UNIVERSITÉ D'OTTAWA ÉCOLE DES GRADUÉS

AN EXPOSITION AND CRITIQUE OF THE LOGICAL STRUCTURE AND BIOLOGICAL BASIS OF THE ORTHOGENETIC THEORY OF PIERRE TEILHARD DE CHARDIN

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CURRICULUM STUDIORUM

Kenneth G. Butler was born August 19, 1941, in Ottawa, Ontario. He received his Bachelor of Arts degree in History and Philosophy from St. Patrick's College, Ottawa, Ontario, in 1965. He received his Master of Arts degree in Philosophy from the University of Ottawa, in 1970. The title of his thesis was The Epistemological Foundations of Bertrand Russell's Philosophy of Science.

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INTRODUCTION

Although there has been considerable commentary on the content of Pierre Teilhard de Chardin's theory of orthogenesis, there has been no major attempt to delineate the structure of that theory, to identify the modes of explanation it employs or to situate Teilhard's approach to the world within the general context of scientific explanation. This is the major task of this thesis.

Such an attempt should be particularly valuable in not only rendering the theory itself more intelligible but also in providing a basis for an answer to the questions of the scientific cogency of orthogenesis which entail the queries as to whether or not orthogenesis is a scientific theory and if it is, is it a good theory.

The first part of this thesis deals with Teilhard's general scientific heuristic, and it attempts to establish initially that Teilhard's overall goals, his methodology and his adoption of narrative description are generated out of his adherence to a biological evolutionary model. This is followed by a description of the Teilhardian usage of a method of synthesis and analysis. It is claimed that both methods employ hypotheses as part of their general procedure and it is further claimed that these methods, just as in the case of the Teilhardian heuristic predetermine to some extent the structure and content of the scientist theory.

The last segments of this chapter delineate an explanatory schema of orthogenesis and present two influential, complementary views as to the major features of scientific theories in general. This provides the foundations for the analytic description of orthogenesis.

Finally, there is a set of appendices concerning the concept of a model, the Teilhardian model and Teilhard's notion of hypothesis, as well as two alternative views to Teilhard's on method- those of John Stuart Mill and Isaac Newton. This supplements and highlights the material within the text.

The initial segments of the second chapter explore the hypothetical nature of Teilhard's problem, the meaning of human consciousness in the universe, and focus on Teilhard's primary categorizing postulate, the notion of complexity. This is followed by a description of the explanatory elements of orthogenesis, and a parallel between Teilhard's Complexity-Consciousness Law and the periodic law of chemistry is established. Here it is also maintained that the orthogenetic theory does not conform strictly to the hypothetical deductive paradigm of scientific theories because of the problem of conditions.

The reasons for the problem, the circumstances presented to the biological scientist by the area of the world with which he must deal, comprise the content of the next sections. It is maintained and demonstrated by the testimony of such eminent biologists as George Gaylord Simpson and Ernest Mayr that the complexity of biological systems with their consequent factors for indeterminacy, as well as the necessary place in biological theories for 'teleonomic' and 'historical' explanation, renders the program of describing the universe of biological events by ideal hypothetical deductive paradigm a practical impossibility. The sections subsequent to this schematically delineate the structure of orthogenesis, taking into account the genetic sub-laws which characterize orthogenesis' theoretical statement. This is followed by an exploration of the meaning of extrapolation for Teilhard. Based on an extension of the analogy established between complexity-consciousness and chemical periodicity, the manner in which Teilhard derives inferences from the Complexity-Consciousness Law is described. The next and final segments of this chapter indicate through inference forms the range of implication, possible to Teilhard, when the hypothetical deductive and narrative forms of inference are considered jointly.

The final chapter of this thesis attempts an evaluation of the Teilhardian theory of orthogenesis.

It is argued initially that Teilhard's most general scientific goals are compatible with the stated aims of some important scientists. It is further argued that Teilhard's notions of 'emergence', 'wholes' and the place of 'historical' explanation, considered outside of the context of the orthogenetic theory, can be accepted on the ground that their necessity is testified to by some of the most important contemporary scientists.

The following passages show that the Teilhardian notions of phenomena physics and ultraphysics do not, if the concept of narrative explanation is accepted, depart so far from the mainstream scientific conceptions to render them, per se, invalid.

It is argued and textually demonstrated that, in fact, Teilhard intended his theory of orthogenesis to be a scientific theory. It is further argued that the incompleteness of orthogenesis provides a key to its structural weakness.

It is contended in the following sections that the difficulties with Teilhard's theory are not of a purely logical type. It is claimed that the logical fallacies which appear to typify some Teilhardian inferences are not unique to Teilhard's theory but are characteristic of the nature of a great many reasoned conclusions in the physical sciences. The main structural weakness of orthogenesis is a result of the fact that Teilhard fails to supply the 'objects' of his investigation with conceptually and operationally specific definitions and this in turn renders the connections between his observational levels and theoretical explanatory levels, nebulous. The implications of this lack of definition for the relationships between his theoretically postulated agency 'radial energy' and its effects occuring on the observational level are explored, and the structural inadequacies of orthogenesis, due to this lack of definitions, correspondence, principles, and bridge constructs, are described. Teilhard, it is maintained, fails to interconnect the various periodicities and postulated regularities in a sufficiently concrete way to make physical confirmation of his theory as a whole possible. Furthermore, it is claimed that certain of his auxiliary support postulates have themselves little scientific warrant and, as such, must be considered ad hoc in nature.

The next segment describes Teilhard's own principles of validation, coherence and fertility and argues that these criteria are not, perhaps even for Teilhard himself, sufficient for rendering theoretical cogency. It is argued further that, because of the structural and evidential inadequacies, the cogency of the elements of orthogenesis, where confirmation is possible, must be considered individually and that the theory cannot be confirmed or disconfirmed as a whole. The last section, however, establishes the point that there appear to be no logically necessary reasons why the theory could not be given the structural connectives, sufficient to rendering it capable of physical test.

Finally there are the appendices to this chapter, which contain material on levels, coherence, fertility and evidence which supplement the text.

CHAPTER I

THE PRE-THEORETICAL DETERMINANTS OF THE STRUCTURE OF THE ORTHOGENETIC THEORY

INTRODUCTION

The first chapter of this thesis tries to identify certain features in the history of science[1] and certain of Teilhard's presuppositions which combine to form an interpretive framework out of which the orthogenetic theory is evolved. Without claiming that either the list or treatment of these pretheoretical factors is exhaustive or that the orthogenetic theory in its structure and content is strictly determined by them, it is posited that these 'elements' did exert a positive influence on the expression of Teilhard's theory.

The pre-theoretical elements concern the topics of 1) Teilhard's views of the ultimate goals of scientific theorizing, 2) the Teilhardian assumptions about what sort of general features the world must have as well as concomitant categories of explanation, if these goals are to be reached, 3) some of Teilhard's reasons for proposing these categories as a function of his utilization of biological explanation as a model for explanation of all phenomena, 4) some aspects of his method, analysis and synthesis, 5) analogical inference as a method

1. This is to say certain attitudes and views concerning approaches to nature and the ultimate aims of scientific theorizing which have exerted an influence on the development of scientific thought.

of research and 6) several important features of scientific explanation as well as typical theory characteristics.

Although it is not worked out in exact detail, it is assumed throughout this chapter that there is an interrelationship among physical, epistemological and methodological presuppositions such that whatever the extramental world is believed to contain, determines to an extent the belief about how its 'stuff' may be known and how it may be known truly.

1. The Problem of the Logic of Discovery and Pre-theoretical Determinants.

There is a profound difficulty in attempting to reconstruct the method(s) employed by a working scientist. Initially there are three distinct areas for consideration wherein discussion of method is pertinent. These are (a) the operations by which (and the attendant reasons for the employment of these operations) a scientist derives new statements about nature; (b) the way he relates these statements, that is, the structure of his theory and the reasons for the mode of relation; (c) the methods used to provide, in the case at least of a new theory, 1) criteria of justification, 2) experimental justification for the theory. The immediately following sections are concerned primarily with (a) and partially with (b).

The difficulty with (a) is a function of the fact that very few contemporary scientists or philosophers of science accept that there is a logic of inquiry. Popper states for example, "The initial stage, the act of conceiving or inventing a theory, seems to me neither to call for logical analysis nor to be susceptible of it".[2] The problem of how theoretical content is derived then, is taken by Popper and many others to be a problem for the psychologist and not the logician or the philosopher of science.

Supposing it is true that there is no logical discovery, that is, no unique set of rules or procedures by which scientists can mechanically infer new facts and theories about nature, and supposing it is also true that the process by which a scientist arrives to explanations of natural phenomena is not a proper subject for philosophical investigation, it does not necessarily follow that every one of the elements composing the context out of which a theory is generated is irrelevant to the understanding of the structure and content of that theory. In Michael Polanyi's words,

> .... even the highest degree of originality can operate only by taking for granted some elements of an existing interpretive framework. In science these elements form the premises and method employed by the scientist. They define his general purpose, inspire his heuristic vision, and eventually bring forth his problem.[3]

Without attempting to establish that there is a logic of discovery, but given the dual assumptions that Polanyi is correct in his assertions about the role of interpretive frameworks, and that the delineation of some elements of this type of context is in fact relevant

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2. Popper, Karl, The Logic of Scientific Discovery, London, Hutchinson, 1959, pp. 31-32.

3. Polanyi, Michael, "Notes on Professor Grünbaum's Observations" in current issues in The Philosophy of Science, (ed. H. Feigl and G. Maxwell), 1959, New York, Hold, p. 54.

to the intelligibility of the orthogenetic theory, the following descriptions are given.

While previous theories would qualify as one such element, this aspect of the framework is set aside for subsequent exploration. It is with the topics of some Teilhardian 'premises'[4], with aspects of his method, his general purpose and 'heuristic vision', that the immediately following passages are concerned.

2. Teilhard's Scientific Heuristic

An insufficient amount of attention has been paid, by his many commentators, to what might be called Teilhard's scientific heuristic. A good deal of the content of Teilhard's theory and its manner of presentation may only be properly understood contextually. One part of the context out of which Teilhard theorizes is his problem viz., "man's place in nature"[5], and the problem logically precedes the theory. Another part of the context which also, in a sense, comes before the theory, is Teilhard's belief in the type of theoretical entities that he, as a scientist, must search for. This belief serves to direct or regulate, to an extent, that which must appear in his theory. This point can perhaps be best illustrated through a comparison and a

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4. Polanyi says elsewhere that "The rules of scientific procedure which we adopt and the scientific beliefs and valuations which we hold are mutually determined. For we proceed according to what we expect to be the case", in Personal Knowledge, New York, Harper, 1958, p. 161.

5. Teilhard de Chardin, P., in the Foreword to Man's Place in Nature, (René Hague Transl.), London, Collins, 1966 (Editions du Seuil 1956), p. 14.

contrast.

Albert Einstein and Teilhard, as scientists, appear to agree with each other on the following points:

(1) There is an external world.[6]

(2) This extramental world is structured.

(3) The structure is in part composed of pervasive and recurrent patterns.

(4) The patterns are to some extent intelligible.

(5) Knowledge of the patterns entailing a high degree of generality may only be arrived at by indirect means.

(6) It is the task of the scientist to provide représentations of the world of increasing scope and accuracy.

(7) The scientist must provide the methods, conceptual and physical, by which such pictures may be constructed and validated.

2.1 Teilhard's Ultimate Scientific Goal

Despite these areas of agreement, there are important points of difference. Einstein expressed the view, that

> Our experience hitherto justifies us in believing that nature is the realization of the simplest conceivable mathematical ideas. I am convinced that we can discover by means of purely mathematical constructions the concepts and the laws connecting them with each other, which furnishes the key to the understanding of natural phenomena....[7]

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6. For a textual validation of these points, see Appendix A "The Heuristic of Teilhard and Einstein: A Comparison and Contrast".

7. Einstein, Albert, Essays in Science, Mein Weltbold, transl. Alan Harris, New York, Wisdom, 1934, p. 17.

While Teilhard would certainly have agreed with Einstein about the usefulness of mathematics as an analytical tool, and as a language of description for the expression of scientific concepts, he does not see the ultimate goals of theory construction to be the same, nor does he see mathematical analysis or hypothetical deduction as the sole means of arriving at knowledge of the world. On the question of goals, Einstein maintained that the final goal of science could be "the explanation of all eventssin nature by structure laws valid always and everywhere"[8] where the structure referred to involves invariant relationships holding among "electricity, magnetism, gravitation.... and the equivalence of mass and energy"[9]. For Teilhard, "the truly indestructable residue of the conquests of science in physics and chemistry is represented by the discovery and cataloguing of a vast family of natural unities, centres and nuclei, defined by specific properties and grouped in graded categories"[10]. And he says as well,

> What conclusion can we reach except that physics, chemistry and astronomy are contributing their most valuable speculative results to a purpose required by both nature and truth: that here before our eyes they are jointly constructing a vast systematics of the inorganic world into

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8. Einstein, Albert and Infeld, Leopold, The Evolution of Physics, New York, Simon, 1938, p. 243.

9. Evolution of Physics, p. 243.

10. Teilhard de Chardin, Pierre, "The Natural History of the World" 1925, in The Vision of the Past, J.M. Cohen, transl., London Collins, 1966, (Editions du Seuil 1957), p. 112.

> which the classification of organic beings can be inserted on the level of the biosphere.[11]

This difference in goals entails a difference in the sort of entities which are to be looked for in the world and in the manner of approach to them. Since Teilhard postulates that the "ultimate speculative goal of science" is "an extended systematics"[12], not surprisingly the concepts involved in the notion of the multi-leveled universe[13] containing

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11. Teilhard de Chardin, P., "The Natural History of the World", in The Vision of the Past, p. 112.

12. __________, "The Natural History of the World", in The Vision of the Past, p. 110.

13. Teilhard categorizes the major stages (and levels) and mechanisms, as he sees it, in the following lines:

"1. We may seek to distinguish the phases or pulsations of the cosmic rise into complexity (that is to say, into the Improbable) as follows:

a) The pre-atomic phase: formation of nuclei and electrons;
b) The atomic phase: grouping of nuclei in atoms (fixed and limited number of free 'compartments');
c) The molecular phase: grouping of atoms in finite or indefinite chains;
d) The cellular phase: grouping of molecules in centrated clusters.

In all these cases, up to but excluding Man, the arrangement seems to have been brought about mainly by the working of chance and of probing; but in phases a to c the majority of the groups (except in the case of very large molecules) represent knots of stability, whereas in phase d the arrangements that survive represent privileged centres of activity.

2. It may be as well here to distinguish between the two types of 'coiling' or 'in-folding' in the evolutionary process.

a) The Coiling of Mass, which sub-divides Matter without organising it (e.g. the stellar masses);
b) The Coiling of Complexity, which organises elementary masses in ever more elaborate structures.

All Mass-Coilings certainly do not result in Coilings of Complexity; but on the other hand all Coilings of Complexity seem to originate or be conditional upon a Mass-Coiling -- for example, Life, which could only be achieved on the physical foundation of a planet." In Turmoil or Genesis? in The Future of Man, London, Collins, New York, 1964, p. 217.

qualitatively dissimilar structures and processes as those involving sequential temporal relation must in principle appear in Teilhard's theoretical statements.

2.2 Teilhard's Methodological Assumptions

The manner of approach, the cataloguing, entails a concept of history which nowhere appears in the theoretical statements of pure physics. Teilhard contends that,

> ....besides the group of phenomena subject to direct observation, there is for science a particular class of facts to be considered - specifically the most important because the rarest and most significant - those which depend neither on direct observation nor experiment, but can only be brought to light by a very authentic branch of physics, the discovery of the past.[14]

The introduction of the concepts of levels and history, (alteration through time) entails the alteration in what might be called the central scientific methodological heuristic of orthodox science by Teilhard as well. This methodological heuristic entails the proposition that the world can be approached as if it were composed of a multiplicity of

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14. Teilhard de Chardin, P., The Phenomenon of Man, (Bernard Wall, trans.), London & Harper & Row, 1959. (Editions du Seuil, 1955), p. 98.

closed systems.[15] About this Ernest Nagel contends, as a question of historical fact, that both theoretical and experimental science have approached the world on the methodological assumptions that, (a) "everything is not relevant to everything else"[16], (b) "occurrences in

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15. However, according to Teilhard,

"....there remains the essential transformist view (that is to say that living forms constitute a natural association of things, connected in such a way that we can picture to ourselves scientifically the history of their successive appearances and expansions). There remains this general view, I repeat, which is increasingly accepted (at least implicitly) by all natural scientists. There is not one of the millions of facts daily noted by specialists in classification, comparative anatomy or physiology that is not in full agreement with it. Everything is classifiable, that is to say everything finds its natural place (spatial and temporal) each day in the general history of the earth. This is an enormous fact: the veritable proof that the sensible appearance and progressive stages of life obey an empirical law, that is to say can be treated by science as a phenomenon. ....transformism is, at bottom, no more than an admission that we can plot the history of life as we plot the history of human civilizations or of matter. All empirical reality is, by nature, historical (capable of narration). How by what unthinkable miracle, could life escape from this universal condition?

Thus understood, transformism is no longer a simple hypothesis. It is a general method of research, accepted in practice by all scholars. More broadly still, it is merely the extension to zoology and botany of a form of science (historical science) which is continually extending its rule over all human sciences (physics and chemistry...", "What should we Think of Transformism?", 1930, in The Vision of the Past (J.M. Cohen, transl.), London, Collins, 1966, (Editions du Seuil 1957), p. 152.

16. However, Nagel also contends that, "It is a fact of history that the search for isolated (or enlarged) systems... not coinciding with the total cosmos has thus far been successful. Indeed our general unhesitant readiness to conduct our inquiries in accordance with the principle is undoubtedly based on the high frequency of successes that have rewarded our past action guided by it"., as found in Nagel, Ernest, The Structure of Science, New York, Harcourt, 1961, p. 323.

one part of the world are not dependant on what happens everywhere else"[17]. According to Nagel as well, these assumptions are incorporated in one version or application of the principle of causality, to furnish a directive to the effect that the world must be approached as if it were composed of a multiplicity of closed, but often parallel, systems.

While Nagel also admits the possibility that,

> It is abstractly conceivable....nothing short of the entire cosmos is an isolated system, with respect to certain types of occurrences which explanations are sought. In consequence, it might not be possible to devise explanations for such occurrences involving references to only a limited set of objects and properties, in conformity with the principle. In that eventuality the pursuit of scientific knowledge in connection with events of that type would be impossible, and the principle a useless guide....[18]

Teilhard makes just such a claim with respect to the phenomenon of man and more generally the phenomenon of evolution. He says for example that, "the order and design of the universe do not appear except in the whole"[19]. In other passages he stresses that no 'level' of the cosmos may be adequately understoood without an understanding of antecedent levels. Teilhard, however, does not completely reject the notion of a closed system, or the type of explanation derived from the assumptions of such systems; rather he augments the assumptions underlying this notion with others of his own. He says for example,

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17. Nagel, Ernest, The Structure of Science, p. 323.

18. __________, The Structure of Science, p. 323.

19. Teilhard de Chardin, P., The Phenomenon of Man, p. 45.

> Everything does not happen continuously at any one moment in the universe. Neither does anything happen everywhere in it.[20]

And this principle allows the possibility of regarding events as localizable in space and time. Temporally, because all events do not happen simultaneously, there exists the possibility of situating events in sequence, that is historically; and spatially because every event does not happen everywhere simultaneously, the possibility exists for analyzing, comparing and contrasting these events in such a way that in some cases they may be treated as if they were discrete or disconnected, for special methodological reasons.

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20. Teilhard de Chardin, The Phenomenon of Man, p. 49

21. Teilhard writes on this

"....under the influence, unconcerted but convergent, of the natural, historical and physical sciences, an entirely new concept the almost imperceptibly shaped itself in our minds.

We have in the first place realised that every constituent element of the world (whether a being or a phenomenon) has of necessity emerged from that which preceded it - so much so that it is as physically impossible for us to conceive of a thing in Time without 'something before it' as it would be to imagine the same thing in Space without 'something beside it'. In this sense every particle of reality, instead of constituting an approximate point in itself, extends from the previous fragment to the next in an indivisible thread running back into infinity.

Secondly, we have found that the threads or chains of elements thus formed are not homogeneous over their extent, but that each represents a naturally ordered series in which the links can no more be exchanged than can the successive states of infancy, adolescence, maturity and senility in our own lives.

Finally, we have gradually come to understand that no elemental thread in the Universe is wholly independent in its growth of its neighbouring threads. Each forms part of a sheaf; and the sheaf in turn represents a higher order of thread in a still larger sheaf - and so on indefinitely", as found in "The New Spirit, 1942", in The Future of Man, (N. Denny, transl.), London, Collins, 1965, (Editions du Seuil, 1959), p. 83.

2.3 Teilhard's Positive Methodological Heuristic

This view, as it is expressed by Teilhard in the previous passage, actually assumes two principles which function in exactly the same fashion as the principle of causality has been interpreted to function[21a]. When Teilhard states that,

> In the world nothing could burst forth as final across the different thresholds successively traversed by evolution (however critical they may be) which has not already existed in an obscure and primordial way,[22]

he is actually stating his own research directive. This directive includes recording the families and describing the 'firsts' according to similarity and difference. This last, is only possible on the basis of a kind of parallel case. The grouping and grading of emerging phenomena, according to their appearance in time, and their structural affinities, carries explanation beyond the description of parallel cases. The reasons for similarity and difference is to be sought, according to Teilhard, in a common origin. The theory of evolution constitutes part of the natural history of the world. The world, according to Teilhard then, cannot be approached as a system composed of non-interacting, if sometimes similar sub-systems, but rather as a universe in which

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21a. That is, in Nagel's words, as "a maxim for inquiry rather than a statement with a definite empirical content, as found in <u>The Structure of Science</u>, p. 320.

22. Teilhard de Chardin, P., <u>The Phenomenon of Man</u>, p. 71.

similarity and difference become comprehensible on the basis of structural and temporally sequential connections. Parallel systems are for Teilhard just a special case of a wider system of relationships and the description of them must be augmented and modified to allow for the recognition of cosmic connection. Teilhard's principles could be summed up in the following way:

(1) If the universe is to be understood, the non-reducibility of the emergent phenomena must be recognized. About this he says that his theory

> ....should not be understood as though spirit were gradually formed simply as an effect of polarization or mathematical summation, with the totality of the centres initially involved in centrogenesis remaining intact (and with no additions) at the term of the unifying transformation. During the process, centres that are truly new emerge from successive syntheses or segmentations under the influence of centro-complexity. And finally, only the reflective nuclei....represent the irreversible portion of the spiritualized universe.[23]

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23. Teilhard de Chardin, P., "Centrology", in Activation of Energy, (R. Hague, transl.), London, Collins, 1970 (Editions du Seuil, 1963), p. 125. And elsewhere, Teilhard states

"What can be put together can be taken apart".

At an early stage of their discoveries biologists were surprised and fascinated by the fact that living beings, however perfect (or even more perfect) their spontaneity, were always decomposable into an endless chain of closed mechanisms. From this they thought they could deduce universal materialism. But they overlooked the essential difference between a natural whole and the elements into which it is analysed.

By its very construction, it is true, every organism is always and inevitably reducible into its component parts. But it by no means follows that the sum of the parts is the same as the whole, or that, in the whole, some specifically new value may not emerge. That what is 'free', even in man, can be broken down into determinisms, is no proof that the world is not based on freedom - as indeed I maintain that it is. It is simply the result of ingenuity - a triumph of ingenuity - on the part of life.

(2) No system is truly closed. In order to adequately understand any system, it is not enough to be able to describe that system's mechanisms, but the origin of its parts and processes must be described as well. While the inter-connectivity of all cosmic processes in Teilhard's world view is testified to by the following passages, he maintains that,

> In its different orders of magnitude, matter never repeats its different combinations....These multiple zones of the cosmos envelop without imitating each other in such a way that we cannot pass from one to another by a simple change of coefficients. Here is no repetition of the same theme on a different scale. The order and the design do not appear except in the whole. The mesh of the universe is the universe itself.
>
> Thus it is not enough merely to assert that matter forms a block or whole.
>
> The stuff of the universe, woven in a single piece according to one and the same system, but never repeating itself from one point to another, represents a single figure. Structurally, it forms a Whole.[24]

Teilhard implies the following two points when he says,

> It was only in the middle of the nineteenth century, again under the influence of biology, that the light dawned at last, revealing the irreversible coherence of all that exists. First the concatenations of life and, soon after, those of matter. The least molecule is, in nature and in position, a function of the whole sidereal process, and the least of the protozoa is structurally so knit into the web of life that, such is the hypothesis, its existence cannot be annihilated without *ipso facto* undoing the whole network of the biosphere.

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24. Teilhard de Chardin, P., *The Phenomenon of Man*, pp. 44-45. Elsewhere on the same topic, Teilhard contends that

"In the nineteenth Century the theory of evolution (transformism) was simply a problem of animal speciation. Today it extends to the general problem of the corpusculization of energy throughout time, from the atomic elements to the individual man...", as found in "The Reflection of Energy", in *Activation of Energy*, p. 324.

> The distribution, succession and solidarity of objects are born from their concrescence in a common genesis.[25]

(2.1) Parallel structures and processes also are partly explicable through historical antecedents.

(2.2) Emergent phenomena, whether unique or multiple and parallel, have historical antecendents.

(2.3) The historical process has been the history of the development from simple to complex. Everything shares, even if very remotely, a common heritage.[26]

(3) No system is unaffected by any other system; rather, the influences vary in intensity according to proximity and other factors.[27]

(3.1) It is this relative remoteness, as well as certain other factors, which allow some systems to be dealt with, for methodological reasons, as if they were closed.

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25. Teilhard de Chardin, P., The Phenomenon of Man, p. 218.

26. About this Teilhard states, "Evolution does not exactly correspond, as Spencer maintained, to a transition from homogeneous to the heterogeneous - but to a transition from a dispersed heterogeneous - or....to a transition from a lower to a higher state of centro-complexity", as found in "Centrology" (1944), in Activation of Energy, p. 103.

27. This may be inferred from the following passage:

"....the radius of action proper to each cosmic element must be prolonged in a straight line to the utmost limits of the world itself. As we said above, since the atom is naturally co-extensive with the whole of the space in which it is situated - and since, on the other hand, we have just seen that a universal space is the only space there is - we are bound to admit that this immensity represents the sphere of action common to all atoms. The volume of each of them is the volume of the universe". As found in The Phenomenan of Man, p. 45.

(3.2) However, according to Teilhard, such a procedure has intrinsic limitations and must be supplemented by procedures which involve historical and structural reconstructions[28]. These directives are completed by one other which may be summarized in the following way; whenever a phenomenon appears to be anomalous or unique, look for its presence as a universal disposition throughout space-time. From the examples that Teilhard gives to illustrate this principle, Teilhard would appear to have in mind those phenomena, having especially to do with energy and its effects. This heuristic principle might be rephrased to read, that whenever there appears to be an anomaly of structure or behaviour, look for its explanation in some general underlying disposition of mass-energy.

Whether Teilhard would have thought about this as a heuristic principle is difficult to know[29]. However, this, along with the other

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28. On this proposition, Teilhard maintain that, "Physics was born, in the last century, under the double sign of fixity and geometry. Its ideal, in its youth, was to find a mathematical explanation of a world imagined as a system of stable elements in a closed equilibrium. Then, following all science of the real, it was inevitably drawn by its own progress into becoming a history. Today, positive knowledge of things is identified with the study of their development". As found in The Phenomenon of Man, p. 46.

Elsewhere in the same work, Teilhard writes, "Up to now, we have been looking at matter as such that is to say - as though it were permissible....to break off a fragment and study this sample apart from the rest. It is time to point out that this procedure is merely as intellectual dodge". As found in The Phenomenon of Man, p. 43. For a further discussion of the notion of the 'closed system', see Appendix B "The Deterministic System".

29. There is reason to believe however that he implicitly viewed his approach as parallelling orthodox scientific inquiry. He says for example about consciousness, as an apparent epiphenomenon, that "...which of us does not constantly see identical problems facing research workers, which have to be solved by the same method, namely to discover the universal hidden beneath the exceptional?" As found in The Phenomenon of Man, p. 56.

methodological heuristic principles, functions very much in the manner that Mill's principle of causation is interpreted to function by several contemporary philosophers of science; this is to say, that each of these are more proposals about how matters of fact should be conceived than statements about facts themselves. Each of these makes reference to the kind of features which should be regarded as fundamental to an understanding of the world. Also, each of these propositions makes claims which go far beyond their inductive base. They are directives about what sort of phenomena should be considered relevant to the overall goals of scientific explanation and about the conceptual categories with which the world should be approached. These directives cannot by themselves supply the positive explanatory categories, however. Rather, they function to provide some sort of a limit to what may be proposed. Teilhard's theory does in fact involve such concepts as 'complexity', 'history', 'levels' and 'emergence', and these, as it will be seen, accord very well with his directives.

3. Reasons for the Methodological Postulates

Teilhard, it must be said, did not reject the methodological postulates such as the causality postulate gratuitously, but for good reasons. These reasons might be subdivided into two kinds, designated 'genetic' and 'purposive'. Concerning this latter, it seems fairly clear that Teilhard adopts the program that he does, because it is only through such concepts of 'history' and 'natural cores', that he may contribute to the ultimate speculative goal of science, as he sees it. Concerning the former, however, there are more difficulties. A tentative answer to the question of the reasons for which Teilhard adopted the program that he did, might be given along the following line. Teilhard viewed one class of cosmic events as being far more important[30]. This viewpoint is perhaps best briefly expressed not by Teilhard himself, but by another evolutionary biologist, G.G. Simpson, who says,

> In our own days, Einstein and others have sought unification of scientific concepts in the form of principles of increasing generality. The goal is a connected body of theory that might ultimately be completely general in the sense of applying to all material phenomena....It is essentially a search for the least common denominator. I suggest that both the characterization of science as a whole and the unification of all the various sciences can most meaningfully be sought in quite the opposite direction, not through principles that apply to all phenomena but through a phenomena to which all principles apply....those latter phenomena are....the phenomenon of life.[31]

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30. Teilhard identifies this class of evolutionary biota when he says, "The three characteristics which make the human individual a truly unique object in the eyes of Science, once we have made up our minds to regard Man not merely as a chance arrival but as an integral element of the physical world, are as follows: a) an extreme physico-chemical complexity (particularly apparent in the brain) which permits us to consider him the most highly synthesised form of matter known to us in the Universe; b) arising out of this, an extreme degree of organisation which makes him the most perfectly and deeply centrated of all cosmic particles within the field of our experience; c) finally, and correlative with the above, the high degree of psychic development (reflection, thought) which places him head and shoulders above all other conscious beings known to us.

