much an element in the total state of affairs at that moment as the appearances of our heads and of the expressions on our faces, or the introspective data whose existence they suggest to each of us as we speculate on the physical or mental state of each other.

At this point some positivist philosopher might assert that since 'I cannot know whether your headache is more violent than mine' is entailed by 'I can be acquainted only with my own headache', it

is a tautology, for the second proposition is analytic, and defines 'I' and 'my own' in terms of 'acquainted with', and vice versa, so that to say 'I am acquainted with your headache' is a self-contradictory. But from this would follow the absurd conclusion that 'You are acquainted with your headache (but not with mine)' is equally self-contradictory since, by the above rule, for the word 'acquaintance', wherever it occurs, we are allowed to substitute only such words and expressions as 'I', 'me', 'in my experience', which formally contradict 'you' and 'yours'; and this is plainly absurd. The proposition that I am acquainted only with a certain class of experiences (defined as mine, provided 'I' is left undefined), which are not objects of your acquaintance, whereas what I believe may well, in an obvious sense, be identical with what you believe, is not, save indirectly, a syntactical statement about words, although it is certainly a priori and cannot be significantly denied. For no one can in fact believe that it makes sense to say that all that is asserted is that there happens to be a rule of the English language which says 'Don't ever use such words as "I am acquainted with" before such words as "your headache"', in the same sense as there is a rule 'Begin new sentences with capital letters' or 'Don't use singular nouns with plural verbs' or even 'Don't substitute $x + y$ for $x - y$, simply.' Indeed, the attempt to reduce it to an analytic proposition is precisely what leads to the absurdities of metaphysical solipsism, and arises from the suppressed and untenable proposition that 'verification' is equivalent to 'verification by me', where 'I' and 'you' as ordinarily used are both logical constructions out of 'my experience'; with the result that 'my', being left unanalysed, and being no longer significantly contrastable with 'yours', becomes a symbol for something transcendental, timeless, unverifiable and, since its presence or absence in propositions makes no difference to their meaning, non-significant. Since, therefore, 'X believes p ' is seen to entail neither 'X can know p ' nor 'There may be a Y such that Y can know p ', I can see no objection drawn from either logic or common usage to the statement, impugned by Miss MacDonald, 'Some types of singular, and no general, empirical proposition can in principle be known', a proposition which seems to be at once clear, true and commonly accepted.

But if empirical generalisations cannot be known, what grounds have we for believing them? Or is this too a pseudo-problem?

If inductive generalisations can be asserted and therefore believed, what do we mean when we call some beliefs rational, others irrational? When we recommend beliefs which we assert to be supported by adequate evidence as against those which are said to be entertained on inadequate evidence, or none at all? What is meant by 'evidence' and by 'adequate'? It is truer to say of this, rather than of Mill's far easier question, that 'Whoever can answer this question [...] has solved the great problem of induction.'⁵ I do not pretend to be able to offer a solution of it, if only because it depends in the first place on the proper analysis of the meaning of general propositions, which, so far as I know, no one has yet given, and in the second place on what we take to be the meaning and logical character of the expression 'Nature is uniform.' It is with the examination of the second question that I intend to conclude this paper.

In a celebrated passage Hume declared that 'There can be no *demonstrative* arguments to prove, *that those instances, of which we have had no experience, resemble those, of which we have had experience.*'⁶ We can now amplify this and add that they cannot be intuitive either, nor in fact a priori at all; for, as we have seen, the proposition to be examined is neither analytic nor reached by intuitive induction, nor, being general, known by sensible acquaintance or memory; nor does it follow analytically from any propositions so obtained. But if it is not a priori, is it empirical, and if so, what verifies it? Is it, as is sometimes asserted, 'presupposed' by inductive inference, and what does this mean?

We may begin by asking what the principle states; to which it might be said that those who affirm it intend to say that every event is an instance of some uniformity, or that everything that occurs is an instance of the operation of a law, or, if precision be

⁵ J. S. Mill, *A System of Logic, Ratiocinative and Inductive, Being a Connected View of the Principles of Evidence, and the Methods of Scientific Investigation* (London, 1843), book 3, chapter 3, section 3, 380. [Mill's question is: 'Why is a single instance, in some cases, sufficient for a complete induction, while in others, myriads of concurring instances, without a single exception known or presumed, go such a very little way towards establishing a universal proposition?']

