METAPHYSICS AND EPISTEMOLOGY

Induction

1. *Inductive* inferences move from the partial to the general. Such an inference may have the form:

$$\frac{\begin{array}{c} a_1\text{, which is F, is G.} \\ \vdots \\ a_n\text{, which is F, is G.} \end{array}}{\text{Hence every F is G.}}$$

E.g. 'Gold, which is a metal, is a good conductor of heat; silver, which is a metal, is also a good conductor of heat; copper, which is a metal, is a good conductor of heat, too. Hence every metal is a good conductor of heat'. Alternatively, an inductive inference may have the form

$$\frac{\text{Every F that has been observed is G.}}{\text{Hence every F is G.}}$$

E.g. 'All the metals that have been observed are good conductors of heat. Hence all metals are good conductors of heat', 'Every uranium fission that has been observed caused a release of energy. Hence every uranium fission causes a release of energy'. There are also other forms of inductive inference, e.g.

$$\frac{\text{n\% of the Fs that have been observed are G.}}{\text{Hence n\% of all the Fs are G.}}$$

The conclusion of an inductive inference, as it concerns all Fs, also concerns any Fs there will be in the future.

Inductive inferences are not valid in the strict sense. They are not *deductively valid,* as we say. E.g. it is logically possible that every uranium fission observed until 2024 should cause a release of energy, but then the laws of nature should change, and no energy should be released in subsequent fissions.

2. We have an inductive practice; that is, we often rely on inductive inferences both in everyday life and in science. E.g. in everyday life, we inductively conclude that whenever someone cuts himself, he bleeds (every cutting is accompanied by an appearance of blood). In science, we use induction to support e.g. Galileo's law of free fall (every falling body falls at a constant acceleration).

The inferences we make in the context of our inductive practice are *rational* or, at least, appear so. It seems that, in such an inference, the premisses, if true, substantiate the conclusion. It seems that if someone is justified in believing the premisses and so, relying on the inductive inference, ends up believing the conclusion too, then her belief in the conclusion is also justified. (The opposite of rational inferences are the absurd ones.) Yet there is a form of scepticism that questions the rationality of our inductive practice. That is Hume's scepticism. According to him, if someone, relying on an inductive inference, believes the conclusion, she is not justified in believing it. (See Hume's argument in the notes on scepticism.)

The traditional problem of induction is to show that the inferences we make in the context of our inductive practice are indeed rational, although they are not deductively valid. In other words, the problem is to refute Hume-type scepticism. (Of course, if you agree with that scepticism, then the problem does not arise for you.)

3. Some solutions to the traditional problem that have been put forward:

(a) Let's take an inductive inference of the form 'Every F that has been observed is G. Hence every F is G'. To this inference let's add, as a second premiss, the principle

(1) It is the case for any F, any G and any time t that if every F that has up to t been observed is G, then every F is G.

The resulting inference is deductively valid. E.g. it is deductively valid to argue as follows:

> It is the case for any F, any G and any time t that if every F that has up to t been observed is G, then every F is G.
> Every metal that has (up to now) been observed is a good conductor of heat.
> ____
> Hence every metal is a good conductor of heat.

Consequently, we can show the rationality of the initial, inductive inference by substantiating (1).

The problem with this way of tackling the traditional problem is that it doesn't seem possible to substantiate (1). On the contrary, we know of counterexamples. E.g. in antiquity every swan that had been observed was white, but there were black swans (in Australia).

(b) We can show the rationality of our inductive practice by substantiating the view that whenever in the past we made an inference in the context of that practice, and the inference had true premisses, the conclusion was usually true, too. And we can substantiate that view with historical research.

There are two problems with this effort to support our inductive practice. The one problem, which has not been discussed much, is that if we examine some inductive inference that people made in the past, it is difficult to prove that its conclusion was true. For, more often than not, the conclusion will also concern things that even now have not been observed. E.g. Pasteur inductively concluded that every living organism is born of another living organism. This conclusion also concerns biological species that have not been studied yet, such as microbes in the depths of the oceans.

The second problem, which is already discussed by Hume, is that the effort in question to support our inductive practice is based on the following induction:

> The inferences made in the past that were included in our inductive practice and had true premisses usually had a true conclusion.
> ____
> Hence the inferences that are included in our inductive practice and have true premisses usually have a true conclusion.

