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PSYCHOLOGY OR LOGIC OF ENQUIRY ?* A REVIEW ARTICLE**

The volume under review is a collection of essays based on a course of lectures on "Psychology and Logic of enquiry" — and some other essays — which Ernst Mach (1838-1916), the physicist and philosopher of science, gave in the winter of 1895-6 in Vienna, and which he published in 1905, bearing the title: *Erkenntnis und Irrtum. Skizzem zur Psychologie der Forschung.*[1] How is one to assess the philosophical value and relevance of a work such as this with as many as twenty-five essays on quite wide-ranging and also interrelated subjects in the field of history and methodology of science, epistemology and philosophy of mind ? The essays and concerned with a bewildering variety of topics: the nature of the physical and the mental, of philosophical and scientific thought, of knowledge and error, of thought experiments, hypotheses, problems, presuppositions of enquiry, psychology and natural development of geometry, the concept, sensation, intuition, phantasy, adaptation of thoughts to facts and to each other, reflex, instinct, will, ego, pathways of enquiry, deduction and induction psychologically viewed, number and measure, space and time, laws of nature, space and geometry, physiological and metrical space.

The treatment of each topic is, no doubt, excellent. Perhaps, one unique feature of this work, which makes it valuable for philosophers of science of all persuations, is this: That although Mach's treatment of a whole range of subjects is premised on assumptions committing him to a historical-genetic method of analysis, in many places he is seen engaging essentially in an enterprise of abstract, logical analysis.[2] It is true that at every step the author's historical-genetic method steps in to illustrate and substantiate in terms of the wealth of historical examples the problems that are raised and the principles that are laid down.

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* Review of Ernst Mach (1976) : *Knowledge and Error : Sketches on Psychology of Enquiry*, Vienna Circle Collection (Volume 3), D. Reidel Publishing Company. XXXVIII + 395 pp. Translated from German by T. J. McCormack and Paul Foulkes.

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But this is done in such a way as does not allow these problems and principles to be lost in the profusion of historical detail or impair their abstract, philosophical significance. This is true of each of the essays individually. Consider in this context how significant the following single remark is :

> " Problems arise when thought and fact, or thought and thought no longer agree."[3]

Indeed, the very problems raised in these essays are of such far-reaching philosophical significance as cannot be grasped by a mere historical-genetic approach to science, philosophy and knowledge. Thus there is more to this work by way of the wealth of philosophical problems raised and solutions suggested than one could expect from its explicit historical-genetic or psychologistic orientation. This is especially true of chapters VII VIII, X—XVII, XIX, XXII, XXIV, XXV.

In yet another aspect, however, there is much in these essays which anticipates some of the recent developments in the history and philosophy of science. I have in mind the historical approach of T. S. Kuhn (1962), Lakatos' methodology of scientific research programmes and Feyerabend's epistemological anarchism, each of which can be considered a variation on essentially a Machian theme.[4] Consider, e. g., the following statement of Mach :

> ".... the scientific procedure is not essentially different from ordinary puzzle-solving, except that in the latter case the field is usually wider and less well-known or previously explored, so that planned searching is more difficult".[5]

There is thus bound to be difference of opinion as to what the essays might be said to achieve both individually and collectively, especially when considered in relation to recent developments and controversies. But there are certain basic aspects to this work about whose philosophical value and relevance there cannot be two opinions. Among other things, what strikes one most is what it aims at : (a) removal of "an old and stale philosophy from science" (XXXII) ; and (b) a philosophical clarification of scientific methodology and of the ways in which knowledge advances (XXXIII). For a philosopher-historian of science, with expertize in physics, psychology, physiology and the history

of ideas, writing at the turn of the century there could have been no less an unconventional way than this to express the aim of an enterprise which Mach, together with P. Duhem, can be said to have initiated. In any case, this is how one might quite legitimately describe the aim of philosophy of science even today.

