Possibilities and Fallibilism
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POSSIBILITIES AND FALLIBILISM

I.

The majority of thinkers agree that one of the important lessons of history is that in science there are no absolute guarantees. No matter how well founded a given belief may be, its truth cannot be established with ultimate certainty. A hypothesis h may be highly credible, even to the extent that it is perfectly rational to act upon it as well as the claim that we know it, and yet we are never justified in having entirely unreserved confidence in h. We may hold many hypotheses that represent genuine knowledge of nature, yet no hypothesis of ours is fully immune to future revision; they are all corrigible.

The thesis of the ever-present possibility of error is called fallibilism. It is often assumed that the difference between the cognate doctrines of fallibilism and scepticism lies essentially in the degree of limitation they ascribe to the inquiring human mind. A sceptic with respect to a species of propositions denies that we can ever *know* any member of that species, while the fallibilist may concede knowledge but not certainty. I believe, therefore, that in this prelimiary section it is important to emphasize that there exists another fundamental difference as well. Fallibilism – unlike many forms of scepticism – is to most people who subscribe to it a 'practical', as distinct from a mere 'metaphysical', thesis. Working scientists are unlikely to engage in lengthy discussions of the problem of how we know of the existence of an external world or of the problem of induction yet they are keenly interested in the idea of the change in fortune that may befall even the best of hypotheses. The reader may be reminded of Hume's famous admission that his scepticism concerning the validity of induction, while very serious, is nevertheless something he puts out of his mind once he leaves his study. It should be different with fallibilism; and awareness of a certain degree of tenuousness attaching to all knowledge claims should be with us at all times.

One famous contemporary physicist, K. G. Denbigh, has recently pro-

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vided some fascinating concrete examples illustrating a ubiquitous practical principle which alone should prevent us from being capable of securing any hypothesis. The principle asserts the invalidity of an inductive argument based on a biased sample class. No matter how many members of the sample class, which is the class of observed individuals that have *P*, turned out also to have had *Q*, we cannot generalize that All *P*'s are *Q*'s, in case each one of these individuals also had *F*. It is possible after all that not *all P*'s are *Q*'s: particulars having *P* but no *F* may not have *Q* either. The principle is, of course, of fairly common knowledge. What is so remarkable is that, in many cases, for centuries no common '*F*' to invalidate a given generalization is discerned by anyone until some entirely unsuspected feature forces itself on the attention of scientists.

One of Denbigh's noteworthy examples in his excellent book *An Inventive Universe*[1] involves predictions made not so long ago concerning what the temperature of the sun is going to be in a couple of years. The calculations were made on the basis of judicious assessment of the relevant constants with the aid of the cooling law of hot substances. However, the predicted results were nowhere near the actual results. The reason, as we know, was that a crucial tacit assumption was made by all, an assumption regarded as not even meriting a second thought since its denial would have been thought of as the height of absurdity. The assumption was that the sun is not gaining heat by some internal non-chemical process. There were not many laws of physics at that time that had received more overwhelming confirmation than the law of conservation of energy and the law of immutability of substances. Nothing would have sounded much more preposterous a hundred years ago than that heat is being generated inside the sun by the conversion of hydrogen into helium.

Nevertheless, our assumptions concerning heat-generating processes, which seemed so irrevocably well-founded, turned out to have been based on a sample class – though vast in size – that was biased in an unexpected manner. All the members of the sample class that had obeyed the widely known laws of cooling had the bias of sharing a certain significant feature, the feature of being associated with relatively low temperature and pressure. There was therefore no real basis for assuming that the case of the sun would be subject to laws essentially similar to those governing the members of the sample class. We had never before experimented with temperature and pressure even approximately as high as inside the sun. Under extraordinary circumstances it is plausible to entertain a hitherto unheard-of process of heat generation.

Thus one of the reasons it is appropriate for a scientist to be a fallibilist is that even the most firmly rooted generalization may not hold universally and might be seen to break down under entirely novel circumstances.

In this paper I propose to offer as precise a statement of fallibilism as I can. Lately there have been a number of attempts to provide a rigorous, formal definition of fallibilism, none of which seems to have been successful. The failure, I believe is really due to the entirely unexpected nature of the task. The thesis which I seem to have rendered adequately enough in plain English may look transparently clear and therefore one may well be expected to go straight ahead and quickly formulate a simple expression of it. Thus it takes some time before one realizes the existence of so many unsuspected difficulties. I believe it is philosophically very instructive to see some of the hidden traps along the way to a satisfactory formulation.