To these may be added a fourth particularity which is also of great significance: that of being the latest product of Evolution". As found in "The New Spirit, 1942", in The Future of Man, p. 87.

31. Simpson, G.G., This View of Life, New York, Harcourt, 1963, p. 213. Teilhard in an early essay makes much the same point. He writes in a footnote that

"What is called scientific 'synthesis' (cf. the general theory of the transmission of gravity) is simply the reduction of the real to a smallest common element". As found in "Science and Christ or Analysis and Synthesis" (1921), in Science and Christ, London, Collins, 1965, p.28

It was with the class of living things that Teilhard was particularly concerned as a paleontologist, especially that part involving their history, and it was from this area of the world that Teilhard derives both his postulates about the importance of this class of phenomena and the concepts of structure, function and historical relation, which appear in the orthogenetic theory. This, of course, does not answer the question of why Teilhard regarded biological phenomena as ultimately significant, but it does, to an extent, explain the presence of notions such as history and levels within the orthogenetic theory.

3.1 Teilhard's Implicit Rejection of Classical Mechanism

While it might not be possible to expose the ultimate reasons for Teilhard's postulates concerning the significance of life, it is possible to demonstrate to a degree, that such a choice marks a divergence from the mainstream of scientific thought about the type of properties and processes that should be regarded as ultimately significant. This contention may be brought out by another contrast. There has been a tradition which regards the types of materials (properties and relations) and the modes of explanation employed by physicists, as paradigmatic, this is to say, as a model toward which all other varieties should attempt to approximate. It is obvious from the previous statement of Teilhard's on the ultimate speculative goal of science, that Teilhard did not accept this paradigm, since his goal entails propositions about structures and processes which cannot be found in physics. This may be further illustrated by contrasting an exaggerated version of the model provided by classical physics with Teilhard's model.[32] Without pretending the list to be exhaustive, the major characteristics typifying the model of classical mechanism could be listed as follows. Classical mechanism assumed that there were two types of properties in the world. (1) Primary properties are those having to do with spacio-temporal configuration. Secondary properties, the qualities in perception, e.g. taste, colour, etc., are either derivitive of primary properties, or of

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32. One clear expression of this viewpoint is that of Einstein who says

"What place does the theoretical physicist's picture of the world occupy among all these possible pictures? It demands the highest possible standard of rigorous precision in the description of relations, such as only the use of mathematical language can give. In regard to his subject matter, on the other hand, the physicist has to limit himself very severely: he must content himself with describing the most simple events which can be brought within the domain of our experience; all events of a more complex order are beyond the power of the human intellect to reconstruct with the subtle accuracy and logical perfection which the theoretical physicist demands. Supreme purity, clarity and certainty at the cost of completeness. But what can be the attraction of getting to know such a tiny section of nature thoroughly, while one leaves everything subtler and more complex shyly and timidly alone? Does the product of such a modest effort deserve to be called by the proud name of a theory of the Universe?

In my belief the name is justified; for the general laws on which the structure of theoretical physics is based claim to be valid for any natural phenomenon whatsoever. With them, it ought to be possible to arrive at the description, that is to say, the theory, of every natural process, including life, by means of pure deduction, if that process of deduction were not far beyond the capacity of the human intellect. The physicist's renunciation of completeness for his cosmos is therefore not a matter of fundamental principle."

Einstein, A., "Principles of Research", in Essays, pp. 3-4.

sensation, or of some combination of the two. Primary properties are stable by implication, while secondary properties are mutable. One early propounder of this view, Galileo, writes

> Now I say that whenever I conceive any material or corporeal substance, I immediately feel the need to think of it as bounded, and as having this or that shape; as being large or small in relation to other things, and in some specific place at any given time; as being in motion or at rest; as touching or not touching some other body; and as being one in number, or few, or many. From these conditions I cannot separate such a substance by any stretch of my imagination. But that it must be white or red, bitter or sweet, noisy or silent, and of sweet or foul odor, my mind does not feel compelled to bring in as necessary accompaniments. Without the senses as our guides, reason or imagination unaided would probably never arrive at qualities like these. Hence I think that tastes, odors, colors, and so on are no more than mere names so far as the object in which we place them is concerned, and that they reside only in the consciousness. Hence if the living creature were removed, all these qualities would be wiped away and annihilated.[33]

(2) It was assumed that the primary properties of the world could be approached as sets of non-interacting, if sometimes parallel, closed systems.

(2.1) These systems might be regarded as closed, both in terms of co-presence and of temporal sequence.

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33. Galileo, The Assayer (1623), in Discoveries and Opinions of Galileo (Stillman Drake, transl.), New York, Doubleday, 1957, p. 274. It is difficult on the basis of his writings to establish Teilhard's position on the tranditional secondary properties. He does say in one Essay, "Around us, bodies present various qualities: They are warm, coloured, electrified, heavy. But also in certain cases they are living, conscious. Besides the phenomena of heat light and the rest studies by physics, there is, just as real and natural, the phenomenon of spirituality", as found in "The Phenomenon of Spirituality" (1937), in Human Energy (Cohen, transl.), London, Collins, 1969 (1962), p. 93. Because of the role played by irreducible 'emergents', in this theory, however, it is possible to be sure that secondary qualities have a very different status for Teilhard than they do for Galileo.

A much later nineteenth century physicist, Hermann Von Helmholtz expressed these points in a different fashion when he said, speaking about the elements of chemistry, that "Science has shown that these elements are truly indestructible, inalterable both in their mass and in their other properties. From any state into which they may be changed they can invariably be isolated, and in every case they show those qualities which they possessed previously in the free state". And Helmholtz continues,

> From this invariability of the elements follows another, more general consequence. Chemistry shows by empirical investigation that all matter is made up of the elements that have been discovered. These elements may exhibit many variations in their combinations and mixtures with one another, in their aggregate forms or molecular structures - that is, they may vary greatly in the way in which they are distributed in space - but in their properties they are altogether unchangeable. In the same compound, or isolated, or in the same state of aggregation, they invariably exhibit the same properties.[34]

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34. In "The Aim and Progress of Physical Science", as found in <u>The Selected Writings of Hermann Von Helmholtz</u>, (Russell Kahl, Ed.), Connecticut, Wesleyan University Press, 1971, p. 230. In the same work, Helmholtz speculates further,

"If all elementary substances are unchangeable with respect to their properties and change only in their combinations and states of aggregation - that is, only in their distribution in space - it follows that all changes in the world are changes in the local distribution of elementary matter and are, in the last analysis, brought about by motion. Further, if motion is the fundamental change which lies at the base of all other changes occurring in the world, then every elementary force is a motive force, and the ultimate aim of physical science must be to find the movements which are the real causes of all other phenomena and to determine the motive forces upon which these movements depend. In other words, its aim is to reduce all phenomena to mechanics".

(3) In a closed system, it was believed that the internal components were invariant as was the pattern of their relationship.

(4) Types of systems were assumed to recur hence there is the possibility of law-like generalizations (prediction and retrodiction).

Einstein comments on this saying,

> The great achievements of mechanics in all its branches, its striking success in the development of astronomy, the application of its ideas to problems apparently different and non-mechanical in character, all these things contributed to the belief that it is possible to describe all natural phenomena in terms of simple forces between unalterable objects. Throughout the two centuries, following Galileo's time, such an endeavor, conscious or unconscious, is apparent in nearly all scientific creation.[35]

(5) The components of systems and their relations, were believed to parallel, or at least be expressable by, mathematical relations.

Bertram Morris writes on this:

> ....much of the genius of the materialistic interpretation consisted in making various phenomena intelligible in terms of motion... The secondary qualities may be regarded as adventitous ideas, caused by bodies' stimulating sense organs. The secondary may also be used as indications of the presence of primary qualities. Nevertheless, grounded knowledge consists in the statement of precise relations among primary qualities. In employing such formulas as $F = ma$ or $F=(G)\frac{mm^1}{r^2}$ knowledge can be

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35. Einstein, A., The Evolution of Physics, pp. 51-52. Bertram Morris in the book Science, Folklore and Philosophy makes several comments about mechanistic materialism which are similar to those enumerated. He maintains mechanistic materialism is "(1) atomistic, (2) reductionist, and (3) constituted as a closed system capable of perpetuating itself without end" and that "the triumph of mechanistic materialism came with the ability to predict motion...the vector in which force and direction is predictable whether it be a terrestrial or celestial body, its position and motion are, theoretically, determinable at any given moment. This determinism which results from the mechanistic world view, constitutes its very core." Girvetz, H., Geiger G., Hantz, H., Morris, B., Science, Folklore and Philosophy, New York, Harper, 1966, pp. 229-231.

> approximated for practical purposes and the formulas can be assumed to hold for ideal connections.[36]

Carl Deutsch partially supplements this characterization when he says,

> Classical mechanism implied the notion of a whole which was completely equal to the sum of its parts; which could be run in reverse, and which would behave in an exactly identical fashion no matter how often those parts were disassembled and put together again, and irrespective of the sequence in which the disassembling or reassembling would take place. It thus implied the notion that the parts were never significantly modified by each other nor by their own past....[37]

Strictly speaking, no physical theory has ever conformed to this model. The picture of the world conveyed by it might be considered more metaphysical than physical, as it is a statement about the ultimate architecture of the universe. Nevertheless, it had some foundation in the developing astronomy and mechanics of the seventeenth and eighteenth centuries, which gave this view a plausibility and influence felt to the present time.

Abstracting from psychological and sociological considerations, the enthusiasm with which this model was accepted by pre-twentieth century scientists might be explained, in part, by the success of classical mechanics and chemistry. The method of the classical physicist, insofar

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36. _______, Science, Folklore and Philosophy, p. 232. Teilhard does not deny the cogency of mechanistic explanations, he just does not believe they are adequate for a full understanding of the system of the world. He writes "Let us keep the proofs and indisputable measurements of physics. But let us not become bound and fettered to the perspective of final equilibrium they seem to suggest", as found in The Phenomenon of Man, p. 43.

37. Deutsch, Karl W., Mechanism, Teleology and Mind, as found in Space, Time and the New Mathematics, (Robert Marks, ed.), New York, Bantam Books, 1964, p. 221.

as it involved the discovery of structure and relation, was analytic. Setting aside for the moment the problem of method, it can be observed that the paradigm of classical mechanism received its first theoretical refutation, not from outside physics, but from inside it. As has been stated, no physical system conformed or performed according to the expectations of the classical mechanists. There were occasionally unlooked-for variations in predictions, the parts of systems wore out, and so forth. However, the notion of the universe as a continuously readjusting system of checks and balances received its first contradiction from the work of Carnot, out of which came the second law of thermodynamics. According to the first law, matter (mass-Energy), can be neither created nor destroyed. But according to the second, in any physical process a certain amount of energy is irreversably lost in the form of heat and this cannot be regained or fed back into the system. Through duration, the amount of usable energy continuously decreases so that by extrapolation, it can be inferred that a point will be reached when the amount of usable energy is zero. That, in effect, renders physical processes negatively historical,[38] in the sense that, while not

38. On this Teilhard states that

"What is most remarkable about entropy (besides its general application) is that it is not, properly speaking, a law like the rest, expressing absolute conditions of equilibrium at a given moment. It expresses a universal tendency of material phenomena throughout time. It explains a historical current as an algebraical formula: the advance of matter towards the most probable conditions and arrangements. In this way it acts as a bridge between mathematical physics and the natural sciences". As contained in "The Phenomenon of Man" (1930), in The Vision of the Past, p. 168.

accounting in any way for the positive causation of any physical process, each process acquires a uniqueness due to the fact that a certain portion of the energy it takes to occur is forever lost.

3.2 Teilhard's Explicit Organic Model

However, these considerations concern more the substance of Teilhard's theory than the assumptions underlying it. The Teilhardian rejection of the mechanistic model extends far beyond a single scientific law.

In a sense, a major portion of the task of this thesis involves the reconstruction an an explanatory model*. alternative to that implicit in classical mechanism. Nevertheless, certain major characteristics of what might be designated the Teilhardian organistic model can be described. These features are the following:

(a) Teilhardian organicism entails the concept of a 'whole', which in a sense can be greater than the sum of its parts. He writes on this:

> After allowing itself to be captivated in excess by the charms of analysis to the extent of falling into illusion, modern thought is at last getting acclimatised once more to the idea of the creative value of synthesis in the evolutionary sense. It is beginning to see that there is definitely <u>more</u> in the molecule than in the atom, <u>more</u> in the cell than in the molecule, <u>more</u> in society than in the individual, and ....We are now inclined to admit that at each further degree of combination <u>something</u> which irreducible to the isolated elements <u>emerges</u> in the new order.[39],

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* The origin of Teilhard's model and the notion of model in general is explored in Appendix C "On The Notion of Model and the Teilhardian Biological Model".

39. Teilhard de Chardin, P., <u>The Phenomenon of Man</u>, pp. 267-268.

(b) Of processes which are asymmetrical (non-reversible)

(c) Of entities which are significantly modified by both their co-temporal relationships and that of their past,

(d) Of non-recurrent structures and processes:

Teilhard argues that, "For expedience and simplicity, we sometimes like to imagine the world....as being a series of planetary systems superimposed, the one on the other....This is only an illusion. The envelopes composing matter are thoroughly heterogeneous the one with regard to the other",[40]

(e) Of organic predicates which are in part non-quantifiable,[41]

(f) Of properties (emergent) which are not always reducible to their component elements,

(g) Of systems which may be regarded as only partially closed,

(h) Of the universe as the only closed system.

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40. ________, The Phenomenon of Man, pp. 44-45. It can be noticed that Teilhard does not reject the fact of parallel structures and processes where "it is sufficient to have recognized the basic unit and to have defined its law to be able to understand the whole by repetition". As found in The Phenomenon of Man, p. 44. It is for this reason he can accept the 'laws of physics'. He rejects such a repetition as occurring between 'envelopes'.

41. According to Teilhard, the "basic spontaneity" of "highly individualized elements" is "a quality not capable of representation in quantative terms...." As found in The Phenomenon of Man, p. 61.

(i) Of an overall asymmetrical temporal process,[42]

(j) Of an overriding cosmic progress.

Without at this point, trying to establish the implications of these characteristics, for Teilhard's explanatory mode and the orthogenetic theory as a whole, it can be asserted that this model is of primary significance to both. A more detailed exploration of the relationship that this model has to Teilhard's theory is continued at a subsequent point in the development of this thesis.

Teilhardian assumptions about the overall speculative goals of science, the kind of structure and relation most likely to render the world intelligible and the best means by which this knowledge may be

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42. Teilhard writes in a footnote that

"It is said no theory of evolution could be extended to the totality of the universe, because all evolution requires an 'environment' and by definition, the universe is without any containing envelope. This objection has no weight against a cosmic transformation of the type put forward here, in which evolution is defined by a movement of the world <u>in relation to itself</u>". As found in "Centrology" 1944, in <u>Activation of Energy</u>, (R. Hague, transl.), London, Collins, 1970, p. 103. It is a narration of the differing stages of the universe through time that constitutes Teilhard's historical approach and composes his historical explanation. As will be developed in the second chapter, for Teilhard, the variation in complexity-consciousness through time (an assymetrical increase) allows a cosmic series to be established and a cosmic progress measured. Teilhard writes on this that "When observed through a sufficient depth of time (millions of years) Life can be seen to move....it advances in a definite direction. And not only does it advance but in observing its progress we can discern the process or practical mechanism whereby it does so". As found in "Some Reflections on Progress (1941), in <u>The Future of Man</u>, p. 64.

attained, all as parts of his interpretive framework, predetermine, to some extent, the structure and content of his theory. This thesis is borne out in part when certain aspects of his method are given detailed scrutiny.

4. Teilhardian Analysis as a Conceptual Method

As it was previously mentioned, Teilhard utilized a notion of history as a segment of his research methodology. In adopting the concept of the importance of the past, Teilhard is forced to employ hypotheses. It is only the present (or segments of it), which is directly observable, while knowledge of the past might only be attained on the basis of assumptions. The paleontologist writes

> ....let us seek to sketch on scientific lines the probable evolutionary curve of any living planet: a problem in which affective reasoning is singularly mingled with speculation, since what we are looking for and seeking to extrapolate is nothing less than our own destiny.[43]

If this is the case, then his method cannot be predominately analytic-abstractive in the way that Newton believed <u>his</u> method to be. On the other hand, supposing his method is not analytic-abstractive,[44] the question remains as to what sort of method Teilhard does use. Analysis

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43. _______, "From the Pre-Human to the Ultra-Human", 1951, in <u>The Future of Man</u>, p. 290.

44. See Appendix D "On Method: Analysis and Hypothesis, a Problem".

is definitely viewed by Teilhard as a component of his method. He says for example,

> When a physicist wants to study the development of a wave, he begins by calculating the pulsation of a single particle. Then he reduces the vibrating medium to its main characteristics and directions of elasticity, and generalizes the results found in the instance of the element....[45]

4.1 An Instance of Teilhardian Analysis

Teilhard then mentions that a biologist uses an analytic method but the question remains as to whether Teilhard does in fact employ an analytic method and if so in what way. The answer to this question may be given through a consideration of the analytic that Teilhard himself provides, utilizing the method that he posits as characteristic of a certain kind of physical experimentation, under the titles of

1. The elemental movements of life,
2. The spontaneous ramification of the living mass,
3. The tree of life[46].

Teilhard isolates those features of living categories that he holds to be significant. The elements he analyzes are the cell, the phylum and

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45. Teilhard continues by saying,

"When he faces the task of describing the ascent of life, the biologist is obliged to follow a similar method in his own special way. It is impossible to reduce this enormous and complex phenomenon to order without first analysing the processes discovered by life for its advance in each of its elements taken in isolation. It is equally impossible to distinguish the general behaviour adopted by the total multitude of individual progressions without choosing the most expressive and luminous features in their resultant effect". In The Phenomenon of Man, p. 103.

46. ______, The Phenomenon of Man, p. 103.

the composite of all phylum, the totality of known biological entities. After sorting through the mass of biological phenomena, Teilhard concludes that development of living beings (evolution) is a fact, "that the problem of transformism no longer exists. The question is settled for once and for all"[47]. Teilhard begins his analysis by considering what are in his view the most important characteristics of the fundamental unit of living things, the cell. It is the fact of reproduction he chooses to regard first and about this he says:

> At the base of the entire process whereby the envelope of the biosphere spreads its web over the face of the earth stands the mechanism of reproduction which is typical of life. Sooner or later each cell divides (by mitotic or amitotic division) and gives birth to a cell similar to itself. First a single centre; then two. Everything in the subsequent development of life stems from this potent primordial phenomenon....[48]

Then Teilhard maintains that, given the power to reproduce, living particles demonstrated the power of vast multiplication[49]. Not only can the cell multiply, according to Teilhard, but it "multiplies without crumbling", and it shows "the capacity for renovation"[50]. Fourthly,

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47. ______, The Phenomenon of Man, p. 122.

48. ______, The Phenomenon of Man, p. 104.

49. About which Teilhard states, "For, once introduced into the stuff of the universe, the principle of the duplication of living particles knows no limits other than those of the quantity of matter provided....The more the phenomenon of cellular division spreads, the more it gains in virulence. Once fission has started, nothing from within can arrest its devouring and creative conflagration, because it is spontaneous. Nor is there any external influence powerful enough to check the process". In The Phenomenon of Man, p. 105.

50. In Teilhard's words, "By the act of reproduction it regains the faculty for inner readjustment and....takes on a new appearance and direction. The process is one of pluralization in form as well as in number". In The Phenomenon of Man, p. 105.

according to Teilhard, there is the developmental characteristic of many biota of both sexual dimorphism and bisexual reproduction by which,

> ....the door was thrown open to those modes of generation whereby a single individual can pulverize itself into a myriad of germs. Simultaneously we find coming into play the endless permutations and combinations of 'characters' so dear to the modern geneticists. Instead of simply radiating from each centre in process of division the rays of life now anastomose - exchanging and varying their respective riches....[51]

Then, according to Teilhard, there is the phenomenon of association which represents

> ....one of the most universal and constant expedients.... used by life and its expansion....Thanks to it living substance is able to build itself up....to escape ennumerable external obstacles....Thanks to it again the organism....is able to find room inside itself to lodge the countless mechanisms added successfully in the course of its differentiation.[52]

Finally, the last main characteristic belonging to the elemental movements of life, according to Teilhard, is that of controlled addivity. Through this phenomenon organisms can be seen to differentiate and develop along separate lines. Teilhard contends in fact, "There seems to be no lack of examples, in the course of biological evolution, of transformations acting horizontally by pure crossing of characters. One example is the mutation we call Mendelian"[53]. However, Teilhard continues,

> But when we look deeper and more generally, we see that the rejuvenations made possible by each reproduction achieves more

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51. _______, The Phenomenon of Man, p. 106.

52. _______, The Phenomenon of Man, p. 107.

53. _______, The Phenomenon of Man, p. 108.

than mere restitution.[54]

According to Teilhard, from the diversification and specialization resulting from the accentuation of dispositions, "a single geneological sequence"[55] results. The changes are law-like and the law "of controlled complication"[56], which governs the process 'from micro-molecule to mega-molecule', is "known to biologists as orthogenesis"[57].

Further, Teilhard maintains, out of this orthogenesis develop biological types and ultimately phyla. The phylum is itself defined or characterized "by the particular direction in which it groups itself and evolves"[58] and by "a sufficient number and variety of potentialities"[59]. It is the presence of these potentialities which allow some phyla to continue, expand and mutate while others without such potentialities remain static or die out. From a consideration of those features which characterize phyletic unity, Teilhard moves on to consider the major

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54. _______, The Phenomenon of Man, p. 108. Teilhard continues, "They add to one another, and their sum increases in a pre-determined direction. Dispositions are accentuated, organs are adjusted or supplemented".

55. _______, The Phenomenon of Man, p. 108.

56. _______, The Phenomenon of Man, p. 108.

57. _______, The Phenomenon of Man, p. 108. It can be noticed that for biologists such as Simpson, as will be discussed in the chapters to follow, there is no law of controlled complication. This 'law' is intimately connected with the Teilhardian postulate of 'centro-complexity'. As such, an element of hypothesis has even at this stage entered in the Teilhardian analytic.

58. _______, The Phenomenon of Man, p. 115.

59. _______, The Phenomenon of Man, p. 115.

product of all phyla, the tree of life and about this consideration he concludes that,

> Under our efforts and analysis life sheds its husk. It breaks down to an infinite degree into an anatomically and physiologically coherent system of overlapping fans. We find barely appreciable fans of sub-species and races; larger ones of species and genera; still larger ones of biota, then of layers, animal and vegetable, forming by association one single gigantic biota....[60]

This breakdown or separating out of the major features of living levels, as described by Teilhard, constitutes an example of the meaning and use of the term 'analysis' for him. It should be noticed immediately, however, that this example is not one of analysis by mere abstraction where what is analysed is simply given. What Teilhard analyses is a representation of the world built up through employing a variety of special assumptions, (e.g. the major forces operative in the present were also operative in the past), physical techniques and methods (e.g. geological dating techniques). And Teilhard introduces his own special postulates as well[61]. However, when he reintroduces analysis on another level, that employing the theoretical assumptions of his orthogenetic theory, the role of hypothesis in his analytic becomes even more obvious. After Teilhard adopts the concept of complexity as an

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60. _______, The Phenomenon of Man, pp. 138-139.

61. _______, The Phenomenon of Man, p. 115. For instance, that a phylum is 'a natural unit with power and singular law of autonomous development.

analytic tool[62], as will be more fully discussed in the subsequent chapter, he has a basis for carrying out an analysis not previously available to him. Teilhard comments:

> Once it is admitted....that the cerebralization of beings is the true index of their vitalization....a radical transformation comes over the picture of the biosphere....whole compartments in taxonomy are automatically down graded in their potential and chance for the future. We need not concern ourselves....with....the vegetable kingdom....nor with the trachophores....The world of the arthropods need not detain us.... this leaves....the chordatevertebrate stem....[63]

Without however, the Teilhardian hypothetical assumption about the meaning and significance of complexity, no such analysis could have taken place.

4.2 Analysis and Hypothesis

Teilhard clearly realized that the analysis he referred to is not simply the isolation and separation of some agglomerate into parts.

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62. Teilhard writes that

"In a universe where science ends by analyzing everything, two advantages are gained by adopting the criterion of 'complexity'. First, in the multitude of things comprising the world, an examination of their degree of complexity enables us to distinguish and separate those which may be called 'true natural units'....from the accidental pseudo-units....secondly, the coefficient of complexity....enables us to establish, among the natural units which it has helped us to identify and isolate, a system of classification that is natural and universal". As found in "Life and The Planets" (1945), in The Future of Man, pp. 105-106.

63. ______, Man's Place in Nature, pp. 49-50.

The analysis entails as well a series of choices or decisions about what aspects of the phenomenon are most significant relative to a problem as well as the more obvious use of imaginative reconstruction which occurs when the scientist attempts to establish the underlying reasons for the phenomena-(effects). Teilhard says about one such reason or 'cause' that,

> To a considerable extent the representation of the atom accepted at this moment is nothing more than a simple means, graphic even while subject to revision, enabling the scientist to establish and confirm the internally consistent and comprehensive picture of ever more various effects manifested by matter.[64]

Teilhard's conception of analytic method does not entail the mere separating of some complex into its constituent parts in order to find out relationship, structure, function, effects or proportion; rather, in his view, the resolution of a whole into parts involves the use of hypotheses or imaginative guesses about what sort of structure and function might underly specified phenomena, as well as techniques for separating composites. About this, he says,

> What I ultimately propose therefore in this essay is to construct a picture of the physical world around the human personality chosen as an element to stand for the whole system. Once we admit that the reflective monad represents <u>the mesh</u> of the cosmos, what structure and what future are we led to attribute to it? This is what I shall try to discover.
>
> On my way, I shall concern myself only to pursue to their logical end the organic links which appear - just to see where they lead - rather as if I were constructing a geometrical system. The overall success will decide. If the construction does not form a complete whole, or if it contradicts some part

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64. __________, *The Phenomenon of Man*, p. 39.

> of experience, it will show that the initial hypothesis was bad and should be abandoned. But if, on the contrary, it seems to encircle and harmonize the world to a greater degree, then we must conclude that in accepting a spiritual direction of evolution we have come near to the truth.[65]

His view of the use of analysis as a method of research, is then quite different from that of Newton or Mill. However, Teilhard's uniqueness does not consist in his belief about the utility of imaginative reconstruction as a method of research;, rather, it resides in his conviction that the analysis must be supplemented by another approach if the most significant group of phenomena are to receive an adequate account.

4.3 Teilhard's Views on the Intrinsic Limitations of Analysis.

While Teilhard does not reject the use of analysis as an essential tool of the working scientist, he believed that as a research method, analytic procedures suffer from certain intrinsic limitations. Teilhard maintains,

> Nineteenth century science....projected the centre of the world downward....At that moment in all realms at once, reality, however simple or spiritual it might have seemed, showed itself capable of spacial and temporal breakdown, or reduction to even simpler elements....the secret of the universe was hidden in the shadows of the past or mysteries of the atom. Analysis would bring it out.....[66]

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65. Teilhard de Chardin, P., "A Sketch of a Personalistic Universe" (1936), in Human Energy, p. 92.

66. __________, "The Mysticism of Science" (1939), in Human Energy, pp. 172-173.

Teilhard says on this, "....analysis, that marvellous instrument of scientific research to which we owe all our advances, but which, breaking down synthesis after synthesis, allows one soul after another to escape, leaving us confronted with a pile of dismantled machinery, and evanescent particles"[67]. And in an earlier work,

> We had to get down to 'atoms' in order to realise this truth, but now we must never forget it: in our analysis we have allowed what constitutes the value and the solidity of beings to escape from us. The <u>only consistence</u> beings have comes to them from their <u>synthetic element</u>, in other words from what, at a more perfect or less perfect degree, is <u>their</u> soul, <u>their spirit</u>.
>
> Let us turn back and examine critically the operation of analysis that gradually led us down from the heights of rational life to the particulate swarming of electrons. We progressed in a series of successive fragmentations. At each operation we separated two elements: an ordering principle, which is imponderable, cannot be analysed, and is synthetic - and ordered (ponderable) elements. On every occasion, as a direct result of analysis, that ordering principle disappeared.[67a]

However, Teilhard maintains, the belief that by the power of analysis alone, the universe might be rendered intelligible, has proved to be an illusion[68]. It proved to be an illusionary hope first in physics, then

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67. ________, "Science and Christ or Analysis and Synthesis" (1921), in <u>Science and Christ</u>, p. 29.

67a. ________, "Science and Christ or Analysis and Synthesis" (1921), in <u>Science and Christ</u>, p. 29.

68. About this Teilhard says,

"On the basic ground of physics, first of all, it was the growing powerlessness of analysis to find a definite final form of cosmic substance. The atoms themselves broke up under the impact of radioactive energies. A new stage was thus discovered below the infinitely small, itself opening onto regions where determinism seemed to lose all mathematical connotation....The stuff of the universe, examined at close texture, resolved itself into a mist in which reason could no longer possibly grasp in what remained in phenomena anything but the forms it had itself imposed on them".

in "the still more critical realm of biology"[69] that while on the whole front of the biological disciplines, after a century of attack, living matter had been methodically broken down into its historical-chemical and energetic components"[70], that "....It would not allow itself to be reduced to those components alone"[71]. Teilhard, on the basis of belief in the inadequacy of analysis proposed to supplement it. Since "the principal movement of reality is synthesis"[72], Teilhard proposes a method by which the movement of the real might be conceptually duplicated or approximated.