The premiss concerns the past, whereas the conclusion concerns past, present and future. (And from that conclusion it is further derived that our inductive practice is rational.) Thus the effort to support the inductive practice is involved in a vicious circle.

Certain philosophers, such as M. Black, have argued that there is no vicious circle here. They have argued as follows: In every inference we must distinguish between the premisses and the rule of inference which leads from them to the conclusion. E.g. in the inference

> If Mary is clever, then Peter is also clever

Mary is clever

Hence Peter is also clever

we have two premisses, but the rule of inference is something third, the so-called *modus ponens,* that is, the rule that allows us to draw the conclusion **B** from premisses of the form 'If **A** then **B**' and **A**. Now, in the argument in favour of the inductive practice, the conclusion is 'Our inductive practice is rational'. If this conclusion also occurred as a premiss, there would be a vicious circle. But that doesn't happen. What happens is that some inferential step within the argument follows the rule which constitutes our inductive practice. But, in this way, what is presupposed (a certain rule of inference) is not identical with the conclusion (which is not the rule itself, but a sentence that attributes to it the feature of rationality).

(c) K. Popper believed that he had solved the traditional problem of induction. In his opinion, a science develops as a series of theories, and those theories are conjectures. Scientists propose a theory and check it; that is, by means of observations and experiments, they try to find something that will show the theory to be false. If they are successful, then they replace the theory with another one; if not, then they preserve the initial theory, always as a conjecture, and continue checking it. Thus the inferences that matter to science are those through which we are led from a finding to the falsification of a theory. Those inferences are deductively valid. Their usual form is 'a, which is F, is not G. Hence it is not the case that every F is G'. Science does not rely on inductive inferences.

One difficulty for Popper's views is that, in science, theories are not always treated as conjectures. Often a theory (e.g. the heliocentric model) is initially treated as a conjecture, then believed, and then treated as a well-established truth. But the most serious difficulty is that Popper's views do not propose a solution to the traditional problem. Popper doesn't tell us why our inductive practice is rational. Indeed, he seems to have believed that it is not, that it is not justified to accept the thesis 'Every F is G' on the basis of the datum 'Every F that has been observed is G'.

(d) In the 50s, some philosophers, such as Strawson, supported our inductive practice in this way: Ordinary speakers of our language are willing to apply the predicate 'rational' to the inductive practice. Let's say, e.g., that a person engages in that practice; someone else often thinks as follows: 'All Fs that have been observed are G. Hence it is not the case that all Fs are G'; and a third one often thinks as follows: 'All Fs that have been observed are G. But this does not help me to form any opinion on whether all Fs are G'. Ordinary speakers will not hesitate to call the first person's thinking 'rational' and the thinking of the other two 'irrational'. So, since ordinary speakers are willing to apply the predicate 'rational' to our inductive practice, there is no doubt that the predicate, in the sense it has in ordinary language, is true of that practice.

This type of argument is called 'paradigm case argument', and in the 50s many British philosophers used it on various issues. They said, e.g., that, since ordinary speakers are willing to apply the predicate 'free' to various simple decisions, there is no doubt that the predicate, in the sense it has in ordinary language, is true of those decisions. The argument-type in question has been abandoned.

The problem is that when we learn a predicate, we do not only learn to what things other speakers usually apply it. We also learn some conditions that are necessary or sufficient in order for the predicate to be true of something. So those who understand the word ‘free’ will agree that in order for a decision to be free, it is a necessary condition that the subject could have decided otherwise. When ordinary speakers apply the word to various simple decisions, they presuppose that the decisions satisfy the condition. But it may be that they do not and so are not free (in the ordinary sense of the word). Likewise, it may be that when we learn the predicate ‘rational’, we also learn some conditions that are necessary in order for it to be true of something. And it may be that our inductive practice does not satisfy those conditions and so is not a rational way of thinking (in the ordinary sense of the word ‘rational’).

4. The so-called new problem of induction:

Many inductive inferences do not appear rational or legitimate at all. And, in some of them, we know that the premisses are true, and the conclusion has not been falsified yet. One famous example is due to N. Goodman: Let’s introduce the predicate ‘grue’. An object is grue iff either it is observed before 2025 and is green or it is not observed before 2025 and is blue. (For simplicity, let’s ignore the fact that an object may change colour.) Correspondingly, we will say that something is *bleen* iff either it is observed before 2025 and is blue or it is not observed before 2025 and is green. Let’s now see the inductive inferences

(2) Every emerald that has been observed is green. Hence every emerald is green.

