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The philosophy of Ernst Mach: a study in the philosophy of development

THE PHILOSOPHY OF ERNST MACH.

A Study in the Philosophy of Development.

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References with Abbreviations.

Mach; Die Analyse der Empfindungen. 5. Auflage. Jena 1900. A.d.E.

Populaer-wissenschaftliche Vorlesungen. 3. Aufl. Leipzig 1903. P.V.

Die Mechanik in ihrer Entwicklung. 5. Aufl. Leipzig 1904. M.

Erkenntnis und Irrtum. Leipzig 1905. E.u.J.

Die Principien der Waermelehre. 2. Aufl. 1900 Leipzig. W'L.

Die Geschichte und die Wurzel des Satzes von der Erhaltung der Arbeit. Prag 1872. E.d.A.

FOREWORD.

The success attending Darwin's application of the concept of development assured the idea an ever-enlarging field of action. The various expressions of human life were progressively brought within its domain. The intellectual disciplines could not escape inclusion. Philosophical inquiry was definitely affected.

a). The category of change became supreme. The conviction was born that nowhere can we find content which we may characterize as absolute. Being is simply Becoming. Everything is in flow. We are in the midst of a great procession which never halts. The possibility of the stable and abiding is vacated. Relativism is the final word.

b). Everything is to be understood from a single point of view. The world- movement is one. A single law binds the most diverse manifestations and widely-sundered parts. Such unbroken unity demands unity of method. The word 'method' received undue emphasis. In many quarters a methodological obsession resulted. The instrumental was given the rank and value of the explanatory. The means employed to further scientific investigation were mistaken for fundamental principles.

c). And if demand for universal method were insistent, what would be more natural than the choice of a method already employed so successfully. The biological became preeminent. Self-preservation is the great impelling force to action and progress. Life must be interpreted in terms of instinct. Economy is vital

and evaluating.

All this has involved a deal of misunderstanding and bad logic. This has not always been apparent. The limitations of the premises and range of the implications have been obscurely understood. The fact outlines the discussion of the following pages. By way of a concrete inquiry we hope to make clear the logic of the situation and disclose the proper limits of certain concepts and points of view.

MACH'S PHILOSOPHY IN OUTLINE.

The interpretation of Mach's philosophy is made difficult by his aphoristic style, and by the fact that his opinions are scattered throughout his various scientific works. Hence it will be of advantage to preface our critical consideration by a sketch of his philosophy as a whole.

Mach characterizes his philosophical endeavors as "anti-metaphysical". All metaphysical speculation is worse than useless. The true goal is that of the discovery of a"world-concept which shall definitely set aside the riddle of the universe—a concept whose content is Pure Experience".(a) Mach's world throughout, is a world of elements. In reality there are no "things", as there is no "ego" standing over against them. Strictly taken and properly conceived, there is no subject and no object; there is no physical and no psychical. The entire inner and outer universe, reason, will and feeling included, is built up from a small number of "gleichwertige" elements, in more or less permanent union. Custom denominates these elements sensations,(b) but since this word carries with it certain prejudicial associations, the word "elements" is preferable. "Colors, tones, pressures, spaces, times, etc.",(c) are the final and fundamental. Everything else is merely "gedacht", nothing more than a symbolisation, the product of certain practical and economic interests—a purely subjective and relative affair—a something possessing mere physiological worth—a "Notbehelf

a. Avenarius: Der menschliche Weltbegriff. Leipzig, 1891.
b. All facts are "contents of consciousness".
c. P.V. 231.

zur vorlaufigen Orientierung", which, with the advance of scientific knowledge, or a change in scientific purpose, must be given up as inadequate.(a)

In this way we are to come to a proper understanding of the Ego. It is not the original and independent as we so often suppose, but rather something constituted. It represents simply a seizure of those elements which are most inextricably bound up with pain and pleasure. They are lifted up into an ideal unity most highly economical for thought. The large significance attaching to this unity, arises out of the fact that it stands in the service of the will, which is always extremely desirous of avoiding pain, and seeking pleasure. We have, thus, a limitation which sets itself up instinctively, and because of its abiding practical significance for both the individual and the species, continually confirms and strengthens itself. However, we must never lose sight of the fact, that, at best, it is relative, something permanent only in the sense of being "a group of elements more strongly coherent, and which more loosely connects itself with other groups of the same sort, namely, the ego of other men".(b) The elements alone are original. They constitute the ego. "To say that I experience, that is, have a sensation of green, is to say that the element green presents itself in a certain complex of other elements, namely, impressions, memories, etc..If I cease to perceive green, if I die, the elements no longer present themselves in their accustomed con-

a. A.D.E.10.

b. A.D.E. 22.

nections. To say that, is to say all.That which has ceased to exist is only an ideal 'denkoekonomische' unity, but no real unity".(a) It is, thus, absurd to define the ego in terms of the absolutely unchangeable, or in terms of real distinction from other egos. Such sharp limitations are false to fact, for the constitutional elements of every individual are in constant alteration. "No soul dwells in the human body, man is not the seat of perceptions, but rather, man is a complex of perceptions; for others as well as for himself, he consists of perceptions alone".(b) Continuity is, after all, the only considerable thing. But continuity, again, is only a means whereby content is assured to the ego. It is this content, and not the ego, which is the chief affair. If we should feel compelled to ask "who has this content, this connection of sensations, who is it that experiences,"we are asking a question of no intellectual significance. We are simply falling back into a "less mature and more limited point of view", which regards "every element, that is, every sensation, as an unanalyzed complex".And, if we assert that a psychical experience apart from a well-defined and abiding subject is unthinkable, and fancy that thus we prove the essential role of the unity of consciousness,we end in absurdity, for we could just as well say that a physical event is not thinkable,which does not take place in any physical environment. The fact is, that abstractions here made in the interests of practical necessity, are given the value of the real. The

a. A.D.E.19.

b. Ibid.

result is the creation of insoluble problems, and committal to preposterous assertions. The supposed necessity for emphasizing the unity of consciousness disappears, as soon as we perceive that the apparent opposition of the real and the experienced world, lies only in the method of consideration. A real cleavage does not exist, and so the life of consciousness, with its apparently peculiar content, is for the understanding, nothing more difficult than the manifold connections of the world. To consider the ego as only a practical unity formulated and retained in the interests of life, resolves our self-created problems, and gives research new freedom and power.(a)

This conception of the ego, it is interesting to note, does not preclude a certain kind of immortality. Though it is impossible to find anything constant and abiding, the content of the ego is not confined to the individual, and does not cease with death. The "elements" of consciousness of an individual, are bound closely together with those of other individuals. Thus, while everyone thinks that he knows only concerning himself, and while he regards himself as a separate and independent unity, contents of consciousness, more universally significant, break through the limitations erected, and though bound to the individual through whom they have developed, continue independent of him, in the form of a more universal, impersonal existence. "To contribute towards this is the greatest good fortune that can come to the artist, discoverer, social reformer, etc."(b)

a. A.D.E.21.

b. A.D.E. 20.

The ego itself is "unrettbar". This insight, with the fear which it frequently inspires, is the source of the most widely diverse religious and aesthetic perversities. To the simple truth, however, the eyes cannot be permanently closed. The ego, at best, is relative. Even in its highest moments, it, in some measure, fails to maintain itself. The belief in individual immortality will disappear with the coming of the true light, and a freer and fuller view of life will result. Here the ascetic ideal is revealed as untenable and false, and place is no longer found for much that has been detrimental to human advancement.(a) "So long as we strive to retain the conception of personal recollection after death, we are on the same level as the Eskimo, who cannot conceive of immortality where there is found no place for seals and walrus".(b)

As there are no psychical subjects, so there are no physical things. In content and manner of constitution "Ich" and "Koerper" are alike. Colors, tones, spaces, times, etc., conjoin in manifold ways, and come into relation with other elements such as feelings and wills. From the resulting complex, there comes forward the relatively more permanent and stable. This, impressing itself upon the memory, and finding expression in speech, is given a special name, is designated as body.

My table is now more brightly, now more dimly lighted. It can be made warmer or colder. It may possess an ink stain. A foot can break it. It can be repaired, polished, part for part

a. Cf. Fred. Harrison's exposition of the Positivist doctrine of Immortality in his book "The Philosophy of Common Sense".

b. A.D.E. 20. Footnote.

replaced. Yet, for me, it remains the table on which I daily write. My friend can put on another coat. His face can become earnest and bright. Form and complexion do not always remain the same. The sum of the permanent elements, however, remains so great, that the changing elements sink into insignificance. It is the same friend with whom I daily take my walk. My coat can possess a spot, a tear. The very expression shows that it depends on a sum of permanent elements, to which the new is united, that we are able to make any deduction concerning that which is wanting.(a) It is the extra weight of the permanent, as over against the changing, which appeals to the partly instinctive, partly arbitrary and conscious economy of representation, and of characterisation which expresses itself in customary thought and speech. The concept is formed, in the first instance, for the purpose of orientation. Then the will demands a more exact consideration of the changes which take place in these elements which are only relatively permanent. The will is thereby moved to action. There results a conception of the elements as qualities of the relatively permanent. And these elements have place in various and widely-diverse complexes. Thus, finally, that which is capable of being seen, heard, tasted, etc. separates itself from the bodies. That capable of being seen resolves itself into colors and forms. From the manifold of colors there comesforward again, with "elementary force", a narrower number of fundamental characteristics. In the end, the complexes fall

a. A.D.E. 2.

apart into elements impossible to analyze. In the course of this process, there is a strong tendency for the relatively permanent to become something in its own right. Because the elements can be removed one by one without the picture changing in essence, or ceasing to represent the totality, we fancy that all could be taken away and still something be left. Thus naturally, and in a manner difficult to avoid, there arises the philosophical conception, impressive at first, but later recognized as nothing less than atrocious, of a thing in itself.(a) And the supposed philosophical problem of the one and the manifold, arises through overlooking the fact that compact synthesis and careful analysis, are operations which cannot be carried on satisfactorily at one and the same time, though both are temporarily justifiable and of exceeding practical value.

Body is one and unchanging so long as we need not pay attention to individual characteristics or elements. For instance, the earth and a billiard ball are alike spheres, so long as we ignore all variation of the spherical form, and do not give that close attention which critical analysis demands. But where detailed and concrete characteristics assume significance, both bodies become more than simple spheres..(b)

Now, it is the privilege of man to change his point of view at will. He may consider body en masse, or give attention to the most trivial details. He may regard the object under consideration as something stationary, or his investigations may

a. A.D.E. 4.

b. A.D.E. 5.

demand that he accentuate its changeability. The task of adjustment is often difficult. Frequently even the trained thinker succumbs, losing himself in meaningless abstractions. He conceives, for instance, of a core of being, a permanent and fundamental something, which appears as the supporter of the transient qualities attached to it. Custom tends to confirm the conception, even after knowledge has dissipated its reality. In addition, the large development of mechanical physics, which ascribes to the spatial and temporal a higher reality than to the corresponding sensations of tones, colors, etc., gives impulse to the tendency to hypostasize abstractions. "The physiology of the senses makes it clear, however, that spaces and times can be called sensations just as well as colors and tones".(a)

Thus, the bodies do not beget sensations. Rather, complexes of elements image forth bodies. Bodies appear to the physicist as the permanent and real, and the sensations as transient and passing appearance, because he loses sight of the fact that bodies are merely intellectual symbols. The fundamental, under necessity, of course, of being submitted to further physiological examination, is the element—the sensation. And here, as in the case of the ego, a recognition of this truth will eliminate from the realm of physics many a supposedly insoluble problem.

The elements are "gleichwertig"—identical. Whether we designate one complex of elements psychical and another physical,

a. A.D.E. 6.

depends on the point of view. We may express the facts, schematically, as follows: The complexes which we ordinarily designate as bodies we may symbolise by the letters A B C....., the complex which constitutes the human body by the letters K L M...., and the psychical elements, such as ideas, memory pictures, etc., by the letters a b c....Which elements we shall consider as uniting to constitute the empirical ego, depends on certain definite circumstances, as, for example the intellectual purpose uppermost at the time. All may be conceived as non-psychical, as 'Aussenwelt', or that which stands outside our physical being may be so regarded. "Just as soon as we come to recognise that the supposed unities,'Ego' and 'Body', are only aids to preliminary orientation, and for particular ends, will....the opposition between Ego and the World, Appearance and Thing, disappear, and the sole remaining concern will be the connection of the elements a b c.... A B C....K L M..., for which this opposition was only an expression more or less correct and complete. This connection is nothing more than the union of those elements with other similar elements—space and time".(a) 'Ego' and 'Thing' are nothing more than intellectual symbols for a complex of sensations of relative stability, and the entire world is only a great complex of such elements in connection with others in more or less unstable, loose, and changing form. "All elements A B C....K L M... only form a 'zusammenhangende Masse' which, caught up in every element, falls entirely into

a. A D E. 10-11. Vide also the following: "Consciousness is no especial(psychical) quality or class of qualities which may be discriminated from the physical qualities". (E.u.J.41.)

movement".[a] "So gibt es also in der Wirklichkeit nur gleichartige und gleichwertige Elemente. Jedes Objekt ist zugleich physisch und psychisch".

Mach's 'Weltbild', as characterised above, gives a certain uniqueness to his Theory of Knowledge. A measure of, at least, seeming originality and independence belongs to the conception of Subject and Object as merely 'praktisch-biologische' formulations. To know, becomes a maximum and minimum 'Aufgabe'. The principle of Economy, recognised as a biological necessity, is everywhere the determining and directive force. Knowing may be termed, in the light of the doctrine of elements, an experiencing of elements in themselves. The immediate impression is the formation of a new complex of elements. Such, too, are memory-pictures, and 'Gedanken-Experiemente'. "The stone let loose from the hand falls, not only in reality, but also in Gedanken, to the earth; the iron moves toward the magnet in the 'Vorstellung' and also warms itself in 'Phantasie' at the fire".[b]

It is by means of such a Monism that Mach seeks to bridge the chasm between Being and Thought. The passage from the most sensuous representation offered by vulgar thought, to the most abstract scientific thinking, is direct and continuous. The difference between 'Vorstellen' and 'Denken' is one of degree alone. To represent, signifies to know. The laws of association govern all experiences. The problem of all thinking, scientific and

a. A.D.E. 13.

b. P.V. 249.

otherwise, is the ideal completion of a fact from a given part, so far as the completion is determined by the case observed. "The power which impels to the completion of the half-observed facts in thought, is association. This power is greatly strengthened through repetition. It thus appears to us as a strange force independent of our will and individual facts, a force which puts both thoughts and facts into motion, and holds both in harmony".(a)

Thus, knowledge consists in the 'completion' of a fact through an earlier representation, on the ground of the process of association. And, in the higher sphere of the true and the false, all is truth and all is error, as one wills. In the world of elements no real distinction is here possible. The most that can be done is to observe the elements in the various stages of their coming together, and to discover the laws whereby they are formed into a complex. The psychological question, is the only rational question.

Mach's philosophy is dominated by the spirit of the natural scientist. His primary interest is Method. This does not mean that he styles himself philosopher in the analysis of the methods of the special sciences, but rather that his philosophical ideal is, throughout, the scientific thought of a uniform and universal method. This thought constitutes Mach's philosophical program. In his own words, his sole desire is "to win a

a. W'L. 383.

standpoint in physics, which it will not be necessary to abandon when one passes over into the terrotory of one of the other sciences." Thus, Mach's Monism is Methodological. Everything else stands in the service of this conception. An all-embracing method moulds our ideas of things at large. How then, we ask, does Mach regard science? Whence does science come? What is its function? Its task?

It is reasonable to assume that science originated in "the instinctive gathering of experiential facts".(a) Man first made experiments, heedlessly and instinctively, in his struggles to satisfy his wants, and just as thoughtlessly and unconsciously applied them. The development of science was made possible by the rise of special classes and professions, which made the satisfaction of definite social wants their lifelong vocation. The necessity of imparting experience and knowledge, first occasioned distinct reflection. From then on, the real nature, task and problem of science, together with the method of all scientific procedure, became more and more apparent.

All natural science has for its goal the adaptation of thoughts to facts. The scientific ideal is the copying of facts in ideas. Thus science only pursues consciously and of set purpose that which takes place in daily life, unnoticed and instinctively. Facts never appear as altogether foreign. Scientific knowledge progressively eliminates the new, strange and perplexing. The development which takes place here, "is only a special

a. M. Introduction.

case of a universal biological process...The origin of theories and hypotheses is not the outcome of an artificial scientific method, but reaches back into the very childhood of science where it already appears quite unconscious of its own existence".(a) Thought and science, like everything else, are the well-determined result of conjoining elements. "The investigator, with his entire thinking, is only a piece of nature like every other piece. All elements are equivalent".(b)

When we come upon a fact which stands in strong opposition to our accustomed way of thinking, and are unable to make an immediate adjustment to the element which requires a new differentiation, a problem arises. But the new fact works as a charm which attracts attention to itself. Then arises intentional thought adaptation, that is, research; for the removal of the opposition which has arisen—the new adaptation of thought needed—is conditioned on practical reasons or intellectual dissatisfaction, which alone can beget the will required for the task.