⁶ David Hume, *A Treatise of Human Nature*, ed. L. A. Selby-Bigge (Oxford, 1888), book 1, part 3, section 6, 089.

preferred to clarity, that every occurrence of a characteristic of a continuant (or, as some [90] would say, substance) is so connected with every other occurrence of every characteristic of the same and of all other continuants (or substances) that it may be denoted by a value of a variable, where each variable denotes a characteristic; each variable is then itself a function of one or more variables whose values thus vary concomitantly with the values of the first.

It must be noted that what are called causal propositions, which assert such uniformities, do not exclude the possibility of their discontinuance if they come into conflict with other uniformities, the result of whose collision can in principle be calculated and asserted as a new uniformity. Consequently no general causal proposition can be conclusively verified or even conclusively falsified: it cannot be conclusively verified because it is general, and no finite number of observation propositions entail the truth of any general proposition; and it cannot be conclusively falsified,⁷ for while it is true that single negative instances conclusively refute general propositions, it differs from other general propositions in asserting not that there is a correlation between two characteristics unconditionally, under all circumstances whatever, but hypothetically, only in the event of there being no counteracting causes. It asserts that φ varies as ψ , but even if φ occurs without ψ this may be due to the presence of ω when some other uniformity (when ω and φ and no counteracting causes occur, then no ψ occurs) is operative. Only if φ and ψ were completely isolable, for example in a universe characterised by a finite number of characteristics all of which were known, and such that at least one case of every possible combination of each of them, and of each possible group of them, with φ had been observed, could it be truly asserted that a case of φ without ψ refutes ' φ varies as ψ .' Since, in the unlikely event of anyone's wishing to assert that he had obtained the required information, the truth of this proposition would entail the truth of at least one general proposition, namely that the list of the characteristics with which he was acquainted was [91] exhaustive, that there were and would be no others, it would entail a proposition which, being general, cannot itself be conclusively verified. If not- p entails q , and q is in

⁷ For a divergent view see Karl Popper, *Logik der Forschung* (Vienna, [1934]) [now translated as *The Logic of Scientific Discovery* (London, 1959)].

principle not conclusively verifiable, it follows that p is not conclusively falsifiable. Consequently the conclusive falsification of the causal proposition ‘ φ varies as ψ ’ cannot in principle take place.

The proposition that nature is uniform thus entails that all events instantiate characteristics each of which varies concomitantly with at least one other similarly instantiated characteristic. It does not entail that any particular causal proposition affirming such a correlation between any one set of characteristics can be either verified or falsified conclusively. Indeed, to say that it is possible to do so by empirical means is, if the above argument holds, demonstrably false. So much for the relevance of the proposition to scientific method; its logical character must next be considered.

When the characteristics in question (φ , ψ , ω and so on) are the simple, not further analysable, absolutely specific qualities and relations, sometimes called qualia,⁸ which characterise ordinary experience, the fundamental relation between them is transitive and asymmetrical; they are members of discrete or continuous series and perceived as such; any proposition which asserts a correlation between the occurrence of constituents of two or more such series may be said to affirm the simplest type of particular causal uniformity. The great majority of words and expressions in ordinary language, referring as they do to physical objects or mental states and their modes of behaviour, are compendious ways of referring to actual and possible conjunctions of instances of such characteristics, whose uniform concomitance and co-variation is taken for granted. Propositions which, like those of ordinary speech, refer to uniformities between such complexes correlate accepted [92] correlations: this upward process towards greater and greater compendiousness under fewer and fewer heads is the aim of every science; but every such higher-order uniformity proposition is in principle reducible to its constituent uniformity propositions, and these into their ultimate logical constituents, where the variables stand for uniformities between the instances of the absolutely specific characteristics which compose the world. The proposition ‘Nature is uniform’, which could equally well be

⁸ Notably by C. I. Lewis in *Mind and the World-Order: Outline of a Theory of Knowledge* (New York, 1929); the discussion of the relation of observation propositions to those concerning physical objects is exceptionally illuminating.

stated by sentences like 'All events are governed by natural laws' or 'Nothing happens without a cause', is itself a general proposition, the generalisation which correlates all other empirical generalisations, but is in kind not different from them; and it is empirical inasmuch as it asserts that if anything is a characteristic it is in point of fact (not by definition) a member of a series all of whose members, actual and possible, are connected by a relation of concomitance (such that some, at least, of its instances are in principle discoverable) with the members of at least one other series.