II.

In an informative paper that touches upon a number of basic aspets of epistemology, L. S. Carrier expesses his support for cognitivism (i.e. opposition for scepticism) about any group of propositions and argues in favor of what looks like fallibilism with respect to all empirical propositions. Like Denbigh, Carrier also presents an all-pervasive practical obstacle, which in his view stands in the way of achieving certainty. Carrier contends that in the process of trying to establish any empirical proposition there is always scope for indefinitely many errors. He declares that it "would require too much of finite creatures to expect them to be in a position to know an indefinitely long conjunction of propositions each asserting that a particular error has been committed". Carrier lays down the principle:

(2) $\sim \mathrm{K}a \sim \mathrm{M}ae$, i.e. an individual a does not know that he is not mistaken that e (where e stands for an empirical statement)

The following is the essence of his explanation:

Empirical propositions are not only inherently open to falsification, but they also leave room for completely undetected error. One can still know empirical facts if we grant premise (2), but to have knowledge that there is no mistaking these facts would have to be denied, for this would require too much of finite creatures. The last point can be put logically in this way: *a*'s being mistaken that *e* amounts to an indefinitely long disjunction, each of whose disjuncts states a way in which *a* would be mistaken
i.e. $\mathrm{M}ae \rightarrow p \vee q \vee r \ldots \vee n$. So *a*'s *not* being mistaken that *e* is logically equivalent to an indefinitely long *conjunction* each of whose conjuncts states a denial of a particular way in which *a* would be mistaken [i.e., $\mathrm{K}a \sim \mathrm{M}ae \leftrightarrow \mathrm{K}a \sim p \;\&\; \mathrm{K}a \sim q \;\&\; \mathrm{K}a \sim r \;\& \ldots . \mathrm{K}a \sim n$.]
But surely *a* does not know all these things[2]

Thus Carrier would approve of

$$(\phi_1)\ (\exists e)\,\mathrm{K}ae \;\&\; (e) \sim \mathrm{K}a \sim \mathrm{M}ae$$

as a rigorous, formal expression of fallibilism as well as cognitivism.

All this sounds reasonable and thus it comes somewhat as a surprise to find that (ϕ_1) is involved in an irreparably damaging error.

Let e_1 stand for a particular empirical statement and 'B' for 'believes that', then

$$\begin{aligned} \mathrm{K}ae_1 &\rightarrow \mathrm{K}a(e_1 \vee \sim \mathrm{B}ae_1) && \text{By the Law of Addition} \\ &\rightarrow \mathrm{K}a \sim (\sim e_1 \;\&\; \mathrm{B}ae) && \text{By De Morgan} \\ &\rightarrow \mathrm{K}a \sim \mathrm{M}ae_1 && \text{By Def}^{\,n} \text{ of `M'} \end{aligned}$$

Thus for any *e*, if *a* knows that *e*, then it follows also that *a* knows also that he is not mistaken that *e* (as long as *a* knows the Law of Addition and De Morgan's Law). Thus (ϕ_1) is inconsistent. It follows that Carrier's (2) is not merely an expression of fallibilism. The denial of $\mathrm{K}a \sim \mathrm{M}ae$ entails the denial of $\mathrm{K}ae$. Thus (2) is an expression of scepticism, something Carrier decidedly wanted to avoid.

III.

Recently Susan Haack has written an interesting paper[3] exploring the possibility of formalizing the thesis of fallibility. After rejecting a number of preliminary attempts she advances

$$(\mathrm{F}_4)\ (p) \Diamond \mathrm{B}p$$

as plausible candidate for properly expressing the universal fallibility of the human mind. (F_4) seems to affirm that we are capable of believing any proposition irrespective of whether it is true or false, and thus any one of our beliefs may be false.