The goal of science, then, may be said to be "a picture of the world, which, in the largest possible degree, shall be complete, connected, uniform, resting, and capable of no significant disturbance because of new entrances".(c) What, then, we ask, is Mach's conception of the method to be employed? The function of science, we are told, is the replacement, or saving, of experiences by the reproduction and anticipation of facts in thoughts: "With the least possible labor, in the shortest

a. W'L. 386 and 388.

b. A.D.E. 253.

c. W'L. 366.

possible time, even with the fewest possible thoughts, to acquire as much as possible of eternal and absolute truth".(a) "Science is a maximum and minimum task".(b) The basis of science is the economy of thought. The fundamental principle of thought activity is the principle of economy. In the acquisition of knowledge it is our aim to spare ourselves all the trouble and labor possible. We are to press forward to a "comprehensive, compact, consistent, and facile conception of facts",(c) by the shortest road possible for us to take. "Economy of communication and apprehension is of the very essence of science. Herein, too, we have an unerring guide to the historical origin of science".(d) The entire development of the various sciences has been under the guidance of this principle. "Within the short space of human life, and with man's limited powers of memory, any stock of knowledge worthy of the name is unattainable except by the greatest mental economy. Science may be regarded as a minimal problem, consisting of the completest possible presentment of facts, with the least possible expenditure of thought".(e)

It is to the economy of thought that we are to look, for the meaning and value of scientific hypotheses and speculations. While the task of natural science is one of description, there comes a time when the formal is essential to the performance of this function. Thus, the developed statements of natural science are simplifications as well as descriptions. In order that facts may be reached and mentally pictured with the least

a. P.V. 16.
b. Ibid. Remark.
c. Mech. 5. Eng. Tr. J. J. McCormack, Open Court Pub. Co. 1893.
d. Mech. Introd.
e. Mech. Eng. Tr. 490.

amount of effort, tabulations and symbols are necessary. The laws of nature are nothing more than such tabulated descriptions. "In nature there is no law of refraction, only different cases of refraction. The law of refraction is a concise, compendious rule devised by us for the mental reconstruction of a fact, and only for its reconstruction in part, that is on its geometrical side".(a) Theories are only connections in which we place, in an orderly manner, such tabulations. "The atomic theory plays a part in physics similar to that of certain auxiliary concepts in mathematics; it is a mathematical model for facilitating the mental reproduction of facts".(b) The justification and value of all intellectual formulations lie in their power to familiarize facts. When they cease to perform this function, or to perform it with increasing difficulty, they must be discarded for more adequate and efficient formulations. It is a mistake, however, to imagine that our formulations ever tell us more than the knowledge of our primitive experiences, if rightly observed, would already say.

The idea of Causality, together with the problems of which it has been the source and center, is resolved, like its fellows, in the melting-pot of our economic needs. Since explanation is not within the range of science, causal connection, even should it exist, would not enable us to look into the reason for any particular concatenation. But scientific investigation shows that there is no such thing as causal connection. It was a con-

a. Mech. Eng. Tr. 486.

b. Ibid. 492.

ception forced upon men in the early stages of scientific development. It arose out of the need of supporting weaker thoughts by stronger. It had its place, no doubt, but to-day is only a hindrance, fromwhich natural science has made itself, for the most part, free. The real goal of scientific endeavor is the exhibition of functional connections. These do not posit one fact as the cause of another, but permit only the calculation of one fact from another. This is a relation convertible throughout. To quote Mach's own words: "The idea of cause and effect originally sprang from an endeavor to reproduce facts in thought. At first the connection of A and B, of C and D, of E and F, and so on, is regarded as familiar. But after a greater range of experience is acquired, and a connection between M and N is observed, it often turns out that we recognise M as made up of A, C, E, and N of B, D, and F, the connection of which was before a familiar fact, and accordingly possesses with us a higher authority....The new experience is illuminated by the mass of the old experience. As a fact, then, there does exist in the mind an 'idea' under which fresh experiences are subsumed, but that 'idea itself has been developed from experience. The notion of the necessity of the causal connection, is probably created by our voluntary movements in the world, and by the changes which these indirectly produce. Much of the authority of the ideas of cause and effect, is due to the fact that they are developed instinctively and involuntarily, and that they are distinctly sens-

ible of having contributed nothing to their own formation... Cause and effect are things of thought, having an economical office".(a)

As with the concept of cause, so with the concept of substance. Anyone who follows purely practical purposes receives essential support from the thought of the ego. The conception, in this respect, has a certain permanent value. If we lose sight of its true purpose and nature, however, it becomes the source of difficulties and contradictions which can be removed only when we regard all as elements of the world. The philosophical hope of explaining the world of experience out of concepts of substance, by means of causal connections between things, is a chimera. The problem resolves itself with the recognition that there is no need of any such explanation, as there are no terms whereby to explain. The supposed terms are not realities, but developments in the interests of life and its activities. There attaches to them a certain subjective necessity, and a certain practical value, but no objective existence. "The principle of continuity, the use of which everywhere pervades modern inquiry, simply prescribes a mode of conception which conduces, in the highest degree, to the economy of thought".(b)

Science itself cannot escape resolution. It is merely instrumental to the mastery of facts. The concept of development rules here as elsewhere. The entire content of science is economic. The business of all its formulations is to put us into

a. Mech. 484-5.

b. Mech. 490.

efficient working relationship with our environment. To understand this purpose, is to understand all that is to be known concerning its existence. The highest terms employed have only transient value. The final goal is always biological. All mediate goals must be regarded as unnecessary detours. The preservation of life is ultimate. "What man has beyond the animal, cultivated man beyond the uncultivated, is only the length of the detour to the same goal, the ability to discover it as a detour, and to annihilate it".(a) Thus, "every scientific interest we may characterise as an ultimate biological interest moving toward its goal at the pace of the particular detour concerned".(b)

The hunger for knowledge is recognised as normal. It must be regarded as contributing, at least mediately, to the preservation of life. A something "independently developed", it makes itself felt psychically as pain, if it cannot set itself to work. The investigator is a man within whom the desire for knowledge storms as one of nature's own elementary forces. Thus, he naturally "strains after its removal", and "seeks a resolving thought as the technologist seeks a resolving construction".(c) Every disturbance of intellectual equilibrium is an impulsion upward to restoration in a higher synthesis, so that life moves forward continuously, out of its ruins to a new fruitage.

It is true that we meet in Mach's exposition of science and scientific method, traces of a point of view which lifts the entire discussion to a higher level, and rescues the endeavors of

a. E.u.J. 58.
b. E.u.J. 443.
c. W'L. 452.

of the investigator from the merely relative and temporal. Though an examination of these belongs more properly to the critical part of our theme, we may anticipate far enough to make mention of the following words as characteristic of the larger and freer point of view. "Scientific thinking frequently distinguishes itself from vulgar thinking in a very significant manner. The latter, at least in its beginnings, serves practical purposes, in the first place the satisfaction of bodily needs. The more vigorous form of scientific thinking creates for itself its own goal, endeavors to satisfy itself, and remove every intellectual unrest. In the service of practical purposes it has grown to be its own lord".(a) Again we read: "There arises the problem of discerning, in the large manifold, those elements present which are constant and abiding".(b)

Mach evidently feels keenly enough that science is not to be grasped by way of its origin, but by way of the goal which it freely sets itself, and in the light of the problems which it feels itself called upon to solve. In short, side by side with Mach's 'pragmatic' and 'relative' conception of science there lies another which recognises the autonomy of reason. And this second conception carries implications which bring Mach's philosophy into wide-spread conflict with itself, and which it will be a part of our critical task to examine.

The philosophy, which we have here described, has been

a. E.u.J. 2.

b. Mech. Introd.

officially catalogued as Sensualistic Monism. As a matter of fact we are offered, so far as the results are concerned, nothing distinctly new, in spite of the so-called 'original' combination of elements which those results present. We have a way of thinking which places Mach in the direct succession of Hume, Condillac, Comte, and all those of the Positivistic school. And Phenomenalism, with its Relativistic and Solipsistic implications, is a type of philosophy with which we are quite familiar. In the following pages, recognising that some things must be left unsaid, it will not be our primary purpose to inquire formally into the accuracy or finality of such a point of view. It sometimes happens that a way of thinking is its own best critic. Logical inconsistency very often springs, not so much from the inability to think straight, as from the presence of a native dialectic which forces the point of view beyond itself; not so much from an incapacity to use facts rightly, as from the insistency of facts which, ignored, demand a hearing in spite of the theory concerned. Then, too, a philosophy may create problems which prove more troublesome than those which it professes to solve. Frequently, too, principles, regarded as superfluous and false, are unconsciously employed as a basis for argument; or a problem, the true nature of which remains unrealised, assumes control. Thus in the following pages we shall come to see that Mach's conceptions transcend themselves, and come into conflict with themselves everywhere, and

that, throughout, he is dominated by an historic treatment of the problem of knowledge which he persistently ignores and endeavors, if not to eliminate, at least to minimise. It will become progressively apparent that we are discussing a philosophy which, while possessing a relative truth, has continued to thrive, in these latter times, only because of the fact that it has not come to the knowledge that it is dead; a philosophy, too, which lays a foundation for itself by means of those very principles which it treats as irrelevant and antiquated. In the present instance particular point is given to our inquiry because of the fact that Mach, almost alone of modern scientists, conceives his positivistic results to be necessitated by the developments of exact research. The march of natural science, according to him, has long been in the direction of Positivism, and it is only the 'Ruckstaendigkeit' of the philosophers which has prevented them from acknowledging this. This leads us to lay special emphasis on Mach's conception of science and his 'economic' treatment of thought, and on the fact that there does not lie a direct and unbroken way, logically speaking, between such conception and treatment and the 'necessitated' philosophic results; that, just as these results depend for their establishment on the surreptitious introduction of that which they hold in contempt, so, here, there is an ignoring of patent facts, a superficial and inaccurate treatment of a fundamental problem, and a development in thought which ends in universal self-inconsistency.

MACH'S ELEMENTENLEHRE.

Complete philosophic endeavor has a two-fold function. On the one hand, it is given the task of arrestment; it is called upon to lay hold on those errors and artificialities which have crept in upon right thinking, or from which thinking in general has never been delivered. It is an intellectual health-officer whose duty it is to take into custody intellectual vagrants, to expose them in their true character, to so pillory them before the public gaze that it will be impossible for them t again to deceive and destroy. Such a task is extremely important, and by no means easy. And wherever thinking performs this function, however inadequate or inaccurate may be its positive endeavors, it does real service, and possesses real value. Critical analysis must always bear this in mind in order to be sympathetic and just. Mach's 'Elementenlehre' must be considered in the light of the criticism offered, of the habit of thought found in vogue.

"I have endeavored", he tells us, "to remove an old and stale philosophy from physical science".(a) This "old and stale philosophy" is one quite familiar. It had dominated philosophy up to the time of Kant, and, in his critical work, is not altogether exorcised. Since Kant's time it has reappeared in a variety of forms and connections. In the present instance we find mechanical science in bondage to it, and under its control becoming decidedly irrational. Mental fictions are mistaken for actual existences; barren abstractions made

a. E.u.J. Vorwort.

the exact transcript of concrete reality; quantitative formulations given all the value of explanatory principles. The means employed to facilitate scientific inquiry became an end; the ideal, which gave inspiring power to investigation, replaced the living fact found by way of continued and careful analysis. So runs the story of the naturalistic obsession with all its attendant woes. No one has better portrayed its true character than Ward, in his book 'Naturalism and Agnosticism'. We read there of "a science which, at the outset, is simply formal and quantitative", seemingly, in the end, yielding "the ideal of concrete physical existence, what Kant might have called the Omnitudo Realitatis of the physical world, and this becomes, for those to whom the physical world is primary and fundamental, the supreme and only Omnitudo Realitatis that science can ever know".(a) But, in its advance, this science overreached itself. Its true character became increasingly apparent, its objects were seen more and more plainly as mere fictions of the understanding instead of conceivably presentable facts, and its descriptive analogies as merely the inevitable outcome of an endeavor to summarise phenomena in terms of motion. Finally, the seemingly advancing tide of matter began to weigh "like a nightmare on the best minds" of the time, and he who could reveal the true logic of the situation, was in the way of performing a true service to his fellow thinkers. This, Mach, in some measure, did, and this negative service we cannot afford to lose sight of. It was no small matter to re-

a. Naturalism etc. vol.1. p.143.

veal a good part of mechanics as merely a device for calculation, as nothing more than a means for dealing with facts, as purely relative and methodical procedure.

-2-

We consider the 'Elementenlehre' first as Phenomenalism. Knowledge contains no metaphysical implication. The Absolute is meaningless and non-existent. Appearance is the only true reality. The subject itself is no final unifying principle, but merely a modification of phenomenal being, of practical necessity for our daily commerce with the so-called objective order. The 'elements' are transcendent, in that they have independent objective existence, but, in so far as they are capable of being known in their full reality, they must become the content of an empirical personal consciousness. They are immanent, in that they must belong to an ego in order to be known; transcendent, however, in that they exist without being linked to any such ego complex. In the final analysis, the opposition between transcendent and immanent reality, disappears.

Is this doctrine as free from all metaphysical content as it claims, and seems to be, or will a closer scrutiny reveal presuppositions which carry it beyond itself? This is the present question. Our interest in the matter is somewhat sharpened by the fact that, historically, Phenomenalism has found it impossible to remain true to its own assertions. Inevitably its exponents have sunk back into the metaphysical stage of thinking. Hume

cries, concerning all conceptual thinking "Into the fire with it", and, then, only by a trick of language, hides his metaphysical presuppositions from himself. He lays special weight on the point that the metaphysical cannot be substantiated either by experience or by logical thought, that it rests upon and is derived from a fictitious substitution of impressions derived from reflection for those of sensation, and yet transcends his point of view with the very assertion itself. He looks without and within, and finds nothing anywhere but activities and qualities of a purely phenomenal order, but the following quotation shows how impossible it is for him to remain on this level. "For my part", he says, "when I enter most intimately into what I call myself, I always stumble on some particular perception or other, of heat or cold, light or shade, love or hatred, pain or pleasure. I never catch myself, at any time, without a perception, and never can observe anything but the perception... If anyone, upon serious and unprejudiced reflection, thinks he has a different idea of himself, I must confess I can no longer reason with him. All I can allow him is that he may be in the right as well as I, and that we are essentially different in this particular. He may, perhaps, perceive something simple and continued which he calls himself, though I am certain there is no such principle in me".(a) We have simply to substitute for the personal pronouns in the above quotation the vanishing impressions for which he is so desirous of standing sponsor, and we see at once how the very

a. Treatise on Human Nature, Part IV., Sect. VI.

assertion itself depends on a transcendence of the position here taken. If the vanishing impressions are all, there remains neither a knower, nor anything known.

Comte does not fare any better than Hume. His 'general facts', by an unavoidable dialectic, pass over into a conceptual existence. His limitation of knowledge to physical phenomena and their laws, becomes decidedly metaphysical before the 'describing' process is completed. "When positivism says more than that the phenomena called mental are so and so related to the phenomena called material—when it says (as it does with Comte) that the former can be referred to or resolved into the latter, so as to be really material phenomena,—it supposes to be true what it professes to deny—viz., the reality of causes and substances; it supposes that matter is not an aggregate of phenomena, but a substance or cause, or both".(a) Worse than this, Comte falls all the way back into the depths of theological 'fictions' and 'superstitions' in his worship of the Grand Etre which, in the final analysis, becomes a mere abstract ideal.

The materialistic positivism of Comte is forced, by its nature, to abdicate in favor of the idealistic positivism of Mill. All our knowledge confines itself to mental phenomena. The whole universe is merely a series of states of consciousness. The implication is Scepticism. Mill tries to save the situation by his doctrine of a "permanent possibility of sensations". As to whether this saves the situation is not our present concern.

a. Flint: Anti-Theistic Theories; Blackwood and Sons, 1894. p.184.

The thing to be noted,is that such a 'possibility' is not a phenomenon, for if we know only what is phenomenal,we cannot know what is distinct from and explanatory of the phenomenal.

Spencer, like Mill, falls into the very way of thinking from which he desires to deliver humanity. The worship of an Unknowable which is the "necessary implicate of all consciousness", and the doctrine of a "superpersonal" reality with a decided content, have very little in common with either Agnosticism or Positivism. Finally, Fred. Harrison spends much labor to prove that the metaphysical is not native to the mind of man, is in fact, merely an excrescence of philosophy, and, in the end, makes his 'human synthesis' an impossibility unless referred to a somewhat which transcends the merely relative and individual. Does Mach fare any better, or are we face to face with a system of thought which, if set forth in speech, hopelessly contradicts itself in the interests of metaphysical inquiry?