(3) Every emerald that has been observed is grue. Hence every emerald is grue.

Both the premiss of (2) and the premiss of (3) are true. Yet only (2) appears to be a rational inference. If every emerald is grue, then those that will be mined after the end of 2024 are blue.

At any rate, it is certain that there are, or there will be, emeralds that no one will see before 2025. As it is not possible for those emeralds to be both green and blue, the sentences ‘Every emerald is green’ and ‘Every emerald is grue’ are not both true. Hence at least one of inferences (2) and (3) has a true premiss and a false conclusion. It is in this way that Goodman demonstrates that there are inductive inferences of the form ‘Every F that has been observed is G. Hence every F is G’ which have a true premiss but a false conclusion.

The new problem of induction is to distinguish systematically between the inductive inferences that are rational or legitimate and those that are not. (If you happen to adopt the sceptical view that no inductive inference is rational, then reformulate the new problem. For you the problem will be to distinguish systematically between the inductive inferences that appear rational or legitimate and those that do not give that impression.) The traditional problem specifically concerns our inductive practice. The inferences included in that practice are, or at least appear, rational — we do not make inferences like (3).

Note that an inductive inference may be rational, but lead from a true premiss to a false conclusion. Such was the inference of the ancients ‘All swans that have been observed are white. Hence all swans are white’.

Further, there are inferences that are like (3) but contain a predicate of the type of ‘grue’ in the position of F and not in the position of G. E.g.

(4) Every emeruby that has been observed is green. Hence every emeruby is green.

Something is an *emeruby* iff either it is observed before 2025 and is an emerald or it is not observed before 2025 and is a ruby. The premiss of (4) is true, but if the conclusion is true, then any rubies mined after the end of 2024 are green (and not red). (4) does not appear to be a rational inference. There are also inductive inferences that do not appear rational, but contain only familiar predicates. (Can you think of any one?)

5. Some solutions to the new problem that have been put forward:

(a) R. Carnap's solution: When we defined the predicate 'grue', we referred to a certain time, the year 2025. Rational inductive inferences contain purely qualitative predicates as F and as G, whereas an irrational inductive inference will contain, as F or as G, some predicate whose definition includes a specific reference to a time, a place or some other object.

Goodman gave the following answer: Whether a predicate is qualitative, as well as whether its definition includes a specific reference, depends on the definitions in whose context we are discussing it. E.g. we may start with the expressions 'grue' and 'bleen' as primitive predicates, for which no definition is offered. Then, we can define the predicate 'green' as follows: something is green iff either it is observed before 2025 and is grue or it is not observed before 2025 and is bleen. And we can define the predicate 'blue' as follows: something is blue iff it is observed before 2025 and is bleen or it is not observed before 2025 and is grue. In this context of definitions, 'grue' and 'bleen' are qualitative, while 'green' and 'blue' have a definition that includes a specific reference. So assuming Carnap means that an inductive inference is irrational iff it contains a predicate that, relative to some context of definitions, involves a specific reference, he accepts that (2) too is irrational. On the other hand, assuming he means that an inductive inference is irrational iff it contains a predicate that, relative to every context of definitions, involves a specific reference, he accepts that not even (3) is irrational.

(b) W. Salmon's solution: Rational inductive inferences contain, as F and as G, predicates that admit of ostensive definition, whereas an irrational inductive inference will contain, as F or as G, a predicate that admits of no such definition. We give an *ostensive definition* for some predicate H when we explain it by demonstrating various things of which it is true and saying 'These are H'.

Goodman gave the following answer: Do we have an ostensive definition when we explain some predicate by showing not the things themselves of which it is true, but how certain instruments react to the presence of such things? If such explanations are not ostensive definitions, then many predicates that concern entities too small to be shown themselves (e.g. particles) do not admit of ostensive definition. Yet many inductive inferences containing such predicates are as rational as (2). If, on the other hand, explanations involving instruments are ostensive definitions, then even the predicate 'grue' admits of an ostensive definition. For we can construct a device that will turn a small bulb on iff either it records the presence of some green object and we are before 2025 or it records the presence of a blue object and we are in 2025 or later.