Haack then points out that if F_4 were indeed an adequate representation of fallibilism then its denial

$$(D)(\exists p) \sim \Diamond B \sim p$$

would have to amount to what may be called dogmatism. Expression D is, however, not strong enough since it does not imply that we actually have any true beliefs. Thus dogmatism is more adequately represented by

$$(D^*)\ (\exists p)\ [\Box\ (Bp \supset p)\ \&\ \sim \Diamond\ Bp \sim p].$$

Consequently fallibilism is represented by

$$(F^*)\ (p)\ [\sim \Box\ (Bp \supset p) \vee \Diamond\ B \sim p]$$

First, let me point out that there seems to be a simple formal error here: how could Haack attempt to replace F_4 by F^* when the two are logically equivalent? It is easily seen that they are. Clearly $F_4 \rightarrow F^*$ by substituting $\sim p/p$ and the Law of Addition. Now, the first disjunct of F^*, $\sim \Box\ (Bp \supset p)$, is logically equivalent to $\Diamond\ (Bp\ \&\ \sim p)$ (from the definition of '$\Box$' and '$\supset$'). Hence F^* logically implies

$$(p)\ [(\Diamond\ Bp\ \&\ \Diamond \sim p) \vee \Diamond\ B \sim p], \text{ which entails}$$

$(p)\ (\Diamond\ Bp \vee \Diamond\ B \sim p)$ since $(a\ \&\ b) \vee c \rightarrow a \vee c$, and this entails F_4, i.e. $(p) \Diamond\ Bp$.[4] Having shown that $F_4 \rightarrow F^*$ as well as $F^* \rightarrow F_4$ it follows that $F_4 \leftrightarrow F^*$.

This, however, is a relatively minor point. The far more serious difficulty is that F_4 has nothing to do with fallibilism.

For suppose there was an immutable law of nature that for some p, whenever Bp then inevitably p was true. In other words we suppose now that it is *nomically* impossible for anyone to believe certain false propositions.

(i) $(p) \Diamond Bp$ may remain true, since it does not amount to a *contradiction* to assert 'Bp' for any 'p', even if false.

(ii) Fallibilism would, of course, be false.

It follows therefore that F_4 is compatible with the falsity of fallibilism. It It should be added that F_4 is so useless that it is not only compatible with the mere denial of total fallibilism but also with the doctrine that we are all absolutely infallible or even perfectly omniscient; that is, by holding only true beliefs and not failing to believe in anything that is true! This follows at once from the fact that even if it was never nomically possible for anyone to hold any false proposition, this would not render Bp self-contradictory and thus $\Diamond Bp$ could hold for every p in spite of the immutable law of nature preventing anyone of us from holding a false belief.

IV.

Peter L. Mott has published a paper in which he discusses Haack's suggestion.[5] In a somewhat roundabout and lengthy way he shows that F^* logically implies F_4, which he declares to be absurd. Mott claims: "… if you believe that 1 is a number then you cannot believe that 1 is the first letter of the alphabet."

Mott's point does not seem to be correct. A statement of the form $p \,\&\, \sim p$ is logically false, however, $B(p \,\&\, \sim p)$ is not a contradiction and logic does not tell us that it must be false. Mott's sentence concerning the number 1 may be absurd because it is not possible *psychologically* for anyone to believe it. That, however, does not imply that $\Diamond Bp$ is false for any p, since that merely claims that Bp is not *logically* impossible.

However, Mott could have raised his objection by using a different sentence. For example let p = '*s* has a toothache', and assume that p is false. In this case there are philosophers who would insist that $\sim \Diamond Bsp$ since the very notion of pain analytically implies that it is the sort of thing that *s* cannot have without *s* believing that she has it and vice versa.

Another possibility might be p = '$q \,\&\, \sim Bsq$', in which case we are once more committed to $\sim \Diamond Bsp$ since otherwise we would have to claim $\Diamond (Bsq \,\&\, Bs \sim Bsq)$. The bracketed expression would be ruled by some to be necessarily false since it necessarily follows from Bsq that $BsBsq$.

Even so, we still should not conclude that Haack's formalization is faulty, since fallibilism is generally assumed to be a somewhat restricted doctrine. Those who maintain the incorrigibility of avowals of inner experiences would exempt such avowals from being included in the doctrine. Haack herself said so explicitly elsewhere:

> However, epistemologists have often thought that, with respect to certain *kinds* of belief – belief about one's own immediate sense-experience are a favored example – people may be infallible: they are liable to have false beliefs about astronomy, geography ... etc., but they are not liable to be mistaken about whether they are in pain, seeing a red patch... etc.[6]

Consequently, provided there were no other objections, these epistemologists could avail themselves of $(e) \Diamond Be$ as an adequate expression of fallibilism by adding that e stands for an empirical proposition.