The question of what made up Teilhard's method of synthesis is a difficult one, for Teilhard nowhere explicitly describes his method as such; nevertheless, he does give indications, by what he says and what he does, of what he means by the expression 'synthesis'. One of the immediately evident things that can be noticed about Teilhard's usage of the term is that is is used in reference to the phenomenon of life and

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69. _______, "The Mysticism of Science", in Human Energy, p. 174.

70. _______, "The Mysticism of Science", in Human Energy, p. 174.

71. _______, "The Mysticism of Science", in Human Energy, p. 175.

72. _______, "The Mysticism of Science", in Human Energy, p. 175. Placing this in context, what Teilhard says is the following, "For perfectly legitimate reasons of utility and method, the physical sciences have principally set out to trace phenomena in the direction of decomposition or atomization. The fact of evolution comes to remind us that the principal movement of reality is a synthesis....in increasingly complex and organic forms", in "A Sketch of a Personalistic Universe", p. 56.

consciousness. What the synthetic method attempts to do is reconstruct the genesis of present complex living things. It also has to do with trying to discover the mechanism of this genesis (laws of birth) and the reasons for these laws (viz. radial energy). It seems to be the case that if the objects of an analysis cannot be approached directly, the analysis becomes intermixed with imaginative reconstructions of possible elements. It seems to be the case as well that a vaste number of the objects of synthesis and their relationships cannot be known or approached directly, but on through hypotheses. The reconstruction that is posited here, the reconstruction that Teilhard envisages, occurs through the 'new systematics' previously mentioned; hence, anywhere hypothesis is used in the reconstruction of the elements, their groups, or there spacial and temporal relations, that manner of use may be recognized as equivalent or identical to the manner in which hypothesis is utilized in the synthetic approach[73].

Speculative analysis is utilized in discerning the structures and processes of the biotic world as well as by extension to those in the prebiotic world. Speculative analysis is used too in discerning the order of appearance of phenomena. Speculative snythesis is employed in regrouping and grading the various categories of biota and speculative synthesis is operative in assigning temporal order and significance so

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73. For example, Teilhard does not abstract the 'fact' of the presence of psyche on the pre-biotic level by simple induction; rather, he infers it on the basis of analogy and supports his inference by his postulated criterion of coherence. Both analogy and coherence contain elements of supposition.

that both analysis and synthesis are utilized in structural and temporal reconstruction.

As it was previously discussed in reference to Teilhard's heuristic, speculative goals, both physics and chemistry, as well as the various biological disciplines, have roles to play in the new systematics; hence, so do the methods by which information in these disciplines is acquired, since part of the method of these various sciences is the type and manner of hypothesis utilization. Teilhard, in carrying out research in his own discipline, used a type of analogical inference in which the terms and the relationships of the terms were posited, partly on the basis of observation and experimentation, but partly too on the basis of supposed structures and processes. It is highly likely that Teilhard employed a form of hypothetical analogical inference in deriving some of the essential data of the orthogenetic theory. If this is indeed the case, then hypothetical analogical inference, too, functions as a pre-theoretical determinant and as such forms an element of the interpretive framework out of which the orthogenetic theory is derived[74].

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74. Teilhard writes, "Consciousness....is nothing less than the substance and heart of evolution". As found in The Phenomenon of Man, p. 178. If, as it has been previously stated, Teilhard's reconstruction of evolution entails the conceptual reconstruction of 'wholes', individuals, classes, levels and series and if, as is the case, consciousness or psyche is regarded by Teilhard as an essential determining property of 'wholes' and if, as will be argued in the following sections, it is through analogical inference that Teilhard posits the presence of psyche through the biotic series and 'below', then it follows that analogy is a primary component of his method of synthesis as it is by analogical inference that psychism and morphology throughout the biotic world are intellectually recombined or recomposed. If this is the case, what occurs in the content of Teilhard's theory is partially determined by the strengths and weaknesses of that method.

5. An Instance of Synthesis as Analogical Inference.

Fortunately, it is not necessary to rely upon just the brief and scattered passages where Teilhard mentions the deep analogies in nature, which must be constructed by a synthetic method, because in a work entitled "Fossil Men", found in its fullest form in L'Oeuvre Scientifique, Teilhard provides examples of his constructions by analogical inference. Here, for example, Teilhard concludes that,

> However primitive his brain-case, Sinanthropus was already far beyond the critical boundary separating the "reflective" from the "non-reflective" animals. Being homo faber, he was certainly also (as far as mental power is concerned) homo sapiens.[75]

Teilhard infers this fact on the basis of structural characteristics[76]. This includes both similarities as well as differences[77], as can be seen from the following lines where Teilhard says,

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75. Teilhard de Chardin, P., "Fossil Men", in L'Oeuvre Scientifique, Tombe IX, 1943-45, (ed. Nicole and Karl Schmitz-Moorman), (orig. publisher, Henri Vetch), 1943, p. 3916.

76. Teilhard says on this, "On the whole, Sinanthropus decidedly stands, in his anatomical features, on Man's side among the Primates: face not projecting, brain twice as large as the largest ape, errect posture....". As found in "Fossil Men", in L'Oeuvre Scientifique, p. 3913.

77. About the importance of these differences for the anthropologist, Teilhard writes,

"To a non-anatomist observer these various peculiarities (which, because they occur identically in all the specimens, are certainly not individual anomalies) may at first seem of little value; but to the eyes of an anthropologist they are of the utmost significance, for not only does each of them make Sinanthropus different from us, but each brings him closer to the Apes." As found in "Fossil Men", in L'Oeuvre Scientifique, p. 3914.

> ....along with those fundamentally human characters, how many deep and significant differences....skull relatively small (1000 cc. on the average instead of 1200-1600 as in Modern Man) skull shallow and elongated....[78]

In this instance structural properties alone are not sufficient to establish the self-reflective consciousness predicated of Sinanthropus. Teilhard states,

> Physically speaking, Sinanthropus on the whole looks much more like a human being than like an ape. We had better, therefore, call him Man. But, psychically, what is his true nature? Shall we, yes or no, place him amongst the really intelligent, that is, amongst the thinking beings?[79]

It is, according to this scientist, by correlating structural and behavioural properties and, more particularly, the historical record of functional activities. that a conclusion can be drawn in this instance[80]. Implicit in this statement, is the argument that, since Man is both self-conscious and a purposeful maker of tools as well as a user of fire, any

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78. _______, "Fossil Men", in L'Oeuvre Scientifique, p. 3913.

79. _______, "Fossil Men", in L'Oeuvre Scientifique, p. 3914.

80. Teilhard writes,
"By good fortune, owing to the peculiar circumstance that the Chouk outien cave was used as a dwelling place for fossil Man, we are apparently in the position to answer: "Yes". And this is why: associated with the bony remains of Sinanthropus, we have found a quantity of ashes, of burnt bones and of artificially chipped stones. If, as is most probable, the Peking Man himself....is responsible for these traces of fire and for this lithic industry, then no doubt remains. However primitive his brain case, Sinanthropus was already far beyond the critical boundary separating the reflective from the non-reflective animals. Being Homo Faber, he was certainly also (as far as mental power is concerned) Homo sapiens." As found in "Fossil Men", in L'Oeuvre Scientifique, p. 3916.

other animal which is structurally similar and fashions tools and uses fire must be also self-conscious. Of course, the analogical inference does not become possible until the various features on which the comparisons are based are analyzed and isolated by the multiple techniques and physical methods which establish time periods, physical characteristics and other important data. It should also be recognized that, for Teilhard, the certitude of analogical inference is not established merely on the basis of being able to draw the inference alone. He utilizes what might be called a secondary verification in order to establish the probability of such a conclusion. For example, in his discussion of another variety of Pithecanthropus, Teilhard states that,

> By analogy with Sinanthropus, it is highly probably that Pithecanthropus also was an intelligent being, that is to say, capable of reflexion. However, it must be recognized that we have as yet no direct evidence to establish this fact. Till now, in fact no stone tool has been found associated with the remains of Jav Man.[90]

From this, it would seem to be the case, that, for Teilhard, the more fully the structural and behavioural predicates can be established, the greater is the confidence that may be placed in the inference.

In this same essay, Teilhard provides examples of analogical inference whereby the inferential motion does not establish a set of characteristics of one individual or a group based upon its similarities and differences with another, but rather his inference posits classes of affinities by establishing parallels. For example the scientist argues,

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90. ______, "Fossil Men", in L'Oeuvre Scientifique, p. 3919.

> However adaptive (Steinheim and Palestine Men), or inadaptative (Solo and Rhodesian Men) they may be, all the Middle Pleistocene Men so far known have this at least in common that none of them could be mistaken for the representative of any of the surviving human races. On this particular point, no anthropologist will disagree. However strongly these various representatives of a past Mankind may differ from each other, still, owing to a certain assemblage of characteristic features, they stand closer to each other than they do to us.
> Hence the possibility, here admitted, of including them all in the same complex, and yet well defined, anthropological unit: the Neanderthaloid group.[91]

On the other hand, according to Teilhard, the Chancelade and other Men of the Upper Pleistocene. can be typed as Modern Men because of their morphological dissimilarities from the Neanderthaloid group and because of, in Teilhard's words, "the simple manifestation of an overflowing of the inner life", which, "represents a considerable biological fact; which would be sufficient in itself to mark and characterize a new age of earth"[92]. The Upper Pleistocene Men are then grouped with Modern Man, on account of the fact that they leave traces of a defining functional characteristic which is a trait of Modern Man but which the Neanderthals do not display.

After having reconstructed the structural and psychic properties

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91. __________, "Fossil Men", in L'Oeuvre Scientifique, p. 3929.

92. __________, "Fossil Men", in L'Oeuvre Scientifique, p. 3934.

of Man, partly, as has been seen, through analogy[93], Teilhard composes an overall representation of the evolution of the hominids. Having re-organized the vast assemblage of hominid evolution according to the catagories he mentions, Teilhard purports to discover a curve. He says,

> And now we grasped the fundamental distribution of branches and leaves on the human stem, let us try to detect the nature of the physical movement written in its very growth....What do we see? There, at the first visible appearance of the trees, lie the Prehominians, with their depressed skull and their rudimentary social aggregation.
>
> Here, at the terminal stage of today, stands out Homo sapiens, with his uprisen brain-case and in such an intensified state of collective organization that he may well seem to approach the critical point of some explosive change.
>
> There below, an early Man, only little, - here above, a modern Man, very much "cerebralized" and "socialized".
>
> What does this difference mean?
>
> Obviously, only one interpretation can be given at the curve. What the prehistorians have so patiently registered, point after point, during the past 80 years, is nothing less than the trace left by Humanity moving persistently towards a higher individual and collective consciousness.[94]

This curve is the curve delineating the continuous rise of complexity correlatable with consciousness, about which Teilhard says,

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93. About this Teilhard writes,
"I have recorded, according to their stratigraphic position and to their anatomical analogies, the various Fossil Men which we have just reviewed along the horizontal divisions....But there is something more to be seen....In a partly hypothetical way I have tried to express the true organic structure of the whole assemblage by grouping the Fossil Men according to their morphological affinities and probably descent; and the result is to reveal three independent curvilinear, human sheets....succeeding each other discontinuously in time. The three sheets fit into one another and they intersect, at a steep angle, the three horizontal positions where, side by side, lie crowded geneo-logically disparate human elements". As found in "Fossil Men", in <u>L'Oeuvre Scientifique</u>, p. 3933.

94. ________, "Fossil Men", in <u>L'Oeuvre Scientifique</u>, p. 3934.

> Since the days of Lamarck and Darwin, the question has been and still is bitterly debated whether there is any definite trend in biological evolution. Here, however, in the particular case of Man, and owing to the fact that in Man psychical properties reach their maximum, a definite drifting of organic matter toward increasing cerebralization associated with increasing consciousness is clearly registrable.[95]

and he argues further through an implicit comparison that what is true of hominid evolution could be true of the whole cosmic evolutionary process. About this he says,

> Why not extend and generalize this law from Man to the rest of the living world? Is not the human stem a branch (or perhaps rather the stalk) of the whole tree of Life? And, if so, can Life be different in the branch and in the tree? The more one ponders this thought, the more one becomes convinced that what is true for Man and Anthropogenesis must be also the rule (at least in a relative and incipient way) at any stage of biological evolution. A definite and universal process, persistently carrying a certain part of cosmic material from highly disintegrated and apparently inanimate elements towards more and more manifestly conscious units: this is, I think, the only type of evolution in which the development of Man (as disclosed by Prehistory) can be placed without physical distortion or even contradiction.[96]

Although for the major part of his written work, what Teilhard does is present his conclusions (sometimes only tentative) and not a statement of the manner of deriving them, it is possible, by going beyond strict textual evidence, to formulate the fashion by which Teilhard could have and did use analogical inference. This can be done

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95. ______, "Fossil Men", in L'Oeuvre Scientifique, p. 3935.

96. ______, "Fossil Men", in L'Oeuvre Scientifique, p. 3935. Teilhard may appear to be guilty of the 'fallacy of composition' here; that is, attributing to the whole that which is only true of a part. However, as it will be argued in the third chapter of the thesis, every scientific statement of high 'generality' is, relative to its evidential base, 'guilty' of this fallacy. The cogency of Teilhard's claim, as it will be argued, must be decided by other criteria.

mainly on the basis of the analysis of the preceding texts.

5.1 An Extended Version of Teilhardian Analogical Inference

As has been previously mentioned, one aspect of Teilhard's method of research appears to involve the use of analogical inference as a conceptual tool. Teilhard does nothing much more than mention his utilization of analogy[97], so what is being attempted in the following pages, is a speculative reconstruction of the manner in which Teilhard may have derived elements of his theory. It is not an abstractive description of the way Teilhard necessarily, in fact, derives his theory. Such a procedure seems justified if it nowhere contradicts anything that

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97. The following passages provide one such example:

"Let us try, then, to assume the second hypothesis: the one in which the social phénonomenon displays an arrangement of truly evolutionary and organic value. From this view-point (the plausible aspects of which I have tried, following so many others, to bring out in another place), it is clear that a very particular method of scientific investigation is placed in our hands.

If in fact the zoological process of evolution is actually being pursued in human collectivization....then it logically follows that by way of introspection we should be in the position to understand directly, in the very modalities of our action, at least certain of the factors that formerly presided over the transformations of life. And one idea particularly seizes our mind, that an important role in the appearance of new zoological characteristics might perhaps be ascribed to the 'forces of invention'. This means that we cannot completely explain the appearance and placing of the wing, for example, or of the fin, or even of the eye and the brain without <u>some reference</u> to the psychic faculties and procedures introduced by the builders of the innumerable machines with which we are every day extending our powers of locomotion, action and vision. In order to know how life operates (if it is really life that operates in us), is it not enough to watch ourselves at work?", as found in "Zoological Evolution and Invention" (1950), in <u>The Vision of the Past</u>, p. 235.

Teilhard does say, and if it serves as a useful device enabling a clearer description of the reasons for, and structure of, Teilhard's postulated biological and hyper-biological entities and their relations. It is contended here that the following schema does do this.

Teilhard derives a series of inferences about the world[97a]. The inferential notion would appear to occur in the following way.

Given his own consciousness, (CX) conjoined to behavioral properties (BP) and structural properties (SP) and given some other entity (X^1) with behavioral properties (BP^1) and (SP^1) then (X^1) has property (C^1). This could be described somewhat more schematically as follows,

X has consciousness properties (C) (BP) (SP)

X^1 has properties BP^1 SP^1 (similar to BP and SP)

X^1 has property C^1

Teilhard's anchor point is a set of primitive experiences (and subsequent refinement of those experiences) in which consciousness (within) structure and behavior (the without) are correlated and in which consciousness and consciousness products are experienced in reflection.

97a. The warrant for regarding these inferences as psychic reconstructions is derivitive of the fact that Teilhard himself regarded the totality of evolutionary thought as a mental representation of physical processes. He writes, for example, that

"It was among the zoologists that this 'transformationist' germ first appeared and increased in vigour, and it was as an effect of the contagious influence of that germ that a rapidly increasing number of 'evolutionary' nuclei have since that time continued to appear in all the various departments of knowledge....Thus were produced multiple centres of mental reconstruction...." As found in "From Cosmos to Cosmogenesis" (1951), in Activation of Energy, p. 255.

About this he writes,

> The scientist writes about this....the reflective psychic centre, once turned in upon itself, can only subsist by means of a double movement which is in reality one and the same. It centres itself further on itself by penetration into a new space, and at the same time it centres the rest of the world around itself by the establishment of an ever more coherent and better organized perspective in the realities which surround it.[98]

Teilhard, it is assumed here, does derive much of his data about the world through a series of inter-locking analogies. These analogies may be roughly divided into two major kinds, particular and general. The first entails the construction of individuals or 'centres'; the second involves the reconstruction of sequences of natural entities as well as the general features of systems. For example, in his discussion of the relationship of radial to tangential energy, Teilhard writes,

> It is not easy, I must confess, to be clear on this point. Later on, in the case of thought, a psychical definition of the 'human critical point' will emerge almost at once, because the threshold of reflection bears in itself something definitive and also because we have only to consult our own deeper selves to measure it. If, on the other hand, we wish to compare the cell with its predecessors, introspection can only help us through repeated and remote analogies. What do we know of the 'souls' of animals, even of those nearest to ourselves? At such distances downward and backward we must

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98. __________, The Phenomenon of Man, p. 172.

resign ourselves to being vague in our speculations.[99]

The order in which the properties are listed has quite clearly more than merely logical significance. The consciousness predicate of (X) has a different epistemological status, as well as a different logical status, from the consciousness property of (X^1). The consciousness of (X) (Teilhard's), is relatively an observational property[99a], while that

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99. __________, The Phenomenon of Man, p. 88. Teilhard makes clear also in another essay that he is aware of the inherent difficulties of analogical inference. He writes,

"Of course two fundamental difficulties appear immediately as theoretical restraints on the practical use of this method of reasoning. On the one hand, even if it is admitted that from man (a reflective animal) onwards the 'invention' factor becomes dominant in the advance of evolution, nothing proves a priori that below man, the action of this factor is not so weak as to escape all observation. On the other hand, and in addition; even admitting that in these pre-human animal forms the psychic element appreciably controls the morphological, nothing guarantees that this psychic element (of non-reflective type) may not be so different from ours in its conditions and functioning that all comparison remains illusory and sterile." As found in "Zoological Evolution and Invention" (1950), in The Vision of the Past, p. 235. Despite this caution, however, through the establishment of the complexity-consciousness terms or variable, as will be shown in subsequent passages, Teilhard does derive a number of analogical inferences.

99a. On this point, Teilhard writes,

"In the eyes of the physicist, nothing exists legitimately, at least up to now, except the without of things. The same intellectual attitude is still permissible in the bacteriologist, whose cultures (apart from some substantial difficulties) are treated as laboratory reagents. But it is already more difficult in the realm of plants. It tends to become a gamble in the case of a biologist studying the behaviour of insects or coelenterates. It seems merely futile with regard to the vertebrates. Finally, it breaks down completely with man, in whom the existence of a within can no longer be evaded, because it is the object of a direct intuition and the substance of all knowledge." As found in The Phenomenon of Man, p. 55. It is however only relatively observational since according to Teilhard, "From our experimental point of view, reflection is....the power acquired by consciousness....to take possession of itself as an object...." As found in The Phenomenon of Man, p. 165. Hence, consciousness does not directly intuit itself for Teilhard.

of (X^1) is dispositional and hypothetical. Furthermore, depending on the level of the world dealt with, behavioural and structural properties may be observational, dispositional or a mixture of types. While structural and behavioral properties may or may not be dispositional, consciousness, except under one special set of conditions, is always dispositional. The fact that consciousness can be experienced, rather than just simply inferred, even if only under a unique circumstance, does, if true, strenghten the evidential link between premises and conclusion. As well it determines the logical order of properties holding between X and X^1. This can be demonstrated as follows,

X has (C), (BP) and (SP)
X^1 has (BP) and (SP)

---

therefore X^1 has (C)

but X^1 has (BP) (SP) and (C)
but X^2 has (BP) and (SP)

---

therefore X^2 has (C)

So that it can be seen, between (X) and (X^1) the inferential direction is from the consciousness structure and behaviour of (X) (or behavior and structure) to the consciousness of (X^1) through the behaviour and structure of (X^1) while between (X^1) and (X^2) the logical direction is not determined this way.

Given any (X) subsequent to (CX) and (CX^1) where consciousness is being inferred to, the order in which the properties are being listed, is the function of purely extra-logical considerations. These extra-logical considerations may be designated epistemological and methodological. It is the case that every object in the world is not a natural core, and all the entities that are a natural core, are not necessarily equally knowable. On this latter point, it can be observed that Teilhard does assume a gradation of objects. He writes, for example, "From the moment we regard evolution as primarily psychical transformation, we see there is not one instinct in nature, but a multitude of forms and instincts, each corresponding to a particular solution of the problem of life. The 'psychical' make-up of an insect is not and cannot be that of a vertebrate....this in virtue of the position of each on the tree of life"[100]. If these 'grades' were correlated with a scale which measured degrees of intelligibility, those natural cores composed of the highest inferential components would be the least known. The amount of inferential content would itself be based on the extent to which behavioural, structural and consciousness properties could be inferentially known or observed. Hence, given three entities, one E^1, of whose behavioural and structural properties could be to some extent observed, and another, E^2, whose behavioural properties alone might be

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100. __________, The Phenomenon of Man, p. 167. Teilhard continues by saying

"....in this variety we begin to see....a gradation formed. If instinct is a variable dimension, the instincts will not only be different....they will form as a whole a kind of fan-like structure in which the higher terms are recognized....by a greater range of choice. And depending on a better defined centre of co-ordination and consciousness, and that is the very thing we see. The 'psychical' make-up of a dog....is positively superior to that of a mole or fish". As found in The Phenomenon of Man, p. 167.

seen, and the third, E^3, the result of whose activity might be only observed through its effects, then E^1 would be placed closer to the observation end of the scale and so forth. This interpretation is strongly suggested by a passage in Teilhard's essay "Centrology" where he says, "In the case of inanimate matter, (the most difficult section of the world for our minds to understand since it is evolutively the furthest removed from us), we can figuratively picture to ourselves the cosmic nuclei (molecules, atoms, electrons) as incompletely closed-in.. .."[101].

This view propounded here of the role of hypotheses, as employed in the Teilhardian method of 'alteration'[102], and his use of analogy, are coherent. While views of the exact relationship between individual consciousness and individual structure are difficult to decipher,

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101. __________, "Centrology", (1944), in Activation of Energy, p. 105. It is also strongly by an answer Teilhard gives to a question he poses. He asks that when the arthropods and the vertebrates are considered "To which side belongs the future....?" Of the insects "so marvellously adjusted yet so terribly far away", he concludes "they seem irremediably 'stationary' but of mammals, Teilhard contends that "our judgment is really being guided by our intelligence" when it is concluded that "the behaviour of a cat, a dog, a dolphin" that "....it is in that direction that the possibilities....crop up". As found in The Phenomenon of Man, pp. 153, 154, 156.

102. __________, "Outline of a Dialectic of Spirit" (1946), in Activation of Energy, p. 143. The actual example that Teilhard provides of his use of this 'law' involves his views on the epistemological relationship of man to God, which is outside the scope of this thesis. Nevertheless, since Teilhard considers 'alteration' to be a general method of human knowing, it should apply to the primary stages of relating the 'within' to the without as well.

starting from the personal 'monad' (BP), (SP) (CX), the Teilhardian synthetic method might work in the following manner. Suppose there is an entity X with (BP), (SP), and (C), and another (X^1), whose property (C) is inferred through the parallels between (BP) (SP) and (BP^1) (SP^1), the inference is then from the known (observed consciousness), (CX) to the postulated consciousness of (X^1). The consciousness of (X^1) is explained by the fact that there is another entity, whose properties are similar, in a number of important and relevant ways, to (X^1), so that whatever (X) has, (X^1) must have as well. However, the postulated presence of consciousness of (X^1) has an explanatory import for (CX) since, (CX) experiences the structure consciousness correlation of (X^1) in a different fashion than it own. (CX) for example could perform an exploratory operation of (X^1's) cranium and from this make certain inferences about its own structure-consciousness correlates. A more general example would involve a proposition to the effect that, while the behaviour of men is partially explicable by the fact that they are composed of simple parts cells, molecules, atoms, etc., the behaviour of these simpler unities is partially explicable by the presence of consciousness in man. Here again, of course, the within of the natural core is postulated on the basis of analogy (and an auxiliary hypothesis) which proceeds from the better known (man) to the lesser known (simple natural unities), back to better known and so forth. This kind of 'dialectical methodology' itself presupposes some prior knowledge. This has been accumulated, it may be assumed, through all the historically recognized research methods of the various sciences, e.g. conceptual analysis, induction, quantification, observation and so forth. The possibility of accurate analogical inference is contingent upon the accuracy of the delineation and correlation of given structures (properties) and processes (action, interaction), for it is only on such a basis that comparison is possible.

Teilhard's use of analogy quite possibly was not simply restricted to inference about the mere presence of consciousness in individuals, but also about levels of consciousness; for example, given an (X) which has (C), (BP), and (SP), where (BP) has a level of behaviour (or structure), then given any other X^1, X^2, X^3, with BP_{L1}, BP_{L2}, (BP)(LT), it is possible to grade the consciousness of X^1... X^2...X^3 as greater than, less than or equal to X, on the basis of approximation to BP LR (or SP LR). Reverting again to a schema, this could be expressed as,

X has BP LR and C
X^3 has BP LS and C
the BP LR of X has a value
(according to some criterion)
such that (BP) (LR) of X is greater than (BP) (LS) of X^3.

therefore C of X is greater than C of X^3

on the assumption that the criterion is sound and a difference in BP is always or usually correlated to a difference in C.

What is the case concerning inferences from the consciousness property (or degree of consciousness) of one individual to the consciousness property of another individual can also be the case, by simple extension, with series or groups of individuals. For instance, given a series X, X^2, X^3, with structural and behavioural and consciousness predicates (SP) (BP) and (C), (SP^1), (BP^1) and (C^1), (SP^2), (BP^2) and (C^2), (SP^3), (BP^3) and (C^3) and another series, Y, Y^1, Y^2, Y^3, with properties (SPQ), (BPQ) where (SPQ) and (BPQ) closely approximates (SP) and (BP), the Y is inferred to have $Q, Q^1 \ldots Q^3$ as well. Teilhard writes,

> How then are we to go about classifying the higher living units so that the position of Man in terms of complexity may be determined? What method shall we adopt?
>
> We can do it very simply by introducing what is called a change of variable. The more complex a being is, so our Scale of Complexity tells us, the more is it centred upon itself and therefore the more <u>aware</u> does it become. In other words, the higher the degree of complexity in a living creature, the higher its consciousness; and vice versa. The two properties vary in parallel and simultaneously. If we depict them in diagrammatic form, they are equivalent and interchangeable. So it comes to this, that when we have reached the point where complexity can no longer be reckoned in numbers of atoms we can nevertheless continue to measure it (and accurately) by noting the increase of consciousness in the living creature - in practical terms, the development of its nervous system. This is the solution of our problem.
>
> Accordingly, if we use the factor of psychic growth (or which comes to the same thing, progress of cerebralisation) as a scale whereby we may measure the growth of complexity through the maze of invertebrates, anthropoids and vertebrates, the position and significance of the human type in nature at once becomes apparent. For of all the numberless types of living unit that have appeared in the course of the last 300 million years, Man, judged by his power of reflection (itself bound up with the ultra-complexity of a brain composed of many millions of cells) not only comes indisputably first, but occupies a place of his own at the head of all the other 'very great complexes' evolved on Earth.[103]

With other pieces of information, but retaining the same basic inferential schema, a variety of other types of inference can be

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103. ________, "Life and the Planets", in <u>The Future of Man</u>, pp. 110-111. Teilhard is able to establish this analytic method, as it can be seen only after establishing the presence of psyche in biota which he does by analogy, at which point the comparison of types becomes possible.

derived as well. For example, if, according to some hypothetical criteria, it is decided that the consciousness of the X group represents an ideal type, then it can be decided that the consciousness property of the Y group is lower than that of the X group. Or again, given some third group Z, where the behavioural properties and structural properties of Z approximate those of Y, but not so closely as the predicates of Y approach those of X, then it can be inferred that Z has a consciousness which is inferior to that of Y and Y a consciousness inferior to that of (X > Y > X). So there is a transitive asymmetrical relationship holding between X, Y, and Z.[104]

Given the same sort of information, that is the same instance of consciousness taken as ideal, a similar type of inference could be made about the members of a group that show some difference in structural properties, so that a series could be derived on the basis of approximation to the ideal type. Schematically such a series might

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104. It is on the basis of such reasoning that Teilhard placed the primates psychically next to man. On adopting the criterion of cerebreo-complexity, Teilhard writes for example that,

"What makes the primates so interesting and important to biology is....they represent a phylum of pure and direct cerebralisation. In the case of the primates....evolution went straight to work on the brain neglecting everything else which....remained malleable. That is why they are at the head....of the march towards greater consciousness". As found in The Phenomenon of Man, p. 159. And elsewhere in the same work, Teilhard writes, "....the upholders of spiritual have no need to be disconcerted when they see....in the higher animals (particularly in the great apes ways and reactions which strangely recall those of which they make use to define the nature and presence in Man of a 'reasoning soul'. If the story of life is no more than a movement of consciousness veiled in morphology, it is inevitable that towards the summit of the series, in the proximity of Man, the psychical make-ups....reach the borders of intelligence". As found in The Phenomenon of Man, pp. 167-168.

appear, $X \ldots X^{-1} \ldots X^{-2}$, meaning X^{-1} is less consciousness than X and so forth. With another piece of information[105], still more interesting kinds of conclusions might be derived. Suppose it could be established that X was not only more conscious than X^{-1}, but also later than X^{-1} in temporal sequence and so forth to X^{-10}, then given another X which, on the basis of structure, was accorded the position of X^{-11}, it could be further inferred that X^{-11} was also less consciousness than X^{-10} and earlier than X^{-10}. By extension again, it is possible to make this type of inference not only inter-group and series, but also infra-group and series, so that one group might be judged earlier than and less consciousness than another and so forth.