Mach characterizes his elements as "letzte Realitaeten". He says: "We must not desire to explain the sensation. It is something so simple and fundamental that to carry it back to anything simpler is, at least for the present, an impossibility."(a) The sensations are the original facts of the psychical life,as they are of the world at large. What does this doctrine of last elements involve? A number of questions arisesso soon as we attempt to give some account of their nature. We find it increasingly difficult to avoid metaphysical implications. How,

a. E.u.J. 41.

for example, do we come to know anything about final, simple sensations? None of them remains for a single moment constant. Is the actual sensation, then, composed of elements which are beyond observation, whose existence and presence are asserted simply because scientific analysis so requires? But, if so, can the elements be distinguished in principle from the concepts to which physical analysis has led? Or are these elementary sensations possessed of self-activity, and in process of change? Then our problem is merely postponed, for we are led to ask, What is the significance of change, if the idea does not carry with it the corresponding idea of a something which remains equal with itself, and, uniting with other constants, simply forms a new grouping? Thus, we are involved in the paradox that either the elements are simple and incapable of being observed, or they are in a state of change and so cannot any longer be simple. The nature of the difficulty points to its own solution. If, in reality, the sensations as 'last elements' of the psychical life, are to have any real value, they must be defined in the same way as the 'last things' of the physicist. namely, as something absolutely simple and incapable of representation in intuition. In other words, the 'last elements' are products of abstraction and nothing more. He who considers them as real subscribes to a metaphysics, and gives to a conception, adapted to a certain narrowly defined purpose, the value of a principle fundamental to all investigation.

Mach, at a late period in his thinking, seems to have become aware of the abstract nature of these fixed elements .He says: "The analysis in the division which I am pleased to characterise as 'Elements', is scarcely thinkable from the naive point of view of primitive man.... In its entirety it is the product of scientific experiences and reflections...But one thing is to be noticed. While no difficulty is involved in building up every physical event out of sensations, thus out of psychical elements, there is no possibility of learning how, out of the elements employed in present day physics, that is out of masses and motions, any kind of psychical occurrence can be exhibited".(a)

Another remark which Mach makes , expresses a recognition of the real nature of his 'elementary sensations'. He says: "We can say, with perfect truth, that the simple sensations are abstractions, but need not necessarily assert that there lies at their root no actual occurrence".(b) These words are significant,for their consistent application would necessitate a thorough revision of Mach's main points of view.

Thus, Mach's doctrine, on its positive side, does not turn out very happily for himself. He is keenly conscious of the inadequacies of the physical metaphysics; the conception of qualities inhering in a something impossible of apprehension is ranked as 'Fetichism; the 'Thing' is made symbolic; yet Mach does not escape t he same way of thinking,for his 'qualitative elements', as we have found, are nothing more than abstractions. In this

a. E.u.J. 131.

b. Ibid.

respect, Mach follows the course of all phenomenalistic doctrine. "Phenomenalism and the extreme of individual idealism are forever, professedly, fighting shy of abstractions. They exhibit an anxiety, usually earnest but often excessive, to get at the concrete facts and to tell a plain, unvarnished tale about them. Hence the customary amount of polemic in the treatises on mental life produced by them, and which is directed against hypostasising the results of the thinking faculty. But what, taken at its literal worth, is this conclusion which they themselves support? It is an hypostasis of the abstract and purely imaginary statical condition of a being, which is made to take the place of the living and acting reality".(a) Nor is this lapse a mere chance or temporary result. It results from the blind, if not wilful, ignoring of facts which must, in the end, be admitted. Phenomenalism, in its emphasis on facts, overreaches itself, for the moment in which it takes account of all the facts, it meets an objection fatal to its own existence. Even illusory ways of thinking are, as facts, quite undeniable. And phenomenalism is asked to explain how, on its principles, their existence is possible. Granting only elements and their laws, no unity is a possibility, and Phenomenalism itself, acknowledging the logic of the situation, must cease to be. Do we not here stumble upon the problem to which all phenomenalistic thinking must succumb, namely, the problem of the One and the Many, or, in other words, the problem of Identity and Change? It was the felt

a. Ladd, Philosophy of Knowledge; p.118-9.

need of finding unity, and at the same time providing for change, which led Mach into ultimate hypostasizations. Elements and relations are distinct. They cannot be resolved into one another. Yet to have meaning they must belong together. Now, to be consistent, Phenomenalism must deny Identity, for is not Identity a real union of the diverse? But how is it possible to deny Identity when Change must be recognised as an undeniable fact, for does not Change itself disappear if there is not a something which, while changing, remains equal with itself? This survival and necessity of identical elements in the midst of change, forces metaphysical consideration, and introduces us, inevitably, to certain metaphysical reals. If we do not care to face the implication, and fall back on laws which alone persist and which appear in successions of fleeting elements, we fare no better, for we must still answer the question as to what are these laws. Are they permanent, real essences? If so, we have made no advance. Are they hypothetical, that is, in themselves merely possibilities, actual only when found in real presentations? But, as possibilities, they are beyond presentation and are nothing at all. In the end, "we can say of them only that we do not know what they are; and all that we can be certain of is this, that they are not what we know, namely, given phenomena!" The words of Bradley do not go far wide the mark. He says: "The view transcends itself, of necessity, and it does so ignorantly and blindly. A little criticism has driven it back

and has left it with a universe, which must either be distinctions within one presentation, or else mere nonsense. And then these distinctions are quite indefensible. If we admit them, we have to deal with the metaphysical problem of the One and the Many; and we cannot admit them, because clearly they are not given and presented, but at least more or less made. And what it must come to is this, that Phenomenalism ends in this dilemma. It must either keep to the moment's presentation and must leave there the presented entirely as it is given, and if so, then surely there could be no more science; or it must become transcendent and launch out into a sea of more preposterous inconsistencies than are perhaps found in any other attempt at metaphysics. As a working point of view, directed and confined to the ascertainment of some special branch of truth, Phenomenalism is, of course, useful and quite necessary. And the metaphysician who attacks it when following its own business, is apt to fare badly. But when Phenomenalism loses its head and, becoming blatant, steps forward as a theory of first principles, then it is really not respectable. The best that can be said of its presentations, is that they are ridiculous".(a)

If Phenomenalism, as an affair of thought, is logically impossible, as an affair of life it is unendurable. "Was it by chance that Comte, in the end, set himself to work with heart and soul to create new ideals? Was it by chance that both Mill and Spencer, at the end of their laborious days, felt painfully

a. Appearance and Reality; Sonnenschein, 1906. pp. 126-7.

the limitations of the solution which they offered—that thus all the leaders of Positivism were impelled by their own natures to transcend their own point of view"? (a) The answer is to be found in the demands made by life and life's activities and aspirations, and not in the training or temperament of the particular individual. The question here is supremely one of arousing and coordinating all our powers. Thus it becomes impossible to renounce ultimate goals. A doctrine which emphasises our inability to pierce beyond the surface of things, and heaps scorn upon all endeavor which has for its aim contact with the Absolute and Eternal, is bound to produce such an unutterable emptiness that no normal nature can finally acquiesce. Within certain limits, man may treat nature as something external, but he cannot permanently maintain such an attitude towards his fellow men and himself. He finds "eternal values" supremely necessary. Morality must be more than convention, and truth more than a passing advantage. To this Mach himself bears witness. In various statements he finds place for an ultimate goal and an abiding content. Speaking of the many attempts to solve certain problems in geometry, he says: "It is an elevating example that these men give us, when, for centuries, driven forward solely by the desire to know—to arrive at scientific explanation—they seek for the intellectual source of a proposition, concerning whose accuracy neither the theorist nor the 'Praktiker' has up to the present time earnestly doubted. With expectation

a. Eucken; The Life of the Spirit: Putnam, N.Y. 1909. p.324.

we follow the persevering manifestations of the ethical power of the desire for knowledge and, with rejoicing, observe how the investigator, by way of many mistakes and false conclusions, gradually"[a] approaches true and abiding results. This recognition of an activity driven forward simply and solely by the desire to discover truth is at farthest remove from the conception of "self-preservation" as ultimate, and gives the word 'true' a content far richer than that supplied by a point of view which makes it merely relative to prevailing circumstances.

-3-

We have found Mach's conception of the 'essence' of knowledge decidedly unsatisfactory. The very nature of the problem forces it out beyond itself and offers us a point of departure for the critical consideration of all phenomenalistic thinking. It may not, however, be superfluous to inquire further into the various elements which lead up to this final result. From the new angle of vision, we will discover the same transcendence and the same pointing forward to a solution which, at once, satisfies the native dialectic, and better accords with all the facts.

Phenomenalism may take the form of Idealism or Realism. With Mach the doctrine has been termed a "subjektloser Objektivismus". The 'elements' which make up the entire world are all objectified. Everything is placed on the outside. The subject, in any real sense, disappears—is ruled out. The reason for this

a. E.u.J. 396.

externalising is not far to seek. Mach recognises the near solipsistic consequences of his doctrine, and wishes, if possible, to save himself from such results. He falls back on the one alternative possible. It is evident that the tendency is decidedly materialistic, but with that we are not here concerned. We wish, rather, to consider the fact that knowledge is brought to full fruition independent of any coordinati ng and unifying principle. Is this possible? Or has Mach overlocked an indispensable fact, a fact whose insistency annihilates any conception which refuses to find a place for it among the items fundamental to its existence? Is there such a thing as knowledge from the realistic point of view? Are things given, or are they made? Is the subject a phase—a point of view— or is it a conditioning cause?

We first call attention to Mach's conception of the nature of thought, and the manner in which he fails to recognise what seems to be a fact of the most outstanding character. Mach fails to determine correctly the relation of thought to experience. Things are not given to us. We do not stand over against the outer world as mere passivities. Things are not brought into us. A critical examination of what we know leads us, inevitably, to this result. In the simplest and most elementary experiences thought manifests itself as an activity of a very definite and distinctive character. The sense fact, in every case is transcended. The impressions are worked over and given a content and meaning which was, in no way, original to them. A trans-

forming power is at work, which leaves our sensations other than if found them. Our ideas cannot be exhausted in the 'given'. They possess a significance and legality all their own. They supply content to, and complete experience, and do not merely copy off the same. They denote, in every case, a surplusage—a something over and beyond. They are intelligibles, and are so constituted by the peculiar activity of the understanding. Anyone can verify the truth of this if he will turn to his own experiences in a critical and intelligent spirit.

A few examples may serve to make this clearer, and exhibit the inescapable nature of the distinction between what is in sense, and what is in thought. Nothing is more common in scientific inquiry than to reconstruct a source which has been lost, or to supply fundamental characteristics with all the certainty of first-hand facts. The actual facts are transcended in all scientific inquiry. They are not merely read off. The mind itself supplies completing content. For example, we bring the ebb and flow of the tide into union with the action of the moon on the earth; we are led to regard the sun as a sort of fiery vapor; on the strength of reports, we trace a picture of times long vanished, or speak of constancy of energy in a closed system; and, in all these cases, we perfect our facts far more than we copy them; we enrich them far more than we describe them; in a word, we broaden experience by means of the ideas which we bring to bear upon it. And what of the necessary work of criticism? We

do not accept appearance as final. Rather, we compare what we term the apparent with the real, that is, the measured and the objectified. We progressively eliminate the false, and with greater certitude confirm the seemingly true.. In a word, we continually deduce new results and laws, and in every way proceed as if it were our prerogative to exercise a lordship over experience, rather than our fate to wait upon the behests of experience, and copy off, with slavish imitation, the various dicta which it deigns to have us know.

And our ideas have independent legality. In no way do they find their norm in the facts which they are to represent. We place our concepts and judgments in certain determined relations, according to certain logical principles, and in our work of research and discovery we exhibit and develop an ever increasing measure of spontaneity. The value of an experiment lies largely in the fact that it is preceded by intellectual preparation, and conducted under the control of mind. We are well aware that reflection and calculation frequently lead to new ways in knowledge. And how are we to account for the particular connections into which facts are formed? Do the various combinations come from the facts themselves, or are they something furnished by the mind? And does not a large measure of the meaning of an event, or the significance of a fact, lie in the combination of the elements concerned? Moreover, in the very fact that we actually master and sup plement the 'given', complete our conscious

life systematically and with planned intention, in a word, create knowledge on our own account, lies a great measure of the charm which attaches itself to intellectual endeavor.

All this is a part and requisite of the most common item of knowledge. With the most minor experience, it is the same as with the mightiest intellectual effort. Every act of observation, if it is to have meaning, entails intellectual activity. Here, for example, is a picture. I get pleasure and satisfaction from it. That is because it has meaning for me. But whence that meaning? What is the source of the content presented? Is it something merely given? We must answer in the negative. The facts demand it. True, the lines and colors are present to the eye. But they do not give the picture meaning. The meaning is not brought to me. It is contributed. It comes from myself. "What the eye gives is one thing, what we see or perceive is quite another". What is true of the picture, is also true of the printed page. All that is really given are certain marks and colors. That which gives content and value to the book, is the contribution of mind. The meaning implies a self-activity, a spontaneous forth-putting.

All this is overlooked by Mach in his doctrine of the 'given'. He fails to see that completion of facts by understanding cannot be avoided. He overlooks the mental activity whereby our sense data assume rational forms. The laws of association are conceived as sufficient for everything that knowledge contains. But the associational movement can give us only certain mechanical

groupings and reproductions which, at best, fall far short of the demands made by knowledge. It is a matter of ordinary observation that things may chance together, and still remain void of rational connection. There lacks that element of necessity which enters into all knowledge and makes it knowledge. This is especially true of the repetition of experience. The elements involved possess an order and fixity which the associational movement is entirely unable to produce. The facts remain to the end mere psychological occurrences—individual and without logical significance. Objectivity, which is the mark of all true knowledge, is wanting. All this, we repeat, Mach overlooks. He fancies that there is nothing to be done but to group the impressions offered, to arrange the facts brought to the mind. He solves the problem of knowledge by completely ignoring the elements fundamental to it. The data which he offers are "in strictness, particular, unqualified impressions; that is, they are impressions of nobody by nothing. And if the strictness is relaxed enough to allow the passive subject, then we have only particular impressions in the consciousness of a particular individual; and these admit of being variously associated. But the real problem still remains, namely, how out of these data to generate the subjective form of knowledge and its objective validity".(a) When we see the problem in this form, we realise at once the inadequacy of the data offered by the associational order. For how are we to get the universal form from the accidentals peculiar to the individual?

a. Bowne; Theory of Thought and Knowledge: pp.16-17.

How is that, which is my own product and possession, to assume meaning and value for everybody? Till this question is answered the problem of knowledge remains untouched. The solipsistic implications are not overcome. Nothing is reported and nothing done, for there is no knowledge where the objective reference, as embodied in the judgment, is absent.

This ignoring of the active moment in thought, is given extra point in the naive trust which Mach places in the certainty of sensations. These are just as they are. We have them or we do not have them, and, if we have them, we have them in determined and indisputable form. I see white, and no one can dispute it away from me. The certainty of its presence is absolute. In comparison with such sensations, the significance of the intelligibles which I employ, for example, the atoms of oxygen or the waves of ether, is secondary. They are not beyond dispute, and the value attaching to them is indirect.

Now the sole significance of this certainty of sensations consists simply in the having of them. In no way can I pass beyond them, and preserve them in their original purity and perfection. To describe them, even to declare myself to have them, involves a reference which destroys them, for the word or act of thought may be shown to be unfair to the facts concerned.

And, if we choose to regard the reference itself solely as a 'given' or a possessed, we destroy its logical character, and nothing remains but the fact without proof or criticism. Thus,

we perceive to what certainty is reduced. That alone is certain which involves no intellectual operation, no matter how much every such operation seems to establish or make possible a proper appreciation. We must be satisfied with experiencing states, events, bare facts. We are confined strictly to the present moment. Certitude is not the result of conflict and struggle. Strife and opposition are impossible. But this means that everything which gives certainty reality, is precluded. We possess a name without a content. Our assurance admits of no application and no contrast, for comparison presupposes judgment, and this, in turn, passing, as it does, beyond the sensation as such, transcends and destroys the doctrine promulgated. And here the true nature of sensations comes into view. They are, in and of themselves, nothing absolute and final; nor are they delusions of the senses. They are, rather, something to be further treated and ordered, something capable of development, but also something in need of criticism and correction.

The above conception leaves us where we began. With it we cannot get beyond the individual. The problem of universal validity remains unsolved. Scientific knowledge is impossible. Moreover, the conception brings us face to face with a fact which we thought to ignore, but which has been insistently pressing for recognition. Modern psychology reveals sensations as products of a scientific analysis. Thus, in our examination of the given in consciousness, we nowhere discover elements. Simple colors,

tones, etc. never come to view. We find these only by way of a process of separation and comparison. The really given, that is, the directly given, are not sensations or complexes of sensations, but rather ideas in determined order of coexistence and succession, in manifold and intricate combinations. In a word, investigation brings to light a something already more or less developed. The question then arises as to how we shall separate that which originates in matter from that added by the individual on the ground of his own peculiar development. Again, does the originally given—that which our investigation reveals—belong to the matters of fact with which the final word is supposed to rest? Whatever position we may take, we must regard thought as active and fundamental. The content of consciousness is not immediate in character. There is revealed a set of relations, varied in form and order. These demand logical proof, and presuppose a self-activity which makes sensations secondary and derived.

Thought, then, is not the passive affair which Mach has chosen to assume. It is an activity which does not require proof as a provisional hypothesis, but which rather demands recognition as a fundamental fact. With this in mind, we may look more narrowly at Mach's reduction of the subject to one of the world's elements. Are the conditions of knowledge to be found in the objective order, or is this order insufficient for the task im-

posed in every act of knowing?

