Review

Reviewed Work(s): The Limits of Scientific Reasoning by David Faust

Review by: Andrew Lugg

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In his version of the theory, Sneed had made use of a pre-systematic and intuitive criterion for T-theoreticity. Gähde has shown how an inner-systematic, formal criterion for T-theoreticity can be introduced with complete precision. Gähde was also able to resolve another problem of the original theory. Sneed had assumed intuitively that one can examine isolated terms with respect to their T-theoreticity; it now appears that it is necessary in this regard to make the correct dichotomy of *all* terms (theoretical and non-theoretical) of a given theory (chapter 6). The holistic implications of the concept of T-theoreticity are discussed in chapter 7. The basic idea of this chapter was again provided by the astrophysicist Gähde. The fundamental thesis of 'holism' states that isolated scientific hypotheses cannot be proved independently. Inductivists and deductivists have objected to this thesis, usually formulated in the form of the Duhem-Quine thesis. Now Gähde has shown that if the issue is limited to the domain of knowledge mediated *by a given theory,* the holistic thesis is correct. Gähde proved his point by first developing a miniature theory (namely, the mathematical apparatus of classical particle mechanics, of which in the miniature theory only very few applications are allowed). The insights gained in this way are then formulated in general terms and proven. A theory that in one or more of its theorems is in conflict with reality can be revised in different ways; now it can be shown that there is definite order of precedence among these alternative efforts to revise the original theory and to bring it again into harmony with the 'facts' (pp. 155–226).

Chapter 8 explains that in most cases a strict reduction of one theory to another is impossible; in most cases one must limit oneself to an approximating embedding of the one theory into the other. In this chapter, basic ideas of the theoretical physicist Ludwig are taken as a point of departure (pp. 227–68).

The macro-logical perspective that one finds in chapter 8 is used also in chapters 9 and 10. The first of these deals with inter-theoretical relations between elements of theories; these relations are called "links." Chapter 10 is concerned with the incommensurability of scientific theories and compares this with the reducibility of the same theories from a structuralist point of view. The chapter (pp. 269–310) tries to refute an important objection against the structuralist approach formulated by D. Pearce. (See his 1982.)

The last chapters of the book are of a typical philosophical nature and deal respectively with the following themes: the implications of the structuralist approach to scientific theories for the debate between scientific realists and structuralists (pp. 311–22), a critical discussion of Kuhn's conception of the change of scientific paradigms (pp. 333–46), and particularly his claim that empirical sciences are not rational enterprises (pp. 347–59). The last chapter shows in what sense the ideas developed here can be meaningfully applied to nonphysical theories such as Jacobson's theory of literature, the theory of exchange economics, decision theory, Freud's theory of neurosis, and Marx's surplus value-theory (pp. 360–449). The book contains a virtually complete bibliography on the structuralist conception of scientific theories.

In my view this book is the most sophisticated, systematic presentation of the structuralist approach available to date. It is essential for those concerned with the structure of theories of mathematical physics. Yet the book will also be invaluable for all philosophers of science. *Joseph J. Kockelmans, Pennsylvania State University*

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DAVID FAUST. ***The Limits of Scientific Reasoning.*** Minneapolis: University of Minnesota Press (1984), xxvii + 198 pp. $25.00 cloth; $12.95 paper.

Human beings may very well be rational animals but they are also remarkably prone to errors of judgment. It is not so bad that some of us reason better than others or that we

all fall short once in a while. What is disturbing is that faulty judgment appears to be as natural as talking, and mismanagement of information to be the norm rather than the exception. Worse still, if David Faust is right, scientists are the same as nonscientists with regard to the quality of their judgments, and we should be equally wary of their conclusions. "For any judgment or cognitive limitation demonstrated to be common to an intelligent adult population," Faust conjectures, "parallel instances will be found with scientists across fields" (p. 84).

As psychologists have shown time and again, expertise is no guarantee of reliability and can even hinder more than it helps. Contrary to common belief, experts' predictions are frequently less accurate than predictions obtained using clerical procedures. For instance, pathologists' judgments concerning the life expectancy of patients are generally worse than projections based on actuarial formulae, and statistical predictions of success in graduate school are for the most part superior to less formal assessments. The sobering conclusion, which Faust embraces enthusiastically, is that "the performance of experts on the tasks for which they claim or are assumed to hold competence is frequently substandard and, at times, barely exceeds the level that would be expected by chance alone" (p. 56).

Faust rejects the tempting suggestion that judgment error is a result of emotional bias. We should, he argues, recognize that it has deeply rooted sources; it is not something that occurs because we are careless. In particular, Faust notes that recent psychological research has clearly established that human beings are invariably afflicted with "bad judgment habits" (for example, we tend to concentrate on positive results at the expense of negative ones) and "cognitive limitations" (for example, we are generally incapable of satisfactorily integrating information in all but the simplest of cases). This point is important for Faust since he wishes to maintain that scientists' judgments are biased by the same bad habits and limitations.

Surprisingly, Faust rests his case on the assumption that what goes for clinicians also goes for scientists. Apart from a few inconclusive "initial findings from studies of scientists" (pp. 89–90), Faust's evidence is entirely circumstantial. He does not attempt to demonstrate that scientists' judgments are in fact faulty but simply states that scientists are as likely to err as other experts, their research projects being more or less the same. What we are left with is the shaky argument that scientists must be unreliable given the many opportunities they have to favor positive results, to mismanage complicated information, etc. True, Faust devotes an appendix to sketching strategies for studying his conjecture, but this only serves to underline the weakness of the evidence that he actually provides.

More importantly, it is surely significant that scientific findings are (in contrast to clinical predictions) routinely submitted to rigorous review both by the scientists who propose them and by the scientific community as a whole. I would agree that it is not enough to assert that "the group overcomes the limitations of individual scientists" or that "the scientific method *ensures* protection from cognitive limitations;" it is indeed important that "the substantive issues raised by the judgment literature" also be directly confronted (p. xxv). But this hardly settles the matter. Even granting that scientists have bad reasoning habits and limited cognitive capacities, one might still insist that the scrutiny of the community goes a long way to securing the reliability of scientific conclusions and that the "scientific method" is a powerful constraint on how individual scientists proceed. The prevalence of human judgment error should be the starting point for a discussion of the limits of scientific reasoning, not its conclusion. *Andrew Lugg, University of Ottawa*

WILLIAM A. WALLACE. ***Galileo and His Sources: The Heritage of the Collegio Romano in Galileo's Science.*** Princeton: Princeton University Press (1984), xiv + 371 pp. $42.50.

The announced objective of this extremely scholarly volume is to provide the groundwork for further investigation into claims concerning the continuity between late medieval and scholastic science and the science of the seventeenth century (the Continuity Thesis), as well as Galileo's relationships with the Jesuits. It is clear that it certainly contributes to the latter. I will address the problems of making good on the former aim shortly.

The text is entirely devoted to determining the correct dates for two of Galileo's early