Again it is to be remembered that this is just a postulated propositional schema. Even if it were true that Teilhard did in fact use some inference schema, similar to the one proposed here, it must be remembered that this schema is an abstraction from some very real physical, epistemological and methodological considerations. For instance, while the inferential schema may be absolutely isomorphic, from a logical point of view, there are very large differences indeed in the epistemological and methodological status of the four cases to follow.

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105. These other pieces of information are derived, as is the case with physical complexity, not through a direct conceptual and composition method like analogy (bringing the 'within' and the 'without' together), but through other theories (Darwinian Evolution) and Physical methods and techniques (e.g. geological dating).

Case one; Consider two entities A and A^1 where a 'picture' of A has been built up on the basis of its effects so that there is an A with 'effective' properties, EP (observed), functional properties, FP (postulated), structural properties SP (postulated) and consciousness properties CA (postulated) and another group of effective properties EP^1. So it is inferred,

There is an A with EP (observed)
FP, SP, and C (all postulated)
and there is an A^1 (postulated)
With EP^1 (postulated)

A^1 has SP^1, FP^1 and CA^1

Case two: There is a B and B^1

B has EP (observed) FP (postulated and confirmed)
SP and C (postulated)
There is a B^1 with EP^1 (observed)

B^1 has FP^1 SP and C

In cases three and four the structural and behavioural predicates are postulated and confirmed respectively. Thus, the inferential strength varies considerably from one to four. Case four, with the highest observational component, is clearly the strongest, while case one, with the highest relative amount of postulated material, is clearly the weakest. However, the question of evidential strength goes beyond the subject at hand.

Even if the question of the cogency of the utility of analogical inference cannot be dealt with in the present context, other useful information about Teilhard's theory may be inferred. If, for example, something approximating the view of Teilhard's use of analogical inference as a research method is adopted, certain things that Teilhard does say about the method (and indirectly about his theory) achieve a specific intelligibility that they do not otherwise have.

The interpretation given here of the Teilhardian use of analogy, as a part of his general research method, articulates well with both his notions of hypothesis and what Teilhard refers to as his 'law of alteration'.

In one of his passages on method, Teilhard says that

> In the course of its attempts to give clarity and coherence to the universe around it, the human mind does not work only through repeated tentative probings. It advances, too, in a succession of ocillations between the more known and the less known: Each higher step taken in penetrating the unknown allowing it the better to see (by stepping down again) the more known and then to rebound towards a more advanced understanding of the less known.[106]

While various interpretations of the passage are possible, that which Teilhard seems to be describing in the first instance would appear to involve what might be considered as analytic research methodology, while the second kind of attempt might well refer to analogical inference.

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106. __________, "Outline of a Dialectic of Spirit" (1946), in Activation of Energy, p. 143.

5.2 Analogical Inference and Certitude

According to the view of Teilhard taken throughout in a Teilhardian epistemology, what human beings experience most intimately is the personal consciousness. Personal structure is known secondarily. However, a study of structure serves to embed the experience of consciousness in a web of 'causal' relations (ultimately Teilhard hopes to specify what kind of consciousness may be correlated with what type of structural arrangement (conditions for consciousness)), and thus, while consciousness is explained by structure (is an effect of structure), structure is defined by consciousness [107].

The former method entails the advancement of hypotheses relative to some problem until some contextually satisfying approximate solution is derived. The solution itself may, because it is only an approximation, form the basis of another problem to which 'tentative' hypothetical solutions are offered. What Teilhard would seem to mean by 'better known' is that which can be directly observed or has been previously explained. The better known in this instance forms the basis of the problem concerning the more pervasive but hidden patterns that it

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107. As will be developed in the next chapter, biota are, for Teilhard, to be analyzed and ordered according to his hypothetically derived complexification criterion and placed in a synchronic series (also entailing assumptions about the correlation of structural organization and appearance in time) However the presence, order and levels of structure are attributable to the workings of psyche. Here, presence and 'degree' are analogically derived, based on variations of structure and function.

(the phenomenon) might be a part of. Hypotheses, then, represent suggestions as to the shape of the hidden patterns. The advance occurs when the 'shape' is approximately discovered. The more universal structure of process, then, itself becomes a subject for investigation. According to Teilhard, however, the conceptual motion need not be simply from the known to the relatively unknown. When the unknown becomes relatively more intelligible there exists the possibility of situating if in turn in a wider system of relations, but there also exists the possibility of returning to the previously better known in order to redefine it and then to redefine the wider pattern which is held to explain its appearance. Concretely, the structure of human beings is 'explained' by the theoretical elements which compose it (atoms, molecules and so forth); further, however, in the Teilhardian context, the activity of the elements (natural cores) is 'explained' by the observed psychic property (consciousness) of the individual which the elements compose.

6. An Explanatory Schema of Orthogenesis as a Consequent of the Historical Explanatory Predeterminant.

It should be noted at this point again that, whatever the logic used in the method of research, it is distinctly different from the logic of explanation. Teilhard, as can be seen in the sections on analysis and synthesis, begins from an agglomerate of biological data, establishes what he believes to be the major features of the entities that he is dealing with, arranges or composes a representation of biota according to similarity and difference, purports to discover a pattern (orthogenesis) within the totality and postulates the universal force (radial energy) of which the orthogenetic series is the most luminous effect. This is the order of discovery but it is not the order of explanation. The particular, as it will be discussed in detail in the subsequent chapter, is explained as an instance of some universally pervasive trait of nature. However, it can also be noted that, unlike many of the theoretical types presently described by some orthodox philosophers of science, on account of Teilhard's adoption of a historical or narrative form of explanation, as well as the hypothetical deductive sort the two logics cannot be neatly separated. This is due to the fact that the necessity of reconstructive individual antecedents and groups of antecedents forces a continual return of the observational base. This, in turn, entails the implication that the forms of analogical inference previously identified as characterizing an aspect of Teilhard's method of inquiry would also play a role within the explanatory framework of the orthogenetic theory which is a product of that inquiry. The conjoint result of the articulation of these dual forms of explanation could be schematically described in the following fashion.

If it is accepted that scientific theories exhibit a general pattern of explanation such as the following,

($\bar{E}$ E) non-explained explainers

(E E) explained explainers

(E $\bar{E}$) explained non-explainers [109]

where observed structures and processes, which themselves do not explain

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109. After Wilfrid Sellars "The Language of Theories", in current issues in Philosophy of Science, 1959, p. 70.

anything, but are merely given (phenomena), may be explained by other theoretical entities, which may be themselves unexplained, it follows from the schema that, no matter how many layers there might be, there has to be an explained non-explainer and a non-explained explainer.

In a sense, the explanatory motion, as explanation is uni-directional, the explained non-explainer receives definition through hypothesizing structures and processes which are continuously farther removed from it. On the other hand, Teilhard appears to be positing a notion of explanation which can be schematized in the following way:

$$\begin{array}{lcccccccl}
(1)\ \text{explaining} & \big\downarrow & \bar{E}\ E & \big\uparrow & & (2) & \bar{E}\ E & & (E\ \bar{E}\ (1)) \\
 & \big\downarrow & E\ E & \big\uparrow & \xrightarrow{\hspace{2em}} & & E\ E & & (\Updownarrow) \\
 & \big\downarrow & E\ \bar{E} & & \text{explained by} & & E\ \bar{E} & & (E\ \bar{E}\ (1))
\end{array}$$

where the explained non-explainer of (1) becomes the partially explained explainer of (2) and the non-explained explainer of (1) the partially explained non-explainer of (2).

Rather than containing a smaller hypothetical content, the Teilhardian explanatory schemata involves a greater one. In the instance of the first schema, there are the relatively 'pure' observational entities which need explanation and the completely theoretical explaining terms (for physical not logical reasons), while in the second schema, the theoretical primitives (givens) are used to furnish an explanation for entities and processes which are themselves theoretical. Neither type of explanation is inconsistent with Teilhard's statement that "Good hypotheses are continually modified but in a definite direction which they perfect themselves by following"[110]. Either type of explanatory process allows for such a continuous modification. However, it is the second type of explanatory form which appears to be specifically Teilhardian, for it is here that the observed properties of the explained non-explainer of the first type become explanatory of hypothetical structural behavioural and consciousness properties of the non-explained explainers of that type, through analogy.

6.1 A Description of Certain Major Features of Scientific Theories as Manifestations of Pre-Theoretical Determinants

As a final point of consideration beyond the previously given schemata of the general pattern of scientific explanation as delineated by Wilfred Sellars, there has been a consensus arrived at by philosophers of science which at least in broad outline provides a picture of the manner in which the composite elements of certain major scientific theories have been articulated. The fact that such an accord could have been reached through reflective analysis, argues for the point that there have been certain pressures, whether the architecture of nature or some other set of reasons[111], that have determined the manner in which scientists have framed their descriptions of natural events.

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110. Teilhard de Chardin, P., "The Natural History of the World", in The Vision of the Past, p. 112.

111. A description of these belongs to a consideration of the forces shaping the general evolution of scientific thought and, as such, go beyond the scope of this thesis.

A statement of these elements provides a basis for description and evaluation of orthogenesis as a scientific theory. If Teilhard's theory can be shown to conform in its general outline to this paradigm of theories, then a statement of certain of the necessary conditions, although as it will be demonstrated not the total sufficient condition for establishing Teilhard's theory, as a scientific theory will have been provided. If, on the other hand, Teilhard's theory does not conform to this model of theories, or does not conform completely, then through the comparison it becomes possible to isolate and assess the difference. In The Phenomenon of Man, Teilhard contends that he wishes to explain the internal aspect of things, since otherwise it is impossible "to cover the totality of the cosmic phenomena by one coherent explanation such as science must try to construct"[112]. The question remains as to what sort of features such an explanation should exhibit in order to be properly scientific.

Fortunately, as has been said, certain general features of theories have been delineated and, to an extent, agreed upon by philosophers of science. Wilfred Sellars describes a 'standard modern account' of a theory type in this way,

> ....there are (a) the vocabulary postulates and theories of the theory as an uninterpreted calculus, (b) the vocabulary and inductively testable statements of the observation framework, (c) the 'correspondence rules' which correlate in a way which shows certain analogies to translation statements in the theoretical vocabulary with statements in the language of observation.[113]

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112. __________, The Phenomenon of Man, p. 53.

113. Sellars, W., "The Language of Theories", in current issues in The Philosophy of Science (1954), p. 58.

Setting aside the problems entailed in the Teilhardian use of correspondence rules, vocabulary and inductively testable statement for development in subsequent chapters, the following points may be immediately made about the Teilhardian calculus.

7.1 A Logical Calculus and the Orthogenetic Theory

Even though philosophers of science sometimes speak as if an uninterpreted calculus antecedes the empirical postulates of a theory, Ernest Nagel[114], who is one of the leading proponents of this view of theories, advances as well the thesis that a scientist may not begin from such a calculus but from a model in which a system of logical relation is implicit. Concerning this, the philosopher of science writes, "The history of theoretical science supplies plentiful examples of the influence of analogies upon the formation of theoretical ideas...."[115], and states that while

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114. He writes for example that, "For the purpose of analysis, it will be useful to distinguish three components in a theory: (1) an abstract calculus that is the logical skeleton of the explanatory system. and that "implicitly defines" the basic notions of the systems; (2) a set of rules that in effect assigns an empirical content to the abstract calculus by relating it to the concrete materials of observation and experiment; and (3) an interpretation or model for the abstract calculus, which supplies some flesh for the skeletal structure in terms of more or less familiar conceptual or visualizable materials." As found in The Structure of Science, p. 90.

115. Nagel, Ernest, The Structure of Science, p. 108. And about this Nagel contends as well, "A scientific theory....is often suggested by materials of familiar experience or by certain features noted in other theories". As found in The Structure of Science, p. 91.

> Emphasis has....been placed on the heuristic value of models in the construction and use of theories, the fact should not be overlooked....that models also contribute to the achievement of inclusive systems of explanation. A theory that is articulated in the light of a familiar model resembles in important ways the laws or theories which are assumed to hold for the model itself; and in consequence the new theory is not only assimilate to what is already familiar but can often be viewed as an extension and generalization of an older theory which has a more limited initial scope.[116]

As it has been previously developed, Teilhard's primary substantive model may be identified with the properties and relations found in physical anthropology and paleontology, in which case Teilhard's calculus is, to an extent, derived from this area of the physical world and embedded in the 'meaning postulates' of the orthogenetic theory. However, any attempt to dig such a schema out and give it an exact formalization would require a consideration of logical issues quite distinct from questions concerning the theory itself. Nevertheless, a partial formalization of some element of Teilhard's theory appears useful in order to suggest the fact that there is such logical framework present and this logical element is, or can be described as if it were related, to the empirical elements in the fashion Nagel portrays.

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116. ________, The Structure of Science, p. 114. And elsewhere he says, "Were a theory stated as a set of uninterpreted postulates, exhibiting not even a formal analogy to some already familiar system of abstract relations, the formulation would provide no clues as to how the theory could be applied to concrete physical problems". In The Structure of Science, p. 113. It can be noted that the part of the orthogenetic theory which is most directly derivitive of paleontology employs a mode of explanation, genetic and historical, for which, according to the research to date, no logical calculi have been developed comparable to the symbolic expressions of logical types in theories of physics. In fact, the consequent partial formulization presupposes a Teilhardian interpretation of an anthropological system which employs a mode of explanation including law-like generalizations similar to those used in physics and chemistry.

7.2 A Logical Calculus and the Law of Complexity-Consciousness

For example, Teilhard's proposed complexity-consciousness law could be regarded as an *axiom*, which could be expressed in ordinary sentential and propositional calculus as,

$$((X)\ CX \supset SX)$$ [117]

which can be translated as, for any X, if X has consciousness, then X has structure (combined complexification). The logical operator in fact does not capture the full implication[118] of the relationship between complexity and consciousness, as Teilhard posits it.

From this 'axiom' alone, with the addition of two inference rules (Universal Instantiation and Modus Ponens), the following argument form becomes possible,

(1) $(X)\ (CX \supset SX)$

(2) Ca

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117. This propositional form is warranted by such Teilhardian texts as the following. Teilhard says for example that "....the large complex (since it does in fact exist) cannot but have *its own proper character*. What that is, we shall now see...........
Consciousness as an effect of complexity." As found in "The Atomism of Spirit" (1941), in *Activation of Energy*, p. 30. Or again,"....'the within' is a universal property of things perceptible only at certain extreme degrees of the complexity of matter: consciousness so-called is the property specific to very large complexes; it is a result of them". As found in "The Place of Technology", in *Activation of Energy*, p. 156.

118. If consciousness type is regarded as a correlate of complexity, then the relationship would have to be expressed as ((X) CX SX). For any X, X has consciousness only if X has complexity. If consciousness type is seen as a result of complexity type, then the relationship is causal and cannot be expressed by the ($\supset$) operator at all.

(3) Ca Sa $\supset$ 1, (U.l.)

$\therefore$ Sa 2,3 (M.P.)

This may be interpreted to read,

(1) For any corpuscle, if that corpuscle has consciousness, then that corpuscle has structure.

(2) There is a particular example of (X) designated (a) which has consciousness and the conscious type of (a) implies the presence of structure in (a). (What is true of the logical whole must be true of the logical part). Therefore, the presence of consciousness in (a) implies the presence of structure in (a).

If the logical language is extended and another axiom is added, an even greater range of arguments becomes possible, e.g. axiom II (X)(Y) (CX $\supset$ CY) $\supset$ (SX $\supset$ SY), could be translated as, any two kinds of corpuscles, if the consciousness of the first is greater than the consciousness of the second, then the structure of the first kind is greater than that of the second. This axiom also allows a range of argument which is more extended that the first, e.g.

(1) (XY) (CX $>$ CY) $>$ (SX $>$ SY)

(2) Ca $>$ Cb

(3) (Ca $>$ Cb) $>$ (Sa $>$ Sb) (U.I.)

Sa $>$ Sb 2,3 M.P.

which may be translated in the same fashion as the first argument.

This type of argument does appear in the orthogenetic theory as such, although usually in a more complicated fashion[119]. The complication presents itself, however, not mainly through pure logical considerations, but through the other elements that Sellars mentions as entering into theory construction. This construction may be illustrated in the following way. The logical formula $(x)\,(Nx \supset (Cx \,\&\, Sx))$ has no meaning other than that of logical relation; however, it can be translated to read for any entity. If X is a natural unity, then X has both consciousness and structure. The terms consciousness and structure are both problematic, as is the relationship between them. The term structure, however, offers less difficulty than consciousness and may be used just as easily to illustrate the following points. The problem of the meaning of consciousness can then be set aside for subsequent development. The notion of structure or, more precisely, 'combined complexity', is utilized by Teilhard in a very special way throughout the orthogenetic theory.

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[119] For example, Teilhard says, ".... by the reflective nature of his psychism, individual man appears in the field of our experience to be the extreme form so far attained in an isolated element by the cosmic process (or drift) of complexity-consciousness". "The Singularities of the Human Species" (1954), in The Appearance of Man, (J.M. Cohen, transl.), London, Collins, 1965 (1956), p. 245. This observation presupposes the complexity-consciousness law of which human intelligence is an instance. It also presupposes a criterion (complexity) by which structures are graded. If the order of complexity-consciousness is reversed, which is permissable according to Teilhard who says, "complexity = centricity = consciousness....This structural formula may be read in either direction...." As found in "The Atomism of the Spirit", in Activation of Energy, pp. 31-32.

SUMMARY AND CONCLUSION

In this chapter, it has been argued that Teilhard approaches the physical world and, specifically, his problem, the phenomena of man, with certain presuppositions. These presuppositions combine to compose an interpretive framework which functions to determine, to a degree, the structure and the content of the orthogenetic theory.

Teilhard, for example, wishes to provide an ever wider explanation of events in the extramental world by subsuming or interrelating more and more discrete phenomena into general patterns or laws. Nevertheless, despite the similarity of overriding goals, Teilhard utilizes concepts, explanatory categories and methodological presuppositions quite different from those of classical physics, which has served as a paradigm for all scientific explanation. Teilhard, for example, proposes a view of theory where concepts such as the non-reducible property and the non-reducible 'level' are regarded as necessary for adequate explanation of events. He proposes a view of theory where the concept of a-symmetrical historical process is, in principle, necessary to adequate explanation.

It was suggested as well, that what Teilhard believed to be the overall speculative goal of science. exerted an important influence on how he approached the world. This is to say, that since he believed that the fundamental speculative goal of science was to trace the development of the universe from simple to complex (through the agency of radial energy), part of his method and part of his directive concerning what should be looked for in the world involved the search for, and the description of, emergent properties, organisms and classes as well as the antecedents.

It was suggested that Teilhard's use of this type of description, while not based on multiple observations of general properties and processes, was nevertheless not arbitrary; rather it was posited that the type of properties and processes that Teilahrd did suggest as necessary to adequate explanation was based on his experience of a 'non-mechanistic biological model.

It was argued further that, because Teilhard did not accept simple induction as a viable method of approach to many facets of the world, and on account of the fact that he did not accept the statement of traditional primary properties related by invariant laws of spatial and temporal structure as explanatory ultimates, he believed that the inductive, analytic and abstractive method must be supplemented with a synthetic, compositional method as a means of research. This synthetic method entailed the reconstruction of the structure and functions of natural cores, the relationships between and among the centres and the history of their genesis. This reconstruction, it was suggested, occurs partly through analogical inference. It was suggested further that, by these concepts, Teilhard evokes a novel form of explanation where there is a reciprocal explanatory between explanans and explanandum. It was not suggested however, that each of these pre-theoretical elements shaped the structure and content in exactly the same way.

His statement about the ultimate goals of science, for example, do not necessitate that his theory be a complete expression of the totality of connections according to his stated classifications. Rather since the statement expresses a proposition concerning the way that the world should be thought about, if it is to be rendered intelligible, it might be expected that his theory describes at least some part of the world according to his systematics.

Similarly, if what has been called Teilhard's methodological heuristic functions as statements about how the world is to be approached, if it is to be described successfully, then it may be expected that Teilhard can describe events as spatially and temporally related in a way that does not necessitate the concept of a completely closed system.

Teilhard's biological model, on the other hand, provides not so much guides in thinking about the world, but, more directly, statements about the kind of structures and processes that it can be expected would be expressed by his theory.

His view of hypothesis, more problematically, allows Teilhard to make assertions about states of affairs which he might not have been able to forward on the basis of, for example, a purely inductive method (Mill's). Beyond this, it says something not so much about the content of Teilhard's theory itself, but about Teilhard's epistemology and the truth status of his theory. It helps to explain, to some extent, the reason that Teilhard frames his theory in the way that he did, as well as providing some basis for judgements on the cogency of what he did.

The topic of analogical inference is even more difficult. If the majority contemporary view of theory construction is taken and if Teilhard's use of analogical inference is considered as restricted to theory derivation (in contrast to theory structure and theory validity), the topic of an analogical inference has no interest beyond the discussion of its utility as a method of research and logical derivation. This is due to the fact as stated earlier, that most contemporary logicians and philosophers of science see the question of theoretical origin of importance to psychological investigation only while, it is considered, what is important to the philosopher is the logical structure of the theory as it is presented and the evidence advanced to support it. If however, analogical inference enters into the very statement of the theory, then this logical form has importance beyond that of theoretical origins. While it is not argued then that these five elements shaped the theory in the same fashion, it has been argued that they did influence the theory and as such that the shaping should be discernable in the theory itself.

The sixth and seventh segments of this chapter move from the consideration of those factors which influence the structure and content of the orthogenetic theory to those features of theoretical explanation and theory construction which are held to characterize theories in general. The basic import of these sections is that, if there is a generally agreed upon consensus among philosophers of science, as is the case about those features which typify scientific theories, there must be some factors, or set of factors, at work determining the shape of scientific theories which allows the agreed upon general description. Given this to be the case, orthogenesis as a scientific theory should manifest these influences.

The sixth section then schematically illustrates the general form of scientific explanation and describes, again schematically, the similarities and differences between this and the general explanatory form of orthogenesis which employs historical and narrative types of explanation as well as the usual hypothetical deductive type. The demonstration of the presence and content of these forms is left for development in the following chapter.

The seventh and last part of the chapter delineates the generally accepted elements of scientific theory, vocabulary, logical framework, correspondence rules and observation statements and attempts to show that the complexity-consciousness law can at least be expressed in the language of a formal calculus.

These indentifications, if correct, render the orthogenetic theory more intelligible by establishing both the reasons for and the basis of an analysis of the articulation of its structure. This constitutes the subject matter of the next chapter.

CHAPTER I - APPENDIX A

The Heuristic of Teilhard and Einstein: A Comparison and Contrast

A: The Comparison

On the first and fifth points, Einstein says,

> The belief in an external world independent of the perceiving subject is the basis of all natural science. Since, however, sense perception only gives information of this external world or of "physical reality" indirectly, we can only grasp the latter by speculative means;[1]

while on the second, third, fourth, fifth, sixth and seventh points, he says respectively,

> Nobody who has really gone deeply into the matter will deny that in practice the world of phenomena uniquely determines the theoretical system, in spite of the fact that there is no logical bridge between phenomena and their theoretical principles; this is what Leibnitz described so happily as a "pre-established harmony". Physicists often accuse epistemologists of not paying sufficient attention to this fact. Here, it seems to me, lie the roots of the controversy carried on some years ago between Mach and Planck.
>
> The longing to behold this pre-established harmony is the source of the inexhaustible patience and endurance with which Planck has devoted himself, as we see, to the most general problems of our science....;[2]

and

> The supreme task of the physicist is to arrive at those universal elementary laws from which the cosmos can be built up by pure deduction. There is no logical path to these laws; only intuition, resting on sympathetic understanding of experience, can reach them.[3]

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1. Einstein, Albert, Essays in Science, Mein Weltbild (Alan Harris, transl.) 1933, New York Philosophical Library, 1934, p. 40.

2. ______, Essays in Science, pp.4. 7-18

3. ______, Essays in Science, pp. 17-18.

On points one and two, Teilhard presupposes there is an extramental world and he states that it is structured in the following passage

> The existence of 'system' in the world is at once obvious to every observer of nature, no matter whom.
>
> The arrangement of the parts of the universe has always been a source of amazement to men. But this disposition proves itself more and more astonishing as, every day, our science is able to make a more precise and penetrating study of the facts....[4]

While on point three, Teilhard says,

> As I shall have to repeat more than once in the course of the argument that follows, life is apparently nothing but the privileged exaggeration of a fundamental cosmic tendency (as fundamental as entropy or gravitation) which may be called the 'Law of complexity/consciousness', and which can be expressed as follows:
>
> 'Left long enough to itself, under the prolonged and universal play of chance, matter manifests the property of arranging itself in more and more complex groupings, and at the same time in ever-deepening layers of consciousness; this double and combined movement of physical unfolding and psychic interiorisation (or centration) once started, continuing, accelarating and growing to its utmost extent'....
>
> This tendency towards complexity-consciousness (leading to the formation of more and more astronomically complicated corpuscles) is easily recognisable on the atomic plane, and it is confirmed on the molecular. But it is patently on the plane of life that it is revealed in all its clarity - and all its additiveness; and here it can, at the same time, be translated into a convenient and simplified formula; <u>the tendency to cerebration</u>.[5]

However, he also recognizes recurrent patterns, expressed as scientific laws which are observable (applicable to particular 'zones') as opperative in particular levels of the universe, and codified by the various

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4. Teilhard de Chardin, P., <u>The Phenomenon of Man</u>, p. 43.

5. __________, <u>The Appearance of Man</u>, p. 139.

physical sciences. Within the context of his theory, however, Teilhard gives these laws a special interpretation. He says,

> Right at the bottom, forming a group apart, there are first of all the multiple so-called 'material' spheres. Matter is habitually regarded as inanimate, and this is the source of all our difficulties in understanding it. We now discover that it may simply correspond (to the extent that it exists) to a state of consciousness so extended and fragmentated that its elements are only visible to us in their statistical properties, that is to say, in the form of inflexible, completely 'dis-animated' laws. From this viewpoint, material determinisms cease to provide the skeleton of the world; they are merely a secondary effect in the cosmos arising from the mass of elementary spheres. They are the true 'epi-phenomenon'.[6]

On points five, six and seven, Teilhard reveals his position in a number of passages, some of which are the following. Teilhard says on the task of science that,

> I am convinced that the two points of view require to be brought into union, and that they soon will unite in a kind of phenomenology or generalised physic in which the internal aspect of things as well as the external aspect of the world will be taken into account. Otherwise, so it seems to me, it is impossible to cover the totality of the cosmic phenomenon by one coherent explanation such as science must try to construct.[7]

And on the indirect approach to natural processes, Teilhard says,

> What ancient thought half perceived and imagined as a natural harmony of numbers, modern science has grasped and realised in the precision of formulae dependent on measurement. Indeed, we owe our knowledge of the macro-structure and micro-structure of the universe far more to increasingly accurate measurements than to direct observations. And, again, it is ever bolder measurements that have revealed to us the calculable conditions to which every transformation of matter

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6. __________, "The Phenomenon of Spirituality" (1937), in Human Energy, pp. 101-102.

7. __________, The Phenomenon of Man, p. 53.

is subject according to the force it calls into play.[8]

And,

> Fortunately there are a number of different ways in which our minds can reach reality. What escapes the intuition of our senses we can encircle and define approximately by a series of indirect attacks. Let us follow this more round-about method, the only one at our disposal when we try to picture new-born life. We can do so by stages in the following manner.[9]

B: The Contrast

In what is probably his most complete statement on philosophy of science, Teilhard says in the Vision of the Past under the title "Systematics, the Speculative Goal of all Science", that,

> Philosophers who have been analysing the value of science for thirty years have very strongly insisted on the relative and provisional character of human knowledge, especially in physics.
>
> They have revealed the simplifications, approximations, interpretations of all sorts that concrete nature, the 'fact', has undergone when submitted to our mathematical laws. They have assessed the precarious life of hypotheses. One might almost think, as one reads them, that capable though science is in its practical mastery of material energies, it is powerless when it comes to the question of extending our perception of reality and constructing a gradually more intelligible universe.
>
> There is a measure of exaggeration in these criticisms, which is immediately evident as soon as one distinguishes the two very different elements in scientific constructions: (a) mathematical expressions relating measures applied to phenomena; and (b) the physical entities (properties, in the first place,but afterwards the natural cores) progressively discerned and discovered by a network of laws and calculations.
>
> The first of these two elements is undoubtedly very relative. The mathematical representation of physical realities depends on the point of view chosen by the modern physicist (and by the whole of physics for a least the last two centuries)

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8. __________, The Phenomenon of Man, p. 50.

9. __________, The Phenomenon of Man, p. 50.

by his method of approaching nature and dividing up phenomena. It varies according to the precision of procedures. It is constantly submitted to a sort of idealization. Mathematical laws, in fact, are a language which could vary greatly from its present form and still describe the same things as it does today.

The same is not true of the physical entities which provide the material basis for mathematical constructions. This second element in scientific theory has in fact an absolute value; it represents a true and definite invariable, that is to say, something which, once discovered, is destined to remain the same under all investigations and analyses, in all languages and from all points of view.

Let us take the typical case of the discovery of Neptune. The astronomical laws which Le Verrier used for his calculations were only approximate. The progress of astronomy and mathematics will perhaps modify them very profoundly. They sufficed, however, for the discovery of an unknown celestial body. This new planet was a definite achievement by science.

Let us now take the more modern case of atoms and electrons. For some years, the study of radiation led scientists to suspect the existence of extremely small centres of matter, the objective reality of which, confirming that of the particles imagined by chemistry, tends to impose itself on science as an actual fact. Clearly, the mathematical laws regulating the distribution and movement of electrons are liable to great changes. But the electrons themselves, once 'seen' (directly), as they very soon will be, will no more depart from the heaven of human experience than Neptune, once seen through a telescope, or the sun. There will be new ways of viewing, combining and understanding them. But they will always be there.

In crystallography also, although the physical laws of symmetry are still very approximate, the Haüy networks are, thanks to the X-ray, in process of taking objective form.