The question is almost answered before we begin. So soon as we recognise the true nature of knowledge and the character of the judgment as embodying and expressing our apprehension of truth, we perceive the inadequacy of the claim here entered. To define knowledge in terms of a passive consciousness and an associational movement, is to overlook that which is evident in every item of knowledge, namely, its objective character. Knowledge is evaluation. In every judgment we pass beyond the mere, bare factual. And every true judgment is a unity. Our question, then, becomes one of considering what is requisite to such a unity. It is clear that simple states of consciousness will not suffice. These states must be transcended and held together in one act of thought. We need not merely states of consciousness, but also consciousness of states. What is to satisfy this need? Mere association is not sufficient, for association itself depends on something which transcends it, and for which it is something. Looking squarely at facts, and recalling what we have learned regarding the true nature of thought, we recognise that there must lie behind the judgment, as bearer of knowledge, a self as its supreme condition—a subject permanent and equal with itself in all its changing states. If Mach choose to pay out scorn to the demand for such a self, it is because he fails to understand what such a self means, to discriminate between it and the hypostasizations of mechanical science. Remaining, as

he does, on the sense plane, he is unable to acknowledge as real anything which cannot be presented to intuition. Logical necessity counts for nothing. But can the self be so treated? Is it not another outstanding fact which the open eye cannot avoid? When we see clearly we find it to be one of the surest items of experience. It is beyond question, and, instead of being a conception deserving the contempt of 'scientific' thinking, it is the postulate of all science and claims scientific recognition. "Whenever the intellect is steadied and focussed for exact statement, it affirms with the utmost certainty, that all we see finds its support and reality in an existence within it, or beyond it, which is self-centered and abiding".(a) "I am not thought, I am not action, I am not feeling: I am something 'that thinks and acts and feels'. The self, or I, is permanent, and has the same relation to all the succeeding thoughts, acts, and feelings which I call mine".(b) This is a fact revealed in thought itself.

If we approach the problem from the standpoint of Descartes, we may say that we can doubt everything but this, for to doubt here is to annihilate the possibility of doubt itself. It is the subject which doubts, and it is conscious of the fact. The subject, therefore, is the logical presupposition of the matter of doubt. And it is the presupposition of every expression and formulation of knowledge. The actual act of knowing, if examined without bias or distortion, will inevitably conduct us to a subject other than, and distinct from, the object as such. It is

a. Bowne; Philosophy of Herbert Spencer: p.33.
b. Quoted from Thos. Reid in "Theory of Thought and Knowledge" (Bowne), p.27.

the subject which forms the starting point and unifying center of all knowledge. Kant has shown us this, if not without certain shortcomings, yet so as to force upon us the truth and necessity of the conception. He asserts that an "I think" must be able to accompany all my representations if I am to become conscious of them as my representations. The judgment "I think" is the vehicle of all concepts. He says further: "We can, however, use as the foundation of such a science(transcendental psychology)nothing but the single, and in itself perfectly empty, representation of the I, of which we cannot even say that it is a concept, but merely a consciousness that accompanies all concepts. By this I, or he, or it(the thing) which thinks, nothing is represented beyond a transcendental subject of thoughts = x, which is known only through the thoughts that are its predicates, and of which, apart from them, we can never have the slightest concept, so that we are really turning round it in a perpetual circle, having already to use its representation, before we can form any judgment about it. And this inconvenience is really inevitable, because consciousness in itself is not so much a representation, distinguishing a particular object, but really a form of representation in general, in so far as it is to be called knowledge, of which alone I can say that I think something by it".(a)

This is the logical presupposition which language so efficiently hides, and which is frequently lost sight of in the

a. Kant; Critique of Pure Reason(Max Mueller's Translation, Second Edition;1905.):p.282.

psychological act of knowing. Quite naturally it cannot be grasped as an individual subject. It appears rather as an over-individual—a universal consciousness—a final point of reference to which, logically, the constitution of the world may be conducted. It is, according to Kant, no reality but rather an abstraction, a product won from ideal acts of knowing. Its significance is solely epistemological, but for the purpose which it serves it is absolutely indispensable.

The significance and function of the subject in respect to the problem of knowledge may be clearly seen if we compare the epistemological 'subject' with other and lower conceptions. We may entertain a conception of the subject which makes it include the mind and body of man. Over against this there stands the object as that which exists in space beyond the human body. Again, we may conceive of the subject so as to leave the physical being of man in the world of objects. Finally, even the psychical facts may pass into the objective, and leave behind only the epistemological subject as the last concept of the subject, and this represents that which, from no point of view, can become object. It is the presupposition of all knowledge, and, in the very nature of the case, cannot itself become the object of knowledge.

For the first two conceptions of the subject Mach is able to find a place, but refuses to recognise the third. He persists in ignoring the over-individual, and tries to account for know-

edge without taking into account that without which all knowledge becomes impossible.

It is from the subject that knowledge begins. This does not mean that the subject creates knowledge, nor that reality can be reduced to the level of our individual desires or points of view. We must not lose sight of the fact that knowledge always implies transcendence of the individual. This is the meaning of knowledge, and it is for this very reason that the mere psychological 'ego' proves inadequate. Of itself it can provide no true judgment. On the ground of it alone, no abiding distinctions are possible between the true and false. That which we grasp as reality is constituted. It is the judgment which first brings this to expression, and here truth and error first emerge. Objective reality, the material for all science, is not something on its own account. From beginning to end it is deeply penetrated by the activity of a knower. Intuition and thought everywhere interpenetrate. Careful analysis is always necessary for the separation of form and content. In experience, neither one is wanting. And so our world does not stand before our gaze ready and finished. It is rather a task, and that task is one of penetrating the given material with a universal content, so that the 'individual to me' has the value of a 'common to all'. The world is 'Ichhaft'. In that fact lies the possibility of coming to a knowledge of it. Objective validity is assured only through subjectivity. The things out of which our reality is constituted

are not things in themselves, but structures which owe their form to the intellectual activity of man , and as such they are not the arbitrary products of individual association, but a union of ideas valid for all, and which all, who desire the truth, must recognise. The supreme condition of all knowledge, and a fact of the most patent character, is a subject, one and abiding, which, in certain determined forms of thought, evaluates and formulates the 'given'.

-4-

It is our purpose in what follows to show briefly how the facts above mentioned force Mach's Sensualism beyond itself, and insert into his philosophy elements which vacate his entire position.

It is significant that Mach recognises understanding as vital to the constitution of our "Weltbild". While he retains understanding as one of the senses, he makes the concession of ascribing to it a certain uniqueness among its fellows. He says: "We possess a sense which..... is richer than any other. This is our understanding. It holds high rank among the senses. It alone is able to establish a durable and satisfying 'Weltanschauung'. From the time of Galileo on, the mechanical 'Weltanschauung' has been a power for knowledge. But now it must give way to a freer manner of looking at things".(a) It is in a remark appended to this statement that there appears a word which lifts

a. P.V. 115.

the understanding out of the category in which Mach has placed it. "This (the freer way of looking at things) will, of itself, result in the expression of the dependence of the natural phenomena upon each other in terms of mere numerical relations, rather than in terms of space and time".

Now, we bear in mind that Mach's conception calls for a monism which eliminates all qualitative differences. His elements are 'gleichwertig' Everything is equivalent to everything else. If this doctrine is to remain self-consistent, numbers must take their place among the various sensations representing the real elements of the copy which we make of the world. But can numbers be so reduced? Are they not, rather, conceptual formations of the understanding? Is not the presupposition of all number the consideration of a content as constant? And does the sensation know anything of such constancy? "For the question is not how the numerical activity begins, or whether it always begins, or whether it often has only a crude and obscure development. These are psychological questions which concern only the temporal order of development; they do not touch the logical question as to what is involved in the numerical activity, whenever and however it may begin".(a) This numerical activity, as implying unity and the power of supplying unity, cannot belong to the sensuous order. Thus, while the task of science is, beyond doubt, to express, by means of numerical relations, the dependence upon each other of happenings in nature, the right to

a. Bowne; Theory of Thought and Knowledge: pp. 71-2.

posit the task, and the possibility of fulfilling it, can never be adduced from a sensualistic imaging of the world.

To save a situation which he could not ignore, Mach assumes certain "functional" relations as existing between the elements. In answer to the objection that his sensations leave things too much in the air, he remarks: "On the contrary, I must call attention to the fact that, so far as I am concerned, the world is no mere sum of sensations. Rather, I speak expressly of functional relations of the elements".(a) But what do functional relations signify? Does not their acceptance do away with a sensationalistic philosophy? Observation knows nothing of necessary connections. Hume has made this plain for all time. But can functional dependence eliminate the element of necessity? A sensationalist who remains true to his own logic must see, in all functions, merely the arbitrary products of men, though it does not lie in his power to make them constitutive factors of the world. "Observations alone supply no organic knowledge".(b)

But Mach is not willing to regard the sense impressions as merely arbitrary. He declares himself for their legal dependence upon each other. He speaks of a body, seen by one person in a certain way, as under necessity of being perceived in similar manner by every other person. The acceptance of a substantial condition of perception external to sense has no other significance than that "similar equations, as they exist between the closely cohering elements which represent my ego, also

a. A.d.E. 283.
b. E.u.J. 379.

find place between the elements of other egos, whose representation facilitates my understanding of the world".(a)

For Mach, the only permanent thing is the law which unites the elements. He says: "We observe, in the first place, simple constancies of individual elements, then the spatial and temporal union of these elements, and, lastly, universal constancies of union. Repeated and careful observation teaches that individual elements, in and of themselves, are not constant. If they have the appearance of constancy, it is only because of the chance stability of other elements united with them. Nor does absolute permanency belong to the spatial and temporal union. Thus, there remains only the universal permanence of the union itself. And if we reckon the sensations of space and time as among the elements, all constancies of union are produced by means of the mutual dependence of elements".(b) In place of an absolutely permanent thing we have only "constancies of reaction, constancies of union or condition. Every physical permanent is always and entirely the outcome of the fact that one or several equations are fulfilled—that a law abides in and through all passing events".(c) "If the collective sensuous elements could be measured, we would say that body consists in the fulfillment of certain equations existing between the sensuous elements. These equations or relations are, thus, the peculiarly constant".(d)

Let us grant the truth of this. The question remains, however, as to whether these "enduring laws" and "constant relations"

a. W'L. 424.
b. E.u.J. 270.
c. W'L. 342.
d. W'L. 424.

can be reconciled with such unqualified empiricism as we find in Mach. Moreover, are laws accessible to the senses? We must give a negative reply. Mach brings a rational element into play, and this element, while bringing his system into line with facts, undermines it as sensationalism, and leads, throughout, to sceptical results. The recognition of the necessity of finding unity, and the demand that this unity be more than a chance and arbitrary affair, dependent for its being upon certain practical necessities, forces thinking beyond the position taken by Mach, repudiates the propriety of his philosophy, and puts it entirely out of commission. Whatever else may be left to settle, it has become apparent that the problem under discussion cannot be settled on the sense plane. In the activity of the understanding is to be found the bond of union necessary for the elevation of "the rhapsody of impressions to the value of an experience"; here we discover the power which lifts the manifold of intuition into synthetical unity. For sensualism this is an impossible task, and the more spirited the attempt to make itself sufficient for the facts of experience the more apparent becomes its inadequacy and superficiality, the more complete becomes the mastery of the principles of the critical philosophy. Mach's treatment leaves him in the place of one who, repudiating the Kantian doctrine of thought as autonomous and constitutive, is forced by the very progress of his discussion to make the Kantian principles fundamental to knowledge and experience. In a word, Mach remains a

dogmatist. He overcomes the naive metaphysics of natural science, but fails to reach a properly critical attitude. He casts aside the conception of a substance in which qualities inhere, but accepts without question certain determining elements as simply present and given. At the very best his attempt is a compromise. When Mach puts laws in the place of matter he does not, as he seems to think, simply replace metaphysical concepts by empirical. In the place of transcendent things he puts transcendent functions. These functions possess, in their "Gesetzmaessigkeit", a characteristic which makes it impossible to find a place for them in any logical empirical system. And if the further question of reaction be considered, and Mach answers in terms of changing elements, we have the unsatisfactory spectacle of the world resolving itself into mere laws. In the doctrine of reactions, all that remains to react are the reactions themselves, and we feel convinced that, accepting the same, we do not remain true to facts, and are not in the way of making much progress.

Thus, at the close of our discussion, we are face to face with a very contradictory situation. We find a doctrine, whose implications are strongly Relativistic, straining and striving after an Absolute; a conception of all things as in "eternal flow", seeking to provide for a united and constant; a system of Phenomenalism—of elements as sole and final reality— falling back into a position as naive and untenable as that from which it endeavors to rescue thought; a Sensualism of the most thorough-

going character, employing, for the furtherance of its own argumentation, principles directly contradictory to its own point of view; a persistent ignoring of facts only to be mastered, in the end, by those same facts. And the whole affair is posited as 'necessitated'. Of what then is this considered to be the implication and outcome? What is that theory of method which supplies foundation for the philosophic results just considered, and what measure of truth and value belongs to it? To this question we now turn.

MACH'S METHODENLEHRE.

-1-

The method of consideration discussed in the following pages is decidedly outspoken and striking, and well merits our attention. We may characterize it, on the one hand, as "psychologisch-biologisch" and, on the other hand, as "entwickelungs-geschichtlich". It is our purpose to inquire whether such a way of dealing with things is true to all the facts concerned, and if it necessitates the conclusions discussed in the preceding section.

The method presupposes a conception already noticed. To science is given the simple task of description. The one thing which the investigator of nature deems worth while is the knowledge of facts. Everything else is an intellectual detour instrumental in the winning of such knowledge. "If all the individual facts were 'immediately' accessible to us in such manner and measure as we desire a knowledge of them, no science would ever have originated. It is only because of our confined and limited condition that the material must be placed in order".(a) This ordering constitutes the goal of science, and this goal is purely practical. Only in the course of development do specific theoretical interests arise and find place. These are always capable of reduction to the practical, and of being conceived as instrumental. To repeat: "We can regard every scientific interest as a mediate biological interest".

It is by way of this conception that science passes over into the category of the phenomenal. It loses all permanence and ideality, and simply represents a phase and stage of the whole

a. A.d.E. 31.

developmental movement. Together with the entire activity of man, it has its source in the desire for self-preservation. Man is one with the lower animals. Self-preservation is his supreme aim and sole endeavor. "The collective life-events of the individual are reactions in the interest of self-preservation, and the turning aside into the life of ideas, is only a part of the former."(a) The law of continuity and the principle of economy, are near products of this conception, for these are elements integral to the doctrine of development. On the other hand, if we apply the principles of continuity and economy of thought, they support the contention that, in the life of thought, there must be found a place for the concept of development.

As concerns the first point of view, we find that the concept of development implies an attempt to account for all the qualities and reactions of life, by selective adaptation to the manifold occurrences in the environing world. Adaptation comes to pass without break, and in the most economical manner. In other words, qualities which we find present under certain conditions are not cast away and replaced by others when new conditions arise, but are progressively modified and re-formed, the modification taking place in the most economical fashion, and going only so far as the new conditions necessitate.

On the other hand, if we begin with the principles of continuity and economy, we find, according to Mach, proof that these principles, which stand for the finally developed consequences of the doctrine of development, are actually fulfilled

a. E.u.J. 107, 110. The same thought is found repeatedly in all Mach's writings, especially in "Erkenntnis u. Irrtum", and "Analyse d. Empfindungen".

in scientific thinking and its development.