The fact that it is tautological to say that anything of which something can be intelligibly asserted is an instance of some characteristic, plus the fact that some characteristics are logically interrelated, may make the principle of uniformity itself seem tautological or at any rate *a priori*. This is not the case, however, as may be seen from the fact that its contradictory is neither self-contradictory nor meaningless: it is logically possible that a characteristic may belong to a series (or be a determinate of a determinable) which is not itself correlatable with any other series; not because we are too stupid or ill equipped to discover the connection, but because there is none in fact. If this were so, the principle of uniformity, while remaining significant and for practical purposes indispensable, would in fact be false, although this could not be demonstrated. Hence it is neither analytic, nor reached by intuitive induction, but is the widest possible empirical generalisation, concerned not with the future merely (as both Hume and Miss MacDonalld appear to suggest), but equally with the past and the present, the actual and the empirically possible.

[93] If the proposition in question is empirical, in what sense can it be said to be 'presupposed' by inductive inference, and, further, what is meant by calling beliefs founded on such processes rational? These two questions are in reality one, and the answer to either is the answer to both. A view widely held among the followers of Ramsey is that, since Hume has conclusively demonstrated that the validity of the methods actually used by scientists or ordinary men cannot be demonstrated from premisses known to be true *a priori*, they cannot be justified at all, but that on the contrary what we mean by 'justify' or 'show to be rational' is itself defined in terms of these methods, whatever they may happen to be during any period. Thus 'rational method', according

to these philosophers, means ‘the method or methods practised by the accredited scientists of the day’, ‘accredited’ being defined as equivalent to ‘widely trusted’ or the like; such trust being in its turn defined as the kind of attitude commonly adopted towards the utterances of persons known or believed to be more successful in their predictions than those who do not use their methods, such as clairvoyants, fortune-tellers, or those who rely on personal intuitions in preference to certain methods of collecting and treating statistical evidence. Rational belief being thus defined as belief obtained by methods used by accredited, that is successful, practitioners, is it possible to describe the belief that methods used by the experts on whom we rely will be successful as itself rational?

It seems possible to reply that if a pragmatist analysis of this kind is correct, the above proposition could be translated into ‘My belief that the method used by X, Y, Z will similarly be successful if used by me will itself prove successful.’ I can ask the same question again, of course, and again obtain the same reply: wherever ‘rational’ is used, ‘obtained by a method known or believed to have been successful’ may be substituted. This analysis may not be plausible, but since it is offered as a definition not of truth but of rationality, it is neither self-contradictory nor meaningless.

A more serious objection is that successful prediction is not normally regarded as sufficient to prove [94] a claim to rationality, and a fortiori as not identical with it. A successful gambler is not commonly described as a capable scientist: one’s surprise at his sudden failure is far smaller than one’s surprise at the failure of a prophecy made by a respected astronomer; indeed, whereas surprise at the latter could be described as rational, there is some sense in which any degree of surprise at the roulette player’s failure can correctly be said to be irrational, however many instances one possesses of his past successes under many kinds of different conditions. Conversely, it is not true that to say of a scientist that he consistently fails in his predictions is, in ordinary usage, precisely equivalent to saying that he is not a scientist at all. It seems far more plausible to maintain that rational belief is belief reached in a certain precisely definable manner; which one could put by saying that the process of ‘social accrediting’ is governed, at any rate ideally, by the supposed faithfulness of persons thus accredited to certain methods, which in their turn are ‘justified’ not

by their success in the past but by the fact that they are what they are, that is, are themselves relied upon because they are founded upon, are cases of behaviour motivated by, the belief that (or behaviour as if) certain empirical but indemonstrable propositions about the world are true; with this further rider attached, that if these propositions do not correctly describe the past or present, or, because of catastrophic change in the world, one day cease to be true, no alternative method can in principle be devised; that in relying on methods at all we behave because, or as if we believed that, there is a certain kind of order in the world. Only in this special sense is it possible to say that such reliance 'presupposes' belief in these propositions, and that by speaking of the rationality of a belief we mean that it does so presuppose them. If this is correct, a given belief can be called rational if, and only if, the proposition believed is thought to be a case of the wider proposition, fundamental to induction, that when two characteristics have been observed to occur in a certain order under certain specifiable conditions in the past, and have never been observed to occur in any other order under [95] similar conditions, then it is the case that any instance of either bears the original relation to the instance of the other, whenever it might occur under such conditions.⁹ This is what the word 'rational',

