3. Deductivism

3.1 The basic idea of deductivism

Deductivism is an attempt to develop a position that avoids the difficulties that beset inductivism. It is accepted that theoretical elements enter science at all stages and that inductive generalizations lack proper justification. The basic idea of deductivism is that theories are not built bottom-up from theory-free data, but that they are deductively tested against data. Inductivism and deductivism share the view of scientific explanation and prediction.

3.2 The demarcation criterion: falsifiability

In order to establish that deductive testing procedures are applicable, scientific hypotheses, theories, etc. must fulfil a specific condition. This condition demarcates scientific hypotheses from others, like metaphysical or pseudo-scientific ones. In the given context, to be a "scientific hypothesis" does not imply that the hypothesis has been accepted or confirmed by science; it only means that it can be admitted to scientific testing procedures.

Demarcation criterion: A hypothesis is scientific if and only if it is empirically falsifiable, i.e., that there are empirical circumstances imaginable such that the hypothesis is refuted. Thus, a scientific hypothesis is in principle empirically testable.

An example of a hypothesis that is not falsifiable is "The universe is governed by love and hate." Whatever happens empirically, it can be subsumed under this hypothesis. Thus, this hypothesis cannot be empirically refuted; and therefore, it is not a scientific hypothesis.

For inductivism, the process of producing a hypothesis is a rule-governed process. By contrast, for deductivism the production of hypotheses is not constrained as long as the resulting hypotheses are empirically falsifiable. Whether the hypotheses are (temporarily) accepted in science, however, will be determined by the testing procedures.

3.3 Deductive hypothesis testing

The main tool for the empirical test of scientific hypotheses is logical deduction. From a general hypothesis, specific sentences are deduced that can be compared with empirical data. Example: Ohm's Law: $R = U/I$. For a specific piece of matter, by simple mathematical manipulation, the following equation can be deduced: $U_1/I_1 = U_2/I_2$. This equation can be compared with the results of measurements. If the measurement differs significantly from the deduced values, the hypothesis failed the test and it is falsified; otherwise it survived the test. Hypotheses are kept in science as long as they have not been falsified.

Thus, the answer of deductivism to the fundamental questions of general philosophy of science (see sect. 1) is: Science is the continual invention of falsifiable hypotheses and their critical test. Science does not try to confirm hypotheses, but to disconfirm (or falsify) them. The spirit of science is thus fundamentally critical. Science tries to be as unbiased and undogmatic as possible by testing all proposals as severely as possible. This is well-expressed in the title of Karl Popper's 1963 book: *Conjectures and Refutations*.

3.4 A consequence of deductivism: fallibilism

In spite of all of the critical tests of a given hypothesis, it never becomes absolutely certain, even if it has passed all of the tests without being falsified. That a new test will be devised which falsifies the hypothesis is never excluded. As a consequence, scientific knowl-

edge never becomes infallible, i.e. absolutely certain. It is bound to be fallible. This insight rejects the predominant (Western) ideal of science from antiquity up until very recently, according to which scientific knowledge should be infallible. According to deductivism, scientific knowledge consists of hypotheses that are accepted until they are falsified. Therefore, science is an intrinsically dynamic enterprise as hypotheses have to be continually tested. To stop testing hypotheses is to stop doing science.

3.5 Historical remark

Deductivism was developed in the 20th century, mainly in the work of Karl Popper (1902-1994). Many scientists, including social scientists, adhere to this position. Deductivism is also called "falsificationism", "critical rationalism", and the "hypothetico-deductive account of science".

3.6 Problems of deductivism

1. Deductivism is attractive because it seems successfully to exploit the "asymmetry between verification and falsification of general hypotheses". The verification of a general empirical hypothesis, i.e. a definitive proof of its truth, is impossible because for general statements one would have to make infinitely many tests (the problem of induction, see section 2.1). The definitive falsification of a general empirical hypothesis, however, seems possible because a single fact that contradicts the hypothesis suffices. On closer inspection, however, the situation is more complicated. The falsification of a hypothesis by, say some measurement, assumes that the measurement is reproducible. But this assumption makes use of an inductive generalization, namely, that the same measurement performed tomorrow will yield the same result. Thus, a definitive falsification is also not possible.

2. The rule that science should never stop its attempts to critically test hypotheses leads to unintended and unpleasant results. Suppose you have a hypothesis that states a specific functional dependence of a variable b on a variable a: $b = f(a)$. The test of this hypothesis does not only include that b does indeed co-vary with the variable a in the way the function f states. It must also include the test of the assumption that b depends only on the variable a, and not on additional variables c, d, e, etc., too. However, the list of potentially influential variables is indefinite (it includes the haircut of the experimenter, the position of Venus, etc.). Thus, a systematic test of the potential dependence of b on c, d, e, etc. cannot be carried out; testing cannot even approximately be complete.

In more general terms, the problem consists in this. Any account of the development of science must contain the following three elements:

a principle for the generation of hypotheses;

a principle for the elimination of hypotheses;

a principle for the (perhaps only temporary) acceptance of hypotheses that allows for (temporarily) halting tests and accepting a hypothesis in order to be justified to apply it.

The fundamental problem of deductivism consists in its lack of a principle for the (perhaps only temporary) acceptance of hypotheses. Deductivism cannot stop testing hypotheses, thus never allowing the move forward to applications. The paradigm theory to be discussed next will provide an answer to this problem.

Bibliography

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