By assembling these facts and others like them, we soon perceive that the most solid part, the truly indestructible residue of the conquests of science, in physics and chemistry, is represented by the discovery and cataloguing of a vast family of natural unities, centres, nuclei,[1] defined by

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1. It will be noticed that during a first phase (Neptune before its discovery by telescope, electrons before the convergent results of the last experiments, etc.) these natural nuclei have been simply 'hypotheses'. This shows how unfair it is always to describe a hypothesis as a provisional and transitory means of arranging our knowledge. Far from being a scientific accessory, hypothesis is the aim, the soul, and true content of scientific theory; it is like life, changeable, fragile but progressive. Good hypotheses are continually modified but in a definite direction, which they perfect themselves by following; and at the end of this evolution they attain the rank of fixed elements, destined to figure thereafter in any representation of the world.

specific properties and grouped in graded categories. These nuclei are too small, too numerous for us to be able yet (or indeed ever) to characterize them individually, which we should have to do in order to know them as well as we know animals. Perhaps, however, we shall come to discern distinctions and races among them (carbon races, albumin races, why not?). In any case, science already understands that it will attain no intellectual mastery of the atomic groups till it comes to know, not only the length of their life, but the long sequence of their sidereal evolution also.

What conclusion can we reach except that physics, chemistry and astronomy are contributing their most valuable speculative results to a purpose, required by both nature and truth; that here, before our eyes, they are jointly constructing a vast systematics of the inorganic world into which the classification of organic beings can be inserted on the level of the biosphere? The tree of inorganic unities (atomic and sidereal) is beginning to envelop and relay with its branches the tree of organic unities. Little by little, systematic biology, that is to say the science of living unities seen in their hierarchies and history, is penetrating and assimilating what were considered the noblest sciences, those most apt to be governed by formulae and figures.

The old systematics would patently be wrong to pride itself on these conquests (or at least on that influence). Its realm, the world of living beings, formed of perfectly distinct and clearly seriated parts, was an ideal field for the simple discovery of the value of natural orders and the enormous importance of evolution in the world. It earned no great merit by being the first to direct its researches along lines that proved to be the right ones. Nevertheless, its detractors have done wrong to despise it.

It is undoubtedly a great glory for the 'naturalists' that, encouraged by the discovery that there are physical relations of antecedence between living forms, the modes series of Buffon and Linnaeus have multiplied and amplified their ramifications till they embrace the whole cosmos: to such good purpose that, if we had to find a general name for speculative science in the form that the alliance of the most abstruse and the exact disciplines of our century tend to give it, it would no doubt be best to call it 'the natural history of the world'.[10]

It should be noted that, at the time Teilhard wrote this essay entitled

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10. ________, "The Natural History of the World", in <u>The Vision of the Past</u>, p. 110, p. 111, p. 112, p. 113.

"The Natural History of The World"[11], 1926, he had not yet 'discovered' the complexity-consciousness Law. In an essay written in 1928, entitled "The Basis and Foundations of the Idea of Evolution", Teilhard speaks this way. He says, speaking of evolution,

> What new contribution does it in fact bring to our vision? Nothing less, as we have seen, than an immense chain of 'becoming'. In the world of the senses, it teaches us, the more conscious regularly succeeds the less. Historically and scientifically a 'more presupposes a 'less'. [12]

When these statements of Teilhard are compared with those of Einstein on the ultimate goals of science, the contrast is immediately apparent. Einstein for instance says,

> We have two realities: matter and field. There is no doubt that we cannot at present imagine the whole of physics built upon the concept of matter as the physicists of the early nineteenth century did. For the moment we accept both the concepts. Can we think of matter and field as two distinct and different realities? Given a small particle of matter we could picture in a naive way that there is a definite surface of the particle where it ceases to exist and its gravitational field appears. In our picture, the region in which the laws of field are valid is abruptly separated from the region in which matter is present. But what are the physical criterions distinguishing matter and field? Before we learned about the relativity theory we could have tried to answer this question in the following way: matter has mass, whereas field has not. Field represents energy, matter represents mass. But we already know that such an answer is insufficient in view of the further knowledge gained. From the relativity theory we know that matter represents vast stores of energy and that energy represents matter. We cannot, in this way, distinguish qualitatively between matter and field, since the distinction between mass and energy is not a qualitative one. By far the greatest part of energy is concentrated in matter; but the field surrounding the particle also represents energy, though in an incomparably smaller

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11. __________ , The Vision of The Past, p. 103.

12. __________, The Vision of The Past, p. 133.

quantity. We could therefore say: Matter is where the concentration of energy is great, field where the concentration of energy is small. But if this is the case, then the difference between matter and field is a quantitative rather than a qualitative one. There is no sense in regarding matter and field as two qualities quite different from each other. We cannot imagine a definite surface separating distinctly field and matter.

The same difficulty arises for the charge and its field. It seems impossible to give an obvious qualitative criterion for distinguishing between matter and field or charge and field.

Our structure laws, that is, Maxwell's laws and the gravitational laws, break down for very great concentrations of energy or, as we may say, where sources of the field, that is electric charges or matter, are present. But could we not slightly modify our equations so that they would be valid everywhere, even in regions where energy is enormously concentrated?

We cannot build physics on the basis of the matter-concept alone. But the division into matter and field is, after the recognition of the equivalence of mass and energy, something artificial and not clearly defined. Could we not reject the concept of matter and build a pure field physics? What impresses our senses as matter is really a great concentration of energy into a comparatively small space. We could regard matter as the regions in space where the field is extremely strong. In this way a new philosophical background could be created. Its final aim would be the explanation of all events in nature by structure laws valid always and everywhere. A thrown stone is, from this point of view, a changing field, where the states of greatest field intensity travel through space with the velocity of the stone. There would be no place, in our new physics, for both field and matter, field being the only reality. This new view is suggested by the great achievements of field physics, by our success in expressing the laws of electricity, magnetism, gravitation in the form of structure laws, and finally by the equivalence of mass and energy. Our ultimate problem would be to modify our field laws in such a way that they would not break down for regions in which the energy is enormously concentrated.

But we have not so far succeeded in fulfilling this program convincingly and consistently. The decision, as to whether it is possible to carry it out, belongs to the future. At present we must still assume in all our actual theoretical constructions two realities: field and matter.[13]

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13. Einstein, A., and Infeld, Leopold, The Evolution of Physics New York, Simon and Shuster, 1938, pp. 241, 242, 243.

Although there are a number of secondary areas of disagreement, the fundamental difference between Einstein's notion of the ultimate goal of scientific description and Teilhard's would appear to concern the kind of reconstruction of the cosmos (structures and processes) which, postulated by a theory, would most likely render the universe intelligible. The sort of description Einstein has in mind entails a reduction of all phenomena to spatio-temporal position which could be expressed as a single set of temporally invariant laws in mathematical language. From these postulated universal structure laws, all the features of the universe, past, present and future, could be deduced. Teilhard's description entails a temporally variant process in which emergent properties (levels of consciousness) are considered the primary datum for limited probablistic extrapolation to the future and retrodiction to the past.

There is reason to believe that Teilhard was, himself, aware of the differences between his own position and that of this central figure (Einstein) of contemporary science.

Teilhard writes for instance,

> The <u>Revue des questions scientifiques</u> has asked me whether they may print a note on <u>The Phenomenon of Man</u>, in which I have managed to express quite a number of things that are important to me - some of them, moreover, not exactly classing me among the "advanced" scientists. My thesis, in fact, is that man is the key to the understanding of the universe (the latter becoming for all true science an <u>irreversible</u> advance toward spirit). Now, following the prophet Einstein, quite a number of physicists (or talkers) are beginning to assert the existence of a universe that is finite and reversible, in which duration will give way to space, the only definitive and fundamental reality, and so disappear. All this seems to me a delirium of

geometrization in ultra-specialized minds (these ideas would radically wipe out all faith, all morality and even all appetite for research). Nevertheless, they are very much in the air. And so now I am among the reactionaries.[14]

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14. Stated July 31, 1930, as found in De Lubac, Henri, The Religion of Teilhard de Chardin, (trans. René Hague), Paris, Desclec (1967), p. 162.

CHAPTER I - APPENDIX B

On The Deterministic System

One of the clearest and most concise explanations of what constitutes a deterministic system is that given by Ernest Nagel, who provides the following example in his Structure of Science. Nagel writes,

> The system consists of a mixture of soda water, whiskey, and ice, contained in a sealed vacuum bottle. It is assumed that no air is present in the bottle, and that the mixture is completely isolated from everything else, such as sources of heat in the environment. Moreover, the only characteristics of the system that enter into the discussion are the "thermodynamical variables", such as the following: the number of components of the system (the components in the example are water, alcohol, and carbon dioxide), the phases or types of aggregation in which the components occur (in the example, water occurs in a solid, liquid and gaseous phase), the concentrations of the components in each phase, the temperature of the mixture, and the pressure on the walls of the container. It is well known that for a given temperature and pressure, each component in the system will occur in the various phases with definite concentrations, and conversely. Thus, if the pressure of the mixture was increased (e.g. by pressing down the stopper of the bottle), the concentration of water in the gaseous phase is reduced, but its concentration in the liquid phase is increased; and analogously for a change in temperature. The variables of the system thus stand to each other in definite relations of interdependence, so that the value of a variable at any given time may be said to be "determined" by the values of the other variables at that time.
>
> Now, suppose that at some initial time the system is in a definite "state" (i.e. the variables have certain specific values), and that, because of some change induced in one or more of the variables at that time, the system is in some other definite state after an interval of time t but suppose also that the system is brought back in some way to its initial state, that exactly the same changes are induced in the variables as before, and that after the same interval the system is again in the second state. If the system behaves in this manner no matter what state is taken to be the initial state, and no matter how large the interval t, the system is said to be "deterministic" with respect to the specified set of thermo-dynamical variables.
>
> If the reference to the physico-chemical example is dropped, 'determinism' may therefore be defined quite generally as the thesis that for every set of attributes (or "variables") there

is some system that is Deterministic with respect to that set.[1] The first thing to be noticed about the system that Nagel described is that it may be regarded as 'closed'; that is, it is assumed to exchange no energy with its surroundings. It is on the basis of this assumption that Nagel's description becomes possible. The second thing of importance is that this system as Nagel describes it, is almost identical to the mechanistic model. Excepting the fact that Nagel's example incorporates chemical as well as physical interactions[2], the system that he describes exhibits no change in number or type of elements and no change in the patterns of interaction. If, for example, the temperature is increased, the volume of the fixed weight of carbon dioxide will increase in a manner directly proportional to the increase in the temperature.

The processes of the system are perfectly symmetrical. It does not matter if the pressure is increased first or decreased first; the elements of the system will act in the same way, that is, independantly of the order of variation. Given the same type of variation, the elements behave in uniform fashion, no matter when in a sequence of variation, that type of variation occurs.

The processes of the system are temporally invariant. Given the assumption that the world contains parallel cases, and that similar causes antecede similar effects, for any given system where the type

1. Nagel, E., The Structure of Science, pp. 594-595.

2. Thus illustrating the point that, while every mechanical system can be assumed to be deterministic, not every deterministic system need be mechanical (where mechanical means no change in property other than spacio-temporal ones).

of elements, phases and concentration is identical, the behaviour of that system will be identical to the one described, no matter when, relative to other cosmic processes, the system occurs, as long as the 'conditions' of the system remains constant. This system could easily be described mathematically. Given the observation of a certain number of instances plus a hypothetical leap, the description of the system could be quantified or universalized so that it purports to describe, not just the isolated system, but all similar systems. The description would then be a law, a statement about some regularity appearing in nature. It would be a law also, in which retrodiction, explanation and prediction are symmetrical; that is to say, that the relations of interdependence of any similar single system would be 'explained' as single instances or manifestations of a universal pattern of behaviour. Also, given any arbitrarily chosen initial state, all the subsequent states are determined, since the general pattern is already known and the system under investigation is a particular occurence of the universal pattern, and, given any arbitrarily chosen final state of a similar system, all the states that were antecedent can be rigorously determined for the same reasons. The whole of Newtonian mechanics describes systems of this type. In Einstein's words,

> Physical events, in Newton's view, are to be regarded as the motions, governed by fixed laws, of material points in space....this theoretical scheme is in essence an atomistic and mechanistic one. All happenings were to be interpreted purely mechanically - that is to say, simply as motions of material points according to Newton's law of motion.[3]

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3. Einstein, A., Essays in Science, p. 41.

In Newtonian mechanics, for instance, given a problem concerning the motion of objects, all that is needed is three numbers specifying spacial position and three more numbers describing their motion (direction), along with the laws of motion and the history of motion or subsequent motion of the objects may be rigidly determined. Given the strength or control over events that this type of explanation allows, it is not surprising that Newtonian mechanics is a description of a class of physical events, and classical mechanism a philosophical thesis about all cosmic events. It is easy to imagine the way in which the propositions of the first then became formed into the thesis of the second. Just as the basis of discovering that some systems may be described deterministically, that discovery can be generalized to the statement, "for every set of attributes, there is some system which is determined with respect to that set"[4], or the even stronger version where it is supposed that for every set of attributes, there is a single system (Laplace) determined with respect to that set. Further, the discovery that some events may be described in terms of primary properties may lead to the thesis that every attribute is either a primary property or reducible to primary properties, and that these properties and characteristics determine the properties and characteristics of every subsequent set.

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4. Nagel, Ernest, The Structure of Science, p. 595.

CHAPTER I - APPENDIX C

On The Notion of Model and The Teilhardian Biological Model

What is meant by the term 'model' here is partially described by Karl W. Deutsch who says,

> When men are trying to understand a complex process of system, they do so by seeking a model. This may be a material model. This may be a material model, a structure of physical processes. Or it may be a formal model, a set of symbols and operating rules which men carry in their heads, or on paper or in a calculating machine....Without models, explicit or implied, there is no understanding. For without simplified models we should have to try to "grasp directly" whatever part of reality we are investigating....The best reproduction of a cat is a cat....Whenever we cannot use a complete replica we must leave something out, as in fact we always do; and thus we are left with a simplified model....[1]

Each model, formal or material, implies four things:

1. A theory which asserts similarity between certain aspects of the model and certain aspects of the situation modeled;
2. Judgments of relevance, explicit or implied, as to which aspects of the model and of the situation under study are most worth investigating; this implies criteria for selection from obtainable data and from practicable operations, if the theory has operational meaning;
3. Predictions from the behaviour of the model to the behaviour of the situation modeled; these predictions should be testable by practicable operations, if the theory is operationally meaningful, (but it may happen that the operations are not explicitly stated and may be found later) and
4. A body of data and propositions accumulated by the use of the model.[2]

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1. Deutsch, K. W., "Mechanism, Teleology and Mind", in Space, Time and the New Mathematics, (R. W. Marks, ed.), New York, Bantam, 1964 (1950), pp. 218-219.

2. __________, Space, Time and the New Mathematics, p. 219.

The source of the Teilhardian model is the biological structures and processes which were familiar to him as an evolutionary biologist or paleontologist. The similarity between these processes and the processes envisaged in the orthogenetic theory is not one of exact identity but one of type. The irreversible "transition from a lower to a higher state of centro-complexity"[3] postulated by the orthogenetic theory is not that proposed by the orthodox biologists. Teilhard's biological model is a material one. Just as Darwin extended the structures and processes he discovered in studying the artificial cultivation of plants and animals as well as the development of Flora and Fauna in certain South-American islands. to the whole of biotic evolution, so Teilhard extrapolates the developmental processes which make up the content of his theory to the totality of cosmic evolution. Teilhard identifies the source of his theory in the following lines. He writes,

> Indeed science appears to be reaching the age at which, having occupied itself principally with elementary magnitudes, it will now attempt a direct approach to the study of cosmic movements and unities. If this tendency becomes sharper, systematics, still the only science explicitly to explore the biosphere, will no doubt see the field of its researches broken up and subdivided. It will perhaps give place one day to an anatomy, physiology and biochemistry of life in general. These sciences, whose combined functions it now exercises, will individualize at its expense. Even so it will retain the honour, not only of having opened the way towards new perspectives, but of having also provided the model and furnished the nucleus for findings that the combined efforts of all the speculative sciences must strain to realize.[4]

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3. Teilhard de Chardin, P., <u>Activation of Energy</u>, p. 103.

4. __________, "The Natural History of The World" (1925), in <u>The Vision of The Past</u>, p. 110.

Individual postulates which were later to appear in the orthogenetic theory are easily identified at this stage in the evolution of Teilhard's thought and even earlier.

For example, the concept of 'Irreversibility' which is a key notion of his theory is directly traceable to Dollo's law. Teilhard writes, for example, "This law is not special to palaeontology but is constantly assumed in all sciences which deal with physical realities... it admits all sorts of counter currents....it is from failure to understand this pliability that some scientists have found Dollo's law at fault"[5]. His complexification series is directly derived from paleontological systematics. Teilhard writes:

> To the great good fortune of systematics, setting out to make certain logical divisions in which to arrange living creatures, and finding instead organic links which proved increasingly numerous and general, it has ended by discovering a physical reality of a higher order without which these links would be inexplicable. One fine day, confronted by the flexible and orderly results to which its classifications led it, 'positional' biology saw that above living creatures there exists life: not, of course, a universal organism of which living beings must be elements, but a physical reality of a separate order, scientifically characterized by perfectly determined specific qualities. From that moment it possessed the right material to study and could fulfil the purpose for which it was born.[6]

His conception of a universe whose 'mesh' is itself also attributable to the same source. He writes,

> Until the appearance of the evolutionary point of view, natural history was not (could not be) true science. Quite the

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5. ________, "On the Law of Irreversibility in Evolution" (1923), in The Vision of The Past, p. 49.

6. ________, "The Natural History of the World" (1925), in The Vision of The Past, p. 107.

> reverse. From the moment when ideas of birth and becoming began to throw light on the ideas which the natural scientists were forming of animal and vegetable species, systematic zoology and botany became part of the block already formed by anatomy, physics, chemistry and astronomy. One need only have performed the modern task of classification for a short time to be convinced that the fusion between the different disciplines has during the last century become closer every day.[7]

and

> In the realm of life, as in that of matter, the fundamental unity of the universe and the inexorable inter-relationship of the cosmic elements, which will only allow any new being to enter our experience in the context of all the present and past states of the world known to science, appear to be ideas now definitely accepted by the human mind. We shall never abandon them again, but explore them, on the contrary, to increasing depth because we have been both drawn and driven to them by the full force of human thought for many centuries; and also because, once they are accepted, reality is found to grow clearer and more orderly so far as the eye can see.
>
> It matters little here whether the different natural groups appearing on the tree of life are comparable on the one hand to the leaves of a plant (organs more or less homogeneous with the stem that bears them) or on the other to independent calyces budding on the axis of a polypary. Whether there is continuity or discontinutity at the root of species; whether the various types of organisms form a series with no other breaks but those between individuals, or whether they are divisible into a finite number of closed specific combinations (analogous to bodies in chemistry), the fact remains - and here classical transformists and mutationists are in agreement - that no living form 'hangs in the air'. Each is attached by some part of itself to a pre-existent prototype, to a morphological antecedent - and each is connected also with its neighbouring forms. This is in itself sufficient to raise the science of classification to an equality with the great sciences of life.[8]

The notions of complexity-consciousness, emergence and the periodic recurrence of properties within biota, so central to Teilhard's

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7. __________, "The Natural History of The World" (1925), in The Vision of the Past, p. 104.

8. __________, "The Natural History of The World" (1925), in The Vision of the Past, pp. 105-106.

orthogenetic theory are all referred to by Teilhard in reference to the biological sciences of systematics and paleontology. Teilhard says,

> A certain number of the qualities that reveal and characterize the natural unity of the living terrestrial mass are merely repetitions on a larger scale of those belonging to the individual living being (vegetable or animal). Such are: the subdivision of groups (orders, families, kinds, geographically isolated fauna, etc.) in regular verticils, conforming to a fixed number of principal lines (tree-dwellers, runners, flyers, burrowers, swimmers, insectivores, carnivores, herbivores, etc.); the power that compels certain lines indefinitely to increase the accentuation of a characteristic, to 'grow' unceasingly (orthogenesis), while others remained imperturbably fixed in their characteristics; the aptitude of a group to produce abundant new forms, or on the contrary, its complete sterility; the general tendency of all phyla, great and small, to attain a higher psychism: all signs of growth, in a word, proving that zoological groups as well as individuals pass through a phase of plasticity, differentiation and fecundity, afterwards to become fixed and die.
>
> These various phenomena which charm us by their breadth without disconcerting us by their novelty, are well known; and they have for long led to discussions (though too metaphorically and cautiously perhaps) of the life of the species, that is to say, in short, of the life of the whole group of living beings. We should no doubt connect with them, by way of specific properties of terrestrial life (considered as a natural whole) a series of other facts, also brought to light by systematics, facts which at a first meeting disconcert the biologist, since they present no exact analogy with any phenomenon of life in the field of experience. We refer to the phenomena of sudden appearance which must have marked the first blossoming of life on earth, and which seem to reproduce themselves periodically each time a really new organized type adds itself to the vegetable or animal series.[9]

Reinforcing the contention that paleontology formed the core and model for orthogenesis, Teilhard writes in a much later essay,

> Palaeontologists are as yet only mildly interested in this anonymous movement of cosmic scale (a movement which complements, perhaps even compensates, thermo-dynamic entropy). They are much less interested in fact than the physicists. But yet,

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9. __________, "The Natural History of the World" (1925), in _The Vision of the Past_, pp. 107-108.

since it is they, the paleontologists, who first detected the existence and can alone continue to inform us on the historical details of the phenomenon, is it not their principal task to exploit their discovery to the uttermost?

Willingly or unwillingly, palaeontology is, and cannot help becoming increasingly the science or orthogenesis, which it must consider both in its general, fundamental drift and in the various branches into which it divides in the course of its route.

And from this point of view it pleases me to imagine the birth and development of a true 'geobiology', as an extension of geophysics and geochemistry, carrying out ever more thorough studies in the field between general speciation and hominization.[10]

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10. __________, "A Defense of Orthogenesis" (1955), in The Vision of The Past, pp. 273-274. It is interesting to note that despite the area of sharp disagreement, G.G. Simpson, another biologist, sees paleontology as occupying a key position in biology. He writes,

"The biological subject most obviously and directly historical is paleontology....In its biological role....it involves all the processes of physical sciences but differs from them....in that its configurational systems are unlike any found in the inorganic realm. Its involvement in geology....as well as in biology is....due to the fact that the history of organisms runs parallel with, is environmentally contained in, and continously interacts with the physical history of the Earth". As found in This View of Life, p. 123.

CHAPTER I - APPENDIX D

"On Method" - Analysis and Hypothesis, A Problem

Unfortunately, the problem of what is constituted in the concept of analysis appears to have received no definitive answer in contemporary literature. One commentator on the subject of types of analysis distinguishes two kinds of usages of the term as it is used by René Descartes. He says about the first, "analysis starts by assuming the truth of the theorem to be proved, and deduces from the latter some other proposition, theorem or axiom already known or assumed to be true"[1]. This is a form then of mathematical analysis. The second form Buchdahl describes might be called physical analysis. About this he says,

> The identification of analysis and synthesis with 'resolution' and 'composition', respectively, was of course no new. It can be found in Galileo and his predecessors, and goes back at least as far as the writings of Grosseteste in the twelfth century. 'Resòlution' suggests that analysis involves a process of resolving a composite whole into its primitive parts, whose being 'explains' the whole. Moreover, this form of analysis (let us call it 'analysis') is thought of, not only as a 'method of proof' but also as constituting a 'way of discovery'; it mirrors the actual advance in science from effects to causes, from the complex phenomena to the elementary components: i.e. once again, from the known to the unknown! This need not necessarily be a substantive kind of analysis, as in chemistry. Still, that Descartes should think of the component elements of the phenomena as 'causes' is not surprising; it is a very common idea,....[2]

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1. Buchdahl, G., Metaphysics and The Philosophy of Science, Oxford Blackwell, 1969, p. 127.

2. ______, Metaphysics and The Philosophy of Science, p. 129.

This conception of analysis as a method by which some physical event is 'explained' by breaking 'down' into its composite parts appears very clearly in Newton's writing. In his Optiks, for example, he says,

> As in Mathematics, so in Natural Philosophy, the Investigation of difficult Things by the Method of Analysis, ought ever to precede the Method of Composition. This Analysis consists in making Experiments and Observations, and in drawing general Conclusions from them by Induction, and admitting of no Objections against the Conclusions, but such as are taken from 'Experiments, or other certain Truths. For Hypotheses are not to be regarded in experimental Philosophy. And although the arguing from Experiments and Observations by Induction be no Demonstration of general Conclusions; yet it is the best way of arguing which the Nature of Things admits of, and may be looked upon as so much the stronger, by how much the Induction is more general. And if no Exception occur from Phenomena, the Conclusion may be pronounced generally. But if at any time afterwards any Exception shall occur from Experiments; it may then begin to be pronounced with such Exceptions as occur. By this way of Analysis we may proceed from Compounds to Ingredients, and from Motions to the Forces producing them; and in general, from Effects to their Causes, and from particular Causes to more general ones, till the Argument end in the most general. This is the Method of Analysis; And the Synthesis consists as assuming the Causes discovered, and established as Principles, and by them explaining the Phenomena proceeding from them, and proving the Explanations.[3]

John Stuart Mill in his System of Logic, provides a set of rules by which analysis may be carried out in a systematic way in order both to discover and establish facts and laws. He does this in a series of passages, some of which immediately follow. Mill says, for example, that,

> For the purposes of the present inquiry, Induction may be defined, the operation of discovering and proving general propositions. It is true that (as already shown) the process of indirectly ascertaining individual facts, is as truly inductive as that by which we establish general truths. But it is not a different kind of induction; it is another form of the very same process: since, on the one hand, generals are but collections

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3. Newton, Isaac, Opticks (1704), as found in Fehl, Noah Edward Science and Culture, Hong Kong, Chung Ch. College, 1965, pp. 365-366.

> of particulars, definite in kind but indefinite in number; and on the other hand, whenever the evidence which we derive from observation of known cases justifies us in drawing an inference respecting even one unknown case, we should on the same evidence be justified in drawing a similar inference with respect to a whole class of cases. The inference either does not hold at all, or it holds in all cases of a certain description; in all cases which, in certain definable respects, resemble those we have observed.
>
> If these remarks are just; if the principles and rules of inference are the same whether we infer general propositions or individual facts; it follows that a complete logic of the sciences would be also a complete logic of practical business and common life. Since there is no case of legitimate inference from experience, in which the conclusion may not legitimately be a general proposition; an analysis of the process by which general truths are arrived at, is virtually an analysis of all induction whatever. Whether we are inquiring into a scientific principle or into an individual fact, and whether we proceed by experiment or by ratiocination, every step in the train of inferences is essentially inductive, and the legitimacy of the induction depends in both cases on the same conditions.[4]

For Mill, the expression "induction" includes a) the 'mental' analysis by which the multitude of phenomena are brought to some initial semblance of order, b) the physical analytic which is carried out on the products of the initial mental sorting utilizing appropriate physical operations, carried out in a systematic manner in order to ascertain natural antecedents and consequents, and c) the generalized product of the dual analytic. On this he says,

> It results from the preceding exposition, that the process of ascertaining what consequents, in nature, are invariably connected with what antecedents, or in other words what phenomena are related to each other as causes and effects, is in some sort a process of analysis....
>
> This operation, which we have called analytical, inasmuch as it is the resolution of a complex whole into the component elements, is more than a merely mental analysis. No mere contemplation of the phenomena, and partition of them by the

4. Mill, John Stuart, A System of Logic, 3rd Edition, London, Parker, 1851, p. 292.

> intellect alone, will of itself accomplish the end we have now in view. Nevertheless, such a mental partition is an indispensable first step. The order of nature, as perceived at a first glance, presents at every instant a chaos followed by another chaos. We must decompose each chaos into single facts. We must learn to see in the chaotic antecedent a multitude of distinct antecedents, in the chaotic consequent a multitude of distinct consequents. This, supposing it done, will not of itself tell us on which of the antecedents each consequent is invariably attendant. To determine that point, we must endeavour to effect a separation of the facts from one another, not in our minds only, but in nature. The mental analysis, however, must take place first.[5]

Mill then describes the first rule of physical inquiry this way,

> ....In every instance which comes under our observation, there are many antecedents and many consequents. If those antecedents could not be severed from one another except in thought, or if those consequents never were found apart, it would be impossible for us to distinguish (à posteriori at least) the real laws, or to assign to any cause its effect, or to any effect its cause. To do so, we must be able to meet with some of the antecedents apart from the rest, and observe by what they are preceded. We must, in short, follow the Baconian rule of varying the circumstances. This is, indeed, only the first rule of physical inquiry, and not, as some have thought, the sole rule; but it is the foundation of all the rest.[6]

The other rules, as far as Mill states them are embodied in his five 'canons' or prescriptions for experimental method. The 'First' and 'Second' canons may be given as examples. Mill says in the first that,

> If two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which alone all the instances agree, is the cause (or effect) of the given phenomenon.[7]

and of the second,

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5. __________, A System of Logic, pp. 382-383.

6. __________, A System of Logic, p. 385.

7. __________, A System of Logic, p. 396.

> If an instance in which the phenomenon under investigation occurs, and an instance in which it does not occur, have every circumstance in common save one, that one occurring only in the former; the circumstance in which alone the two instances differ, is the effect, or cause, or a necessary part of the cause, of the phenomenon.[8]

The application of Mill's methods presuppose some sort of whole or event whose parts are in some sense intelligible. An occurrence, to express it alternatively, cannot be broken into parts if those parts cannot be discerned.

Newton in his General Scholium to Principia says that,

> ....hitherto I have not been able to discover the cause of those properties of gravity from phenomena, and I frame no hypotheses; for whatever is not deduced from phenomena is to be called an hypothesis; and hypothesis whether metaphysical or physical, whether of occult qualities or mechanical have no place in experimental philosophy. In this philosophy, particular propositions are inferred from phenomena and afterwards rendered general by induction.[9]

In Cotes' preface to the second edition of the same work, Cotes says,

> There is left then the third class, which possess experimental philosophy. These indeed derive the causes of all things from the most simple principles possible; but then they assume nothing as a principle, that is not proved by phenomena. They frame no hypotheses, nor receive them into philosophy otherwise than as questions whose truth may be disputed. They proceed therefore in a twofold method, synthetical and analytical. From some select phenomena they deduce by analysis the forces of Nature and the more simple laws of forces; and from thence by synthesis show the constitution of the rest. This is that incomparably best of philosophizing, which our renowned author most justly embraced in preference to the rest, and thought alone worthy to be cultivated and adorned by his excellent labors....[10]

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8. __________, A System of Logic, p. 397.

