

## The Genesis of a Hypothesis: Did Hanson Win the Battle and Lost the War?

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**Abstract:** On April 8, 1967, Norwood Russell Hanson, Professor of Philosophy at Yale University, U.S.A., who was one of the greatest 20th century American Philosophers of Science, was flying his own plane to lecture at Cornell University, died in the crash near Cartland in New York State, when he was just 43 years old. Hanson, who was popularly known as “The Flying Professor”, critically evaluated the fundamental presuppositions of the British positivist tradition in philosophy of science and gave a new direction to the history and philosophy of science. N.R.Hanson, a student of Wittgenstein, was a pioneer in advancing the thesis that observation is theory laden. For him observation language and theory language are deeply interwoven. Hanson made serious efforts to formulate a logic explaining how scientific discoveries take place. The recognition of centrality of patternizing in scientific theorizing by NR Hanson will enable us to realize what mode of thinking we must inculcate in the minds of science students and also how to enable them to see the relation between science and other domains of human creative endeavor such as art,craft,dance, literature, etc. This article is an attempt to understand how Hanson addressed the question how are scientific ideas generated and the significance of his contributions to education.

**Key Words:** hypothesis, hypothetic-deductive logic, abduction, retroduction, inductive reasoning, patternizing.

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In his celebrated work *Patterns of Discovery* Hanson confronts Popper's Hypothetico-deductive account, according to which we start with a hypothesis in science and the way the hypothesis is arrived at is not a concern of methodology which ought to confine itself to the way in which theories are evaluated by testing their deductive consequences. Hanson says:

“There is something wrong with the H-D account ...If it were construed as an account of physical practice it would be misleading. Physicists do not start from hypothesis; they start from data (though not in the inductivist fashion). By the time a law has been fixed into a H-D system, really original physical thinking is over. The pedestrian process of deducing observation statements from hypothesis comes only after the physicist sees that the hypothesis will at least explain the initial data requiring explanation” (Hanson 1981:70-71)

In fact, according to Hanson, not only is the process of formation of hypothesis a rational process and therefore has a logic, but also in it resides the continuity of physical explanation from the past to the present day. Hanson discusses the case of Kepler and also takes the ideas of Peirce to defend his position in *Patterns of Discovery*, where he says,

“Kepler never modified a projected explanation capriciously; he always had a sound reason for every modification he made. When he did make an adjustment which exactly satisfied the observations, it stood upon a totally different logical footing from what it would if it had been struck out at random... and had been found to satisfy the observations. Kepler shows his keen logical sense in detailing the whole process by which he finally arrived at the true orbit. This is the greatest piece of retroductive reasoning ever performed” (Hanson 1981:85).

Therefore, according to Hanson, Kepler did engage in reasoning a fact which H-D account fails to recognize. But this reasoning is neither deductive nor inductive. It was what Aristotle considered reductive as different from inductive and deductive reasoning. Peirce calls the same type of reasoning as reproductive or abductive and says that, “Deduction proves that something must be; Induction shows that something actually is operative; Abduction merely suggests that something may be” (Hanson, 1981:86)

Hanson explains the nature of Retroductive reasoning by quoting the following words of Peirce, “although it is very little hampered by logical rules, nevertheless is logical inference, asserting its conclusion only problematically or conjecturally, it is true, but nevertheless having a perfectly definite logical form” (Hanson, 1981:86)

The general form of the retroductive inference, according to Hanson (Hanson 1981:86), is:

1. Some surprising phenomenon ‘P’ is observed.
2. ‘P’ would be explicable as a matter of course if ‘H’ were true.
3. Hence, there is reason to think that H is true.

In this scheme, the content of the hypothesis H is already contained in the premises. In other words, H cannot be retroductively inferenced until its content is present in the premise 2. Hence the retroductive inference differs from Inductivists' and H-D theorists' accounts of theory formation. Commenting on retroductive inference Peirce says,

*"Abduction...amounts...to observing a fact and then professing to say that...it was that gave rise to the fact..."* (Hanson 1981:89)

Hanson's discussion of Kepler's discovery reveals the limitations of inductivistic and hypothetico-deductivistic account. Hanson says that,

*"Perceiving the pattern in phenomena is central to their being 'explicable as a matter of course'... This is what philosophers and natural philosophers were groping for when they spoke of discerning the nature of phenomenon, its essence; this will always be the trigger of physical inquiry. The struggle for intelligibility (pattern, organization) in natural philosophy has never been portrayed in inductive or H-D accounts."* (Hanson 1981:87)

Hanson's theory of discovery has not been as fool-proof as it appears. Innumerable criticisms have been made and some, though not all, have been damaging. Hanson says, in criticizing H-D Model, that scientific thinking starts from data though he does not construe data in the inductivist sense. The very idea of data constituting the starting point speaks sufficiently of an inductivist hangover to get rid of which many philosophers replace data by problem. Hanson might say, since he speaks of 'surprising' data being the starting point, he did mean that it is the problem which is the starting point. But merely placing problem at the starting point is not sufficient to break with inductivism. In fact" *the standard presupposition concerning the nature of the scientific problems has completely precluded any account of problem-solving as a rational process"*. (Nickles 1980:35)

According to Nickles, problem in Hanson's scheme is generated by something 'surprising' with the result problem becomes a psychological phenomenon. This idea of a pure problem is as vulnerable as the idea of pure observation. Hence problems should be viewed as theory laden, in the sense that they are characterized by normativity, which means that the notion of constraints is central to them.