⁹ A possible way of describing the situation is this: Three propositions are involved, all empirical: (i) the proposition that if anything is an event it is an instance of a regular concomitance: this is equivalent to the proposition 'Nature is uniform' – let us call it p ; (ii) the proposition that all events characterised by some specific characteristic F are instances of a concomitance of this kind – let us call it q ; (iii) the specific causal proposition that all instances of φ are instances of a particular concomitance ' φ varies as ψ ', that is, will, in the absence of certain unfavourable conditions, be followed by instances of ψ – let us call this r . Then it will follow from the above (a) that q is entailed by p but does not entail p ; thus if q could independently be shown to be false this would falsify p ; while if it could be shown to be true or probable, this would probabilify p ; (b) that q is entailed by r but does not entail r ; and therefore, if q is false, r is false, while if q is true or probable, this probabilifies r . From this it follows (c) that p neither entails nor is entailed by r ; but p and r reciprocally probabilify each other, by entailing q , which probabilifies both: ' r probabilifies p ' \equiv ' r is evidence for p ' \equiv 'It is rational to believe p when r ', where 'rational' is defined as above, in terms of belief in the proposition referred to above as fundamental to induction. The proposition that nature is uniform is thus in at least one sense a proposition whose probability is established by the same methods as the probability of any other empirical proposition; and in the sense in which it is a statement about the

when applied to empirical beliefs about the world, means. It follows that we cannot significantly ask whether it is *rational* to believe that such repetitive patterns, that is, uniformities, ever occur or will continue to occur; for what could be the meaning of such a question? What kind of answer does it expect and how would its truth be tested? What would be the evidence of its being either rational or irrational? Any answer to this question would necessarily itself include the concept of rationality, and therefore be circular: which amounts to no more than saying that the question cannot properly be asked.

The above statement of what is in substance Mill's first method serves to indicate the kind of meaning which such words as 'evidence', 'method', 'rational' have. For if the characteristics of past and present events are not relevant to the determination of future events, nothing is, for there is nothing else [96] open to our inspection; and since the only relation which all events necessarily possess to one another is that of resemblance (which includes spatiotemporal relations), in virtue of which alone they are classifiable under universals, and since those in their turn form series between which systematic correlations can be believed to exist, we are bound to say that the only kind of universe in which the future is in principle predictable is one in which uniformities can be discovered, because in it alone the future resembles the past. Only in such a world can uniformities be usefully symbolised by mathematical formulae, or geometrical and mechanical models, which compendiously represent permanent types of recurrent orders, possibly idealising the relatively imprecise reports based on sense experience, but such that, with a certain margin of error, this or that type of order has been recorded once for all. This can now itself be treated as a datum and correlated with other such records into a wider functional formula. Thus to assert that the proposition 'Belief that p is true is rational' presupposes 'Nature is uniform' is equivalent to saying that the word 'rationality' is in this context *defined* in terms of uniformity, 'presupposes' it in this sense, and in this sense only, while the *definiens* is a descriptive phrase which, when it is asserted to have application, states a proposition which, for all its generality, is empirical; it owes its uniqueness to the fact

world it is nonsensical to say to say that it is 'presupposed' by induction or anything else.

that it is probabified by all other general empirical propositions, and so by those empirical concepts (used alike by scientists and ordinary men) which are frequently telescoped general propositions disguised as substantives or substantival phrases, useful in proportion as these propositions are in fact true.

If the proposition that nature is uniform, or that the future repeats the past (or the past the future), is empirical, it is legitimate to ask whether it is possible to state what would be the case if it were false; whether a world could be conceived in which our beliefs and methods, although still rational by definition, would prove false and useless, in which it would in principle be impossible to emend them systematically and adapt ourselves to the new environment. This is the function which was performed for the [97] classical philosophers by a malignant demon introduced into their systems for this purpose: a figment used to discover what must be the irreducible characteristics of a universe in which alone induction, when practised under ideal conditions, is a means of obtaining true information.