9. Newton, I., Mathematical Principles, Motte's Revised Transl. 6 Florian Cajor , Berkeley, University of California 1792 1960 ed., p. 547.

10. ________, Preface to The Second Edition, PP. XX-XXI.

Again, in the same work, under the title of Rules of Reasoning in Philosophy, Newton states,

> In experimental philosophy we are to look upon propositions inferred by general induction from phenomena as accurately or very nearly true, notwithstanding any contrary hypotheses that may be imagined, till such time as other phenomena occur, by which they may either be made more accurate, or liable to exceptions.
>
> This rule we must follow, that the argument of induction may not be evaded by hypotheses.[11]

The import of these passages concerns the fact that several commentators, Albert Einstein[12] among them, believed that Newton held his theories were derived directly from the perceptual world without recourse to imaginative reconstructions of the possible components of events. Einstein rejects the view that "the fundamental concepts and postulates of physics....could be deduced from experience by "abstraction"[13] on the grounds that "the fictitious character of fundamental principles is perfectly evident from the fact that we can point to two essentially different principles, both of which correspond with experience to a large extent....[14]. Various suggestions have

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11. ________, Mathematical Principles, p. 400.

12. Einstein says on this, "Newton, the first creator of a comprehensive, workable system of theoretical physics, still believed that the basic concepts and laws of his system could be derived from experience. This is no doubt the meaning of his saying, hypotheses non fingo". Einstein, A., Essays in Science, pp. 15-16.

13. ________, Essays in Science, p. 16.

14. ________, Essays in Science, p. 17.

been offered as alternatives to the abstractive-analytic method as the way natural phenomena are actually approached by the theoretical scientist. One of the better discussions, at least in terms of conciseness, of the problems attached to Newton's and Mill's views, if Mill is interpreted as believing his canons are mechanical procedures of discovery, and of an alternative to the narrow inductivist view is that found in Hempel's Philosophy of Natural Science. Hempel states

> The idea that in scientific inquiry, inductive inference from antecedently collected data leads to appropriate general principals is clearly embodied in the following account of how a scientist would ideally proceed:
>
> > If we try to imagine how a mind of superhuman power and reach, but normal so far as the logical processes of its thought are concerned,...would use the scientific method, the process would be as follows: First, all facts would be observed and recorded, without selection or a priori guess as to their relative importance. Secondly, the observed and recorded facts would be analyzed, compared, and classified, without hypothesis or postulates other than those necessarily involved in the logic of thought. Third, from this analysis of the facts generalizations would be inductively drawn as to the relations, classificatory or causal, between them. Fourth, further research would be deductive as well as indictive, employing inferences from previously established generalizations.[15]
>
> This passage distinguishes four stages in an ideal scientific inquiry:
> (1) observation and recording of all facts, (2) analysis and classification of these facts, (3) inductive derivation of generalizations from them, and (4) further testing of the generalizations. The first two of these stages are specifically assumed not to make use of any guesses or hypotheses as to how the observed facts might be interconnected; this restriction seems to have been imposed in the belief that such preconceived ideas would introduce a bias and would jeopardize the scientific objectivity of the investigation.

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15. A.B. Wolfe, "Functional Economics", in The Trend of Economics, ed. R.G. Tugwell (New York: Alfred A. Knopf, Inc. 1924), p. 450 (italics are quoted). As found in Hempel, Carl G., Philosophy of Natural Science, New Jersey, Prentice Hall, 1966, p.11.

But the view expressed in the quoted passage - I will call it the narrow inductivist conception of scientific inquiry - is untenable, for several reasons. A brief survey of these can serve to amplify and to supplement our earlier remarks on scientific procedure.

First, a scientific investigation as here envisaged could never get off the ground. Even its first phase could never be carried out, for a collection of all the facts would have to await the end of the world, so to speak; and even all the facts up to now cannot be collected, since there are an infinite number and variety of them. Are we to examine, for example, all the grains of sand in all the deserts and on all the beaches, and are we to record their shapes, their weights, their chemical composition, their distances from each other, their constantly changing temperature, and their equally changing distance from the center of the moon? Are we to record the floating thoughts that cross our minds in the tedious process? The shapes of the clouds overhead, the changing color of the sky? The construction and the trade name of our writing equipment? Our own life histories and those of our fellow investigators? All these, and untold other things, are, after all, among "all the facts up to now".

Perhaps, then, all that should be required in the first phase is that all the relevant facts be collected. But relevant to what? Though the author does not mention this, let us suppose that the inquiry is concerned with a specified problem. Should we not then begin by collecting all the facts - or better, all available data - relevant to that problem? This notion still makes no clear sense....for what particular sorts of data it is reasonable to collect is not determined by the problem under study, but by a tentative answer to it that the investigator entertains in the form of a conjecture or hypothesis....

In sum, the maxim that data should be gathered without guidance by antecedent hypotheses about the connections among the facts under study is self-defeating, and it is certainly not followed in scientific inquiry. On the contrary, tentative hypotheses are needed to give direction to a scientific investigation. Such hypotheses determine, among other things, what data should be collected at a given point in a scientific investigation.[16]

and

The second stage envisaged in our quoted passage is open to similar criticism. A set of empirical "facts" can be analyzed and classified in many different ways, most of which will

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16. ________, Philosophy of Natural Science, pp. 11, 12, 13.

> be unilluminating for the purposes of a given inquiry....
> Thus, if a particular way of analyzing and classifying empirical findings is to lead to an explanation of the phenomena concerned, then it must be based on hypotheses about how those phenomena are connected; without such hypotheses, analysis and classification are blind.
> Our critical reflections on the first two stages of inquiry as envisaged in the quoted passage also undercut the notion that hypotheses are introduced only in the third stage, by inductive inference from antecedently collected data. But some further remarks on the subject should be added here.[17]

Hempel continues by saying, "Scientific knowledge....is not arrived at by applying some inductive inference procedure to antecedently collected data but rather by what is often called "the method of hypothesis" i.e. by inventing hypotheses as tentative answers to a problem under study then subjecting these to empirical test"[18].

Hypothesis

A good deal of what Teilhard means by the word 'hypothesis' is succinctly expressed by Wartofsky who writes, "In empirical sciences.... hypotheses are taken to be proposals concerning either matters of fact or concerning how it would be best to conceive of matters of fact"[19]. Teilhard clearly uses both kinds of hypotheses. About the second type of hypothesis he says,

> Hypothesis: a very unsuitable word for the supreme spiritual act by which the dust of experiment takes form and life in

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17. __________, Philosophy of Natural Science, p. 13.

18. __________, Philosophy of Natural Science, p. 17.

19. Wartofsky, Marx W., Conceptual Foundations of Scientific Thought, New York, MacMillan (1968), p. 183.

> the fire of knowledge. A double criterion, of course, guides the advances of thought when it reaches this synthetic phase of its operation. First the general vision which has arrested one begins without forcing or distortion to arrange the elements that are called up....[20]

One example of such a use of hypotheses concerns the Teilhardian belief that the function of science is to attain "intellectual mastery of nature" by the discovery of and cataloguing of "natural cores". In fact, Teilhard clearly identifies this as an hypothesis in a footnote that refers to this heuristic device, saying,

> It will be noticed that during the first phase, (Neptune before its discovery by telescope, electrons before the convergent results of the last experiment, etc.), these natural nuclei have been simply 'hypothesis'. This shows how unfair it is always to describe a hypothesis as a provisional and transitory means of arranging our knowledge. Far from being a scientific theory, it is like life, changeable, fragile but progressive. Good hypotheses are continually modified but in a definite direction, which they perfect themselves by following; and at the end of this evolution they attain the rank of fixed elements, destined to figure thereafter in any representation of the world.[21]

Clearly Teilhard does believe that an understanding of processes may be attained with inference to natural cores. There is, however, another sub-category of hypothesis which is not directly about how matters of fact should be pictured in the same sense that the natural core hypothesis is. In a continuation of a passage previously quoted, Teilhard contends,

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20. Teilhard de Chardin, P., "The Natural Units of Humanity" (1939), in The Vision of the Past, p. 205.

21. __________, "The Natural History of the World" (1925), in The Vision of The Past, p. 112.

> A double criterion, of course, guides the advances of thought when it reaches this synthetic phase of its operation. First the general vision which has arrested one begins, without forcing or distortion, to arrange the elements it has called up. And then from the grouping acheived there come a new understanding to the intelligence and new powers of arrangement to the active mind. Coherence and fertility: the two inimitable touchstones, and the two irresistible attractions of truth.[22]

Coherence and fertility, as hypothetical heuristic principles, are not directly about how the world should be pictured, but rather about what sort of characteristics any 'picture' of the world should have in order to be acceptable.

The first type of hypothesis Wartofsky mentions is that about 'matters of fact'. There are any number of them present in the orthogenetic theory ; for example, when Teilhard identifies an electron as a natural core, he is clearly ascribing a hypothetical set of characteristics to an entity which is already known by hypothesis.

The foregoing appears to describe in part at least, what Teilhard believes the function of hypothesis to be. Wartofsky would again appear to delineate certain views on the structure of hypothesis which Teilhard would find acceptable. There are, according to Wartofsky, several meanings of 'hypothesis' that have some agreement in usage. Among these are two which would appear to closely approximate the Teilhardian meaning. Wartofsky describes these in the following manner,

> (3) Hypotheses are postulates or suppositions, created freely by the mind so that other statements can be ordered by or derived from them. A hypothesis in this case needs no

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22. ________ "The Natural Units of Humanity" (1939), in The Vision of the Past, pp. 205-206.

> "justification" in terms of its source, or derivation, but only in its use. Like the folk heroes of fable, such postulates appear and do their work of ordering things and saving appearances, and no one inquires into their mysterious and godlike birth. They prove themselves by their deeds. The connection with experiential sources, with "deep structures" of the human mind, or with the creative genius thus falls outside the scope of what concerns such postulates. Their function is not to describe what is the case, or to alledge that the facts are such and so, but to provide the means of ordering or reconstructing the order of known facts in some way better than some previous ordering. Such postulates must also permit one to deduce consequences as yet not tested or known, so that the function of such hypothesis is both formal-systematic and empirical-fruitful in suggesting new factual consequences.
>
> (4) Hypotheses are intuitions concerning either what appears self-evident, or necessary to believe or what suggests itself as plausable in some vague but insistent way. The sources of hypothesis here are taken to be some deeply working "intuitions of the mind" (especially of a mind prepared to make use of such intuitions by wide knowledge of facts to which they would be relevant). In one or another version of this view, hypothesis are "hunches", or the work of deep recognitions of analogy in the subconsciousness or preconscious mind, or felicitous recall of archtypal patterns or the explicit form which the a priori structures of knowledge take when they are brought to the surface by the suggestions of experience....the role of speculative activity, of the exercise of the imagination, freed from the considerations of the empirical sources or logical deduction within some system, is "justified" by the role which such hypotheses play in ordering and unifying known facts and in producing testable consequences....[23]

Wartofsky's statement of (3) and (4) are not mutually exclusive in certain important respects. They are, for example, in agreement as to what the general products of hypotheses should be and with this statement Teilhard agrees. He contends that,

> In spite of all the theoretical objections that would seek to discourage the belief, our minds remain invincibly persuaded that a certain very fundamental rule lies hidden beneath the overpowering multiplicity of events and beings: to discover

23. Wartofsky, Marx W., Conceptual Foundations of Scientific Thought, pp. 186-187.

> and formulate this rule, we believe, would make the universe intelligible in the totality of its development.[24]

and,

> ....I am so bold as to offer here, in the form of a series of linked propositions, an essay in universal exploration - not an 'a priori' geometric synthesis starting from some definition of being, but an experiential law of reoccurrence which can be checked in the phenomenal field and can approximately be extrapolated into the totality of space and time.[25]

However, Teilhard would appear to favour (4) over (3) in that his provisional statements about the universe and its categories are rooted in intuition and analogy. He says, for example, that the whole orthogenetic theory rests on an "intuition and two observations"[26]. This has a significance because, even though the questions of the origin of Teilhard's theory and the cogency of it are independent questions, the fact that the orthogenetic theory, as it will be argued, is structurally incomplete, reinforces the point that the problems of the origin of Teilhard's theory cannot be separated from questions concerning its intelligibility. Despite this, however, and even for Teilhard, the question of origins is secondary to the questions of function and validity. Teilhard's rejection of an analytic abstractive view of theory construction is testified to not only by his views on hypothesis, but also by some of his general statements about the epistemological status of scientific theories as well. He writes, for example,

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24. Teilhard de Chardin, P., "Centrology" (1944), in Activation of Energy, p. 99.

25. ________, "Centrology", in Activation of Energy, p. 99.

26. ________, "Centrology", in Activation of Energy, p. 101.

> As a result of a very natural psychological illusion, our great modern science was born and developed under the exclusive sign of objectivity. Examining matter and life, physicists and biologists have always worked as if they had emerged from and were independent of the world whose elements and laws they were trying to ascertain. Long ago Kant (and in fact the Scholastics before him) pointed to the connexions which make the perceiver and the perceived indissolubly one within the universe. But this fundamental condition of knowledge only perturbed the rare and somewhat unapproachable adepts of metaphysics. For investigators of nature, it seemed indisputably established that things are projected for us 'just as they are' on a screen where we can look at them without being mixed up in them. Scientists contemplated the cosmos without suspecting that they could be influencing it in any degree by the contact of their thought or their senses, without even being aware of belonging intrinsically to the system which they were analysing with such wonder,[27]

and in the Foreword of The Phenomenon of Man,

> Instinctively physicists went to work as though they looked down from a great height upon a world which their consciousness could penetrate without being submitted to it or changing it. They are now beginning to realize that even the most objective of their observations are steeped in the conventions they adopted from the outset and by forms or habits of thought developed in the course of research; so that, when they reach the end of their analysis they cannot tell with any certainty whether the structure they have made is the essence of the matter they are studying or the reflection of their own thought.[28]

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27. ________, Human Energy, p. 113.

28. ________, The Phenomenon of Man, p. 32.

CHAPTER II

THE LOGICAL STRUCTURE AND BIOLOGICAL BASIS OF ORTHOGENESIS

INTRODUCTION

This chapter then, attempts to isolate, through analysis and interpretive inference, Teilhard's central problematic and the reasons for it, as well as the components and their relationship to the solution of his problem. Through doing this, it is hoped that, either directly or indirectly, the influence of what has been identified as pre-theoretical determinants or assumptions will be domonstrated. It was claimed, for example, that many Teilhardian concepts concerned with the structures, found in the world were derived by him from a model based on evolutionary biology. It will be shown in this chapter that Teilhard's central problem concerns the place of man in nature and that his solution involves both a general acceptance of the fact of evolution, and a partial acceptance of the traditionally postulated mechanisms of evolution.

It was claimed that Teilhard accepted both analysis and synthesis where both employ imaginative leaps. It will be argued that Teilhard formulates his problem by hypothesis and uses hypothesis in collecting the data relative to constructing his solution. He also accepts, in the main, the general results of previous scientific analysis in his construction and reconstruction of physical processes. Teilhard composes his answers out of different levels of data and uses different types of explanatory forms.

It is shown also that Teilhard employs types of explanations which are either recognized as scientific in general or are employed and accepted by other biologists. In either case, the kinds of explanations he uses are quite compatible with his stated overall speculative goals.

In describing some of the major elements, as well as their stuctural, logical and empirical relationships, as this chapter attempts to do, it is believed that aspects of the meaning of the Orthogenetic Theory not previously uncovered. will emerge. It is also believed that the exploration and delineation of the structure of the Orthogenetic Theory goes a distance towards fulfilling a third object. Granting that Teilhard intends the Orthogenetic Theory to be scientific, the question still remains as to whether or not he succeeds. It is difficult to imagine how such a question could even begin to be answered without explaining the structure of the theory itself. By identifying these theoretical components, then, it is contended that a basis for a viable critique of the scientific nature of Teilhard's theory, which will be attempted in the subsequent chapter, is provided.

1. The Problem

A scientific theory proceeds out of a problem to be solved but, as Hempel put it, "Empirical" 'facts' or findings... can be qualified as logically relevant .... only in reference to a given hypothesis but not in reference to a given problem"[1]. The force of this conjecture is well illustrated by the Orthogenetic Theory. Teilhard begins the first chapter of Man's Place in Nature with the words,

> Man is part of life. He is even, and this in fact is the thesis maintained in the pages that follow, the most characteristic, the most polar and most living part of life.[2]

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1. Hempel, Carl C., Philosophy of Natural Science, New Jersey, Prentice, 1966, p. 12.

2. Teilhard de Chardin, P., Man's Place in Nature, p. 17. Teilhard clearly recognizes his views about the significance of life, represent a choice, a position based on hypothesis; that is, his position represents just one possibility. Teilhard writes on this,

"Sir James Jeans and Marcel Boll, and even convinced believers like Guardini, have uttered expressions of amazement (tinged with heroic pessimism or triumphant detachment) at the apparent insignificance of the phenomenon of Life in terms of the cosmos - a little mould on a grain of dust....Small wonder, I repeat: but it is no less astonishing that minds so outstanding should not have perceived the possibility and the advantages of adopting a precisely opposite viewpoint. Life seems to occupy so small a place in Space-Time, that it cannot reasonably be regarded as anything other than incidental and accidental. That is the difficulty. But why whould we not reverse the position and say: 'The fact that Life is so rarely encountered in the sidereal immensity is precisely because, representing a higher form of cosmic evolution, it can only come into existence in privileged circumstances to time and place'. We shall see the full force of this argument (based on the premise that Life, forever struggling to assert itself, is liable to appear at any point in the Universe when the conditions are favourable)". As found in "Turmoil or Genesis" (1945), in The Future of Man, p. 215.

The problem, in its most general form, is that of situating the human species among other biotic structures and processes and, ultimately, situating the place of living structures and processes among all physical structures and processes. On this, Teilhard writes,

> By the expression 'The Phenomenon of Man' we mean here the empirical fact of the appearance in our universe of the power of reflexion and thought. For enormous periods the earth certainly lacked any real manifestation of life. Then for another enormous period in the layer of organic matter which appeared on its solid or watery envelope, it presented only signs of spontaneity, and unreflective consciousness (the animal feels and perceives; but he does not appear to know that he feels and perceives). Finally, in a relatively recent epoch, automatism and consciousness acquired on earth, in the zone of life that had become human, the property of isolating and individualizing themselves in their own sight. Man knows that he knows. He emerges from his actions. He dominates them in however feeble a way. He can therefore abstract, combine and foresee. He reflects. He thinks. This event can serve as a point of departure for many philosophical, moral or religious trains of thought. We would only view it here, at least preliminarily, as a simple point in history and science. For a very long time there was no thought on earth. Now there is, and to such a degree, that the face of things is entirely changed. Now we are really viewing a purely scientific fact, a phenomenon. What are we to think of this phenomenon?[3]

As a problem, however, there is more than one direction along which data can be collected towards its solution. On the strict inductivist view of the logic of inquiry, this should not be the case. In this view, scientific inquiry would be directly relevant to a given problem. Ideally, scientists would simply observe and record and collect all data germane to the given problem, then analyse and order the various data according to some inherently obvious classification.

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3. ________"The Phenomenon of Man" (1930), in <u>The Vision of The Past</u>, p. 161. Also, see Appendix A "Reasons for Man as the Problem"

From this statement of similarity and difference, generalizations concerning structures and processes would be induced. From these inductive generalizations, implications are deduced which may be observed and what is observed serves as inductively confirming instances of the generalization. The methodological difficulties connected with this view were documented elsewhere, but, for purposes of clarification in the given context, it seems worthwhile to mention a few.

In order for the scientist to begin to collect the data where the relationship between problem and inquiry is held to be direct, he would have to know, a priori, specifically what data is related to his problem. No human observer has access to all the facts which might be relevant to a given problem, because no observer has access to all present causal or systematic relationships, let alone all those which may exist in the future. Furthermore, there is no unique procedure whereby the relative importance of present phenomena may be estimated.

In lieu of all the facts and criteria of selection, an hypothesis concerning the type of data which might be germane to a given problem must be proposed if the activity of the theory construction is even to begin.

2. Problem and Hypothesis

One of the first things that may be noticed is that "hypothesis" enters into the very formulation of Teilhard's problem. Teilhard does not begin with the phenomenon of man as a raw datum, but as a datum already embedded in a web of assumptions. Teilhard was a convinced evolutionist and he saw man as a product of an evolutionary process. More than this, he accorded the phenomena of consciousness, man and life in general a significance not found in other scientific theories. Teilhard states for example in Man's Place in Nature,

> ....we cannot correctly appreciate his position in the world without first determining the place of life in the universe: this means that the first thing that we have to do is to decide what life represents in the general structure of the cosmos; In doing so we may still find it well, too, more or less deliberately, to use such evidence as provided by an examination of man himself.[4]

And about this position he says.."he tends in our experience to represent the very leading shoot of a universe that is in process".[5]... Teilhard, of course, does not specify the criteria or decision procedure by which he has decided that man is a 'key' phenomenon. Teilhard was well aware that many other scientists, while accepting that man is a

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4. __________, Man's Place in Nature, p. 13.

5. __________, Man's Place in Nature, p. 14. This is not to suggest that Teilhard had no reasons for proposing man as a special object for investigation; he had reasons. He writes for example,

"The three characteristics which make the human individual a truly unique object in the eyes of Science, once we have made up our minds to regard Man not merely as a chance arrival but as an integral element of the physical world, are as follows:

a) an extreme physico-chemical complexity (particularly apparent in the brain) which permits us to consider him the most highly synthesised form of matter known to us in the Universe;

b) arising out of this, an extreme degree of organisation which makes him the most perfectly and deeply centrated of all cosmic particles within the field of our experience;

c) finally, and correlative with the above, the high degree of psychic development (reflection, thought) which places him head and shoulders above all other conscious beings known to us.

To these may be added a fourth particularity which is also of great significance: that of being the latest product of Evolution". As found in "The New Spirit" (1942), in The Future of Man, p. 87.

part of life, did not and do not accept either life or man as "the principal axis of the world"[6]. Rather, many have supposed that the property of life is a statistically insignificant phenomenon comparative to that of other properties of matter such as gravity.

It is relative to these assumptions or hypotheses about the importance of man in the universal process, that Teilhard sets out to find his solution. Teilhard's problem concerning man's place in nature and his initial assumptions concerning this place, to a certain extent, predetermines the area of the world in which he looks for a solution. The definitions afforded the phenomenon of man and the assumptions of evolution and the significance of life and self-consciousness, are not sufficient for theory construction. For even with the predetermination afforded by the problem and its surrounding assumptions, there still exists a welter of facts within the framework of life which might or might not be relevant to the solution of the problem. Teilhard needs some further means by which he can select and classify his facts. Since he does not have a unique decision procedure for such selection, he formulates another hypothesis about the sort of data and relations most germane to his problem. He decides that those phenomena which have to do with complexification, that is, the coming to be and the interrelationships of natural complexities, are of first importance in the solution

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6. ________, Man's Place in Nature, p. 14.

of his problem[7]. Data, then, are to be classified according to level and types of complexity as well as appearance in time, since Teilhard assumes there is a correlation between complexity and consciousness. The notions of complexity and consciousness are themselves embedded in a web of assumptions and it is with these, as well as their theoretical functions, that the immediately following passage deals.

3. Hypothesis: Granularity, Complexity and Definition

Teilhard begins (from a logical point of view) to construct his theory, (gather facts, cite evidence, formulate laws), on the basic assumption that 'granularity'[8] is a fundamental property of the universe

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7. Teilhard maintains that there are two immediate advantages gained through accepting the complexity postulate: "First, in the multitude of things comprising the world, an examination of their degree of complexity enables us to distinguish and separate those which may be called 'true natural units', the ones that really matter, from the accidental pseuso-units, which are unimportant. The atom, the molecule, the cell and the living being are real units because they are both formed and centrated, whereas a drop of water, a heap of sand, the Earth, the Sun, the starss in general, whatever the multiplicity or elaborateness of their structure, seem to possess no organisation, no 'centricity'. However imposing their extent, they are false units, aggregates arranged more or less in order of density. Secondly, the coefficient of complexity further enables us to establish, among the natural units which it has helped us to 'identify' and isolate, a system of classification that is no less natural and universal". As found in "Life and the Planets" (1945), in The Future of Man, pp. 105-106.

8. Teilhard does not assume 'granularity' per se. The fact of the atomicity of the universe is derived from observation. What he does 'assume' is that granularity is not a mere by-product of varying physical forces but, rather, a most significant manifestation of the nature of radial energy. He does not try to support this foundational assumption through any more basic propositions but forwards it on the basis of an intuition saying, "In the swarming multiplicity of living elements....we find an authentic continuation of the granulare(atomic molecular structure of the universe). In consequence,....the human body....is simply a 'super-molecule'. In "Centrology" (1944), in Activation of Energy, p. 101.

and that this property is found in all the structural stages from most simple to most complex; and, further, on the assumption that, whatever exists as a property at one corpuscular stage, must exist in some fashion in every other stage. Against the background of these assumptions, Teilhard introduces as primitive 'observation', data that man is both an extremely complex corpuscle and this complexity is correlatable with the property of consciousness[9].

Teilhard, then, seeks his explanation of man's place in nature, relative to the hypothesis that,

(1) There is a phenomenon termed 'consciousness';

(2) Consciousness is a universal property correlated with corpuscularity.

Teilhard maintains that, in a state of genesis, there is "to begin with a critical phase, that of granulation....which gave birth to the constituents of the atom....Next at least from the molecular level of going on additively by a process of growing complexity"[10]. Teilhard says elsewhere, on the correlation, that

> If the fantastic mass of granular energy which we see as having in the past formed the primitive substance of the cosmos

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9. Teilhard writes on this that, "As the foundation for the whole edifice of propositions that follow we have an intuition and two observations....The observations: Man, the final product of....evolution is both supremely complex in his physico-chemical organization measured by the Brain and at the same time viewed in his psychism, supremely free and conscious". As found in "Centrology", in Activation of Energy, p.101.

10. _______, The Phenomenon of Man, p. 49. Teilhard writes that it is because of an initial disposition. "Matter coalesces or crystallizes...." As found in "The Reflection of Energy" (1952), in Activation of Energy, p. 324.

> is left to the play of chance and to itself for a sufficiently long time, it has a natural tendency to associate in groups and to concentrate upon itself (wherever it can, and as much as it can) in systems of the highest possible complexity and centricity: this 'centro-complexity', which soon becomes extremely marked, coincides with the appearance of progressively more luminous centres of consciousness.[11]

(3) Degrees of consciousness are correlatable (defined operationally by) degrees of complexity. Teilhard writes, "....the distinguishing characteristic of authentically 'vital' arrangements of matter is that their psychic temperature rises proportionately to their degree of complexity...."[12].

(4) Man is the most complex entity in the known universe.

(5) As has been previously stated, man is a product of a universal evolutionary process, (pre-theoretical)[13].

The way in which Teilhard arrived at these hypotheses, as has been previously suggested, is, in part, analogical inference.

A scientific theory is, in a broad sense, a tentative answer to

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11. __________, "The Stuff of the Universe" (1953), in Activation of Energy, p. 377. Making the same point, in another work, Teilhard writes, "Left to itself, every population tends....in the course of multiplication to consolidate in itself....It automatically granulates (like energy itself) by the effect of large numbers". As found in "The Singularities of the Human Species", in the Appearance of Man, p. 219.

12. __________, "On the Probably Coming of an 'Ultra-Humanity' " in The Future of Man, p. 274.

13. The proposition that man is a product of a universal evolutionary process is 'pre-theoretical' in the sense that it constitutes one of the "three primary evidential data" or postulates on which the orthogenetic theory is founded.

a problem[14], and the complexification criterion, for Teilhard, does in part supply an answer to his problem, and

> I shall confine my use of the word 'combination', i.e. that particular higher form of grouping whose property it is to knot together upon themselves a certain fixed number, whether great or small matters little, of elements, with or without the secondary addition of aggregation or repetition - within a closed whole of a determined radius.[15]

Teilhard thus provides an intensional definition. According to him, a natural unity has the following set of properties:

(a) it is made up of a finite number of parts in a constant relationship;

(b) both types of parts and their relationships persevere (in number and their relationship)[16];

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14. As Hempel writes, "Theories are usually introduced when previous study of a class of phenomena has revealed a system of uniformities that can be expressed in the form of empirical laws. Theories then seek to explain those regularities and generally to afford a deeper and more accurate understanding of the phenomena in question. To this end, a theory construes those phenomena as manifestations of entities and processes that lie behind or beneath them....These are assumed to be governed by characteristic theoretical laws, or theoretical principles, by means of which the theory then explains the empirical uniformities that may have previously been discovered and usually also predicts new 'regularities'". As found in Philosophy of Natural Science, p. 70.

15. Teilhard de Chardin, P., Man's Place in Nature, p. 20.

16. Elsewhere, Teilhard says, "We will define the 'complexity' of a thing, if you allow, as the quality the thing possesses of being composed- a) of a larger number of elements, which are
b) more tightly organised among themselves.
In this sense,an atom is more complex than an electron, a molecule more complex than an atom, and a living cell more complex than the highest chemical nuclei of which it is composed, the difference depending (on this I insist) not only on the number and diversity of the elements included in each case, but at least as much on the number and correlative variety of the links formed between these elements. It is not, therefore a matter of simple multiplicity but of organised multiplicity; not simple complication but centrated complication". As found in "Life and the Planets", in The Future of Man, p. 105.

(c) it resists an alteration in parts and relationship (closed);

(d) it exhibits regular repeated patterns of activity which are attributable to the specific organization from which the activity issues. Some natural entities are typified by novel emergent patterns of action as well.