Moreover, in these essays, the author is seen grappling with essentially philosophical problems with the help of "data" and examples drawn from such disciplines as physics, geometry, physiology, psychology and anthropology each providing a sound and concrete basis for his penetrating analysis. The underlying assumption that philosophy of science — even if mistakenly preconceived by Mach as psychology or enquiry — must proceed in a manner which ensures a wide anchorage for it in the sciences themselves is what is in itself commendable.[6] Considering just these two aspects, one can speak of Mach's essays as initiating at the turn of the century a whole new enterprise which is now better known as the philosophy and methodology of science. This does not mean that their relevance is just historical. On the contrary, the essays provide a deeper understanding of some of the current controversies in the philosophy of science — controversies such as those arising out of Kuhn's (1962) and Feyerabend's (1978a, 1978b) and touching on the larger theme of logic versus psychology of discovery. Thus each of the essays deserves a careful attention if only as part of the philosophical background against which the present day psychologistic[7] currents of thought concerning science must be properly assessed before being subjected to deeper philosophical criticism.[8]

The aim of philosophy of science may accordingly given what Mach says, be conceived very generally as: (1) critical appraisal of philosophical/methodological assumptions that may be widely in vogue in different scientific communities; and (2) elucidation/formulation of better alternatives to these assumptions as far as possible.[9] But how is one to proceed and to achieve this aim ? Are there rules or procedures by which a philosopher of science, like the scientist, must abide if he is to enquire into the methodology of science ? The assumption that there must be some rules/constraints under which alone such an enquiry is possible seems quite inescapable, Kuhnian and Feyerabendian scepticism notwithstanding.[10] However, as to the exact nature of these const-

raints, one must attend to the widely differing conceptions of the enterprise of philosophy of science, the actual scene here being one of disagreement on the fundamentals themselves.

Among other things, it is largely the following assumptions which Mach makes and which shape his conception of the very enterprise he presently engages himself in : (1) That what science is concerned with are constancies in nature – "The mutual dependences of given elements, functional relations or equations between them";[11] (2) That " objects " of knowledge such as sensations, physical objects, systems of physical objects in space and time are combinations of elements;[12] the nature of elements themselves being, however, a subject of discovery;[13] (3) that animal and human behaviour fall on the same continuum with a " rigorously determined regular automatism "[14] as its basic feature; (4) that there is a fundamental kinship between commonsense thinking and that of science, the latter being continuous with the former; (5) that science aims at determining the facts in a conceptually economic way; (6) that questions in physics and hence in science in general must not be interpreted metaphysically; and (7) that the process by which new insights are gained usually designated as ' induction' is not a logical but a non–rational mental process.[15]

As regards the assumptions (5) and (6), Mach does not find himself alone, similar assumptions being discernible in P. Duhems *La Théorie physique son object et sa structure* (1906). However, one may readily agree with assumption (6) in so far as what it says or requires would be warranted under a sharp demarcation between science and metaphysics. In so far as the assumption (5) is in germ the instrumentalist view of scientific theories, it must be rejected if only as an obstacle in the way of a more reasonably defensible realistic view and of the growth of knowledge itself. The assumption (3) unfolds itself in chapter II which contains a brief discussion of what is traditionally known as the dualism of the mental and the physical, dismissing it as a legacy of the inconsistencies inherent in the attitude of the ' great doubter ' Descartes. What emerges in the process is a crude version of the better known ' identity theory ' (say in the sense of J. J. C. Smart and others).[16] Consider the conclusion that Mach arrives at :

> " Thus there is no isolated feeling, willing and thinking. Sensations, being both physical and mental, form the basis

> of all mental experience. Indeed sensations are always more or less active triggering of the most varied bodily reactions, directly in lower animals and indirectly via the cortex in higher ones. Mere introspection without constant regard to the body and so to the physical as a whole, of which the body is an inseparable part, cannot establish an adequate psychology." [17]

A stage-setting as anti-metaphysical as this, it might be argued, is necessary if an essentially Machian enterprise of philosophy of science is to proceed within a sound framework of assumptions whether epistemological, ontological or otherwise. But, for any discussion, in an epistemological setting, on the mental and the physical—or on *man versus animals* (conceived as automata)—such as this, it seems a serious shortcoming not to attend to deeper problems relating to man in his capacity as a *knowing subject*, despite brief critical comment on Descartes whom one might describe as the pioneer epistemologist who finds mind-body dualism quite inescapable as a broadly conceived methodological and ontological framework.[18] I think, any ontological framework, monistic or dualistic, must among other things be judged on the basis of its capacity to come to grips with the problem of *knowing subjects* as a separate, irreducible, ontological category, but short of a *specially created one*.[19]