Be that as it may, Mott proceeds to advance his own suggestion for the formalization of fallibilism. He proposes that the doctrine is best defined as the claim that there are no infallible methods of securing knowledge. To be more precise, it is the claim that there exists no procedure δ such that

(a) applying δ always leads to a correct-decision whether p

and

(b) S's decisions are always correctly determined by the experimenter.

To express this in symbols, fallibilism amounts to the denial of the conjunction:

$$(D_1) \qquad (p)\,(\delta p \supset p)$$
$$(D_2) \qquad (p) \sim \Diamond\,(B\,\delta\,p \,\&\, \sim \delta\,p)$$

where 'δ' is called by Mott a Cartesian functor.

There are, however, a great number of objections to Mott's suggestion, and I do not know how he would react to them:

(1) Let us suppose that 'δ' denotes any method whatever, then as long as δ has never been applied to test the veracity of *any* p, $(p) \sim \delta\,p$ is true, and this logically implies the truth of (D_1) $(p)\,(\delta p \supset p)$. Thus we are driven to the absurd conclusion that we are entitled to proclaim the doctrine of perfect infallibilism as long as there is *some* method that has never been applied to *any* p. This in fact amounts to the conclusion that we are infallible under all practical circumstances!

It does not seem possible to salvage the core of (D_1) by replacing it by

$$(D_1{}')\ (\exists p)\ \delta p\ \&\ (p)\ (\delta p \supset p)$$

which is incompatible with δ being a method that has never been applied. $(D_1{}')$ is not a useful expression since, for example, if δ has been applied to no more than a single p, which happens to be true and yielded positive results, $(D_1{}')$ would be satisfied.

On the other hand, to suggest that we should have

$$(D_1{}'')\ (p)\ \delta p\ \&\ (\delta p \supset p)$$

seems to have the obvious defect of claiming that we *actually* know everything there is to be known, which of course even those who hold the doctrine of perfect infallibility concede to be false. They might *perhaps* maintain that omniscience is a possibility but this cannot be expressed as

$$(D_1{}''')\ \diamond\ (p)\ \delta p\ \&\ (\delta p \supset p)$$

since this merely asserts logical possibility of omniscience without indicating that it is practically within reach.

(2) Let us ignore what we have said so far and assume that D_1 & D_2 adequately defines dogmatic epistemology. If so then $(\exists p) \sim (\delta p \supset p)$ would have to express fallibilism. But surely it is not a sufficiently strong expression since $(\exists p) \sim (\delta p \supset p)$ would be true as soon as there was one specific proposition p_1 whose truth has not been successfully established. Fallibilism says, however, much more: that with respect to *all* propositions of a certain kind there must be some reservation.

Incidentally, it may be noted that Mott seems not merely to have failed to capture in the language of symbolic logic the idea of fallibilism but there is also a subtle error in the way he renders it informally. Mott explicitly states:

Let us characterize fallibilism as the doctrine that *there are no Cartesian functors*.

Fallibilism says much more than that. The fallibilist wishes not merely to deny the existence of a secure method which "*always*" leads to a correct decision whether p" but even just that of the existence of a secure enough method leading to absolute certainty with respect to *even one* empirical proposition.

Oddly enough, $(\exists p) \sim (\delta p \supset p)$, besides being too weak to express the full scope of fallibilism, also seems too strong! Fallibilism implies only that there is no absolute certainty about any of our beliefs, but does not go as far as to claim that all, many or even that some of our beliefs are decidedly false.

$(\exists p) \sim (\delta p \supset p)$ is, however, equivalent to $(\exists \mathrm{p})\ (\delta p\ \&\ \sim p)$, asserting that we do hold at least one false belief.

(3) An examination of (D_2) may give rise to even stronger objections. If (D_2) were adequate then its denial would have to be supposed to yield fallibilism. But the denial of (D_2) amounts to

$$(\bar{D}_2) \sim (p) \sim \Diamond\ (B\ \delta\ p\ \&\ \sim \delta\ p)$$

$$\text{i.e. } (\bar{D}_2)\ (\exists p) \Diamond\ (B\ \delta\ p)\ \&\ \sim \delta\ p)$$

which is compatible with δ being a perfectly fool-proof method for establishing the truth of any proposition it is applied to. $(\bar{D}_2)$ says no more than that $B\ \delta\ p\ \&\ \sim \delta\ p$ is logically possible i.e. that there is no contradiction in asserting $B\ \delta\ p\ \&\ \sim p$. Fallibilism says, of course, more: it says that it is not contrary to any *causal law* to have both $B\ \delta\ p$ and $\delta\ p$; that they are *nomically* co-possible.