Very briefly stated, Mach's weightiest statements run somewhat as follows:

1. The origin of the life of consciousness is thoroughly and entirely economic. Self-preservation is the instinctive and controlling demand. Thus, there is urgent call for the adaptation of the reactions of an organism to the events of the external world. As a consequence, it comes to pass, that, because of the increasing complexity of the conditions of life, the manifoldness of the actual becomes far greater than the weighty number of biological reactions. Thus, reactions must take place without exact consideration of existing differences. A group of related facts is made the unit of consideration, and the measure of necessitated adaptation. The resultant reaction is, in large degree, undifferentiated, but, if it prove sufficient for the practical needs connected with the situation, the entire movement bears the character of sparing and economy. Here we have the first beginnings of the conceptual life. The facts of "like reactions", in accord with the demands of economy, are grasped under the form of an 'idea' and forced into a symbolic combination. By this means, consciousness becomes the type of a more or less imperfect physical apparatus, answering to the happenings of the outer world only within a limited area, and according to but few directions.(a)

2. In other respects, consciousness bears the character of an

a. E.u.J. 126, 134-5.

economical instrument. Even when it has acquired a certain stability as regards ideas, it is weighted with demands made by new facts. To meet these demands, it does not form new ideas but takes those which are already present and adapts them to the new problems. This modification or transformation is completed with the least possible expenditure of effort, and in no larger measure than the new facts necessitate. Moreover, the original thoughts themselves are made more secure and stable. It is this movement which Mach designates as the Principle of Continuity or the Principle of Permanence.(a)

From the above it will be seen that Mach discriminates between a) the adaptation of thoughts to facts, and b) the adaptation of thoughts to each other. As regards the first, he speaks of the adaptation as an imaging and typifying of facts in thoughts. It is this which first makes possible 'sufficient' adaptation—sufficiency being measures in terms of self-preservation. "In order to place ourselves in some kind of relation to our surroundings we need just this thing—a 'Weltbild'".(b)

As regards the second—the adaptation of thoughts to each other— he says: "The ideas, thus, adapt themselves to the facts in that they exhibit a copy sufficiently exact, and meeting, in a sufficient degree, the various biological needs, but this exactness of the copying does not reach further than the momentary interests and conditions demand. Since, however, these interests and demands change from case to case, the results of the

a. E.u.J. 110, 134, 298.

b. W'L. 394.

adaptation in the various circumstances,do not exactly agree among themselves. The biological interest now impels to the correction by means of each other of the various results found in the images. The best possible compromise is sought after and effected".(a) Thus, adaptation of thoughts to each other is the further problem,by way of which thought is fully satisfied, and "this demand is fulfilled by the union of the Principle of Permanence with that of the Sufficient Differentiation of Ideas".(b)

3. If thinking proceeds as Mach here conceives, it follows that the principles of Economy and Continuity must find application in the sciences. Mach is not content to let the implication rest, but employs all the wealth of his scientific and historic knowledge towards its elucidation. He regards the point as of considerable weight,and worth careful and repeated argument. We give below some of the proofs and illustrations which he offers.

a). Scientific thinking shows itself as the type of Economy and Continuity. Newton offers illustration of the fact, in his conception of the planets as bodies thrown off, and in his modification of the constant weight to the pull of gravity. Fourier formulates a theory of currents of heat,and, for this purpose, modifies the vibrations of strings. Again, the idea of a rectilinear propagation of light,was simply broadened by the incorporation of the refraction exponent,in order to find place for the new facts of deflection and refraction. The further discovery,that every color demands a refraction exponent,necessitated

a. E.u.J. 162.

b. Ibid.

further modification. "Finally, there is everywhere recognised in the overpowering manifoldness of the phenomena of light, the spatial and temporal periodicity of light, and the dependence of the celerity of its propagation on matter. This goal of surveying a territory with least expenditure, and of copying all facts by means of an intellectual process, may rightly be named an economical process and goal".(a) Through its formation of hypotheses, science makes progress according to the type of continuity. Hypotheses are, in the first place, taken from the existing stock of known experiences. The results deduced are then compared with new facts, and, finally, the particular hypothesis is modified to correspond with the results of this comparison.

b). As we proceed we discover that the various aids employed in our work of investigation serve the principle of economy. This is especially true of mathematical science. But it is also true of all methods leading to fruitful results. The fundamental method is one of change. "The method of change brings before us similar cases of facts, which, in part, possess elements of a common nature, but which, in other respects, are different".(b) Comparison brings to light both similarities and differences. It at the same time leads attention to the highest abstractions and finest distinctions. And, since comparison forms the core of all inductive process and all experiment, we perceive that this entire "Methodik" aims at continuity, for the intention of the comparison is to recognise the new, as arising out of the

a. P.V. 223-4.

b. P.V. 258.

elements of the old,which, in the last instance, have been modified to suit the exigencies of the occasion. Thus, the entire procedure is as truly economical as was the case in the formation of hypotheses.

c). If we turn to a consideration of the results achieved by science, namely, to Concept, Law, Theory, we find everywhere correspondence to the principles of Economy and Continuity. The laws of nature, as was said above, have simply the economical task of sparing the knowledge of individual facts. In every single case we must note that the law joins typical cases by means of a thought. Given certain conditions, expectation by means of the law is regulated and narrowed.(a) In other words, the law "fungiert" as a schema. The only need is the insertion of the special conditions. And since a law is recognised as a special case of a universal law, a schema is replaced by one more inclusive. What is said of law, is also true of the concept. The exact concept of natural science is the condensation within itself of labor economically performed and completed. In defining it,we consider characteristics which are to be, and combine them according to law. Thus, the concept always has a forward look. It has respect to future experiences. It stands for an attempt at diagnostic representation. We may say: "All physical laws and concepts are abbreviated cheques,frequently enclosing other cheques".(b) The "mysterious power of science" lies in their economic arrangement. As formulations at the service of

a. E.u.J. 441.

b. P.V. 226.

experience, they satisfy the demands of Continuity, and correspond to the need of Permanence. In them, thought seeks to grasp the idea, which, in every change, remains self-equal, and without which, the change would lack unity and meaning.

Such, then, is Mach's conception of the origin and life of consciousness, and of the substance, development and goal of science. The method is evolutionary, psychological and economical. Granting it to be true to fact, does it necessitate certain philosophical conclusions? Are we shut up, thereby, to a particular theory of Thought and Reality? Or may the method be accepted, and the essence of philosophy remain untouched? Even allowing that the method enriches and animates philosophical consideration, does it, in any manner or measure, lead to a transmutation of final principles of explanation? We shall answer the question first in general terms.

-2-

A proper understanding of what method means will do much towards insuring correct conclusions. When we perceive that it is merely an instrument, a tool, we see that one method does not necessarily exclude all others. In the present instance, the method may be regarded as simply "neben" the specifically epistemological examination of the grounds, and criteria of knowledge, and, as such, remains indifferent so far as epistemological reference is concerned. On the other hand, if we assert that the epistemolog-

ical examination cannot be carried to completion without its aid, we make it vital to the entire situation. We assert that we cannot know the nature of thought as a faculty for the acquisition of truth, except on grounds of the biological, economical and psychological. Which point of view is true to Mach's conception of the method which he emphasizes?

a). We may allow Mach's animating considerations, and still regard the problems proper to epistemology as entirely untouched thereby. This is evident so long as we bear in mind that the psychological and epistemological are two wholly different questions. The one is a question of fact, the other a question of values. The former considers the life of consciousness as an event, the latter as a faculty engaged in the apprehension of truth. Our peculiar problems begin with this latter conception of the mental life. We are under necessity of confessing that all thinking, correct and incorrect, all judgments and prejudices, take course psychologically and according to the principle of continuity, no special factor or circumstance arising to prevent. But there are other questions which are not thereby exhausted, and these latter questions have a special significance and must be settled before their own judiciary. For example, when is a course of thought to be regarded as continuous? Under what inner and outer conditions does it come to continuous intellectual development? When is the result of a certain intellectual consummation to be regarded as correct, independent

of the fact as to whether this has developed continuously or discontinuously, economically or otherwise? These questions serve to show that insight into the instrumental nature of laws and concepts, by no means exhausts the questions which may be asked concerning them. For these laws and concepts must be evaluated and arranged in order of importance; the fundamental connection between different groups of facts, moving under the direction of similar laws, must be ascertained; and it is not sufficient to answer that we find all such operations satisfactory and pleasant. The real question has not been touched. The point of view is secondary, and lacks finality.

b). Now does Mach consent to regard his method simply as 'neben', or does he make it all sufficient and necessary to the solution of the problems peculiar to epistemology and metaphysics? We consider first his Principle of Permanence. According to it, certain primitive suppositions are originally given. "The most important advances have constantly resulted, when it has been found possible to bring into communicable form, that which was known hitherto only instinctively". There was, in such case, an adaptation to the facts of knowledge with minimum modification. Thus, the motion theory of heat, like the material conception of electricity, owes the appearance of justification which is ground for its existence, to an historical accident. Even the purely conceptual and quantitative, are largely colored by reason of the manner of their development. We may even say that sometimes

an entire discipline would have taken a totally different direction, except for some trifling historical circumstance; that the result would have been quite other concepts and conceptual systems. From this point of view, the most exact and fundamental becomes accidental and convenient, and an atmosphere of uncertainty, lack of finality and scepticism envelopes our intellectual, ethical and aspirational life. This is the result which lies near at hand when the psychological and biological are made controlling and ultimate. Individual influences and accidents are given the value of the normative; knowledge and truth are expressed and exhausted in terms of chance conjunctions; the choicest and deepest categories of science, are reduced to the rank and worth of mere dependents, and the entire story of progress must be read in the light of the arbitrary and aimless. Adaptation and self-preservation are the interpreting powers of life's chief impulses and loftiest ideals. Science is a phenomenal product, and bears within itself nothing definite and certain. Results, everywhere, permit large play. In our knowledge of nature there is nothing determined, simply one outcome along side other possible outcomes, and all completely explicable on purely historical grounds. Absolute truth and objective necessity are alike denied. A point of view is true in so far as it sufficiently adjusts us to our environment, and satisfies our practical needs. The final word, we repeat, is a practical convention, and a relative satisfaction. The final

interest is self-preservation. Such a view is necessitated only because of the failure to see that the psychological is not necessary to, or sufficient for, the properly epistemological and metaphysical. When we read that there is no such thing as absolute, unconditioned knowledge; that no assertion can have unqualified validity; that subjective convictions, and not objective certainty, is the only goal possible even to the most earnest and protracted scientific endeavor, we perceive them to be the conclusions of one who has made the questions of origin and validity identical; who makes the associational movement sufficient for rational experience, and fancies that, in tracing the course of a mental event, he is establishing the proper character, range and criteria of knowledge. And all this we have seen to be false to fact. The sceptical results may arrive but they are not logically necessitated. They may well enough be individual convictions, but they have no warrant either in reason or experience. The "Elementenlehre" is not an implication or a necessitated result. It is the product of an undue emphasis and illegitimate application. The raising of a method, though a very common procedure, cannot be justified. A critical examination of the life of thought as the faculty of knowledge, in terms of the economical and biological to the exclusion of every other way of consideration, is without foundation and lacks constructive power.

If it should be said that the above interpretation fails to

do justice to Mach's point of view, we reopen the discussion from a different angle. We begin with Mach's demand for a large measure of scientific stability, and interpret his principles in the light of this demand. We soon find that his principles are insufficient and philosophically insignificant.

The examination brings to the front Mach's assertions as counter-statements with the necessity of making proper discrimination and giving due emphasis. For example, Mach says, on the one hand, that every development of a scientific thought, so far as it completes itself without break, is also economic. This supplies us with a conception of Continuity, and asserts the close connection existing between it and the Principle of Economy. But, on the other hand, we have the statement that we can arrive at entirely distinct and widely separated results by way of a like measure of continuity. It is this, as we have found, which makes him desire to effect an efficient compromise between the results of the various adaptations.(a) But what is the logical implication? Is it not that mere continuity and economy are not sufficiently decisive? And if Mach attempts to assert them as sufficiently decisive, he contradicts himself. "All the points of view of natural science which are of value, remain preserved", is an express statement regarded as interpretative and fundamental. In harmony with this, is a deep concern for fast and plain certitude in all matters scientific. But the warrant for this concern cannot be carried into execution through the power

a. E.u.J. 162.

of mere continuity, and this again, on Mach's own assertion, for he repeatedly affirms that, after this fashion, knowledge and error alike develop. To carry forward the same process of affirmation and negation, we mention the fact that while Mach, in harmony with certain concessions, deprives continuity of coercive authority, he still desires of science clearness, and characterises such clearness as the very goal of adaptation "according to the law of continuity".(a)

It seems plain, in any case, that the demand for sufficient differentiation, necessitates a limited conception and application of the principle of continuity. The peculiarly determining moment now is, that an insufficient adaptation is no adaptation at all. Here the harmony between Mach's different points of view seems again restored. But, in the same moment, another question arises. What does the emphasis on the word 'sufficient' signify? We have seen that it may mean that the adaptation never results with any more finality and exactness than is absolutely necessary for the occasion. But this means nothing more than that, in the inductive sciences, knowledge must be worked over from below up; that what is received as valid to-day may, to-morrow, be recognised as in need of correction; that we attain the goal of intellectual endeavor slowly and by way of many mistakes. But to say this, is to reduce the consideration to the level of a universally conceded fact; in no particular, and at no time is it vital to, or can it be made to interfere with, a deeper method of consideration. Instead of working in the interests of

a. A.d.E. 48.

exclusion, Mach's principle falls into line with the customary theory, becomes merely a phase of it, a point of emphasis, a working basis. This is seen further in the statement that an adaptation is sufficient only at that time when it permits an imaging and typifying of the facts, that is, when the intentions of thought and the facts to which thought is related, exist in a relation of consistency and harmony. This is just the sort of agreement which the ordinary intuition desires. For it the absolutely sufficient adaptation is that which leads to no contradiction, which corresponds to every known and newly discovered fact within its range. This, in customary terminology, we denominate knowledge or truth. And such adaptation is clearly economical, for, since every other must fail in certain cases, they must be insufficient, misleading and, consequently, not economical. From this point of view the criterion is, in its best estate, merely secondary. Even with the principle of economy at hand we must first know whether a supposition agrees with collective experience, that is, we must know whether it is true. Then, and then only, can we say without reservation that it is economical. With this reduction of the principle, every apparent contradiction with the customary theory of induction disappears. The secondary role played by economy in investigation and generalisation, is nothing specific, determining and exclusive. It is wrong to draw the conclusion that adaptation of thoughts to facts, must come to pass in one certain and well-defined manner. Men are

still permitted to carry on their investigations in indicidual manner, and employ the method in different ways. But "we will be able to compare these various scientific efforts with each other and find the one as economical as the other. Economy will thus offer us an orientating point of view full of value. According to this we conduct our scientific endeavor".(a) A procedure is seen as economical in the light of the results achieved, but cannot be defined in terms of an evaluating principle. It is purely instrumental and relative. Economy is a normal demand. It stands for the desire to avoid the incongruous, to overcome the imperfect, to realise the ultimate, whether or not this desire be exhausted in terms of the biological. But when this is said, it is still left to the individual to make selection of means in terms of what he conceives to be the goal most desired, the end most worthy of attainment. Our aims and ideals determine what we shall consider economical.

Thus, Mach's principles become philosophically insignificant. They contain no necessary implications so far as knowledge is concerned. They have no specific value as foundation principles. At best they are illustrative, and in a reflective way, interpretative. Mach himself says: "As an investigator, I am accustomed to attach the beginnings of investigation to the special, and to rise from this to the universal. This custom I also followed in examining the development of physical knowledge. I was so determined because a universal theory of theory

a. W'L. 393-4.

was, for me, too difficult a task. Thus I directed my attention to individual phenomena; adaptation of thoughts to facts, adaptation of thoughts to each other, economy of thought, comparison, intellectual experiment, permanence and continuity of thought, etc. For me it was logical, and at the same time prudent, to regard vulgar thinking and science in its entirety, as a biological and organic phenomenon, in harmony with which logical thought was considered as an ideal 'Grenzfall'. I shall not for a moment doubt that investigation may begin at both ends. From here out, one may see that I know well how to discriminate between psychological and logical questions. However, no one who has carefully considered the logical analysis of the Newtonian expositions in my mechanics, will dare to reproach me with wishing to annihilate the difference between natural, blind thought, and that which is logical.(a) Even if the logical analysis of all science lay, ready and prepared, before us, there still remains the biologico-psychological examination of its growth....This is a need which would not exclude the possibility of once more analysing this examination in a logical manner".(b)

We repeat, that, if this does represent Mach's true point of view, rather than a position forced upon him by a native dialectic and the facts of experience, he has affirmed nothing more than has already been said and agreed to, so far as the epistemological is concerned. Would it be too much to say that he has labored hard to prove truisms? At best he has but illustrated the customary course of thought. His principles, as inter-

a. There is no cleavage anywhere in the life of consciousness.

b. M. 537.

preted above, affirm nothing so far as philosophy is concerned. If the sceptical significance of the principles is asserted, and attempt made to exhibit the 'Elementenlehre' as the implication of the 'economic' discussion, Mach continually contradicts himself, and denies what must be regarded as the most weighty elements of his exposition. On the other hand, if we view things from the higher level, the inadequacy and superficiality of the principles for philosophical inquiry become increasingly manifest.

-3-

Our general discussion of Mach's Theory of Method, leaves the epistemological problem untouched. We have found a system welded into oneness only by reason of a psychological usurpation, and, if such usurpation be disclaimed, a hiatus at once appears. Universally considered, knowledge as a product of adaptation, offers no deduction concerning the limitation of knowledge. But another way of approach is possible. We may make inquiry from the individual and particular point of view, and may find limitations necessitating a sceptical conclusion. We are now to consider Mach's attitude towards mechanical physics, and, in particular, his criticism of the various physical concepts. Here we find his theory at work and best suited to critical inquiry.

In the part of this essay devoted to the "Elementenlehre", we have already spoken of the fallacious nature of the reasoning of mechanical physics, and of Mach's general position re-

garding it. We saw that Mach finds in these theories, and in the concepts which they employ, no independent value. They are merely economic representations of facts. Their value is relative. The hypotheses and concepts of mechanical science have no teleological worth. They are instrumental. There is no absolute goal, simply means for the mastery of facts, and every function which goes beyond this, is exhibited as full of contradictions.