Above all, it is the assummption (4), when taken together, with the assumption (7) above, which is crucial to Mach's conception of his present enterprise. His conception can be presented as follows : That in so far as philosophy of science is concerned with the very process of discovery or of gaining of new knowledge in science, it must be recognized as a first step towards any attempt to schematize this process that, howsoever inductive in character it may be, it is essentially a non-logical, non-rational process. Accordingly, any attempt to raise the problem of method in the context of discovery will be essentially suspect in so far as it would have to proceed from contrary assumptions. However, the only context in which one can raise and pursue the problem of method is one of validation or justification of hypotheses after these have been conceived and formulated. Consider how Mach looks at science :

> "The enquirer seeks for a clarifying thought, but at

> first knows neither it nor the way in which it can be securely found. However, when the goal or the way to it has become revealed, he is as surprised by his find as somebody who was lost in a forest and suddenly, stepping out of a thicket, gains a free prospect and sees everything lying clearly before him. Not until the principle is found can method intervene in an ordering and adjusting capacity."[20]

What can philosophy of science then enquire into, if not the nature of method in the sense of a *logic of discovery*, there being no such thing according to Mach as according to many others? I think, Mach's answer to this question is this : that what it must resort to is essentially *the historical and genetic method* of presenting physical theories — and scientific theories generally — a method on which he finds a fundamental agreement with P. Duhem.[21] The implications of this view are as far-reaching as can be seen not only in the works of the empiricist predecessors of Mach but in the present essays themselves. A fundamental affinity between Mach and contemporary philosophers of science such as T. S. Kuhn, I. Lakatos and Paul Feyerabend connot be missed, considering this particular aspect of Mach's approach. Indeed, their views can be seen essentially as veriations on the Machian theme expressed by Mach himself more sharply as follows :

> " Schematizing the cognitive stages may perhaps benefit further equiry when similar situations recur, but there can be no widely effective instructions for enquiry by formula."[22]

Expressing total scepticism concerning method as it does, its logical culmination is, I believe, epistemological anarchism.[23] But this is not the place to examine or to critisize epistemological anarchism.[24]

There is no doubt that in this work, as elsewhere, Mach thinks and writes in the tradition of Berkeley and David Hume, i.e., the tradition of phenomenalistic and psychological empiricism. Thus one is reminded of Hume when Mach writes :

> "It is thus a matter of natural development, that what the subject interacting with this environment has gradually formed in the way of instinctive expectations of constancies, he will in the end carry over into enquiry

> as a postulate, as a deliberately conscious methodological presupposition often tested by past success and promising more of it." [25]

What deserves a closer and critical scrutiny are the type of assumptions on which Mach's approach to methodology and epistemology is based. Some of these assumptions have already been considered above; others are discernible not only in the pronouncements Mach makes throughout these essays but in his explicitly psychologistic conception of the present enterprise: methodology and epistemology conceived as part and parcel of psychology — and perhaps also biology — of enquiry. This conception of his, as we have seen, is based, to a large extent, on his scepticism concerning method or the very logic of discovery; and it explains his selection of subjects/problems around which this work is essentially woven.

But can epistemology, particularly in the context of its concern with science or scientific knowledge, be conceived and pursued as biology and psychology of the evolution/development of human thoughts/belief systems, from commonsense to science, or of their adaptation to one another and to facts? The answer is in the negative since it can be argued that there is more to epistemology than what this reductionistic view implies or permits; unless of course one dogmatically sticks to a Human sceptical view of knowledge thereby landing oneself in an enterprise as reductionistic as epistemology conceived as psychology of enquiry.

Psychologism, and hence reductionism and scepticism, of this variety has no doubt surfaced again and again in epistemology, more particularly in the recent and current controversies in philosophy of seience.[26] In my view, most prominent among those who have contributed to its revival are T. S. Kuhn and W. V. O. Quine whose versions are traceable to Mach's and further down to David Hume's.

