Reasoning within Scientific Theories: A Logic

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Russell, by the time he delivered the William James Lectures at Harvard (1940), had already overcome the textbook vision that a scientific theory is developed by a combination of some kind of induction, in order to establish its *basic propositions* (as he calls them, following a terminology he credits to Ayer) with strict logical deduction, in order to derive the consequences of the assumed knowledge. In the introduction of his book "An Inquiry into Meaning and Truth" [1], made up from these lectures, talking about the role of epistemology, he draws the following picture of the constitution of scientific theories: "Epistemology must arrange all our believes, both those of which we feel convinced, and those that seem to us only more or less probable, in a certain order, beginning with those that, on reflection, appear to us credible independently of any argument in their favour, and indicating the nature of the inferences (**mostly not strictly logical**) by which we pass from these to derivative believes". He insists on this remark about the nature of the inferences within scientific theories in a latter passage when talking about the role of logic in connection to epistemology: "Logically, we have to consider the inferential relation (**usually not that of strict deduction**) between basic propositions and those that we believe because of them." So, his more nuanced view about the matter is that these two phases of theory development are not so completely separated and that the logical machinery supporting them are not so dichotomous. There is some deduction in hypothesis formation, but also there is some induction in the inference inside the theory. This realization raises a question that is not treated in his book: if the derivative inference within a theory is not that of classical deductive logic, what is its logic after all?

This question was considered by philosophers of science such as Hempel [3, 4] and Toulmin [5], as part of the efforts of providing the formal basis for a logic of induction. Under the influence of Carnap [2], following the dominant trend among the logic positivists, their approach was based on probability, resulting in what they called *inductive-statistical explanations*. However, their attempts did not succeeded, being plagued by the problem of *explanatory ambiguity*, or, more directly to the point, of *inductive inconsistencies* [4].

So many years after this problem was almost completely disregarded in the philosophical literature, we think that we have now better chances of success by adopting a completely different approach, no longer based on probability, which is a quantitative notion, but on the notion of *plausibility*, a qualitative one. This latter concept seems to be more akin to symbolic treatment, although it still leads to the mentioned *explanatory ambiguity*, a feature not due to the formalism but to the problem itself. However, the authors realized that it not prevents a logical formalization, it just requires a suitable logic in order to confer a fair treatment for it. The authors claim that they present do so.

References

[1] Russell, Bertrand, *An Inquiry into Meaning and Truth*. Allen & Unwin, 1940 (republished by Pelican books, 1962 and in Penguin University Books, 1973).

[2] Carnap, Rudolf, *The Logical Foundations of Probability*. University of Chicago Press, 1950.

[3] Hempel, Carl G., *Inductive-Statistical Explanation*, in *Aspects of Scientific Explanations*. Free Press and Collier Macmillan, 1965.

[4] Hempel, Carl G., *Inductive Inconsistencies*. Synthese, 12, 1960.

[5] Toulmin, S., *The Uses of Argument*. Cambridge University Press, 1958.