V.

Matters could be set right by introducing nomic concepts and by asserting that fallibilism is adequately represented by

$$(D_3)\ (e) \sim (\mathrm{JB}e \rightarrowtail e)$$

where 'JB' denotes 'is justifiably believed that' and '$\rightarrowtail$' denotes 'if ... then it follows by law of nature that' or 'if... then it is causally necessary that' (D_3) asserts that for no proposition does the fact that it is justifiably believed, because it is supported by any amount of evidence, constitute a nomic guarantee for its truth.

The obvious objection that will be leveled against (D_3) is that it fails to accomplish what philosophers have set out to accomplish, namely to formulate a definition out of simple logical terms, which $\rightarrowtail$ is not. In fact, the precise explication of the notion of nomic or causal necessity has been the subject of considerable controversy. It would be inappropriate to attempt defining the relatively transparent notion of fallibilism in terms of the more opaque concept of causal necessity.

Some might think of suggesting

$$(\mathrm{D}_4) \qquad (e)\,(pr(e) < 1)$$

as an expression of fallibilism. (D_4) implies that no amount of justification will allow the value of the probability of an empirical proposition to reach one. (D_4) is undeniably equivalent to fallibilism since $pr(e) = 1$ amounts precisely to saying that '*e* is certain to be true', and fallibilism is a denial of just that. It is important to realize, however, that (D_4) is no use as a philosophical explication. One may, for example, define '*a* knows that *p*' by '*a* is cognizant of *p*', which may be fine in a dictionary, the function of which is to translate a word into other words. Such a translation is not, however, what epistemologists have been looking for. Philosophical value attaches only to a definition in terms of different concepts from the definiens.

It might still be thought that one could make use of the basic features of probability in our definition of fallibilism without making any reference to probability, but only to elementary epistemic notions. Given that for any proposition e_1 no matter how well grounded our belief in it may be, still the probability of e_1 is less than one, then obviously if e_1 and e_2 are logically independent then $p(e_1 \,\&\, e_2) < p(e_1)$ and of course $p(e_1 \,\&\, e_2 \,\&\, e_3) < p(e_1 \,\&\, e_2)$ and so on. The suggestion could be made that fallibilism be expressed by

$$(\mathrm{D}_5)\ \mathrm{JB}e_1 \,\&\, \mathrm{JB}e_2 \,\&\, .\,.\, \&\, \mathrm{JB}e_n \,\&\, \sim \mathrm{JB}(e_1 \,\&\, e_2 .\,.\,.\,.\, e_n)$$

when n is a large enough number.

There is no question about it, (D_5) *is* true. It is, however, not an adequate representation of fallibilism; it is too weak for that. Even if fallibilism were false (D_5) would be true: it may justifiably be believed of each lottery ticket that it will fail to win but not that all of them will fail to win. This, however, is not due to any imperfection in our methods of inquiry. It is due to the fact that it is clearly given that one ticket is definitely going to win as well as that there are many tickets, in consequence of which the probability of any particular ticket to win is very small.

This suggest that the appropriate way to express fallibilism should be:

$$(D_6)\ Ke_1\ \&\ Ke_2 \ldots \&\ Ke_n\ \&\ \sim K(e_1\ \&\ e_2 \ldots \&\ e_n)$$

However, even (D_6) is still too weak. A quick way of showing this is to consider a person *s* who cares about one particular proposition e_1, more than about anything else, and spending a inordinate amount of time to make sure it is true. The fallibilist should want to say to *s* that even though he is willing to renounce his knowledge of anything else and has concentrated all his efforts to find a firm basis for his belief that e_1, he is still not entitled to claim infallibility with respect to it. This of course does not amount to saying that $\sim Kse_1$; such a radical claim would be made by only a sceptic. What the fallibilist says to *s* is: you may of course know that e_1, but not with absolute certainty. Expression (D_5), which affirms a large number of knowledge claims which *s* does not make, does not seem to speak to his situation.