6. Goodman's own solution:

According to him, (3) is an irrational inference because, on the one hand, its conclusion conflicts with the conclusion of (2) and, on the other, the predicate 'green' is much more entrenched than the predicate 'grue'. When Goodman says that the sentences A and B *conflict,* he means that there is something x such that the two sentences ascribe two predicates respectively to x, but not both predicates are true of x. The sentences 'Every emerald is grue' and 'Every emerald is green' conflict in the case of emeralds that will not be found before 2025. How *entrenched* a predicate H is depends on how much either H itself or predicates with the same extension as H have been used in inductive inferences in the past. (The *extension* of a predicate is the set of objects of which it is true.)

In order to see Goodman's solution more precisely, we need more terminology. (In the following I have somewhat simplified both the definition of *overrides* and the solution itself.) A sentence of the form 'Every F is G' is *supported* iff there are some Fs that have been found to be G. The sentence is *violated* iff there are some Fs that have been found not to be G. A sentence 'Every F is G' is *better entrenched* than another sentence 'Every F′ is G′' iff either the predicate G is more entrenched than G′ while F is not less entrenched than F′ or F is more entrenched than F′ while G is not less entrenched than G′. (The formulation *G is not less entrenched than G′* is equivalent to *G is equally entrenched to G′ or more entrenched than G′*.) The sentence 'Every F is G' *overrides* 'Every F′ is G′' iff the two sentences conflict and 'Every F is G' is better entrenched than 'Every F′ is G′'. So, according to Goodman, an inductive inference in which the conclusion, A, has the form 'Every … is ---' is rational or legitimate iff the following condition is satisfied: the sentence A is supported and not violated, and every supported and not violated sentence having that form and conflicting with A is overridden (either by A or by another sentence).

It is sometimes thought that if we introduce a predicate in order to express a physical property that has just been discovered, then according to Goodman the inductive inferences containing the predicate will not be legitimate. This view, however, is a misinterpretation of Goodman — thankfully for him, as it happens in science that such predicates are introduced, and the inductive inferences containing them are as good as (2). According to Goodman, an induction whose conclusion, A, is supported but not violated and contains the new predicate can very well be rational. Only in certain cases is it not rational, and the most typical such case is when the sentence A conflicts with a sentence B which is also supported and not violated but, in addition, contains only predicates that have existed for a long time and have been used in human inductive thought; in that case, B overrides A.

In the solution he finally offers, Goodman writes 'is overridden (either by A or by another sentence)' and not just 'is overridden by A' in order to avoid an objection that had been raised by D. Davidson. Davidson pointed out that an inductive inference is sometimes rational despite the fact that, in its conclusion, both F and G are predicates of the type of 'grue'. One example is the inference

(5) All emeralds that have been observed are green; all rubies that have been observed are red. Hence all emerubies are gred.

(Naturally, something is *gred* iff either it is observed before 2025 and is green or it is not observed before 2025 and is red.) The conclusion, 'All emerubies are gred', is equivalent to the statement 'All emeralds that are observed before 2025 are green, and all rubies that are not observed before 2025 are red'. Now, the conclusion conflicts with the sentence 'All emerubies are green' and does not override it. (On the contrary, that sentence overrides 'All emerubies are gred'.) So if Goodman had written 'is overridden by A' in his solution, he would have had to accept that (5) is not a legitimate inference. But if we write 'is overridden either by A or by another sentence', (5) turns out legitimate. For the sentence 'All emerubies are green' is overridden by the sentence 'All rubies are red'. (But 'All emerubies are gred' is not overridden by 'All rubies are red', since it does not even conflict with it.)

The basic problem with Goodman's solution is other. According to him, if two inductive inferences end with conclusions that are supported, not violated but conflicting, and the one conclusion contains only predicates with what is up to now the highest degree of entrenchment, while the other contains a predicate with small entrenchment, then the former inference will be rational, and the latter will not be. But why should this difference in entrenchment, a difference that is to do with what kind of inductive thoughts people thought in the past, have consequences for the rationality of the inferences? Why should history determine what inductions are rational and what are not? Perhaps history determines what inductions are considered rational; it doesn't seem, though, to determine what are rational. Goodman clearly admits (*FFF,* 4th edition, p. 98) that what inductions we performed determines what inductions are right.