There is no doubt that the mechanical physics considered, offered abundant material for criticism. They represented many and conflicting points of view. Moreover, systems were seen to be superseded simply because of their economical unfittness. Even surviving theories were continually manifesting their economic incapacity and insufficiency. Such a situation implied, or at least suggested, some fundamental weakness. Search accentuated the lack of clearness inherent in the concepts force, matter and motion. It also hit upon a reason for the apparent weakness and ambiguity. The scientific ideal was at fault. The task of explanation was too large. The concepts were deprived of their value because of too wide range of application. They were asked to solve a problem which was not properly theirs. So they were brought back within their proer sphere, as it was conceived, and were allowed authority only in respect to their economic moment, since this it was which actually came into view.

Mach falls in line with this general movement. In several places he attempts demonstration of the fact that explanation

is possible by hypotheses which, in the final analysis, contradict each other. The conclusion is evident. The hypothesis can decide nothing concerning the true and the false. A good illustration of this is the theory that heat, in its essence, is motion, and not, as was earlier thought, matter. Mach points out that the grounds on which this decision rests are not sufficient. It is simply a point of view. Accidental circumstance led to the choice of the former theory. Economic reasons secure it validity. The heat hypothesis can be more easily put to work and be employed to more effective purpose, but we cannot thereby conclude anything as to the necessary elimination of matter. The conditioning elements throughout, are purely historical. A further illustration is found in the doctrine of electricity. Here we can arrive at two opposite results concerning the nature of the agent, and that with equal ease. In a word, the conception entertained amounts to saying, that, if we are apt in the application of certain conditions, we can bring almost every hypothesis into harmonious relation with phenomena. Thereby we please and satisfy the imaginative faculty but, in no way, increase our stock of knowledge.

The following words express Mach's conception of the character and value of the hypothesis."It is a matter of complete indifference, and has not the least scientific value, whether we think of heat as a material affair or not. We simply accept for the moment that all physical occurrences allow themselves

to be carried back to molecular movements. But, in the act, what do we really do? We take the position that things which cannot be seen or tasted, which exist solely in our imaginatin and understanding, can be infected with the qualities and relations of that capable of being tasted. We lay upon thought the limitations of the seen and tasted. Why do we not represent the molecular occurrences as musical? As a matter of fact there is a possible advantage in thinking chemical occurrences as in a space of more than three dimensions. Thus, the results may be established even without the mechanical theory. The latter is not necessary. Frequently it is a positive hindrance".(a)

We may now understand whatever expositions Mach has to offer regarding the essence and kind of "Bilderhypothesen". It is in reference to them that Mach employs the expression "indirect description". Such a description is given when we say "the fact A behaves itself like an already known fact B, and that not in one particular but in many or in all". There is here an appeal to a description already given or now, for the first time, exactly and fully manifesting itself.(b)

Thus, Being is thought in terms of analogy. "In thought, in the place of a fact A, there is always placed another simpler or more familiar fact B, which can represent the former intellectually, but, just because it is another, at the same time cannot represent the former".(c) Here both the excellence and danger of hypotheses appear. "What an unloading of difficulty it must

a. P.V. 268.
b. P.V. 268. Cf. E.u.J. 231f.
c. P.V. 269.

afford when one can simply say; a fact A, brought into consideration, behaves itself, in many or in all particulars, like a fact B already known. Instead of one simple mark of similarity, there enters, on the contrary, an entire system of characteristics—a well-known physiognomy—by means of which the new fact becomes suddenly well-assured. Indeed, the idea can offer more than we are readily able to perceive, for it is possible to widen and enrich the new fact by characteristics which, for the first time, we are under occasion to seek, and which, too, are often discovered. It is this rapidity with which knowledge is broadened, which gives a theory a quantitative excellence beyond simple observation".(a) It is here that we find the source of preference for a theory, and the peculiar value attaching to it.

But there is danger also. Two groups of facts, simply analogous, are expressed as identical. "Besides the elements indispensable to the exhibition of the fact out of which an hypothesis is created, the hypothesis very frequently possesses others which are not requisite to the presentation. For the hypothesis is formed according to an analogy whose points of similarity and difference are incompletely known, otherwise there would be nothing more to investigate. For example, the doctrine of light speaks of waves, while periodicity alone is necessary to an understanding of the facts. These accessory and dispensable elements, are those embodied during the course of

a. P.V. 267f.

transformation. They are gradually eliminated and replaced by necessary elements".[a] "Now, if, as quite easily happens, sufficient care is not taken", that is, if too much trust is placed in the hypothesis, "the most fruitful theories become a positive hindrance to investigation".[b] History furnishes a large number of such cases.

If, however, we are able to keep ourselves free from such mistakes, there comes gradually to completion what Mach names the "teils....sich selbst befestigende, verschaerfende, teils sich selbst zerstoerende"[c] function of the hypothesis. That is, there remains over from the various hypotheses only that wherein they all agree. This is the essential—the conceptual expression of facts freed from every bit of imagery. Everything exceeding this is in danger of coming into contradiction with new facts. This purely conceptual expression, Mach names a "direct description"[d]. Such a description is a requisite for the conceivability of facts. It is the result of analytical examination. "We can confirm the same as certain even if we find no kind of analogy therefor".[e] Movement is constantly towards the replacement of indirect description by direct. "If the geometrician wishes to grasp the form of a curve, he analyzes it, in the first place, into small rectilineal elements. He knows, however, that these are merely a temporary, arbitrary means for the seizure, part by part, of that which cannot be seized all at once. When the law of the curve is found, he thinks no longer

a. E.u.J. 241f.
b. P.V. 269.
c. E.u.J. 223f.
d. P.V. 267.
e. E.u.J. 244-5.

of the elements. Thus, it would not become natural science to see in its self-created, changeable, economical means. ..realities behind phenomena. With the growth of intellectual knowledge concerning its material, natural science forsakes its mosaic play with pebbles, and seeks to ascertain the limits and form of the channel in which flows the living stream of phenomena. The most sparing, simplest conceptual expression of facts it recognises as its goal".(a)

Almost inevitably there remains behind, in the conceptual, a certain coloring from the original figurative. This presents little danger so long as we bear in mind that our theories rest on analogy. We may guard against considering the figurative as real, and appreciate the high value of analogy. At the same time, we do not lose sight of the necessity of progressively eliminating the metaphorical.

Thus, we perceive that Mach considers the primitive goal of me chanical physics as purposeless, and incapable of attainment. The sole value of theoretical formulations is their economical fitness, and this alone comes into consideration. The exposition brings to the fore the Principle of Economy, and sharply emphasises its significance. Nevertheless, the presupposition throughout, is that the hypotheses must agree, in their consequences, with the facts, and this is something which the Principle of Economy cannot decide. The normal epistemological

a. P.V. 235-6.

criteria remain determining. The exposition accords to the principle of economy, a certain limiting and prescribing significance, in respect to the ideal of knowledge formerly entertained by the mechanical point of view. This is sufficient to make it worthy of recognition.

Concerning the doctrine of 'direct' and 'indirect' description, a special remark is proper at this time. The doctrine furnishes no information that facts are the merely sensuously presented, and these alone, it must be borne in mind, determine the content of a 'direct' description. Even for the founding of an analogy, direct description is necessary. We move altogether in the sphere of the conceptual. Facts are prepared and certified affairs. The only thing insisted on, is that our descriptions, to be exact—that is, direct— must not go beyond the factually guaranteed.

This is important, for a second course of thought, which surrounds the whole with a very distinct atmosphere, is near at hand. In regard to all the physical concepts, the element of necessity is considered merely an addition of thought. It does not belong to the facts in any degree. The motives for its addition are various. The historical, psychological, and economic, call for special attention. Necessity is an unproved 'plus', and must be removed from our simplest concepts. The manner in which Mach accomplishes this, constitutes his Critique of the Physical Concepts. This Critique we shall now consider.

In his Critique of the Concepts Peculiar to Physics, Mach attempts to do two things. First, he wishes to establish that which is fundamental to the concepts; Second, he seeks to show that every attempt to pass beyond the principles here present, can and does lead to nothing but error and confusion.

We begin with the Law of the Conservation of Energy. It is impossible to create work out of nothing, and the most manifold changes in physical conditions are brought to pass by means of mechanical work. Where conditions permit complete reversal, the amount of work expended is capable of recovery. Such equivalence is the entire meaning of the possible transformations of energy. To posit something incapable of destruction—something substantial and self-equal— represents nothing more than a need of thought, a striving for stability of conception. It is not necessary to the facts. If so considered, it leads astray.

As with this law, so with the various other concepts. Space, Time, and Motion may be discussed. These are assured through experience, and contain merely relative moments. We express uniformity of motion in terms of other motions. Uniformity is merely relative.[a] With the elimination of absolute motion, there disappears absolute space. In experience, only relative positions are given. Dynamic differences are denied, and no absolute stopping-place is possible. To posit an absolute space, is to go beyond experience.[b] It is the same with time. We cannot absolutely measure the changes of things.[c] Consequently an ab-

a. M. 243-4.
b. M..243.
c. M. 238.

solute time, independent of every change, cannot be measured. Such an idea has no scientific value. It is a thing of thought. It is a concept with which we cannot operate, for we pass beyond experience, and no assertion can be made regarding the trans-empirical.(a)

The concepts of Mass and Inertia are won from experience. Of the mass concept he says: "In such a concept there lies no theory. The quantity of mass is unnecessary. It possesses merely the sharp fixation of a fact".(b) "Over and beyond the recognition of this fact, we cannot go without breeding confusion and error".(c) The law of inertia only says that there are accelerations which determine bodies to each other under certain circumstances.(d) If these conditions fail, the accelerations fail to appear. While extended application is possible, all accelerations are relative.(e)

What is the epistemological significance of these discussions? This is the only question which concerns us. And first, we ask: How much is here proved—established beyond a fact?

The first thing is self-evident, namely, that certain physical concepts receive a large and determining part of their content from experience. The definition of such a concept is also self-evident, namely, that which "possesses a sum of experiences concentrated in itself".(f)

Also "all physical concepts are abbreviated methods, which frequently hold within themselves other methods, ordered in

a. M. 243-4.
b. M. 232.
c. M. 236.
d. M. 268. e. M. 247. f. E.u.J. 112.

economical manner for the use of 'ready prepared' experiences"(a). It is further shown that actual attempts to secure for certain physical concepts a significance beyond that warranted by the actual facts, miscarry.

Against this proof however, it may be said first, that it works in unison with the demand that we attach ourselves, after hasty attempts, once again to the figurative concept; that we lift ourselves in the smallest possible measure above the sure basis given by means of it. Such prudence is quite harmless, and may easily become a methodical demand. It exhibits itself as a matter of fact, in a noteworthy way, in modern physics, which aims to secure itself most expediently against the uncertainties of the metaphysics which touch its borders. It separates in sharpest manner that which comes into consideration as purely physical, from all that lies beyond. Mach emphasises this demand. His face is decidedly towards experience. Our concepts, as far as possible, must assume and retain empirical form. They are to represent experiences in the most economic manner. This is their only service. "If we wish to remain true to the method which has led the greatest investigators of nature to their choicest results, we limit our physics to the expression of the actual, without building up behind this certain hypotheses in a region where nothing is capable of being seized and proved. We have given as the actual, simply a connection of mass movements, changes of temperature, chemical changes, without thinking for ourselves under these elements anything else than certain phys-

a. P.V. 232-3.

ical marks or characteristics, given mediately or immediately by observation".(a)

So much for what is proved. We readily agree with what so far has been said. There is nothing new here. We have an emphasis on the word experience, that is all. But there is another tendency present in the expositions. Mach's critique aims at showing, that in no possible way, can we conclude anything from experiences, or form a corresponding physical concept, except through the immediately, sensuously experienced. This interpretation falls into line with the broad characteristics of his thought. His position is that of a Sensualist. Sensuous phenomena are the real, and it is for these alone that scientific concepts are present. Their function is one of orientation. Beyond this their affirmations cannot pass.

Such assertions, however, are dogmatic. To recognise difficulties and actual miscarriages is not to present impossibilities. Maturer experience may carry to a successful issue, attempts which hitherto have failed. Historical failures constitute no final argument as to the legitimacy of a certain precedure.

It is worthy of notice that in those very experiences to which Mach appeals, and which he considers final, there is a strong impulse to the formation of concepts which pass beyond them. We see this if we consider his definition of Mass. It is merely something given according to facts. It is something

a. M. 541.

which expresses itself only in relation to other bodies. But it is significant that these other bodies can change, and yet the behavior of the body under examination remain constant so that the same affirmations regarding it are possible. The question naturally arises as to whether the individual mass is peculiar to the body examined, or to the other bodies with which it is compared. This question, it is to be noted, is in the sphere of substance, and according to Mach, to attempt an answer can lead to nothing but error and confusion. Is an answer withheld? By no means. While it may be more difficult than at first sight appears, the answer is begun and inevitably stated in favor of the body examined. As with Mass, so with Space and Time. In spite of the various bodies which we may employ for the purpose of analogy, we may speak of similar temporal and spatial behavior. The behavior, then, is something independent of the particular bodies themselves.

If we were to examine the other physical concepts, we would find everywhere the same impulse to pass beyond the present and given. A compelling force drives us forward. This Mach ignores, not because of any proof offered, but in the interests of his point of view. Yet it is clear that Mach finds it impossible to remain within the compass of this point of view. He, too, is urged forward. Within his conception of a reciprocal connection of phenomena, only in a greater or less degree possessing stability and constancy, the hope asserts itself that in spite of

circumstance, deeper consideration will make it possible to set up an ideal of knowledge self-confirmed, and capable of resolving or satisfying a need which had forced thought out beyond the prescriptions laid upon it by previous ways of thinking.

The situation has entirely changed. Mach's discussion does not end as it began. The views here presented are necessary but in quite another way than Mach would have. Their necessity lies not in the fact that they result from the critique here offered, but that they are necessary to the critique, if its results are to be definite and satisfying. The best we can say for Mach's discussion so far, is that it may prove an aid to further argumentation on behalf of his position. But so far as definite and full proof is concerned, the discussion has no decisive value.

-4-

The Concept of Causality has been the storm center of the classic battles of philosophy. Mach's critique brings it once more to the front. Through it he strikes at science itself, at least as it is generally conceived. Helmholtz' idea of cause and its importance for scientific research, furnishes Mach with a point of departure. According to Helmholtz, "the final goal of physical science is the discovery of the ultimate, unchangeable causes of natural occurrences".(a) Mach declares this goal to be unattainable and unreal. His reasons for so declaring may

a. Ueber die Erhaltung der Kraft, 1847.

be briefly stated.

a). Helmholtz' definition of cause, presupposes that the same causes precede the same results, and vice versa. Mach states this to be an impossibility. In the first place, such an assertion is merely an abstraction, secured by overlooking certain phases of the actual facts and occurrences. In reality we never find like cases repeated. "If we speak of cause and effect, we bring into prominence in an arbitrary manner just those moments which we must regard as at that time most suitable or necessary for our purpose. In nature there is no cause and no effect. Nature is present but once. Repetitions of similar cases, in which A is always connected with B, in which like results follow under like conditions,.... exist only in abstraction. This again has its source in the purpose which it serves—the copying of facts".(a)

Now we readily see that if this objection has right on its side, there can be in nature no causal law, in fact no law at all, for every law aims at the expression of constant union. All this however belongs to a later part of the discussion.

b). From the preceding, it follows that all our talk concerning cause and effect as actual, arises out of inexact and incomplete observation. A more exact analysis would exhibit the so-called cause as merely the complement of a complex of facts, which determines the so-called effect. The complement varies as different elements of the complex are taken into consideration. To use a classic example: A body is warmed through the rays of

a. M. 524.

the sun. The one follows upon the other. We say that they are related as cause and effect. But what does closer analysis reveal? Certain influencing conditions and factors which must be taken into consideration, if we are to give a just and full account of the matter. The sun turns out to be not the complete cause, but only a complement.(a)

c). The so-called causal relation thus turns out to be a very complex affair. Instead of a single, we have a manifold. The isolation of any one of the many relations present, is an abstraction. In a majority of cases a certain reversibility is possible. Every causal relation is in the final analysis, found to be a system of simultaneous actions and reactions.

d). The reversibility of the relation nullifies the idea of succession. Every element becomes a function of the other. Cause is a misnomer. "If we, exactly and one by one, consider physical occurrences, it appears that we are able to regard every immediate dependence as reciprocal and simultaneous. Just the opposite holds good of the common concepts, cause and effect. Even in entirely unanalyzed cases they find application, in manifold ways, to an indirect dependence".(b) Mach profusely illustrates the conception here entertained.

Thus with Mach, the causal gives way to the functional. "In the more highly developed physical sciences the use of the concepts, cause and effect, is less frquent and more circumscribed. There is good reason for this, in the fact that these concepts

a. A.d.E. 75-6.

b. E.u.J. 274-5.

characterise any state of affairs in only the most elementary and incomplete fashion. They lack keenness....The exhibition of the dependence of the elements upon each other by means of the concept of function, is much more complete and precise. Not only does this hold good when more than two elements under consideration, stand, not in indirect but in direct dependence, but much rather when they stand in the midst of a vast chain of elements. Physics, with its equations, makes this relation clearer than can words".(a) Causal relations are the incompletely, functional relations the completely analyzed. Instead of saying that the fact B follows upon and out of the fact A, we must speak simply of the possibility of calculating the one from the other. Out of the functional relation and the metrical characteristic of the one fact, there follows the characteristic of the others, and vice versa. Thus functional relations are simultaneous and reciprocal, and express nothing more than the dependence "of the conceptual 'Bestimmungselemente' of a fact simply in purely logical form, in just the same way as does the mathematician".(b)

The 'Funktionsbegriff' finds a large place in modern physics. Every physical equation manifests it. And in the experiences which these equations describe, we are to find the basis of the various concepts. All this we are willing to grant. And we are willing to recognise too, that in the presentations of natural science, there is a tendency to minimise the concepts of Force

a. E.u.J. 273.

b. P.V. 281.