4. The Concept of Complexity as 'A Correspondence Rule' and Definition

Teilhard defines his terms in three different ways: a) theoretically; b) operationally; c) implicitly, which appear in relationship with the other terms of the theory. It is only with the first two ways of defining and their relationship to 'transformation' rules that the present passages are concerned. Teilhard gives the term 'complexity' a theoretical definition when he asserts that 'complexity' means an assembly of elements which, "while organically limited in its contours so far as its own existence is concerned, it also, at certain higher levels of internal complexity, manifests strictly autonomous phenomena. We find complexity giving rise to a certain 'centricity' not of symmetry, but of action"[17].

As is the case with a large number of intensional definitions, Teilhard does not list all of the properties common to everything named by the defining term; rather, he states merely those properties which distinguish natural unities from other kinds of unities. It is the actual number of elements, type of relationship and range of activity, however, which serve to define the 'radius' and kind of natural unity. A specific kind of natural unity is defined by its activity and, where

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17. __________, Man's Place in Nature, p. 20. It can be noted that Teilhard has a more fundamental transformation rule than complexity which presupposes an arrangement of parts. This might read, 'that the presence of consciousness is empirically detectable in the plural or corpuscular state of the world'. He says, for instance, that,

"Consciousness is a universal molecular property; and the molecular state of the world is a manifestation of the pluralized state of some potentiality of universal consciousness". As found in "Centrology" (1944), in Activation of Energy, p. 101. And elsewhere, Teilhard concludes, "Atomicity is a common property of the within and the without of things". As found in The Phenomenon of Man, p. 59. It is logically possible that there could be a subatomic particle which was so simple that it had no parts yet whose within could be known by the very fact that it exists as a separate entity. The difficulty with this proposition, however, as will be developed in the third chapter, is that, since all known energy is manifested through particulate motion, radial energy has no effects specific to it, at least on this level of organization.

possible, by its structure as well.[18]

Teilhard is, of course, not simply describing (or attempting to describe), natural entities of some world which is merely logically possible but about the empirically given world, and so the abstract properties of natural unities must be made to correspond to real events. Teilhard provides such a correspondence through an ostensive definition. He states as examples, natural unities, "the atom, the molecule, the cell, the metazoon, etc."[19]. The etcetera encompassed the whole range of living things as systematized by Linnaeus and subsequent biologists. Teilhard, in fact, goes further than this when he proposes a physical operation by which the kind of natural unity may be determined prior to the level of the cell. He suggests the level of complexity may be established

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18. On this, Teilhard maintains,
"....what, at every point and every moment, defines and measures the convolution of the universe, is, by definition, the degree of vitalisation attained by matter at the point and peak in question. This, yet again, is not all. We must add that what, in its turn, defines and measures the vitalisation of a given corpuscle is its degree of interiorisation, or "psychic temperature" (consciousness, culminating, in man, in freedom): the reason for this being....that the two are closely linked. This can only mean that if there were by chance in the living being some part (some organ) more particularly connected with its psychic development, it would be the complexity of that part and that part alone (the rest would only confuse our measurements!) that could be used - would have to be used - to estimate the degree of corpusculisation attained by the being under examination. ....animal's skeleton or musculature matters little. Even the gross volume - up to a certain point - of its brain matters little. The only thing that ultimately counts in the absolute classification of higher living beings, is, besides the number of their cerebral neurones, their degree of perfection in structure and functioning". As found in Man's Place in Nature, pp. 48-49.

19. __________, Man's Place in Nature, p. 20.

by either the atomic number or molecular weight. The scientist writes,

> Where relatively simple molecular units are concerned, their order of complexity may be roughly expressed by the number of atoms they contain, their 'corpuscular number' as one might call it. But when this corpuscular number exceeds a million (from the virus on) and still more when we come to the higher forms of life (there are something like a hundred billion cells in an average mammal, and hundreds of millions of atoms to each cell!) it becomes impossible to estimate the number of atoms, which would be so vast as to be almost meaningless even if it could be calculated. At this level of organisation, in fact, the actual number of atoms contained in complex units is of minor importance compared with the number and quality of the _links_ established between the atoms.[20]

This operational definition intimates a procedure by which a quality (complex) may be given a definite numerical value in individual cases. Teilhard's suggested use of atomic number is especially interesting, as it functions in a manner quite typical of scientific definitions in general. It serves in part to specify or stipulate a meaning for the term 'complex' so that to be complex (below the level of the cell), means to have the sort of subatomic arrangement to which an atomic number may be assigned. It also serves a descriptive function in that it provides the physical criteria which furnished the conditions for applying the term to physical events. Hence, carbon, for example, can be called complex because it has an atomic number 6 and it is more complex than boron with an atomic number of 5 . Also, given a series of events occuring within the atomic domain where behaviour differs, behavioural differences may be closely specified and termed on the basis of a series of operations, so that structure X, for example, is called

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20. _______, "Life and the Planets" (1945), in _The Future of Man_, p. 111.

hydrogen on the basis of the discovery that it has an atomic weight of 12.011, while structure Y is boron because it is discovered to have an atomic weight of 10.82.

Teilhard's suggested operational definition is typical in another way as well. Rather than attempting to define the full range of descriptive application for the general theoretical term 'complexity', it provides an interpretation of the particular physical context to which it may be applied. Atomic number constitutes a criterion for complexity centers below the level of the cell. More exactly, Teilhard proposes a second criterion to augment the first from the level of the carbon molecule to that of the cell.

This criterion Teilhard suggests when he says,

> Corpuscular complexity is expressed in the following lines- There are two different ways in which we may conceive such closed systems according to whether they are found definitely arrested at their own level (as with a molecule of water or benzine) or, on the contrary, show themselves capable of modifying their composition.....
>
> In this second type of corpuscule, the unit remains.... at every moment closed in itself - but it is a mobile enclosure- for the complexity, too, can continue to increase at each moment without the particle being broken up.[21]

What Teilhard suggests here is that first, the direction of complexification is defined by the ability to form the largest number of relationships, then by the ability to replicate, and then by the ability to replicate "without the particle breaking up. Each of these stages has its physical expression in known substances, e.g. the carbon molecule, the amino acids and the virus.[22]"

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21. ________, Man's Place in Nature, p. 20.

22. ________, Man's Place in Nature, p. 31.

While the operational definition was structural on the pre-molecule level and that of the pre-cellular level is functional, the definitions fulfill the same function. The next operational definition, that of measuring the order of complexity of the multi-cellular level, is "the number of their cerebral neurones"[23] and their degree of perfection in structure and functioning. This particular operational definition has a far greater significance than merely giving an empirical expression to the term complexity; however, it's broader function can best be left for subsequent development.

5. The Orthogenetic Theory and Its Correspondence Rules

More specifically, the actual arrangements of these elements of the orthogenetic theory into an explanatory pattern may be seen to occur approximately, if incompletely, in the following way. Teilhard in a much quoted passage contends that,

> Under this name, which conveys the experience of effort with which we are familiar in ourselves, physics has introduced the precise formulation of a capacity for action or, more exactly, for interaction. Energy is the measure of that which passes from one atom to another in the course of their transformation. A unifying power then, but also because the atom appears to become enriched or exhausted in the course of the exchange, the expression of structure.[24]

and,

> We shall assume all energy is psychic in nature; but add that, in each particular element, this fundamental energy is divided into two distinct components: a tangential energy which links the elements with all other of the

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23. ________, Man's Place in Nature, p. 49.
24. ________, The Phenomenon of Man, p. 42.

> same order (that is to say, of the same complexity and the same centricity as itself in the universe); and a radial energy which draws it towards every greater complexity and centricity - in other words, forward.[25]

Teilhard evokes a 'non-material' theoretical agency to explain phenomena such as the consciousness and behaviour of man, on the observational level. Radial energy, whatever its derivation, is clearly a theoretical entity postulated by Teilhard as serving to provide the ultimate reason for the processes and structures of the universe.

Radial energy is, for Teilhard, what gravity is for Newton, a non-explained explainer. Teilhard writes about the complexification series, for example,... how could these exceptional combinations maintain themselves, once they have appeared; and, furthermore, how could they increase by addition (as they do) once they have begun, unless there existed, in the Weltstoff itself, some 'second form of gravity', making preferential selections, rare and fragile... of everything, from the atom to the vertebrate, that...rise...in the

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25. ________, The Phenomenon of Man, p. 64. The appearance of reflective choice as a product of evolution is explained not only by historical antecedents but also as 'an instance' or effect of "a play of chances which are selected by a sort of polarity or preference (like a sort of higher gravity in the Weltstoff itself) in The Reflection of Energy (1952), in Activation of Energy, p. 332.

direction of a maximum centro-complexity."[26]

The route, however, between this basic postulate and phenomena is not direct. Teilhard does not simply argue that because everything in the universe is derived from (a manifestation of) psychic energy, and man is in the universe, then man is derived from psychic energy. Teilhard does not do this because he claims to be advancing the orthogenetic theory as a scientific theory, which leaves him with the further problem of formulating hypotheses about structures and processes which underlie observed events in such a manner that the postulates entail physical and detailed implications about the relationships between the explanans and the explanandum. It is, in other words, not enough for Teilhard to hypothesize the presence of radial energy[27] as the ultimate condition of universal structures and processes; he must also, to some

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26. ________, The Singularities of the Human Species, in The Appearance of Man, p. 214-215 Teilhard says in a footnote, referring to orthogenesis as a determined process, that the reconciliation of the two ideas of determinism and indeterminacy included in the process will no doubt be discovered to be an effect of great numbers combined with an innate (and therefore scientifically inexplicable) preference of the stuff of the universe for higher states of complexity and consciousness in Hominization and Speciation (1952), in The Vision of the Past, p. 259 and elsewhere he says, p111, in virtue of some initial (and because 'initial' inexplicable) disposition of the Weltstoff matter coalesces or crystallizes... As found in The Reflection of Energy, in Activation of Energy, p. 324.

27. Consciousness can be considered the direct manifestation of radial energy about which Teilhard says,

"...let us postulate in principle that consciousness (like such phenomena as the variation of mass according to speed, or radiation as a function of temperature) is a universal property common to all the corpuscles constituting the Universe, but varying in proportion to the complexity of any particular molecule: which amounts to saying that the degree of psychism, the 'within', of the different elements composing the world, will be small or great, according to the place of the elements in the astronomically extended scale of complexities at present known to us." As found in The Planetisation of Mankind (1946), in The Future of Man, p. 130.

extent, provide a statement of the mechanism by which the structuring takes place and the means by which it is discerned. This he does, to a degree at least, through the use of auxiliary principles.

6. The Primary Explanation Postulates and Bridge Constructs

If Teilhard's first 'principle' is that all energy is psychic, and his second is that all energy is manifested as either radial or tangential, then his third 'principle' is auxiliary, in that it introduces a special postulate by means of which the presence and the relationship[28] between radial and tangential may be discerned.

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28. Teilhard says about the two energies that,

"Granted this, we have adopted the habit of reserving for the 'tangential' effects (the proper domain for statistics and entropy) both the name of energy and the privilege of constituting the primal matter of things; the 'radial' being then regarded as only a subsidiary effect or a fragile super-structure of the determinism of matter. But, turning the perspective upside down, why not decide on the contrary that, of the couple under examination, it is the radial that is primitive and consistent, the tangential being only a minor product statistically engendered by the interactions of the elementary 'centres' of consciousness, imperceptible in the 'pre-living', but clearly discernible to our experience once matter has reached a sufficiently advanced degree of arrangement? From this point of view, if one accepts it, the edifice of physical laws would remain absolutely intact and valid in the domain of pre-life, where the radial does not yet exist for our eyes. But on the other hand, it would be possible for us to conceive that where the interiorisation of corpuscles is sufficiently developed, the axial consciousness, at last capable of directly coiling on itself, centre to centre, escapes the peripheral servitudes of physico-chemical complexity.

And on the same page in a footnote, "Briefly, the 'trick' consists in distinguishing two types of energy: the first primary (psychical or radial energy) escaping from entropy; and the other secondary (physical or tangential energy) obeying the laws of thermo-dynamics: these two energies not being directly transformable into one another, but interdependent on one another in their functioning and evolution (the radial increasing with the arrangement of the tangential, and the tangential only arranging itself when prompted by the radial)." As found in The Singularities of the Human Species (1955), in The Appearance of Man, p. 265.

Teilhard says that,

> Since the variation of radial energy in terms of tangential energy is affected, according to our hypothesis, by the intervention of arrangements, it follows that as much as you like of the first may be linked with as little as you like of the second.[29]

and,

> Whatever instance we may think of, we may be sure that every time a richer and better organized structure will correspond to a more developed consciousness.[30]

The concept of complexity itself, as was discussed previously, by which the position and direction of the operation of psychic energy is defined, is meshed in another set of auxiliary assumptions. These include the concepts entailed in the operational definitions of complexity itself on the various biotic and prebiotic levels. The concept of complexification and consciousness provide Teilhard with the ideational basis for his complexity-consciousness law.[31] About this, he says, in the Activation of Energy that,

> I am so bold as to offer here, in the form of a series of linked propositions, an essay in universal explanation - not an a priori geometric synthesis starting from some definition of 'being' but an experiential law of recurrence which can be checked in the phenomenal field and can appropriately be extrapolated into the totality of space and time.[32],

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29. ________, The Phenomenon of Man, p. 65.

30. ________, The Phenomenon of Man, p. 60.

31. Teilhard writes on this,
"The simplest form of protoplasm is already a substance of unheard-of complexity. This complexity increases in geometrical progression as we pass from the protozoon higher and higher up the scale of metazoa and so it is for the whole of the remainder always and everywhere..... Its importance is decisive. Thanks to it we possess a tangible 'parameter' allowing us to connect both the internal and the external films of the world, not only in their position (point by point) but also as we shall verify later on, but in their motion."

32. ________, The Phenomenon of Man, p. 49.

and elsewhere,

> The stuff of the universe, woven in a single piece according to one and the same system, but never repeating itself from one point to another, represents a single figure. Structurally, it forms a whole.[33]

And that system, Teilhard remarks in a footnote, is called the "Law of Consciousness and Complexity"[34].

7. The Complexity-Consciousness Law

Teilhard, in these passages, would appear to hold a notion of 'law' that is widely accepted in scientific circles, that is, as a statement which asserts "an invariable sequential order of dependence among events or properties"[35]. The 'invariable sequential order of dependence' that Teilhard asserts includes the following,

(1) Useful complexity is always centred and centricity is always correlated with consciousness. Hence the generalization, for any X, if X is complex, then X is conscious.

(2) Any increase in organic complexity is preceded by an increase in conciousness.

About which Teilhard writes,

> But why do we, or more precisely <u>how can we</u>, fail to detect in this same process, and to the exact extent that it constitutes an organised whole--how fail to perceive, beneath what looks at first sight like a purely blind mechanical operation, the same

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33. __________, The Phenomenon of Man, p. 45.

34. __________, The Phenomenon of Man, p. 85.

35. Nagel, E., The Structure of Science, p. 76.

> process of 'complexification' which, if our new concept is valid, constitutes the essential proceeding of Life? What discloses and measures, both as a reagent and a parameter, the eu-complex or organic arrangements of matter, as opposed to the purely fortuitous or mechanical (pseudo-complex) groupings that take place between atoms and molecules, is the appearance and growth in the former of psychic properties. In physico-chemical terms a very high degree of complexity begets consciousness: few laws of Nature are so sure, so consistent (or so little exploited) as this.[36]

(3) Consciousness is always a necessary condition for the continuance of complexity.

(4) Any increase in consciousness is a necessary condition of an increase in complexity[37].

Teilhard writes that what characterizes the appearance and developments of life throughout the geological periods is the operation of 'complexity-consciousness'. By it can be found, "Here, a material arrangement generating psychic growth. And there, the awakening of a psyche

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36. Teilhard de Chardin, P., "Does Mankind Move Biologically Upon Itself" (1949), in The Future of Man, pp. 252-253. Teilhard writes that the complexity-consciousness law is "a structural law" which is "valid....for all particles great and very small in the universe". In The Singularities of the Human Species" (1954), in The Appearance of Man, p. 241. There are, as will be developed, two principal forms of invariability encompassed in the complexity-consciousness law as the invariability of association of eu-complexes with consciousness and, more fundamentally, the centering activity of radial energy which for Teilhard represents a 'cosmic constant'. Complexity and its types are, on the other hand, historically variable and dependent.

37. The interpretation implied by the second and fourth points is warranted by Teilhard's discussion of radial energy, as will be explored in a subsequent passage and such statements as the following: Teilhard writes, "During a first phase, the grains of consciousness arrange themselves spontaneously in mechanism in such a way as to construct the selector-switches and amplifiers (the 'servo-motors') required to widen the 'angle and radius of choice' around psychic centres: the consciousness of these latter, moreover, increasing in direct ratio with their field of action". In "The Analysis of Life", in Activation of Energy, p. 137.

generating still more arrangement"[38].

(5) There has been an increase in both complexity and consciousness.

(6) Under the condition of the continuation of the play of large numbers (chance), both the complexity and consciousness will increase.

(7) Under the condition of an increase in the factor of active preference, the rate of complexification will accelerate[39].

(8) Relative to other types of structures and processes, the tendency towards ever increasing organic complexification represents a unique 'direction' which, Teilhard maintains, will be continued.

A statement, then, of the complexity-consciousness law, to the effect that there has been a gradual increase in complexity-consciousness in the past which will be continued into the future, is a short form way of expressing a 'law' which presupposes a number of regularities

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38. __________, "The Singularities of the Human Species" (1954), in The Appearance of Man, p. 237.

39. On the sixth and seventh points, Teilhard says, "....under the influence of a growing complexity, the radius of choice increases and opens up to a wider angle, so the cosmic organic centres exercise a continually more effective over the chance in which they are adrift; but it is always only with the chances they make use of that they....build up the fabric of their finality". As found in "The Analysis of Life", in Activation of Energy, p. 137. And elsewhere the scientist says, "In biology, a further fact....cannot fail....to be equally revolutionary: I mean the fact that the organic complexity of beings (the true parameter....of evolution) cannot increase concretely without producing at its core a rapidly increasing quantity of indetermination and psychism. By its very nature, as the cosmic stuff's power of self-arrangement is realized more fully, so there tends to be a gradual interiorization of its driving force and the methods it uses....the process....among highly cerebralized being....tends irreversibly to become one of active preference". As found in "The Mechanism of Evolution", in Activation of Energy, p. 303.

as components of it[40]. Teilhard's 'law', then, might be more formally and more exactly expressed in somewhat the following manner: for any X at time t there is a Y and a Z, such that, if X is a true complexity then Y is antecedent to (situated at t-1), less conscious than and less complex than X, while Z is subsequent to, more complex and more conscious than X; further the increased consciousness of X is a function of the structural and behavioural properties of Y, while alteration of Z is a function of the specific modifications of X, as is the case with Hempel's paradigm. As it is illustrated, the orthogenetic theory is comprised of more than one 'law'. More than this, in a sense, it encompasses another complete theory.

The relationship of the complex of law-like statements which make up Teilhard's complexity-consciousness 'formula' may be illustrated more concretely through a structural comparison with another law universally accepted in science.

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40. Teilhard says about this, "....what I called the 'law of complexity-consciousness' ....was only an abbreviation and condensed expression. It needs no more than a moment's reflexion to see that matter could only grow in complexity (under the favourable play of chance) if the adaptable elements were previously brought close together.

'Compression/complexity/consciousness'

or further, if one prefers it:

'Compression/Competition/Complexity/Consciousness'

Such actually is the three (or four) term formula, really capable of expressing the process of Biogenesis along its complete chain.

Only under pressure....does vitalised matter react, in order to survive, by ultra-organising: such is the general primary condition of the cosmic tendency towards Improbability." As found in "The Phyletic Structure of the Human Group", in The Appearance of Man, p. 159.

8. Complexification and Periodicity: A Comparison

Teilhard writes, "If my interpretation of the pithecanthropeans is correct, all the other human fossils that we know must find their place in a system of a scale type like the simple substances of chemistry, which can only be arranged in periodic system"[41]. The reference to the periodic system provides a useful indication of the answer to the question concerning the manner in which the law of complexity-consciousness law is a law. It also, as will be explored in a subsequent section, makes intelligible the scientific foundation of the Teilhardian extrapolation to the future.

R.T. Sanderson writes in his book <u>Chemical Periodicity</u>, that

> It was in 1869 also that Mendeleev presented a now famous paper on "The Relation of the Properties to the Atomic Weights of the Elements". He not only described a periodic table, but left certain gaps in it and predicted boldly that new elements would one day be discovered to fill those gaps. From their position in his periodic table, he was able to predict many of the properties of these hitherto unimagined elements. Within his own lifetime, three of them were discovered and indeed found to have properties amazingly close to his predictions.[42]

What Mendeleev did can be shown using a contemporary description of the periodic table. Mendeleev organized a group of known elements according to a criterion (atomic weight) in an ascending order. This Teilhard

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41. __________, "The Phyletic Structure of the Human Group" (1951), in <u>The Appearance of Man</u>,p. 133. Since, as it will be shown, complexification does resemble the universally accepted scientific Law, it provides a basis for evaluation through comparison, as will be developed in the following chapter.

42. Sanderson, R.T., <u>Chemical Periodicity</u>, New York, Reinhold, 1960, p. 2.

does, too, according to his previously discussed criteria of atomic number and centro-complexity. When he does so, he produces the following series. There is according to Teilhard:

> The whole atomic series relatively limited in its combination of electrons, protons and neutrons.
> The whole molecular series, in which on the level of organic chemistry the number of atoms associated in each particle (not to mention the number of inter-relationships) rapidly achieves astronomical figures.
> And lastly, inevitably connected by way of the large proteins, the whole zoological series formed by living things: Since to the observant, the cell (and so stage by stage, man or the whale is nothing else than a super molecule.[43]

What Mendeleev discovered, then, may be shown using atomic number instead of atomic weight and the first nine elements of the periodic table.

If for example, the first nine elements are listed as follows, there is found to be very little qualitative chemical similarity,

H	He	Li	Be	B
(1)	(2)	(3)	(4)	(5)
C	N	O	F[44]	
(6)	(7)	(8)	(9)	

While, for instance, hydrogen is like helium, a gas, helium is inert, but hydrogen reactive. However, excluding hydrogen from the tenth to the seventeenth to the twentieth, there is a definite set of family resemblances. Helium (2) for instance, shares the property of neon (10) of being a completely inert gas, while tithium (3) is a soft metal like Sodium (11) that is very reactive to water and so it goes to chlorine

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43. Teilhard de Chardin, P., "The Singularities of the Human Species" (1954), in The Appearance of Man, p. 212.

44. Graham, R.P., and Cragg, C.H., The Essentials of Chemistry, Toronto, Clark, 1956, p. 206.

(17), which is a reactive non-metal similar to florine (9). Furthermore, from argon to calcium there is a partial third period, that is to say argon (18) is as helium (2) and neon (10), an inert gas, potassium (19) a reactive soft metal and so forth. There are many other secondary structural and functional affinities. Within the Alkali family (and others), as the atomic weight increases, the metallic properties increase, whereas between families, as the atomic weight decreases, the metallic characteristics increase. Metallic characteristics, as was suggested, entail not only structural properties (e.g. increasing metalicity = increasing hardness) but also functional attributes (viz. formation of positive ions).

There are, then, structural and functional resemblances occurring at regular intervals within the series. Teilhard, too, purports to discover a periodicity occurring within his theory. According to Teilhard, as "A direct or specific effect of complexity"[45], there is associated consciousness varying "in each case"

1. Consciousness is an effect of complexity.
2. There has been a continuous rise in complexity.
3. There has been a continuous rise in consciousness.
4. Among all biota this rise has been associated with the development of a nervous system[46].

The discovery of this periodicity occurring within the series is what

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45. Teilhard de Chardin, P., The Appearance of Man, p. 214.

46. __________, The Appearance of Man, p. 214.

makes complexification or the complexity-consciousness law "an experiential law of recurrence"[47]. The periodic affinities of the chemical elements need not be interpreted as exhibiting anything more than structural affinities while the conception of levels of arrangement being equatable to orders of birth is central to Teilhard's thesis; the complexification law is not merely a structural law but a genetic law as well.

Teilhard writes,

> Hitherto, in the eyes of Science too much accustomed to reconstruct the world on one spatial axis extending in a line from the infinitely small to the infinitely great, the larger molecules of organic chemistry, and still more the living cellular composites have existed without any defined position like wandering stars, in the general scheme of cosmic elements Now, however, simply by the introduction of another dimension, a new order and definition become apparent. Traversing the rising axis from the infinitesimal to the immense, another branch appears, rising through Time from the infinitely simple to the supremely complicated. It is on this branch that the consciousness-phenomenon has its place and eventually shows itself. There is first a long, obscure stretch which seems dead but is, in fact, 'imperceptibly alive'. Then, at the stage of corpuscles reaching a million atoms in their complexity (viruses), we come to the first flush heralding the dawn of Life. Later, after the cell, there is a definite radiation growing richer and more intense with the formation and gradual concentration of nervous systems.[48]

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47. __________, "Introduction to Centrology" (1944), in <u>Activation of Energy</u>, p. 99.

48. __________, "The Planetisation of Mankind" (1946), in <u>The Future of Man</u>, p. . By this re-ordering of things, not only does Life, despite its extreme rarity and localisation in Space, show itself, in symmetry with atomic disintegration, to be a fundamental universal current (the current); not only does Man, with his billions of interacting nervous cells, find a natural, cosmically enrooted place in this generalized physical scheme; but something begins to take shape ahead of Man. Once again we find ourselves confronted by the forces of collectivisation.

Despite this major difference, however, there are other major similarities between the chemical periodic laws and complexification. Teilhard writes, "....that by analogy and in symmetry with the past we are led scientifically to envisage the future of mankind"[49], and elsewhere he writes, "....when the curve of moleculization is extended into the future, it enables us to forsee the awakening....of irresistable human affinities"[50]. It was precisely on the basis of analogy, as suggested by Sanderson, that Mendeleev predicted quantitative and qualitative properties of as yet undiscovered elements. For, since, he was able to establish a recurrent appearance of quantitative and qualitative similarity within the known elements by an extrapolation or extension of the pattern, he was able to construct a representation of the undiscovered elements and with considerable success. Two other parallels between complexification and periodicity are of considerable interest. With periodicity, as later developers of chemical theory were to show, besides the primary recurrence, there are secondary repetitive patterns and that these phenomenal properties are manifestations of underlying structures and processes.

On this first point, Graham and Cragg say,

> The regular gradation in properties from element to element in a family is not limited to metallic or non-metallic character. The melting point, boiling point, density, atomic diameter and other properties of the elements are usually found to vary within a family in a regular way. Nor are such regular trends

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49. __________, The Phenomenon of Man, p. 251.

50. __________, "The Atomism of Spirit" (1951), in Activation of Energy, p. 241.

> limited to the properties of the elements themselves; they extend to the properties of their compounds.[51]

So there are both secondary regularities occurring within families and within the primary periodicity of the total series. Because the recurrence involves not just a repetitious variation among similar events, but rather a pattern of regularity whose variation is accounted for by structural, and perhaps temporal, relations of antecedent and consequent, and because complexification entails the same kind of structural relations, the two series may be considered as belonging to the same family of explanatory forms. Excluding the fact that with the periodic table the structural relationships of antecedent and consequent need not be interpreted as entailing temporal sequence as well, while temporal transformation is central to Teilhard's conceptualization of complexification, the periodic law more closely resembles the Teilhardian notion more than any other type of statement found in physical science. It is evident, at least in its broadest outline, by the principle of parity, that if chemical periodicity may be identified as a law-like statement, so too may complexification. The notion of 'complexification' alone, without reference to consciousness or the secondary regularities which are the products of their joint interaction, may be regarded as Teilhard's primary postulated regularity. Complexification, as is the case with periodicity, asserts that there is a graded series, grouped according to physical criteria in an ascending order in which no element (natural core)

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51. Graham, R.P., and Cragg, C.H., <u>The Essentials of Chemistry</u>, p. 200.

or class or stage of entities is identical to that preceding or subsequent to it, because it is incorporated in or incorporates some or most of the features of its antecedent or consequent, together with those characteristics which distinguish antecedent or consequent. As is the case with the periodic series as well, there is a gradual differentiation demarcating the members of a series[52], from those of another. Also, as with the chemical series considered as a whole, there occur recurrent relational patterns among regularly varying members of the series. In complexification among natural cores, there is not only a continual variation in complexity, but a continual increase in that variation (but not necessarily a proportional variation), and also a regularity in the general manner in which centro-complexes become more complex. On every 'level' (or stage) of complexity, despite the various mechanisms characteristic of that stage, the general pattern of differentiation is followed by concentration (convergence) and an emergence of novel properties. It is on the basis of such patterns, that Teilhard explains the emergence of consciousness, 'raised to a power of two' with the coming of man, and it is on this basis that Teilhard infers that there will be a future convergence and emergence (hyper-human) for mankind at a future

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52. The real difference between the elements of the chemical series and those of a biological series concerns the fact that with any given 'class' of chemical elements (as distinguished from 'series'), a member of a class is theoretically identical to every other member. This is to say that any atom of arsenic is identical to any other atom of arsenic (excepting alletropes).

point. This is precisely the type of extrapolation which occurred in the formation of the periodic table.

What is important about this paragraph in assessing the cogency of Teilhard's notion of complexification, is that Mendeleev made what is universally recognized as a legitimate scientific extrapolation from the known and qualitatively distinct elements of a series, to a previously unknown set of qualitatively and quantitatively distinct elements which could be classified as members of the same series. Teilhard, then, claims this conception of complexification is scientific and his law does in fact resemble a universally recognized scientific law.

The parallels between complexification and the periodic table do not end merely with explanation and extrapolation within a series. Just as the complexification series is seen as a consequent of an all pervasive force (radial energy), so too are the qualities of the periodic table seen as the manifestation of the all-pervasive atomicity of mass, energy and the forces binding together sub-atomic particles.