The non-normative construal of problem by Hanson is liable to take him towards a non-cognitive position on the issue of discovery very much similar to that of Positivists and Popper. But this criticism of Nickles is unfair since there is nothing in Hanson's scheme which conflicts with the acceptance of constraints as constitutive of the problem. In fact, Hanson himself recognizes some of the constraints as for example, that the very phenomenon that is sought to be explained should not figure in our explanation. However, Hanson's construal of the nature of scientific problems leaves much to be desired. Nickles' another criticism of Hanson is that

*"sometimes Hanson claimed to be providing a logical method for conceiving or generating new ideas, but the retroductive schema obviously fails to do that. The hypothesis H appears among the premises and not simply in the conclusion of the argument. Since it is not a logic of generation but takes H as given, Hanson's claim that retroductive inference differs from hypothetico-deductive inference is shaky."* (Nickles 1980:23)

This criticism is off the mark since Hanson purports through his abductive model to provide the way in which the plausibility of ideas is sought to be established. Hanson's schema brings to bear the centrality of the idea of pattern and the concept of pattern has no place either in the HD model or in the inductive model. Also, one must bear in mind that Hanson is more for giving a pattern than a logic. Not only does Hanson attempt to advance a theory of scientific reasoning in terms of a pattern (rather than a logic) but he also looks upon scientific theorizing as a patternizing activity.

Hanson takes Kepler to have based his inference on the fact that there is a central pattern discernible in Tycho's data. Though Hanson is perhaps wrong in his assumption that scientists make discoveries by seeing pattern in the data he is definitely right in pointing to the role of patternizing in theorizing (Lugg 1985:209). It may also be noted that Hanson seeks to in so far as he talks of *Patterns*, make room for plurality of scientific reasoning. The title of his important work where he attempts to give an elaborate theory of retroductive reasoning gives the impression that his construal of the philosophical account of discovery process was not only much weaker and broader than a logic of discovery but also, unlike the latter, a pluralistic one. But it must be admitted that in the elaboration of his view Hanson fails to be faithful to the spirit of the approach suggested and promised by the title of the work. Hanson construes his account in terms of a monolith and even seeks to establish it as a logic on par with, if not identical with, logic as traditionally construed. According to Hanson the retroductive form of an argument like any logical form of an argument

*"is static, time-independent, problem-neutral."* (Hanson 1963:26)

This is confirmed by his attempt to bring out a structural identity between retroductive reasoning and Hypothetico-deductive reasoning. Hanson's use of the idea of 'Gestalt Switch' is adduced as supporting the portrayal of discovery as something unanalyzable.

The above criticism does not hold since Hanson's use of Gestalt's metaphors are for establishing the theory ladenness of observation and not for bringing in the idea of imponderable in the context of theorizing. If the use of Gestalt metaphor brings in the idea of mysterious or non-rational than Wittgenstein's use of it in the context of "seeing" should also lead to non-rational conclusions- It is to be noted here that Hanson's use of Wittgenstein's metaphor is not for a dissimilar purpose. Yet another charge against Hanson is that Hanson underestimated the richness of the preliminary evaluation context and therefore permits inferences to wild theories as long as they explain the initial data. This criticism by fiat sets aside the highly problematic character of theory choice on methodological grounds so well pointed out by Paul Feyerabend.

As Feyerabend argues, any methodological criteria put forward in connection with the initial acceptance of theory can be questioned on both logical and historical grounds. We shall look at this point later in detail. However, this is not to deny that in science some theories are rejected at the initial stage itself in favor of some other theories but this will be for reasons which are too specific to the situation and do not follow from any logic of discovery or for reasons which are in accordance with certain value commitments entertained by the scientific community as a sociological entity.

*"However, it is true that Hanson is somewhat guilty of promising a logic of discovery, but delivering only a logic for selecting among Hypotheses whose initial invention be must relegate to psychology." (Leplin 1980:267)*

This is due to the absence of any notion of problem in Hanson's scheme of things or at least due to his inadequate construal of a scientific problem as has already been pointed out. In other words, Hanson fails to work out a rational account of generation though he works out, though not with complete success, a rational account of pursuit. In Laudan we find this failure portrayed as a virtue though this does not mean Hanson's and Laudan's views are one and the same. For, Hanson fails to recognize the very distinction between the sub-contexts of generation and pursuit which together constitute the context of discovery. Apart from relegating one aspect of the context of discovery to the realm of psychology, however unwittingly, Hanson's model suits only one of many types of scientific theorizing.