Thing, and Causality, at least in their primitive form. Mach illustrates all these matters profusely, and for the present, we concede their force.

But what follows? What significance do these concessions have as relating to our present question? How is the epistemo.-logical affected?

In the first place, we call attention to the fact that these various concepts cannot well be avoided. And it is somewhat significant that Mach himself makes use of them for "Hand und Haus-Gebrauch".(a) Moreover these concepts have a sphere of interest other than the purely physical. They belong to the field of philosophy as well. It would seem then, that we have here again, a matter of emphasis—a desire to discriminate clearly between two fields of activity, that they may not infringe upon each other's rights. The physicist stands guard over his discoveries and acquisitions. He seeks to prepare himself against surprise. He strives, so far as in him lies, to make his Laws, etc., independent of the wider usage and significance philosophically attaching to them. The natural scientist sets for himself a certain horizon, and what he perceives within it he perceives in a certain way—a way which assures him economy and efficiency of treatment.

Surely this is nothing new,and nothing to create alarm. Have not all the great physicists of modern time been controlled by the same desire? Fechner, for example, says that Force is

a. A.d.E. 258.

for the physicist, nothing more than an aid to scientific expression. Kirchhoff, to cite another, makes the task of Mechanics to be the representation of the movements of bodies by means of the simplest and most unambiguous description. The word Force no longer stands for a metaphysical cause of motion, but is solely a name for certain algebraic expressions employed.

So far we have no objection to offer. We are in the field of scientific labor, beholding the working out of certain purposes, by ways and means considered best. The aim is definite and the field is circumscribed. The question for us, is whether Mach keeps within his proper domain. There is something specific to his endeavors which is not integral to the position of modern science. We hear him saying for instance, that the various concepts here discussed do not disappear partially but absolutely. They are alike impossible and superfluous. The scientific 'Weltbild' is without them, completely self-enclosed. The functional equations are sufficient for all things. They pass into all territory. Through them, all consummations are possible.

But it is quite evident that the functional equations are not adequate to the task imposed. The 'Funktionsbegriff' is purely subjective. As such it represents an incomplete method of consideration. It is self-evident that there corresponds to the union expressed in a functional equation, a real dependence in nature. Now if the various concepts, Force, Substance, Caus-

ality, etc., are capable of being formed out of such functional equations, it is also evident that the necessity of an objective dependence holds good for these also. Thus, even if the special historical forms of these concepts should be shown to be untenable, as Mach believes he has shown, the real affair is not touched. We are dealing here, with the results of special endeavors. Are these endeavors themselves justified? The question cannot be so dogmatically settled as Mach would have us believe, for upon consideration we perceive that these concepts are capable of many and large transformations. They have a history, and a development in history. As yet that development is not closed and complete. But imperfect formulation and interpretation can never, as we have said before, constitute an argument inimical to the existence and necessity of the particular affair concerned.

Bearing in mind what has just been said, we are able to appreciate the objection, such as was offered in connection with the concept of Substance, that in nature, there is no real constancy corresponding to that found in the concept. Such an objection cannot be final. The fault may lie in the means at our disposal, and not in the concept itself. These means are able to reveal only functional dependence, instead of spatial and temporal unity and permanence. The "impossible and superfluous" nature of the concept, is, so far as Mach's argument is concerned, a dogmatic assertion, and not a necessitated con-

clusion. And this becomes more evident when we reflect, that in that permanency of reactions, of which Mach himself speaks, there lies a reference to a something which endures, and in the fixed connections and reciprocal relations of a group of equations, a reference to a real moment uniting the various relations expressed by them. Further epistemological analysis may lead us to think of this real in a way widely different from the present. That does not allow us to neglect or eliminate it. To do so is simply to leave unconsidered, a question whose consideration the facts themselves demand.

This is true also of the concept of Causality. The very facts force reference to it. For example, by means of the proper equation, a certain amount of work is connected with a certain amount of heat, in a purely functional way. There is something which belongs of necessity to the discussion that the equation does not express, namely, the fact that while rubbing produces heat, heat does not produce rubbing. Reversibility, which is an element in Mach's presuppositiinn, is not here possible. But even if such reversibility were shown to be actual, this would not exclude causal relations from the members of such processes, even if they are not immediately related. Mach himself makes mention of the fact, that if two physical bodies belong together, while the change in one can correspond to the change in the other, this is not necessarily the case.(a) It would appear that we have an element which lies beyond the domain of the 'functional'.

a. M. 548.

The functional does not then, exhaust all the possible relations. Mach asserts that this does not constitute a metaphysical problem.(a) Even if that were true, a place is found for the concept which he so readily eliminates. This Mach persistently refuses to recognise, at least in any satisfactory manner. Everything is dealt with 'economically' and 'psychologically', and that in a dogmatic and arbitrary spirit. Mach's equations do not cover all the facts nor do they provide for all exigencies. We continually come upon situations where they fail to meet the demands laid upon them.

Does reference to the universal connection offer any relief? We have heard that all conditions are mutually dependent. Everywhere we find the relative. The concepts presuppose the equations, and the equations the concepts. What does this seem to signify? We appear to be dealing throughout with the provisory, instrumental, and limited. By means of equations and concepts, we lay hold of some few elements out of the universal context. But it has become increasingly clear, that certain stopping-places are found in the universal flow, a certain stability and constancy assured. Mach employs these unwittingly, but this makes their necessity the more apparent. In a word, as we found in our discussion of the 'Elementenlehre', the supposed resolution of certain difficulties, gives rise to others more numerous and more insoluble. Mach's discussion so far has been suggestive. Within prescribed limits no objection can be raised. Beyond this it becomes dog-

a. A.d.E. 275.

matic and vacillating, using supports where necessary, removing them where convenient. To concede Mach's exposition special content and significance, forces it to recognise facts, at once contradictory and destructive. Without opposing it by a constructive point of view, we perceive that it has not well laid its foundations. This becomes more apparent as we consider Mach's 'Naturbegriff'.

-5-

Mach completes his polemic against the Idea of Causality by a denial of 'Naturnotwendigkeit'. Here his subjective interpretation of the categories is seen at its clearest, and the consequent inconsistencies become most evident.

The following quotations express Mach's general position. "If I find that a physical fact behaves itself so as to agree with my calculation or my construction, it is impossible to accept the contrary at the same time. I must, thus, expect the physical result with the same certainty with which I regard the consequence of the calculation or construction as correct. It is self-evident however, that this logical necessity must be distinguished from the necessity of the presupposition of the parallelism between the physical fact and the calculation, for the latter, constantly and progressively, rests on a customary sensuous experience. On the practice of firmly uniting the idea of the facts with that of their universal behavior, rests the strong expectation of a known result, which appears to the investigator

of nature,as a necessity. Thus there arises and expresses itself what we ordinarily characterize as a feeling for Causality".(a) Again, he says: "The physical complex of facts is simple,or allows itself to be so simply formed by means of experiment, that the immediate connections become visible. Now if, by sufficient commerce with this territory, we have woven for ourselves concepts of the nature of these connections considered as universally corresponding to the facts, we must expect every single fact which presents itself to correspond with these concepts. In this, however, there lise no necessity of nature. That is 'kausale' Verstaendnis".(b) Finally, Mach expresses himself in the following direct and pointed manner: "There is only logical necessity: if to the fact A there belong certain qualities, I cannot at the same time avoid them. But that they belong to it is simply a fact of experience. A physical necessity does not exist".(c)

In the light of these quotations,there can be no doubt as to Mach's position. There is no necessity other than the logical, and the logical is merely psychological.(d) A few further quotations may define more clearly the significance of this position.

a). "To explain,means to lead complex facts back to the fewest and simplest possible. These simplest facts are, in themselves, always unintelligible, that is, incapable of further analysis....Our choice of obscurities is merely a question of taste. [illegible]. We generally deceive ourselves with the fancythat

a. W'L. 457.
b. A.d.E. 72.
W'L. 437.
d. Cf. P.V. 227-8: M. 524.

we conduct the unintelligible back to the intelligible. But to understand consists in analysis, this and nothing more. We conduct unfamiliar obscurities back to familiar obscurities. In the end we always come to propositions of the form, if A is, B is, thus propositions which must follow from the intuition and which, thus, are in no further measure, intelligible".(a) Thus an explanation, an understanding, is merely a leading back to the known, an analysis into the simple. That is explained which is familiar. And "science does not create one fact out of another, it simply arranges the known".(b) The history of science furnishes abundant illustration.(c) "The correctness of a new rule can be made clear by the fact that this rule is often used, compared with experience, and tested under the most widely separated conditions. In the course of time this process completes itself. The discoverer wishes, however, to arrive at his goal more quickly. He compares the result of his rule with all his familiar experiences, with all the older rules, which have been many times proved, and inquires as to whether it encounters any difficulty... It is quite in order, that , on the occasion of a new discovery, all means are employed which can serve for the testing of a new rule. If the rule in the course of time has been proved with sufficient frequency, it becomes science to recognise that any other proof is entirely unnecessary, that there is no meaning in considering a rule as more fully assured simply because it rests on another which has been won by the same way of observation, that one

a. E.d.A. 31-2.
b. P.V. 239, 240.
c. M. 16, 12, 77, 75.

thoughtful observation is as good as another. As a matter of fact, this desire for proof leads, in science, to a false and perverse austerity. A few propositions are considered more certain, and are regarded as the necessary and unassailable principles of others, while possessing no extra certainty, and quite frequently a less degree of certainty".(a) In summing up his observations Mach asks the question: "How can the impression arise that an explanation accomplishes more than a description? If I show that a certain occurrence A behaves in a way similar to another more deeply trusted, B, then A becomes still more dependable; if I show that it is composed of the series or the combination of the facts B, C, D, already known. With this, however, one actual is replaced by another, one description by others better known. The affair, thus, becomes more familiar to me. It simplifies itself, but no other change occurs. If we ask 'When is a fact clear?', we must answer 'When we can copy the same by means of very simple and familiar intellectual operations'".(b)

b). "If all the facts were directly accessible to us, just as we desired knowledge of them, no science would ever arise. Because the memory of the individual is limited, the material must be arranged. This is brought about by an 'Ableitungsregel'. This has no more actual value than the individual facts together. Its worth lies in its convenience. It is an 'economical'".(c) There are many passages of a similar nature.(d) They

a. M. 80-2.
b. W'L. 437.
c. E.d.A. 31.
d. P.V. 282-3; W'L. 121.

all point to the same conception of our so-called laws and concepts. Everywhere there comes to the front the psychological method of consideration. The language of Hume is frequently employed. There is the 'feeling' of necessity, 'custom', 'expectations'. Our so-called explanations guard us against 'surprise'. Clearness lies in familiarity, and the process leading to such result is one of 'imaging'—'copying'. The legal is reduced to the symbolic and economic. How much does Mach mean by this psychological emphasis? Are his assertions satisfied if the subjective is given the value of a 'neben'; or does the exposition demand a more exclusive interpretation? And if so, what proof is offered for such position? Or again, what does such an embracing conception of the psychological involve, and what reactive effect has it on the system in whcih it occurs?

Mach's 'logische Notwendigkeit', in respect to nature, may mean any one of three things.

a). In nature there is nothing adequate to our concept of necessity. In this sense nature can never supply us with anything beyond an 'as if'.

b). The assertion of such necessity may rest on the fact that the results won through induction are largely vitiated by error. "The agreement of the concepts among themselves is a logically necessary demand, and this logical necessity is the only one we know. The belief in a necessity of nature arises only where our concepts of nature are sufficiently adapted to

hold inference and fact in agreement. The assumption of a sufficing adaptation of our concepts can be refuted at any moment by experience".(a)

c). Mach's conception may mean also that occurrences in nature, when considered with exactness and completeness, are 'gesetzlos und regellos' and possess a contrary appearance only in certain measure—a measure, however, sufficient for practical purposes.

Which of these possible interpretations best accords with Mach's entire exposition? The foregoing discussions have pointed strongly in one direction. We shall see here that the indications were not misleading.

The first two possible interpretations leave the epistemological and metaphysical quite untouched. They neither exclude nor replace so far as evaluating principles are concerned. We can all agree that there is a subjective side to scientific research, and remain easy in our minds so far as hostile implications are concerned. That experience of necessity in nature is not full and complete, that regularity is all we at present really know by way of empirical science, is not to be disputed. If Mach says only this, he says nothing which affects the criteria of knowledge. But if he does so limit his meaning, other statements must be regarded as errors or lapses in syllogistic reasoning. The quotations given above make this sufficiently evident.

a. M. 280.

It is the more radical interpretation then, which demands our attention. The demand is reinforced by Mach's Critique of the physical concepts, and his attack on the idea of causality. In the former case, we were under necessity of ascribing to Mach the point of view that it is impossible to conclude to anything not sensuously mediated. We found, however, that this position was the expression of a dogmatic attitude. Thus Mach's elimination of conceptual validity must not be considered authoritative and final. In the latter case, we were forced to a like conclusion concerning the functional. The more radical view projects itself as representative of the entire exposition, but does not account for the facts, nor fully compass the implications of Mach's own assertions. We do not eliminate the causal idea when we conceive of functional relations. The legal relations expressed by the functional equations, presuppose real, necessary connections.

What then, is the situation? On the one hand, we perceive certain interests, definite and assertive; on the other hand, we confront facts which threaten those interests— make the desired goal difficult to attain. The dissolution of the concepts, force and substance, is the consummation longed for, but this is made impossible by the fact of necessity involved in any normal and rational interpretation of Mach's 'Funktionsbegriff'. The goal must be abandoned, or some interpretation of necessity must be offered which makes it compatible with the dissolution desired.

And thus 'Naturnotwendigkeit' is denied. The radical interpretation given above is necessitated by the context. Can it stand examination before the bar of reason and experience?

It is worth remarking, that there is in nature the appearance of necessity and law. Nature seems to proceed in regular fashion. Even if we believe it impossible to get behind this regularity as other than an 'as if', there are features and functions involved which force the matter upon our attention. We may find it easier to give some account of the matter, than to withhold a verdict. What does Mach himself have to say? The following quotations may be considered representative.

"Our physical science consists in the conceptual quantitative expression of facts".(a) "But every proposition of physical science is an abstraction which has for its presupposition the repetition of similar cases".(b) "If we copy the facts in thoughts, we never copy them absolutely, but only that phase of them which we consider weighty; our copies are always abstractions".(c) "The progressive refining of the laws of nature, the increasing limitation of expectation, corresponds to a more complete adaptation of thoughts to facts. A complete adaptation to every individual thought is naturally impossible. The manifold and largely universal application of natural laws to concrete, actual cases, is possible only by abstraction, by the simplification, schematising, idealising of facts, through intellectual analysis of the same into such simple elements that, out of these, the

a. M. 547.
b. M. 549.
c. M. 523.

given facts permit of recomposition with sufficing completeness. ....Natural science can be defined as a kind of 'Instrumentensammlung' for the intellectual completing of whatever facts incompletely present themselves, or for the largest possible limitation of our expectations in all cases which the future may offer".(a)

The idealising moment in our natural laws is here emphasized. Our laws are won by abstraction. Our idea of legality is found by idealisation of the actual. We note, however, that this idea, with its large fictitious element, presupposes the repetition of like results under like conditions. But because it is an abstraction, even this presupposed regularity does not exist in nature but only in the abstraction, in the idealisation. Thus Mach explains the regularity of nature by eliminating it. Even the regular is not objective. The only necessity is a psychological necessity, a necessity found in the dependence of our ideas upon each other. "It is only our schematic image which produces like cases. It is only in it that there exists dependence of certain marks upon each other".(b) "The facts are not required to adjust themselves according to our thoughts. Our thoughts, our expectations, merely arrange themselves according to other thoughts, namely, according to the concepts formed of the facts. If we assume that a fact corresponds exactly to our simple, ideal concepts, our expectation in agreement with this will also be exactly determined. A proposition of physical science has

a. E.u.J. 447.

b. P.V. 228.

always only hypothetical meaning....Absolute exactness, that exact and clear determination of the results of a presupposition in every particular complete, exists for physical science not in sensuous reality, but only in theory".(a)

This conclusion ,we repeat, involves Mach in the most serious difficulties. The following words absolutely contradict the statements cited above. "As a matter of fact the proposal to investigate a certain field requires the assumption that it is of such a nature as to lend itself to investigation. This, in turn, presupposes permanence, for not otherwise could anything come by investigation.(b) "That dependence is a fast and firm affair, we presuppose if we enter upon investigation.Previous experience has given this presupposition the right of preemption, and every fresh result of investigation strengthens us in the same".(c) "Only that can be described, copied conceptually in thought, which is uniform, under law".(d) "We have made no blunder in our postulate of the uniformity of nature if, on account of the inexhaustibility of experience, its absolute application does not permit of proof and if, like every aid to science, it remains largely ideal".(e) "That we, by the help of a law, can prophesy proves the deep uniformity of our environment".(f) "I am convinced that, in nature, only that happens which can happen, and that this can happen in only one way".(g) "The more exact quantitative research aims at the greatest measure of exactitude".(h) "During investigation,every investigator

a. E.u.J. 447-8.
b. E.u.J. 277.
c. E.u.J. 28.
d. M. 6.
e. E.u.J. 450-1.
f. P.V. 250.
g. W'L. 393.
h. E.u.J. 446.

is necessarily a determinist. This is the case even when he has to do with mere probabilities. The propositions which express the computation of probability hold good only when chances are discovered to be regularities".(a)

The assumption of necessary relations in nature could scarcely be more definitely expressed than in the above quotations. If it be said that these represent mere accidental lapses, we reply that their frequency and emphatic character make it scarcely possible for us to bow them out so courteously. They hold too integral a place to be passed by as casual slips. Rather do they signify a dialectic which demands attention.