The easiest and most economical way in which the demon could achieve his end would be, as Venn pointed out, by ensuring that no causal law ever had more than a single instance in the history of the universe. The truth of general propositions would remain unaffected. If φ was once followed by ψ , and ψ by χ , it might remain true that if it ever recurred it would again be followed by ψ and χ ; but since the series of events $\varphi-\psi$ and $\psi-\chi$ is unique and will not reproduce itself, neither experiment nor observation can secure conditions under which relevant evidence could be collected. Since in such a world every sequence must have a separate label, no two sets of phenomena can be regarded as manifestations of the same general causal law, and the generally accepted proposition that position in time or space is, as such, irrelevant to causal laws cannot be rendered even plausible. Although it is still possible to describe events and collect statistics, nothing can be stated compendiously, and consequently induction cannot take place. Not even the proposition that nothing ever repeats itself could be reached by any rational process, since the laws of psychology would be similarly confined to single unique instances, so that in the absence of memory or reproductive imagination such a thought, even if it did once occur in someone's mind and was true (as it must be: otherwise the demon would both

be and not be pursuing a given policy), would never recur in it, and so could not be tested or usefully acted upon. In such a universe blind guesswork would necessarily be more successful than rational induction, although this fact could not be rationally inferred by any inhabitant of it; it seems reasonable to say that the concept of rationality would never be conceived of, since it would have no possible application. Such a state of affairs seems to differ from the normal only in empirical respects.

[99] The demon could, however, if he chose, introduce a confusion far more upsetting than this. He could, while allowing situations to repeat themselves, suspend Keynes's principle of limitation of independent variety both in time and in space. Any characteristics might occur in company with any other and be followed by yet others at random, that is, not in accordance with any law whatever. Groups of characteristics could, indeed, be observed to recur, but the statistical propositions which recorded this, if acted upon, would prove treacherous guides to the future: visual data, after reliably suggesting the existence of tactile ones for some time, would for unpredictable intervals cease to do so, and experience would be punctuated with uncertifiable hallucinations. In such a world no hypotheses could conceivably be framed; for in order to establish a hypothesis, as the word is commonly understood, it must be one of a disjunctive set of hypothetical propositions which must be (*a*) finite and (*b*) exhaustive, that is, such that not all its members can be false. Such conditions could not in principle be thought to apply to the world described above. If any logically conceivable kind of event could occur and be followed by any other, no disjunctive set would be either finite or exhaustive. Thus no proposition could be said to possess any initial probability. It would therefore be impossible to increase it in any way, since there would be none to increase (this would hold whichever view of probability is correct).

It is dubious whether, under such circumstances, significant expression could occur, for the symbols used in ordinary language refer as much to the remembered and imagined past and the expected future as to the data of the immediate present; which applies to the names of simple characteristics as much as to words applying to physical objects or more elaborate descriptive phrases; and this, in its turn, depends on the reliability of a minimum number of inductively reached beliefs about the kind of event that

is liable to happen. These would be constantly undermined by the fact that all combinations of characteristics would seem equally compossible both in space and in time, as is indeed [99] noted by Hume, who observes that successful communication by symbols could not occur without the kind of crude induction which, whatever may occur in early childhood, is semi-automatic in later life.

Perhaps the demon could go even further than this. Keynes's postulate about the restricted number of characteristics is itself finite. This too might be rendered false: new properties, uncompounded out of the old and not necessarily describable even by analogy, would continually occur; if every property occurred only once, it could be described only by a unique symbol; language would thus consist exclusively of logically proper names. In such a language nothing could be stated, since nothing could be asserted about anything in the absence of general terms referring to characteristics. Indeed, a language possessing no general terms is not in any recognisable sense a language at all: it seems dubious whether thought or any kind of articulate consciousness could intelligibly be said to occur in such a world. Whether this last is so or not, sufficient has in any case been said to show that not every kind of conceivable universe would in principle be amenable to inductive methods.

It appears to me that four main conclusions follow:

1. The proposition that induction is one of the original sources of information about the world, like memory or sensation, is true only if, or so long as, our universe is of a certain specifiable kind, that is, one in which simple characteristics repeat themselves in identical or systematically varying patterns.