VI.

The justification of beliefs admits of degrees. The degree to which a belief needs to be justified in order to be rationally held is not so high as to ensure the truth of that belief. Let us denote by 'JF*ae*' the expression '*a* is justified in having *full* conviction that *e* ' and let us stipulate that (α): $(e)\ (JFae \rightarrow e)$. It then seems reasonable to maintain that fallibilism is adequately expressed by

$$(\phi)\ (e) \sim JFae$$

Expression (ϕ) is compatible with there being any number of propositions that may be regarded as highly credible to the extent that it is perfectly rational to act upon them. We are nevertheless not justified in having entirely unreserved confidence in any one of them.

Clearly, however, (α) does not amount to a complete definition. It might therefore be suggested that we employ a different notion, one that various philosophers have denoted by 'C', signifying 'convinced that'. 'C' too represents a stronger belief than 'B' and it has the supposedly great advantage over 'F' that it may fully be defined in terms of already existing notions. W. Lenzen in his very helpful survey of epistemic logic[7] argues that 'C' is not a new predicate since it may be shown that

$$(58)\ \mathrm{C}ap \equiv \sim \mathrm{K}a \sim \mathrm{K}ap$$

Hence it might be thought feasible to express fallibilism as

$$(\phi')\ (e) \sim \mathrm{JC}ae$$

Unfortunately, this does not work. After all, the notion of 'justification' yields:

$$\sim \mathrm{JC}ae = \mathrm{R}a \rightarrow \sim \mathrm{C}ae$$

asserting that '*a* is not justified to hold *e* with conviction' is equivalent to saying 'if *a* is rational then *a* is not going to hold *e* with conviction'. Consequently we may rewrite

$$(\phi')\quad (e)\ (\mathrm{R}a \rightarrow \sim \mathrm{C}ae), \text{ which of course is}$$
$$(e)\ (\mathrm{R}a \rightarrow \mathrm{K}a \sim \mathrm{K}ae)$$

by Lenzen's (58). (ϕ') is however unacceptable since it is more destructive than fallibilism. Fallibilism does not deny that we know something whereas, of course, $\mathrm{K}a \sim \mathrm{K}ae$ entails $\sim \mathrm{K}ae$.

Incidentally, judicious as Lenzen is in general, here he seems to have committed a mistake. Earlier in his book he implies that C*ap* (as distinct from B*ap*) is not required for knowledge. But, as we see, his (58) implies otherwise.

Thus we shall make use of the operator 'F' which, even if it may not be fully defined, can be clarified by making several statements about it. First we may assert

$$(p)\ (\mathrm{JF}p \rightarrow \mathrm{JP}p)\ \&\ \sim (p)\ (\mathrm{JB}p \rightarrow \mathrm{JF}p)$$

where '*p*' stands for all sorts of propositions including those which are exempt from coming under the doctrine of fallibilism.

Since there are indefinitely many degrees of justification we may insert between 'JB' and 'JF' the operator 'JC' of which it may be said:

$$(p)\,(\mathrm{JF}p \rightarrow \mathrm{JC}p)\ \&\ \sim (p)\,(\mathrm{JC}p \rightarrow \mathrm{JF}p) \text{ as well as}$$
$$(p)\,(\mathrm{JC}p \rightarrow \mathrm{JB}p)\ \&\ \sim (p)\,(\mathrm{JB}p \rightarrow \mathrm{JC}p)$$

and any further number of operators representing different degrees of justified belief.

Each valid expression involving these operators contributes to their explication. And there are more such expressions. It may, for example, be asserted that

$$(\exists p_1)\,(\exists p_2)\,(\mathrm{JC}p_1\ \&\ \mathrm{JC}p_2\ \&\ \sim \mathrm{JC}(p_1\ \&\ p_2))$$

for the reason indicated before, namely, that rational belief to a given degree in each of his propositions does not necessarily carry over into a rational belief of the same degree in the conjuction of those two propositions. It may however still carry over into a rational belief of a lower degree. Consequently, it may also be asserted that

$$(\exists p_1)\,(\exists p_2)\,(\mathrm{JC}p_1\ \&\ \mathrm{JC}p_2\ \&\ \sim \mathrm{JC}(p_1\ \&\ p_2)\ \&\ \mathrm{JB}(p_1\ \&\ p_2))$$

But of course 'F' is unique among all the operators since

$$(p_1)\,(p_2)\,(\mathrm{JF}p_1\ \&\ \mathrm{JF}p_2 \rightarrow \mathrm{JF}(p_1\ \&\ p_2)$$

is true in its case.