Moreover if we should minimise these inconsistencies in the largest possible degree, Mach's system does not regain its stability thereby. The keystone to the arch is lacking . No proof is offered that 'Naturnotwendigkeit' does not exist. And so long as nature gives evidence of regularity and constancy, it is legitimate to demand such proof, for we are not under necessity of doubting everything which can be doubted. Rather is it our privilege to doubt nothing except for sufficient reasons. We accept things on their own report till contrary judgment is forced upon us. This is quite necessary and thoroughly scientific.

Again, it is a mere chimers to fancy that denial of an objective order leaves any epistemological standing-place, let alone furnishes such by reason of its demands. Such a denial involves intellectual annihilation. The assumption of a rational

a. E.u.J. 277-8.

order is bound up with the very structure of knowledge. And by rational we mean just what Mach so dogmatically denies, namely, an order moving under the control of fixed laws, an order composed of real connections, a decidedly objective cosmos, however ideal may be our conceptions and whatever the ultimate explanation.

This leads us to say, that Mach's conception of the relation of the idealising moment to necessity, is false to fact. It is wrong to say that idealisation first introduces necessity. It is the facts which motive the idealising act. An analysis of scientific procedure tends to confirm this statement. Every examination of nature, strengthens our faith in the report which nature makes of her own structure. And once more we call attention to the fact that Mach seems to recognise the true relation of the facts to the idealising moment. He says: "It is experience which must first teach what dependence of phenomena upon each other exists, and this experience alone can teach".(a) Again he asserts: "Our concepts are, as a matter of fact, self-made, yet they are for that very reason not made in a manner entirely arbitrary".(b)

Thus Mach seems under continual necessity of transcending his position. He denies necessity in nature, only to restore it in the most unmistakeable manner. And with such restoration, every specific point of view taken in the earlier part of the discussion loses its force and lays aside its nature. Law is no longer a mere synopsis; economic experience once more takes on

a. M. 293.

b. M. 280.

the form of real investigation; sensation is dethroned; the theoretical is again given real content and function; causality receives anew proper place and worth; Mach's whole course of thought is given a new and strange appearance. One thing we cannot avoid in analysing Mach's 'Methodenlehre'. No matter how we may approach it, whether on the higher level or on the lower, we bring it into conflict with itself. The problems concerned receive no satisfactory solution. The philosophical remains as it was before. No new necessity has been laid upon it by exact research and scientific method. Mach's philosophic results must be judged otherwise than in the light of the premises here discussed.

CONCLUSION.

In the preceding pages, comparatively little has been said, specifically and directly, concerning the 'large words' of Mach's way of thinking. However, the general discussion has made it pretty clear that the principles and conceptions peculiar to his treatment, must move within a well-defined and limited area, and that whatever value belongs to them, must be secondary and relative.

As a matter of fact, very much is settled, once and for all, when we are made to see the nature and conditions of thought as a faculty concerned in the apprehension of truth. We have a tribunal before which to cite all doubtful and suspicious characters. The main thing called for, is proper and sufficient insight. The task is no longer one of general settlement but rather one of the working out of detail. The principles of the system are established beyond the possibility of removal; there remains the critical consideration of candidates for the system, and the proper placing of elements which have secured admission. It is interesting, in this connection, to take note of the following words of a disciple of the New Realism; "The reality we know and the reality we predicate, with any intelligibility or significance, is reality for us as predicators. Even when we think of this kind of reality as being possible in another universe unradiated by a single gleam of intelligence or sense experience, we still are thinking of it, we cannot think our-

selves and everything out of such a universe without being in the universe to do the thinking away. No thinker—no object thought".(a) Knowledge and the Objective order are, thus, construed in terms of a fundamental condition which admits of enlarged acquaintance, but which defies reduction to the passive, instrumental and utilitarian.

Science, at once, takes on a far nobler form than that which Mach ascribes to it. It is a free activity. It creates its own goal, and, at every turn, displays the unique character and sublime self-mastery of the life of reason. "No one attempts to bring a science to pass, without laying an ideal foundation. Only from a single, supreme and inner purpose, which, first of all, makes the whole a possibility, can that originate, which we call science".(b) "In the system is the whole earlier than the part.....The idea is architectonic; it creates the sciences He who builds a house, first makes for himself the idea of the whole". Science is not the answer to biological necessities; it is a self-set task. It is not the sport of circumstance, but the progressive unfolding of an absolute value. It is not adaptation but realisation, not description, but, in a very real sense, creation and transformation. It exhibits, not the blind groping of an instinct, largely uncertain as to its own wants and desires,, but the free, glad leading of an ideal toward a goal which it is given to the eye of faith to see. "Scientific faith survives all errors, all inadequate theories,

a. Fullerton; Introduction to Philosophy.
b. Kant; Critique of Pure Reason.

and triumphs in the face of contradictions which seem overwhelming and final".(a) If science begins with a question it ends with a theory. The theory is the chief thing. Once established it is more certain than concrete facts, for, where contradictions arise, it is the observations, rather than the law, which are questioned.

We have seen that this conception of knowledge and science is not absent from Mach's system of thought. Certain statements give express recognition of it, and lift the entire point of view to a higher level. But, even where it is not expressed, it is presupposed, for it is this conception which enables Mach to carry his way of thinking to an apparently successful issue. His argumentation is grounded on principles which he affects to despise, and which he desires to eliminate. When once we come to see this— to perceive how utterly impossible it is to get away from the deeper conception of thought as an active and constitutive principle—we understand how secondary and relative the psychological and evolutionary must become. At the very best, we have descriptions of settled facts within a system, and not explanation of the way in which that system itself came to be; we have a possible enrichment of knowledge regarding phases and forms of historical development, but no final word said concerning constitution and validity. It is within this sphere that we are to look for the legitimate meaning and real value of Mach's peculiar conceptions. The principles of adaptation,

a. **Knox; The Direct and Fundamental Proofs of the Christian Religion. p.34.**

economy and continuity will serve as illustrations. We give them brief consideration.

a). "The adaptation of thoughts to facts, we characterize as observation, the adaptation of thoughts to each other, however, as theory".(a) "Experience grows by means of progressive adaptation of thoughts to facts. By means of the adaptation of thoughts to each other, there arises the clearly ordered, simplified and consistent system of thought, which hovers before us as the ideal of science".(b) "The impulse to the completion of half-observed facts in thoughts arises, as we indeed feel, not in the individual facts; nor does it lie, as we just as well know, in our will; it appears rather as a strange power, as a law standing over against us, which drives both thoughts and facts forward".(c)

These quotations place before us afresh the meaning and scope of the principle of adaptation as conceived by Mach. We also perceive, at once, something of the difficulty accompanying such a biological conception of this idea. Adaptation is determined for us, and not at all by us. The process of adaptation moves forward without our help and in spite of our will. We are under compulsion to a law foreign to ourselves. We are driven forward from behind. We are, in deed and in truth, a piece of nature. But this contradicts all we have said above concerning the nature of thought and science. The two are entirely incompatible.

a. E.u.J. 162.
b. E.u.J. 18.
c. P.v. 249.

Nevertheless, Mach speaks of the 'Ideal' of science. It is difficult to see how, under the conception we have just mentioned, an ideal can have any real place or meaning. An ideal is something freely posited, not something fated to arrive in ordained season. And this ideal, with Mach, is adaptation itself, the adaptation of thoughts to facts. But, then, Mach vacates his former position. Adaptation cannot remain a law of nature.

But, perhaps, we are to define adaptation in terms of truth. Then, again, one of two things comes to pass. We have in the fact of adaptation, a criterion for the correctness of a theory or of a thought, and so have introduced a 'worth estimate', which means transcendence of the psychological point of view, and the presupposition of a deeper principle of interpretation upon which the psychological itself rests. Or we are simply giving a name to that which we find present. That which we find to be at present existing, we characterise as adapted. If it were not adapted it would not exist. It is easy to see that we have here really said nothing. The whole matter of truth is still left to be defined, or we must accept every existing fact as the truth, which, of course we would, by no means, be willing to do. We are reminded, here, of the doctrine of the survival of the fittest. This was thought to do great service as a principle of explanation. And yet when the ambiguity was removed, and it was seen at its true value, what did it mean? Simply this, that the able to survive survive, and the

unable to survive do not survive. No one doubts the truth of this, but for purposes of explanation, we might very well feel that we have not made much progress. Before we get anywhere, we must define fitness and unfitness as related to survival. Otherwise we are only uttering commonplaces, no matter how much we may think we are talking wisdom. Is it not just the same here? Leaving aside the mechanical implications of Mach's use of the idea of adaptation, the whole affair reduces itself to this: Either Mach must transcend his own position and make the idea an entirely subordinate one, or he simply utters platitudes, and leaves the whole question of truth untouched, as he fails to make any real distinctions within the merely existing. We have, it would seem, a show of wisdom lacking the power. And yet phrasings, especially when giving forth a certain kind of sound, can give the appearance of much deep thought on matters philosophical. Adaptation may be useful to describe an order of events, but put forward as a principle of explanation, it either beats time, or leads to its own annihilation.

b). The same general argument holds good for the principle of economy. In the best of cases it is a biological hypothesis. As such, it is secondary, and subject to logical and epistemological examination. When we once call to mind the meaning of method, we perceive something of the measure of truth present in the conception. The very name method suggests economical

procedure. But in terms of what, are we to define the economical? And is economy the only principle which governs achievement? All experience answers in the negative. The aesthetical and artistic are certainly not governed by this principle alone. There is a homely saying to the effect that "the longest way round is the shortest way home". It would seem to have a large measure of application wherever there is present a distinctly ideal goal. A proper conception of the task of science, makes it only one of several considerations. Convenience, here, is not the only or the chief concern. The man who investigates nature aims to understand the facts. His goal is a victory of thought over matter. The welfare of the human race may constrain him. How largely would mere convenience then figure? And even if we limit scientific endeavor to the acquisition of knowledge for its own sake, a knowledge of facts as facts, would not put a quietus on achievement. For facts can never replace laws and the search for laws would still go on. The need of knowledge is not limited to the biological.

This conception finds a counterpart in Spencer's conception of movement along the line of least resistance. Here, again, what seems so full of promise, turns out, on examination, to be an abstract and barren affair, or else implies what carries it entirely beyond itself. What looked so simple, becomes enormously complicated; what appeared so ultimate, is forced to take its place among the subordinates and relatives. The principle

of economy is largely in the same place. It may be said to be a description after the fact. As such it is made to include all the motives and ideals which led up to the goal attained. But to so use the name economical is to completely transcend its original meaning. It is made to fit the facts and no longer denotes that which meets the demand of the biological. In any case, its value remains purely and solely descriptive. As a means of evaluation it quits its proper sphere, and says and does many foolish and unwarranted things.

c). "Evolution and the inviolability of natural law are supposed to be proved, but the scientific man knows that so far from being proved, they are merely the popular expression of the presupposition of scientific proof, the law of continuity, with its consequences. For with the principle of continuity assumed, development in some form is the necessary outcome.....The law of continuity is fundamental to the modern view of the world. Thus the universe takes on the aspect, not of a manufactured article, but of a growing organism".(a)

This law of continuity is fundamental to Mach's entire treatment. It may be said to be the shaping force in his system. Its interests and supposed demands are everywhere paramount. What, then, we may ask, does this law demand? What is the nature and the measure of its coercion?

As employed by Mach, the law seems to rule out the possibility of a leap. All progress is by way of successive modifi-

a. Knox: The Direct and Fundamental Proofs of the Christian Religion; Scribner's, 1908. pp 16-17.

cations. We pass from point to point without a break. True, discontinuity is expressed as a fact in certain statements, but these, once more, we may regard as written on the level of the free activity of thought, and contradicting the fundamental motive and point of view. Is Mach's conception, we ask, integral to the law? And does this law possess the coercive force which Mach conceives it to have?

We might be more diffident in the matter of questioning here, were there any consensus of opinion among the scientists themselves as to what the law under consideration requires. As a matter of fact we find all varieties and shades of opinion. "As used by some speculators, it seems to exclude all antitheses whatever; and Spencer's attempt to deduce all heterogeneity from the homogeneous, may be viewed as an attempt to give the law this universal significance.....The empiricist has no difficulty in showing that sensation is the only fact, because to allow anything different would be to break continuity. But while one speculator deduces life from the lifeless by the principle of continuity, another denies the possibility on the same ground.... Materialism is affirmed and denied in the name of continuity....Sometimes it is simply a denial of creation and the supernatural; sometimes it means that nature never makes a leap; sometimes it means that all phenomena are but phases of a common process, and that from any fact whatever in the system we can pass to any other, however different, by

simple modifications of this process. In short, it means anything which happens to be desirable".(a)

We seem, thus, to be confronted with a rational demand, but with very unclear and unsteady notions as to just what this demand signifies. May we be allowed to interpret it in the light of what was said above concerning the life of reason as free and purposive activity.

The law of continuity, from this point of view, cannot exclude personal initiative. It erects no barrier of necessity against anyone. It cannot be interpreted in terms of mechanical necessity. The antecedent cannot be traced into the consequent on the impersonal plane. Natural causality becomes insufficient. Self-determinations cannot be so explained. Even our sensations, cannot be deduced from an antecedent state of mind. In a word, the whole affair is carried up, of necessity, into the sphere of purpose. Here, for the first time, does it become clear and answer to the demands made by the facts concerned. Only in the light of the volitional and purposive can we understand much of the content of the material world. Personal impress modifies and transforms. A new antecedent is introduced and consequents arise for which the natural system is not sufficient and is not responsible, but which, at once, take their place within that system, and submit themselves to the common order of law. And it is just in terms of this common order that the law of continuity must be interpreted. Continuity can mean no

a. Bowne; Metaphysics; pp. 263-4.

more than the continuity of phenomenal law. And this continuity it is, which insures our purposive activities recognition, and provides a place for their proper interpretation and constant functioning.

Thus, continuity is not the fearsome thing that it was supposed to be. It is not a metaphysical doctrine necessitating a fundamental revolution, but rather an inductive postulate by means of which we construe experience. It advantageth much for certain purposes, but it is neither productive nor prescriptive. It imposes no barrier to free purposive activity, but rather offers conditions which make the exercise of freedom most thoroughly effective. It determines us to the acceptance of no new epistemological or metaphysical principles, but rather describes the manner in which thought as a living power expresses and realises itself in a phenomenal order. As such it is worthy of all acceptance; as frequently conceived it demands chastening and exorcism.

Having once rid curselves of the psychological and evolutionary obsession, we may with profit consider the value of the genetic mode of treatment. And this value is not far to seek, nor can it be depreciated or despised. The psychological point of view emphasises the life of thought as something concrete and actual. This has been too frequently overlooked in the interests of the purely logical. Failure to give full credit to

the psychology of knowledge has been a primitive cause of failure to many otherwise notable schemes of epistemology. Thought has been reduced, in the interests of logic, to a merely formal affair. An 'intellectual barbarism' has frequently held the field. Matter-of-fact thinking has been disregarded. All that makes thought a real and concrete has been held in contempt as a sort of by-product scarcely worthy of consideration.

This the psychological treatment aims to rectify. If we are to know thought, we must study it as a full-orbed and vital activity. Knowledge is more than the result of logical arrangement. It comes "through the feeling-full commerce of an intelligent, self-conscious will which finds itself in relations of action and reaction with other purposeful wills. This is the fact of experience, although we can only partially explain the fact. This is the truth with regard to the development of experience, although we can never wholly clear up the mystery of such a development...Without intellect there is no knowledge; without feeling there is no knowledge; without doing, and experiencing the effects upon ourselves and our object, of this doing, there is no knowledge". (a) A narrower conception is bound to call forth protest. Such protest we have in the psychological emphasis. As such we bid it welcome and stand ready to aid it in the furtherance of its purpose.

a. Ladd; Knowledge, Life and Reality: Dodd, Mead Co. N.Y. 1909. pp.60-1.