CHAPTER 5.4

DOES SCIENTIFIC DISCOVERY HAVE A LOGIC?†*  

It is unusual for an author, less than one-tenth of the way through his work, to disclaim the existence of the subject matter that the title of his treatise announces. Yet that is exactly what Karl Popper does in his classic, The Logic of Scientific Discovery, [4], announcing in no uncertain terms on p. 31 that scientific discovery has no logic. The disclaimer is so remarkable that it deserves to be quoted at length:

I said above that the work of the scientist consists in putting forward and testing theories.

The initial stage, the act of conceiving or inventing a theory, seems to me neither to call for logical analysis nor to be susceptible of it. The question how it happens that a new idea occurs to a man — whether it is a musical theme, a dramatic conflict, or a scientific theory — may be of great interest to empirical psychology; but it is irrelevant to the logical analysis of scientific knowledge. The latter is concerned not with questions of fact (Kant's quid facti?), but only with questions of justification or validity (Kant's quid juris?) ....

Accordingly, I shall distinguish sharply between the process of conceiving a new idea, and the methods and results of examining it logically. As to the task of the logic of knowledge — in contradistinction to the psychology of knowledge — I shall proceed on the assumption that it consists solely in investigating the methods employed in those systematic tests to which every new idea must be subjected if it is to be seriously entertained ....

.... my view of the matter, for what it is worth, is that there is no such thing as a logical method of having new ideas, or a logical reconstruction of this process. My view may be expressed by saying that every discovery contains 'an irrational element', or 'a creative intuition', in Bergson's sense. In a similar way, Einstein speaks of the 'search for those highly universal laws ... from which a picture of the world can be obtained by pure deduction. There is no logical path', he says, 'leading to these ... laws. They can only be reached by intuition, based upon something like an intellectual love ('Einfühlung') of the objects of experience'. ([4], pp. 31–32)

This mystical view towards discovery, while shared by most of the world, including most of its creative scientists and artists, has not gone without challenge. Peirce coined the term 'retroduction' as a label for the systematic processes leading to discovery; while Norwood Hanson, in his Patterns of Discovery, revived that term and gave us a careful account of the retroductive

†[Philosophy of Science 40, 471–480 (1973)].
path that led Kepler to the elliptical orbits of the planets. It is instructive to confront Popper's view, just quoted, with Hanson's:

H-D [hypothetico-deductive] accounts all agree that physical laws explain data, but they obscure the initial connexion between data and laws; indeed, they suggest that the fundamental inference is from higher-order hypotheses to observation statements. This may be a way of setting out one's reasons for accepting an hypothesis after it is got, or for making a prediction, but it is not a way of setting out reasons for proposing or for trying an hypothesis in the first place. Yet the initial suggestion of an hypothesis is very often a reasonable affair. It is not so often affected by intuition, insight, hunches, or other imponderables as biographers or scientists suggest. Disciples of the H-D account often dismiss the dawning of an hypothesis as being of psychological interest only, or else claim it to be the province solely of genius and not of logic. They are wrong. If establishing an hypothesis through its predictions has a logic, so has the conceiving of an hypothesis. ([2], p. 71)

Hanson made his case for retroduction by examining historical examples of scientific discovery. He did not propose an explicit formal theory of the retroduction process, nor did he draw any sharp line between psychology and logic. Indeed, his analysis places great emphasis upon perceptual processes, upon the discovery of pattern — a pun upon the title of his book that, I am sure, had occurred to him. For this reason, it is easy for persons of an H-D persuasion to judge Hanson's work superficially as a contribution only to psychology and not to the logic of science. In this, they are wrong also.

It is the aim of this paper to clarify the nature of retroduction, and to explain in what sense one can speak of a 'logic of discovery' or 'logic of retroduction.' Like Hanson, I shall proceed from examples of retuctive processes, but examples that are less impressive than his. Their modesty as instances of discovery will be compensated by their transparency in revealing underlying process. The argument of Popper and of the others who agree with his position is, after all, a general argument. If "There is no such thing as a logical method of having new ideas", then there is no such thing as a logical method of having small new ideas.¹

1. WHAT IS A LOGIC OF METHOD?

At the outset it is important to make clear what might be meant by the term 'logic' in this context. I suppose no one any longer imagines that there exists a process for deriving scientific laws deductively (much less, for validating them) either from particular facts or from any other kinds of prevalidated premises. Nor is that what Popper means by 'logical analysis' in the passage quoted at the beginning of this paper. The distinction Popper draws is