2. We cannot show that our universe is such except by arguing in a circle, that is, showing it by a rational method, this itself being defined as the method employed in looking for and isolating uniformities. It is not certain that there are any such, although philosophers have claimed to know this: some, like the pre-Humean rationalists (among whom we may include certain contemporary philosophers), claimed either to be able to apprehend necessary connections between phenomena, or to conceive what would be the case if [100] they could so apprehend them; to which, with Hume, I am compelled to say that the

expression seems *prima facie* self-contradictory, that I am not acquainted with any experience which could even misleadingly be so described, and do not know what kind of experience could possibly be so referred to. Others, like Kant, claim to be able to demonstrate their existence by deductive steps from propositions known by a species of intuition, or, as we should say, intuitive induction; to which one can say only that he misconceived the nature of propositions of intuitive induction; from which, as I have tried to show, no existential propositions, no propositions referring to the actual as opposed to any conceivable world, could possibly follow, whereas the proposition that nature is uniform might easily not hold of more than one conceivable universe. Since the proposition turns out therefore to be empirical, and inductive rational belief is defined in terms of it, it follows that to ask 'Is it rational to seek for stable uniformities? What guarantee have we that they exist?' is to ask a pseudo-question, since it is equivalent to asking 'Is seeking for uniformities seeking for uniformities? What known uniformity makes it certain that others will never break down?', which is as unanswerable as 'What makes it absolutely certain that a table is a table, and not, for instance, a chair?'

3. Further, although we cannot ask for proofs of the existence of uniformities in general, nevertheless, given that we accept the probability of some, we thereby make probable the existence of others; and so establish the probability, although a low one, of the proposition that every event belongs to some set of uniformly co-variant sequences. This gives an initial probability to the proposition that any given event is not an uncaused cause; which increases with every new specific uniformity discovered, and in its turn strengthens the probabilities of all accepted, that is, more or less firmly established, uniformities. The proposition that some event E is undetermined is thus empirical, and so therefore is its contradictory. The proposition that E is determined, that is, obeys discoverable laws, is thus not analytic but follows from certain empirical generalisations; its [101] probability increases with the success and coherence of the inductive sciences generally; it never reaches either certainty or what is by no means identical with it, infinite probability. This, I think, is all that Mill wished to assert when he claimed that the principles of induction themselves were only probable. It is sometimes asserted that the argument is circular. It would be so only if it claimed to prove the rationality of

inductive beliefs to be probable; which, so far as I know, neither Mill nor any other well-known philosopher has ever tried to do.

4. Finally, I have tried to show why it is misleading to use the word 'knowledge' in connection with inductive propositions. Words are misleading when they obscure a distinction of type of fact with which in experience we are familiar. It seems to me self-evident that we are acquainted with such general distinctions not reached by ordinary induction when we compare states of mind in which we believe that the proposition that X is F is corrigible with those in which it is not. The proposition that inductive generalisations cannot be objects of the latter type of awareness is not itself self-evident, for many philosophers appear to doubt it, nor is it made so by the attentive study which Miss MacDonald has given to selected cases of English linguistic usage. Someone may very well begin not only by saying, but also by supposing, that when he sees something which appears to be a stick bent in water, he *knows* (because he cannot, in fact, doubt) that the stick is bent (that is, in a sense which entails that it is false that it would not feel bent to the touch) in the same sense as he *knows* that one of its limbs looks much shorter than the other. I cannot see how the minutest exposition of the normal use of English idiom could help to disillusion him: only some experiment like that of making him touch the stick both above and below the surface of the water could begin to do so; only an experienced negative instance could function as the crucial experiment which refutes unconditionally asserted general propositions, whether empirical or not, and with them all the propositions which they entail. One instance exhibiting the difference between [102] two modes of awareness would suffice to establish a general conclusion by intuitive induction; which is as it should be, since philosophy is not an experimental science, and does not advance by investigating social habits by the methods of scientific induction.

Words are examined by philosophers for the purpose of discovering whether, as they are used in successful communication, they tend to exhibit or obscure some characteristic by which one type of fact differs from another, or alternatively suggest falsely the existence of distinctions which direct inspection of experience fails to reveal. This is done because inattention to either tends to lead to systematic confusion and

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error, not necessarily in the use of words, which, being conventional and intended for common practice and not the convenience of philosophers, is rightly not altered by their criticisms, but in the accurate discrimination and description of irreducible types of experience. Attention is and has at all times been paid to words by philosophers for this reason; and, so far as I can see, for no other reason whatever.

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