Is scepticism concerning method by itself sufficient to warrant psychologism in one's approach to science ? Does psychologism—especially in its contemporary forms—have deeper roots than those discernible in the essays under review ? Why does it raise its head again and again in the epistemological discussions on science? How are we to resolve

the controversy : psychology versus logic of enquiry? These and similar questions deserve a serious thought if one wants to learn anything (intended or unintended) from these essays, the wealth of examples from physics and the insightful analysis thereof which Mach offers not-withstanding. These essays themselves do not help us in arriving at an answer to these basic questions. In any case, I think it is a deeper, dogmatic commitment to the subjectivistic tradition—of Hume and others—in theory of knowledge and a corresponding scepticsm concerning an abstract, objectivistic approach to method and to scientific knowledge which gives rise to psychologism.

I would like to conclude with the following remarks : Even when reductively conceived as psychology of enquiry, rather than as logic of discovery, epistemology and methodology, are bound to suffer from inherent tensions between psychologistically neutral *abstract* methodological pronouncements and the characteristic *recurrent* features of a psychologistic-historical approach to methodological issues. This seems no less true of Ernst Mach's present work than those of other thinkers like Kuhn, Quine and Feyerabend. Thus, e.g., while science is seen by Mach essentially as continuous with common-sense thinking, he admits that "progress in scientific thought consists in constant correction of ordinary thought."[27] Now this is something with which we might readily agree, but concerning which we must ask : But what is the nature of this progress by a process of correction? Is it, in its turn, a logical or only a non-rational psychological process? Philosophers of science like Karl R. Popper, Mario Bunge, J. W. N. Watkins et al would answer : Yes, it is surely a logical process and one which is amenable to schematization—a view with which I agree. But is it open to Mach, and his followers, to do so? The answer is clearly in the negative.

The style in which Mach writes and thinks is not only refreshing and fascinating but intellectually stimulating. Like all works by great minds, this one will tempt the serious reader to come to it again and again if only to understand science such as physics more and more comprehensively.

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NOTES

1. It is indeed ironical that the German edition should have waited so long to become available to the English-speaking world otherwise so familiar with the work of Ernst Mach.
2. Consider, e. g., the degree of abstractness with which Mach (1976 : 185--202) brings home the valuable distinction between the synthetic and the analytic method of problem-solving in science.
3. *Ibid.*, p. 185.
4. Mach's influence on Feyerabend is discernible in latter's (1981) : *Problems of Empiricism* Cambridge University Press, p. 81.
5. E. Mach (1976 : 189)
6. This particular feature is greatly admired by Feyerabend (1981).
7. For a critical discussion of psychologism see G. L. Pandit (1971): "Two concepts of Psychologism", *Philosophical Studies* XXII, Nos. 5-6, pp. 86-88; and G. L. Pandit (1981) : "The Cartesian Questions of Methodology and Against Psychologism: A Rejoinder". *Indian Philosophical Quarterly* VIII, No. 2, pp. 299-303.
8. For such criticism see G. L. Pandit (1983) : *The Structure and Growth of Scientific Knowledge BSPS* 73, D. Reidel Publishing Company, pp. 126-38.
9. See G. L. Pandit (1983: 77).
10. See G. L. Pandit (1983 : 1-5).
11. E. Mach (1976 : 207).
12. Cf. P. K. Feyerabend (1981 : 80).
13. Cf. *ibid.*, p. 80.
14. E. Mach (1976 : 20)
15. Cf. *ibid.*, pp. 235-6.
16. Cf. *ibid.*, pp. 15-6.
17. *Ibid.*, pp. 17-8.
18. Cf. G. L. Pandit (1981 : 300-1)
19. See G. L. Pandit (1983 ; 19).
20. E. Mach. (1976 : 236).
21. Cf. *ibid.*, XXXV.
22. *Ibid.*, p. 223.
23. See P. K. Feyerabend (1978) : *Against Method* Virso edition; and his (1978b) : *Science in a Free Society* NLB.
24. For criticism see G. L. Pandit (1983).
25. E. Mach. (1976 : 207) see also pp. 207-8.
26. For a discussion see G. L. Pandit (1971, 1981, 1983).
27. E. Mach (1976 : 2).