VII.

Now we are in a position to say something useful about the important notion of 'epistemic possibility'. G.E. Moore, in a famous passage, pointed out that in general there are three major senses of possible:

(1) *Logical*. It's possible that I should have been seeing exactly what I am seeing and yet should have no eyes. I *might* have been seeing what I do and had no eyes.
It's possible that every dog that has ever lived should have climbed a tree.

(2) *Causal.* It's possible that I should have been blind by now. I *might* have been blind now. It's possible that I should have traveled 200 miles since an hour ago.
(3) *Epistemic.* It is possible that Hitler is now (12pm Oct. 25) dead.
Hitler *may* be dead.

There have been several attempts to elucidate the concept of epistemic possibility. Paul Teller has, for example, written a paper in which he attempts to improve upon a suggestion by Ian Hacking and in which he produces a series of increasingly more elaborate definitions. However, he does not seem to have managed to get even the most basic things right.

One of his earlier formulations, which he believes conveys roughly the idea of epistemic possibility, is:

D2: It is possible that p if and only if

(a) p is not known to be false

nor

(b) are propositions known which could serve as basis, date or evidence on the strenght of which we could come to know that p is false.[8]

It should be sufficient to consider but one reason why D2 completely misses the point. Let 'h' denote 'All copper expands when heated' which may be said to be paradigmatic of a solidly established generalization. Yet a thoughtful scientist like Denbigh will tell us that because of inevitable practical limitations on the available evidence, 'h' could *possibly* turn out to be false in spite of the overwhelming amount of inductive confirmation it has received. We must ask now, which type of possibility, would he have in mind? Surely not (1), Logical possibility since then all he would be conveying to us is that we are not involved in a contradiction in asserting $\sim h$. That, however, is compatible with h being absolutely certain and fully immune to all future revision.

But neither could he mean (2), physical possibility, since there is no sufficient basis for that. That is, there is no justification for maintaining that though h is as well confirmed as anything could be, nevertheless it is physically possible that it is false. Reasonable scientists do not claim to know that h is definitely false. Should h happen to be true, then it is in fact an immutable law of nature that no circumstances will ever arise under which copper fails to expand when heated. But in that case it is physically *impossible* that h be violated.

Therefore it is inevitable that the term 'possible' in the present context can stand only for (3), epistemic possibility. But scientists do believe that h, and they are justified in believing that h, therefore, should it also be the case that h is true, they *know* that h. But if h is known to be true then, of course, $\sim h$ is known to be false, and yet it is appropriate to regard at present $\sim h$ as epistemically possible.

This might, however, strike some of us as being somewhat strange. Moore's example, involving the possibility of Hitler being dead, was expressed at a time when there was no firm evidence that he was alive. Are we really using the same notion when on the one hand we are across the channel in England, having no peace-time means of communications, and therefore can definitely not be regarded as *knowing* that Hitler is not dead already, and thus declare 'Hitler is possibly dead', and on the other hand when speaking of the vastly more remote possibility of h being false?

All puzzlement should, however, disappear once we realize that just like everything else in epistemology, possibilities, too come in different degrees. There are stronger and weaker beliefs, convictions, doubts and justifications, and there are stronger and weaker epistemic possibilities. Thus, for example, we may define

$$p \text{ is epistemically possible}_i = \sim \text{JB} \sim p$$

implying a fairly strong possibility, since when p is possible$_i$ we definitely do not know that p is false. In addition we may also define p is epistemically possible$_j$ $= \sim \text{JC} \sim p$ implying a more remote possibility since p being possibly$_j$ is compatible with our knowing that p is false.

It does not come as a surprise to find that fallibilism too admits indefinitely many degrees. Our expression

$$(e) \sim \text{JF}ae$$

stands for the weakest kind of fallibilism. A stronger kind would be given by, for instance,

$$(e) \sim \text{JC}ae$$

Obviously, for any degree of justified belief that is stronger than B, there exists a corresponding degree of fallibilism.

NOTES AND REFERENCES

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