Robert Monk criticizes Hanson's model to be of very narrow and limited application. It confines itself to the domain of determination-problems. He says:

*"In their abstract discussions, Hanson and Peirce represent retroduction as inference from data to explanation, but their archetypal example, Kepler's work on Mars, has the overall form of a determination problem. Though Kepler required explanations of planetary motions, determining the characteristics of an orbit that would agree with observations is not itself a problem of explanation." (Monk 1980:342)*

The solution to the problem of explanation may presuppose solutions for those of determination. But this does not make the two identical, nor does it warrant subsumption of the former under the latter. This raises doubts about the applicability of Hanson's model to the fundamental and deep-structure problems, and theories (Hanson 1963). It seems Hanson's model holds more in cases where small-scale discoveries are involved (i.e., where conceptual innovations are not called for) and where all the relevant data is available. Cases which may prove amenable to such procedures involve pattern-recognition in sets of data. For example, Mendeleev's periodic table, Balmer's formula for Hydrogen spectra, and Kepler's laws. But cases like these are not the general ones nor are they the most important. This criticism is an important one in the sense that it again reflects how the failure to work out a broad notion of the nature and types of scientific problems will very much diminish the scope of the resulting philosophical account of discovery. It is this failure which makes the current focus on the nature of scientific problems a methodologically progressive step.

As pointed out earlier, the contextual duality between discovery and justification is very much central to Hanson's scheme. He puts forward retroductive reasoning on the logic of discovery and accepted Hypothetico-deductive model as constituting the logic of justification. That Hanson was not happy with such a duality and wished for a unitary picture of science is clear from his assertion that *"the logical structure of each procedure is the same as the other"* (Hanson 1963:25) with the only difference being one of direction such that the Hypothetico-deductive argument moves from hypothesis to data whereas a retroductive argument moves data to hypothesis.

But the above said structural identity thesis conflicts with Hanson's characterization of the evaluation of hypothesis as 'Pedestrian' (Hanson 1981:70-71). It also conflicts with his assertion that the process purported to be captured by Hypothetico-deductive model starts when real scientific thinking is over (Hanson 1981) This means not only that Hypothetico-deductive model has nothing to do with science but also that it is not even 'logic' since it is a formal picture of a pedestrian process. If the structural-identity thesis holds then retroductive reasoning must share its poverty and Hanson would definitely not like to maintain this. Therefore, the structural identity thesis has to be rejected. The only alternative of establishing the unitary picture of science is by rejecting the structural identity thesis and maintaining that there is only one logic for science and that such a logic is a logic of discovery (and that logic is retroductive) which means that only discovery as distinguished

from justification is a philosophical worthy object of study - a position which is directly in contradistinction with the Hypothetico-deductivism of Popper.

Apart from the questionable characterization of the context of justification as constituted by the moribund procedures, the extremity of the position conflicts with Hanson's propensity for 'middle of the channel' way of resolving philosophical disputes, a propensity which he considered a necessary ingredient of philosophical craftsmanship (Hanson 1972:1-2) Also, the one extreme position which altogether denies the philosophical relevance of justification in favour of an exclusive emphasis on discovery misses significant points about discovery that can shed light on the justification, just as the other extreme position which altogether denies the philosophical relevance of discovery in favour of an exclusive emphasis on justification misses very important points about justification that can shed light on discovery. However, given his inadequate attempts at a unitary picture of science, Hanson has to live with the contextual duality. By showing that discovery is rational process amenable to a philosophical account he has definitely won the battle. But being unable to transcend the contextual duality he has lost the war. According to Sami Paavola,

*“Hanson tried to analyze not only how "patterns" influence the way we see and interpret things, but also the manner in which these patterns are searched for (Hanson 1965, 47-65). Although there are no "pure" observations, and although background information and background theories always influence how things are seen, this does not mean that new theories cannot be searched for with theory-laden observations. Hanson's point was that although there is no mechanical way of making discoveries on the basis of observations (an old inductivist dream), observations and surprising phenomena operate as triggers or clues when explanations are searched for (and this suggests abductive methodology.”(2001)*

What is interesting to note is that Hanson has not extricated himself totally from the traditional biases in philosophy of science like discovery-justification dichotomy. The fact that the current work on discovery has taken a direction different from the one taken by Hanson shows that Hanson's contribution does not lie in giving an adequate theory of discovery. It lies in his success in showing how a serious study of discovery will enable us to go a long way in understanding the central features of the mode of thinking we consider scientific. Scientific frame of mind consists in a certain mode of thinking and type of response to certain problems. In order to develop these qualities and attitudes one has to imbibe and internalize the dynamics of the method of science. But the vital question is what is that pattern of thought, if at all it exists, that lies behind the discoveries of science? The answer to this question has something substantial to contribute to our knowledge of scientific method and therefore, to science training, science education and to the philosophy of science education.

Hanson shows how patternizing is central to scientific thinking. Scientific creativity and thinking is more than mere patternizing. But definitely it involves patternizing, may be of a type not understood by Hanson. The recognition of centrality of patternizing in scientific theorizing will enable us to realize what mode of thinking we must inculcate in the minds of science students and also how to enable them to see the relation between science and other domains of human creative endeavor such as art,craft,dance , literature ,etc.

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