Granting that there is a similarity in general outline between the expression of complexification as a law and another recognized scientific law, this similarity is not sufficient to enable a positive judgement on the scientific soundness of complexity-consciousness. The two questions which must be asked specifically about complexity-consciousness concern the quality of its bridge concepts and the veracity of its empirical assertions. The second question can only be answered legitimately by a researcher in the biological field, however, the possibility of an answer to the second question is contingent upon the quality of the bridge constructs. The presence or absence of these is amenable to philosophical analysis and judgement. This will be done in the chapter to follow. The comparison of complexification with chemical periodicity is of little help in establishing the relation of the notion of complexity to the mechanisms of transformation occurring within the biological series. In order to do this, the concept of complexity must be considered in conjunction with orthodox evolutionary theory.

9. The Notions of 'Complexity' and 'Fitness'

A number of different Teilhardian texts suggest that Teilhard had no intention of completely supplanting Darwinian or Neo-Darwinian theory. Rather, these texts suggest that the orthogenetic theory was proposed by him to explain a class of events that traditional evolutionary theory was not able to explain. And so the traditional theory of evolution is augmented and, to an extent modified by the orthogenetic theory but not invalidated by it. On this, Teilhard says, for example,

> When we hear people speaking of evolution, the idea that comes naturally to our minds is that of the origin and transformation of living forms - that is, the idea of an operation which is essentially phyletic and divergent - based on chromosomic heredity - and maintained by the combined play of chance and selection. A '<u>transformism</u>', corrected, of course, and improved by genetics, but nevertheless still essentially the transformism of the nineteenth century, with its fully homogeneous mechanism extended to no more than a strictly limited field. Nine times out of ten that is the picture the <u>word</u> 'evolution' calls up for us.
>
> We have only, however, to reflect for a moment to realize that it is something very different from, and something much more than, a mere 'genesis of animal species' that the <u>phenomenon</u> of

> Evolution, both as an over-all process and in the forms it assumes, is now tending to become for science, and indeed has already become.[53]

The causative factors pointed to by Darwin and later evolutionary theorists. were all incorporated into the orthogenetic theory. What Teilhard means by 'the tentative grouping of large numbers' and 'arrangement by chance', includes the Darwinian concepts of 'survival of the

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53. Teilhard de Chardin, P., "The Energy of Evolution" (1953), in Activation of Energy, pp. 362-363. What is not explained by Neo-Darwinian theory is 'orthogenesis'. On this Teilhard writes, "....to reduce the whole mystery of animal morphogenesis to a pure mechanism of dispersion would be all the more interesting because, as a result, the passage from micro-to macro-phenomena (that is to say from the genetic to the phyletic) in the field of speciation might then operate by a sort of direct 'integration'. Always the same mechanism in small and great alike. A charming perspective, of course, and one whose attraction certainly counts for a great deal in the present day tendency of the Neo-Darwinists (particularly in the United States) who will not recognize in the history of living forms anything but a vast phenomenon, planetarily extended, of diversification pushed to its extreme. A principally (if not entirely) dispersive evolution, supported by no fundamental polarization (no curving) of the stuff of things. This is exactly the perspective, described as 'new' (but should one not call it regressive?), against which I think it is important to react, by reintegrating a certain 'preferential' into the mere 'dice-play' - if we wish to save the greatness of the phenomenon of life". In "A Defense of Orthogenesis" (1955), in The Vision of the Past, p. 270.

fittest' through environmental pressure and variation[54]. Teilhard would also have accepted, along with the Darwinians, differential reproduction and the random processes of genetic mutation, genetic recombination and genetic drift. However, along with these factors, he introduces one other which is entirely anti-chance. Teilhard speculates for instance that,

> Supposing....we substitute 'most complex'....for 'most fittest'. In other words, supposing we admit that, under the tentative play of chance, the Weltstoff behaves by nature as though by preference it fell into those forms of arrangement which are at the same time the richest, the most closely associated, and the most fully centered[55].

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54. About which Teilhard writes, "However little one may, by conviction or temperament, be 'Darwinist', it is impossible to deny the immense part (at least in the first stages of the phenomena played by chance effects in the appearance and intensification of life within our universe. 'Given a very large number of elements taken in a state simultaneously of agitation and compression (or, which comes to the same thing, of agitation and multiplication), experience teaches us that such a system tends intrinsically and automatically to develop its arrangement additively to an ever more marked degree: subject to the condition that, for some reason, certain types of arrangement can be considered as specially favoured. For once such a type of association has been effected by chance at one point for the first time (as an effect of the tentative gropings of large numbers and of agitation), then this "initial atom of arrangement" tends (through the selective influence of compression, that is, of competition) to take advantage of new chances and so grow and intensify in the favourable direction - and this continues indefinitely". As found in "The Mechanisms of Evolution" (1951), in Activation of Energy, p. 301. It is, of course, the class of specially favoured phenomenon which is not explained by Darwinism and which were meant to be explained by the orthogenetic theory.

55. __________, "The Mechanisms of Evolution" (1951), in Activation of Energy, p. 302. Teilhard continues by saying, as an explanation (and still more as a standard of measurement) of this so clearly oriented (or polarized trend), to speak of 'the greatest for survival in organisms' is quite useless. On the other hand, "By the introduction into biogenesis of the notion (or principle) of greatest complexity....the general situation of life in the universe can be seen accurately in terms of energetics". In "The Mechanisms of Evolution" (1951), in Activation of Energy, pp. 302-303.

Hence, for the 'relative' criterion of 'fittest', which is a standard of judgement applicable only within the context of a specific environment, he wishes to substitute the concept of complexity, which is absolute for any environment. This does not mean, however, that the notion of 'fittest', in the Darwinian sense, is entirely replaced, because, for Teilhard, as for any other theorist, there are characteristics whose continuance might only be explained on the basis of fittness relative to a given environment. Rather, Teilhard suggests there is a higher order, a preferential factor which tends to 'select' one type of characteristic for continuance and accumulation above all others and interdependently of any special environment. This characteristic is, of course, the type of centred complexity which gives rise to consciousness.

As well as the 'regularities' postulated by Darwin, there is another type of regularity covered by the complexity- consciousness law which acquires a significance within the framework of the complexity-consiousness law, a significance which it does not possess outside of it. Examplesles of this type of 'regularity', are the phenomena of Emergence, Divergence and Convergence. 'Convergence', for example, within a

Darwinian context, is an "accidental generalization"[56], a 'coincidence of the random interactions of the components of the biological world'. Within the Teilhardian context, the emergence of novel properties, individual or types, is sometimes, at least, a consequence of consciousness.

10.. A Primary Statement of the Complexity-Consciousness Law, Sub-laws, and Conditions

The conditions for the application of the complexity-consciousness law have been, in part, previously discussed. However, even though

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56. Or what Simpson calls a non-law-like "descriptive generalization". In _This View of Life_ , p. 127. He says about such descriptive generalizations as 'convergence' that, "Recurrence of more or less similar conditions within the great complexity of historical causation may evoke some similarities of response, but these will be flexible, non-identical, and representative of tendencies rather than of invariable responses to law. Laws like those....are not laws in the usual mechanistic sense. At most they are descriptions of what has commonly happened or in some cases only of what has sometimes happened. The fossil record is consistent with historical causation that is in continuous flux. Non-repetitive and....essentially non-predictive". In _This View of Life_, p. 187. Simpson also maintains, "Members of two groups diverging in ways involving some of the same opportunities converge towards each other". In _The Meaning of Evolution_, New York, New American Library, 1951 (1949), p. 70. Simpson's description (representative of a Neo-Darwinian position) clearly accords with Nagel's delineation to the effect that, "A universal of law "supports" a subjunctive conditional, while an accidental universal does not". In _The Structure of Science_, p. 52. One of the reasons, according to Nagel, a universal can offer such support is because it "occupies a distinctive position in a system of explanations....and is supported by evidence....". In _The Structure of Science_, p. 70. This is clearly not the case with 'convergence' in a Darwinian context.

it entails a certain amount of repetition, this element of Teilhard's theory seems important enough to justify some further discussion.

The general condition for the application of the complexity-consciousness law to biota from the appearance of the vertabrates onward, is the development of sympathetic nervous systems within or between some group of higher mammals. The consciousness and relative complexity of each may be inferred on the basis of some sub-system of the central nervous system. Thus, for example, a porpoise would be judged to have consciousness on the basis of being a member of the family of chordata and more consciousness than a horse on the basis of the relative amount and organization of nerve cells in the cerebral hemispheres. Teilhard's orthogenetic theory, then, does have the two principal elements of Hempel's and Oppenheim's[57] deductive nomological or covering law model, so that the phenomenon of man could be said to be explained in the following fashion:

Law 1

Consciousness is a universal property of the universe (postulated).

Law 2

Atomicity is a universal property of the universe.

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57. The model is represented this way:

" $L_1, L_2, \ldots\ldots L_r$ Explanans sentence

$\underline{C_1, C_2, \ldots\ldots C_k}$

E Explanandum sentence

where $L_1 \ldots L_n$ refers to general laws

C_1 to assertions about particular states of affair, and

E the event explained." Hempel, Carl, "Deductive-Nomological Vs Statistical Explanation", p. 100, in The Philosophy of Science, (Feigl), Vol. III, p. 100.

Auxiliary hypothesis

Consciousness type is a correlate unitary type (viz.,type of complexity) so that whatever is complex is also conscious and whatever is more complex than something else is also more conscious than that thing.

Auxillary hypothesis about complexity

Whatever is a natural unity is 'closed' to direct environmental influence.

Law 3

Neo-Darwinian theory of evolution with its statement of regularities explaining the development from simple elements to more complex.

Law 4

The Complexity-Consciousness Law posits,

1) Consciousness is always correlated with true complexity,

2) Increases in complexity necessarily entail increases in consciousness,

3) Increases in complexity are effects of the activity of consciousness.

Condition 1

Taxonomy- chordate, vertebrate, mammal, primate, anthropoid, homo, homo sapiens, sapiens.

Condition 2

Postulated preferential taxonomy- chordate, cranial capacity- 900 cc. to 2250 cc., cerebreal cortex viz. volume of grey matter to volume of contained nerve cells.

(grey/cell coefficient and cephalization coefficient)

$(K = \frac{E}{S^r})$ where E is the brain weight
S is the body weight
r constant 0.65 [58].

Condition 3

Behavioural properties: "an extraordinary power of expansion"

"an extreme rapidity of differentiation"

"a persistence of germinative power"

"a capacity....for interconnection between branches within a single fascicle"[59].

To the question then, 'What is Man's place in nature'?, the answer may be given that man is a living species which occurred through the agency of the evolutionary mechanism postulated by Darwin and the Neo-Darwinians and through the agency of a universal force (radial energy) which tends to produce higher and higher states of consciousness as a correlate of greater and greater complexes of tangential energy. Man is both an instance of the complexity-consciousness law and the highest expression of it. It would be tempting, then, at this point, to suggest that while Teilhard's theory may be a good or bad theory, depending on its explanatory 'force', and its degree of validation, its explanatory form is identical to that usually found in science. Such

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58. LeGros, Clark, The Antecedants of Man, New York, Harper, 1959, p. 260.

59. Teilhard de Chardin, P., Man's Place in Nature, p. 73.

estimation, however, despite some broad general resemblances, actually disguises some exceedingly important differences between the type of conditions and laws (at least some of them), that Teilhard postulates and those envisaged by Hempel.

10.1 The Complexity-Consciousness Law and the Problem of Conditions

One commentator on scientific theories, Wartofsky, characterizes the notion of scientific law in the following manner. He writes,

> A law states an invariant relation among all members of a given class (with respect to some parameters taken to be relevant). This may be in the form of a universal conditional $(x)\ (Fx \rightarrow Gx)$....For any x, if Fx were the case, then Gx would be the case. We take a law of nature to hold for an indefinitely large or infinite class of natural events or instances and, in general to be unbound to any particular time, or to hold indifferently at any time.[60]

Carl Hempel makes another point about laws to the effect that what is important is the unvarying sequence and not the standard conditions. He argues that, the more conditions may be varied without altering the sequence, the more confidence may be felt about the lawful nature of the discerned sequence[61]. Nevertheless, it is probably the case that very often initial confidence in supposed natural patterns is accorded to the sequence which is observed to occur under uniform conditions.

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60. Wartofsky, Marx W., Conceptual Foundations of Scientific Thought, p. 252.

61. Hempel, Carl, Philosophy of Natural Science, pp. 20-21.

As was posited in the first chapter, standard conditions and, more generally, parallel sequences represent only a limited class of events for Teilhard, while emergent, non-repetitive properties, entities and classes are for him the primary phenomena. In principle, Teilhard expects a continued asymmetricality of processes which include limited uniformity as a subset of process type.

For Teilhard, a knowledge of 'conditions' is not primarily a knowledge about under what conditions a uniformity of events may be expected to occur; rather, the statement of conditions serves to continuously define the pattern. The statement of conditions not only serves to operationally define the complexity-consciousness law but also to theoretically define it. Unlike the sort of deterministic law found in Newtonian mechanics[62], where the meaning of the law can be considered quite independently of any given application, the very meaning of the complexity-consciousness law is interdependent with the statement of its

62. Teilhard says about this that, "For Newton, gravity was still no more than the way of explaining the working of a stationary system. We shall have to wait for Laplace and....spectral analysis before a mechanics of the heavens begins to be transformed into an embryology of heavenly bodies....Now however....there has been born the sense of a universal....movement in virtue of which the totality....is shifting integrally and as one whole, from top to bottom, not simply within space and time, but in a (hyper-Einsteinian) space-time whose special bias is to introduce an even higher degree of arrangement into that which moves within it. It is what I....called a movement of 'complexity-consciousness' or of 'corpusculization', or of 'centration' or 'interiorization'....It is....a true, absolute movement....<u>Definable in relation to itself</u>". As found in "From Cosmos to Cosmogenesis" (1951), in <u>Activation of Energy</u>, pp. 253-256-257.

conditions (viz. its direction).

11. Certain Biological Reasons for 'The Problem of Conditions'

How and why this is so can be considered a consequent of the following reasons rooted in biological phenomena. Teilhard contends that,

> For a natural scientist worthy of the name, to class an animal or vegetable is to find its true, natural place in the organized assembly of living forms, considered as a whole process of development. To understand a being therefore, it is no longer enough to have enumerated its characteristics.......
>
> ....The labour must be more exhaustive. It is necessary, (at least approximately and provisionally) to have reconstituted its organic history, explained its biological surroundings, and accounted for its geographical distribution.[63]

Once past the simply descriptive activity of classification, the understanding of biota involves two separate forms of explanation, which may be entitled evolution (viz. historical) and structural-functional. This is true of biology in general[64], and it is also true with important qualifications of Teilhard's orthogenetic theory. This point is essential to the understanding of the problem of conditions in Teilhard and his statement of the complexity-consciousness law. As the immediately previous quotation suggests, much more is involved in understanding a

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63. __________, "The Natural History of the World" (1925), in The Vision of the Past, p. 105.

64. E. Mayr, a working biologist writes on this, "As soon as one goes beyond the level of purely descriptive structural biology, one finds two very different areas which may be designated functional biology and evolutionary biology....". In "Cause and Effect", in Biology in Science, Vol. 134, Nov. 1961, pp. 1501-1506.

living organism than just its gross morphological characteristics. Below these characteristics, there are the multiple systems which jointly compose the organism.

12. Centric Determinacy and Genetic Indeterminacy

Teilhard did not work in the area of genetic biology. He was, however, not completely uniformed about this area, and he knew something of the effects of the Mendelian laws of inheritance. He was aware that these laws are probabilistic and that their mechanisms work to produce variations or multiplicity as well as similarity.
Teilhard says about this,

> In the case of expanding life, the elementary phenomenon is represented by the numerical growth of beings at the moment of reproduction. Each living being is capable of giving birth to several other living beings, who at the same time differ from it and differ among themselves. ....multiplication and diversification; a double property by which life is defined in its external manifestations.[65]

However, unlike other biologists, Teilhard interprets the concept of genetic indeterminacy within the context of the orthogenetic theory. What this means concretely is the following: in order to catalogue

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65. Teilhard de Chardin, P., "The Natural Units of Humanity", in The Vision of the Past, p. 194. Teilhard continues to explain, "To explain this strictly empirical fact, modern geneticists imagine that the reproductive cells, in the course of their individualizating division distribute themselves according to the laws of chance. A certain number of the characteristics or genes defining, by their grouping on the filaments of the cellular nucleus, the 'germ' of the individual to which they belong". In "The Natural Units of Humanity", in The Vision of the Past, p. 194.

and chart the patterned rise of consciousness, there has to be some continuity, some perseverance of characteristics and function, to allow a basis for comparison, classification and grouping. For Teilhard, this stability is provided for in the natural unity of 'core' or centre. A complexity has the previously discussed property of closure, it is "confined within itself"[66]. From Teilhard's definition of radial energy as well as from what he has to say about organisms as systems that are centred, consciousness is the coordinating agency of both the multiple systems which make up an organism and its stages of development. As Teilhard says, "A centre does not simply exist, it builds itself up"[67]. Such phenomena as growth, development, and homeostasis are all the results of the centering activity of consciousness. However, it must be remembered that consciousness is a consequence of levels of development. Teilhard says for example,

> ....the most significant characteristic of any of the units whose association makes up the universe is distinguished in those units, by a certain degree of interiority - that is to say centricity (soul), which is itself a function of a certain degree of complexity (body and more particularly brain). This coefficient of centro-complexity (or what comes to the same thing), of

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66. __________, Man's Place in Nature, p. 20.

67. __________, "The Atomism of Spirit" (1941), in Activation of Energy, p. 31.

> consciousness, is the true absolute measure of being in the beings that surround us.[68]

There is no vicious circle here nor any inconsistency. By a mechanism which Teilhard only partially explains, one natural unity gives rise to another. When, as Teilhard says, "Hardly is such a particle centred upon itself before it displays a remarkable power of self-complexification (and therefore of auto-centration)"[69], the parent unity then establishes preconditions for consciousness by multiplying itself, but once the arrangement occurs and consciousness is posited, it begins to effect changes in the structure. For Teilhard then, consciousness is essentially the ordering, stabilizing and conserving fact or[70] while, as the previous statements by Teilhard would seem to demonstrate, genetics provides one of the multiplying, fragmenting and randomizing elements as well as providing a secondary unifying role. Considering this last point

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68. __________, "Centrology" (1944), in Activation of Energy, p. 102. Also, in "The Atomism of the Spirit", in Activation of Energy, p. 31, Teilhard says as well, "The centricity of an object does not correspond in the world either to an abstract quality or to a sort of all or nothing with no half-tones or degrees of intensity. It represents a magnitude which is essentially variable, proportionate to the number of elements and inter-connections contained in each cosmic particle under consideration. A centre is more simple and profound, the greater the density and the wider the radius of the sphere in which it is formed."

69. __________, "Centrology" (1944), in Activation of Energy, p. 107.

70. In his earlier writings, Teilhard virtually uses the terms 'life' and 'psyche' as synonyms. He writes for example, that, "....if life is conceived (as all spiritual causes should be) as a synthetic force of a higher order than that of the physico-chemical forces, capable of co-ordinating them and acting on them without falsifying their determinisms, then one cannot see why science should blind itself to them....". In "The Transformist Paradox" (1925), in The Vision of the Past, p. 96.

first, it is fairly certain that Teilhard accepted contemporary genetics in so far as he was aware of this area of biology. As such, he was aware that the basic structural patterns of an individual are determined by the sexually-transmitted genetic load of the individual parents. In Teilhard's words,

> ....by coming together in pairs to fertilize, the cells provided by different individuals put their respective genes in a common fund. Thus, each daughter cell finds its characteristics finally determined by the meeting of genes first contributed haphazardly by two parents, then fortuitously combined by the unpredictable whim of fertilization.[71]

While the basic type is determined by genetic combination, according to the Mendelian laws of inheritance, there is a tremendous variation possible within the limits of the 'type'. The actual configuration of produced individuals is a consequence of a series of random events, starting from the controllers of characteristics themselves. By the mechanisms of sexual fusion, each offspring inherits a recombination of character determinants which, while identical in number to each parent, is unique in the way in which these determinates are combined. Genes that are linked in the parent may be segregated in the offspring or the converse. When it is realized how vast is the number of factors carried in the sex cells of any organism, it can also be realized how great is the

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71. ________, "The Natural Units of Humanity" (1939), in The Vision of the Past, p. 194.

possibility for variation[72]. As well as the production of variation in the offspring through recombination, there is an occasional alteration of the determinant type itself. Through such chance events as the eradiation of a gamete, the material of the chromosomes sometimes mutates and this change may appear as an operation of phenotype. Beyond the level of the gene, other factors enter as random variables in the process of combination. However, before these are considered, it seems necessary first to consider certain other features of wholes, touched on in the first chapter.

12.1 Wholes and Relational Properties

The mechanisms by which the dispositions an organism inherits are realized to become the anatomical organization, are multiple. The growth of organic systems and the manner in which these systems are maintained are not fully understood by contemporary biologists. It was certainly not understood in any great detail by Teilhard. Nevertheless, certain observations relevant to the first chapter[73] may be made. Two initial observations might be made concerning the fact that development

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72. Teilhard clearly recognizes this form of randomness, for he says, "Multiplication and diversification: a double property by which life is defined in its external manifestations....modern geneticists imagine that the reproductive cells, in the course of their individualizing division, distribute themselves according to the laws of chance a certain number of characteristics or genes defining....the 'germ' of the individual to which they belong....each daughter cell finds its characteristics by the meeting of genes contributed haphazard by two parents, then fortuitously combined by the unpredictable whim of fertilization". In "The Natural Units of Humanity", in The Vision of the Past, p.194.

73. For example, the implications of Teilhard's adoption of the concept of 'wholes'.

takes place from relatively simple to relatively complex and that as Waddington says, "the development of normal structures of an animal is largely the result of 'self-organization'"[74]. It might be observed as well, that the conservation or perseverance of organic system is the result of self-maintenance. Both sorts of processes entail the interaction of complex parts or systems where the functioning of the part is significantly modified by its sequence of development and relationship to other parts. The absence or malfunctioning, for example, of parts of the endocrine system may be absolutely critical in influencing subsequent developments of an organic system. As one biology treatise describes it,

> The endocrinal system is responsible for such major functions as the proportionate growth and development of the body, the regulation of the intercellular metabolism, the maintenance of the constant composition of the bathing body fluids, the appearance of puberty, and support of all reproductive functions including pregnancy, parturition, lactation and the identifying characteristics of the sexes, hormones and also is critical to the establishment of normal behavior patterns and essential to the learning processes. Acute removal of the adrenal, parathyroid and pancreatic islet secretions is quickly followed by the death of the animal.[75]

It has been known, as well, by biologists, that organisms that are experimentally removed, function differently from those in situ. It is, then, only in relation with other organs, that certain behavioural properties become manifest[76]. The very possibility of the presence of many

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74. Waddington, C.H., Biology, New York, 1963 (1962), p. 36.

75. Biology and the Future of Man, (ed. Philip Handler), New York Oxford, 1970, p. 271.

76. As the capacity of the hormone producing endocrine gland to influence parturition, lactation, etc., in the presence of birth producing organs, learning producing organs, and so forth.

such relational properties is conditioned by the presence or absence of other systems. On a more functional level, as suggested by the previously quoted passage, the very presence or absence of organs or organ states is also conditioned by the situation of other parts.

The genetic as well as the various other morphological organizing factors (e.g. consciousness), produce the fixity of type and continuity of organism which allows classification and limited prediction of the natural kind, variety, and the symmetry of action that Teilhard speaks about in Man's Place in Nature. Although Teilhard in his writings, does not focus on the reconstruction of 'natural cores', it may be assumed that, in fact, he presupposed such a theory, otherwise the program of scientific grouping becomes impossible and, consequently, so does a mapping of the rise of consciousness[77]. It is likely that Teilhard would have readily agreed with that part of Ernst Nagel's description of 'natural kinds' which Nagel phrases in the following manner as a law which, "asserts that there are objects of various kinds such that every object of a given kind is characterized by determinate forms of a set of determinable properties and such that objects belonging to different kinds will differ in at least one....determinate form of a common determinable"[78]. The determinate properties in the context of the

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77. Since, according to Teilhard, natural unities can be classified and typed according to determinable degrees of centro-complexity, it follows that he was working within the framework of a theory of natural kinds where biota are differentiated and grouped according to structural, functional, and consciousness predicates.

78. Nagel, E., The Structure of Science, p. 75.

orthogenetic theory are those having to do with complexity type and, secondarily, with more usual biological criteria, such as intra-specific fertility[79], as well as other morphological traits. The determination of complexification must be supplemented, where possible, with the determination of behavioural correlates; for, in many instances, degrees of morphological differences are not sufficiently great to make cogent assertions about 'natural wholes'.

12.2 Natural Kinds, Causality and Purpose

Teilhard's theory of 'natural kinds' is, in fact, causal. He writes, for example, that

> ....there is no doubt that (1) an animal acts much less vigorously when it is calm and satisfied than when hungry or hunted; and (2) that under these circumstances, fear and appetite, far from being simple echoes or conscious reflexions of what is happening in the cell-chemistry, in their role as excitants form an essential link in the chain of causality.
>
> From this point of view, what we may call the 'psychic

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79. Teilhard writes on this, "1. Speciation. For modern biology, as we know, a species has lost all metaphysical significance; it no longer represents anything but a mutually fertile collection of individuals whose morphological variations are grouped statistically around a mean type (corresponding to the maximum ordinate of a simple Gauss curve).

In this perspective the phenomenon of speciation (or formation of species) represents the secondary appearance (by mutation) somewhere within a population thus composed of one or more statistical centres at which morphological grouping takes place: the curve representing the frequencies consequently presenting several maxima susceptible under the influence of factors which are still obscure (geographical isolation, for example) of separating from one another biologically, as if the initial species had given birth, by fission, to one or several new species." In "Note on the Present Reality and Evolutionary Significance of a Human Orthogenesis", in The Vision of the Past, p. 249. In this instance, it is mutual fertility which comprises Nagel's common determinable.

> temperature' of living beings is a factor of the first importance in the energising of all organised substances; an importance which grows stronger and more specific with each advance of cerebration. In man, by the fact of reflexion, it is normal for this phenomenon to become preponderant and at the same time to differentiate along certain new lines. Not only does the release of energy in thinking beings follow an exceptionally rich scale of repulsion and attraction; but also (as a result of the dangerous faculty of foresight) we all find in their case ... fears and hopes, extending beyond the present and the immediate future,....[80]

He does suppose that the presence of morphological characteristics (i.e. complexity) does precede and is a necessary condition for action and interaction, although again, he barely makes reference to its purposive behaviour. Yet, the observation of such behaviour constitutes one of the datum of his theories. Individuals exhibit a continuous predisposition toward greater complexification (higher unity) as well as toward other secondary goal-oriented activity relative to an environmental context, although this form of goal orientated behaviour only becomes manifest when great numbers of individuals are considered over a large period of time. Teilhard, for example, writes about "the behaviour of closed particles - specific elements of the biosphere", saying,

> Hardly is such a particle centred upon itself, before it displays a remarkable power of self-complexification (and therefore of auto-centration). It is not that it is emancipated, to its advantage or detriment, from the laws of chance but though still immersed in chance, it behaves as though it were in a

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80. __________, "The Singularities of the Human Species" (1954), in The Appearance of Man, p. 26. Teilhard writes, "The (relative) size of brain is not the principal condition, but is a necessity for developed psychism. Good brains are found among large brains. One can, therefore, on a first approximation, relate the progress of animal psychism with the quantitative increase in cerebral lobes." In "Palaeontology and the Appearance of Man" (1923), in The Appearance of Man, p. 38.

> nutritive medium, choosing, seizing hold of and actively incorporating at the whim of chance, the elements of centro-complexity... so marking out a phylum....As a result of a sort of exhaustion...., each particle is....capable of producing only an infinitesimal advance along the phylum to which it belongs....each one serves as a starting point and an anchorage for a complex ramification.[81]

If, still considering the natural core, structural behaviour and consciousness properties are considered simultaneously, something of what Teilhard means when he says, an organism is not just 'a sum but a synthesis'[82], may be discerned. He would seem to mean that, unlike the

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81. ________, "Centrology" (1944), in Activation of Energy, p. 106.

82. In a series of short observations on François Meyer's book Problématique de l'Evolution, Teilhard writes, "Je reconnais aussi avec Meyer que, en biologie (comme en physique!) on ne peut pas passer déductivement du micro au macro (de l'infime a l'immense), parce que, en chemin, des paliers se franchissent, de nouvelles propriétés émergent. Mais ceci n'empêche pas de reconnaître - du haut en bas - l'existence de certains processus généraux (tels que ceux que j'appelle "dérive vers la Complexité-Conscience", ou "cérébration"...) où les phénomènes de genèse (et de généalogie) gardent leur place nécessaire". In "Extrait du Bulletin de l'Union des Scientifique Français", N° 25, Nouv. série mars-avril 1955, in L'Oeuvre Scientifique, Tome X, pp. 4574. For Teilhard, as will be further discussed in subsequent sections, the properties of organism and their parts can be predicted on the basis of 'natural kind' parallels; nevertheless, the emergence of altered capacities, particularly those of consciousness and spontaniety produces a level of difficulty to the biologist not present to the physicist for whom the manifestations of the forces under investigation are relatively limited. Predictions based on structural and functional affinities can only occur on the basis of established parallels, yet no such parallel can be drawn where a disposition is acquired until the disposition manifests itself. There are, according to Teilhard, continual variations in dispositions which must be taken into account before inferences based on parallels can be made. The effect of this is to tie biologists much more closely to an observational base than is the case with physicists.

case where a sum (a whole) and its properties might be predicted from a knowledge of its constituent parts, the properties of an organic complexity cannot. As a consequent of what was said previously about inter-systematic connections, where the whole is regarded as a system of relations whose relationship is one of causal interdependence, the natural whole exhibits properties which are not manifested by any of its elements considered independently. Also the parts of a natural unity, if those parts themselves are natural unities, may display a capacity for centred action within the larger natural unity and without loosing their own integral capabilities. This is the case with the structural properties of a unity and its morphologically external behavioural characteristics. Within the confines of the synthesis, a new capacity is formed out of the specific interrelationship of the parts. Teilhard says about this in an early work,

> Let us turn back and examine critically the operation of analysis that gradually led us down from the heights of rational life to the particulate swarming of electrons. We progressed in a series of successive fragmentations. At each operation we separated two elements: an ordering principle, which is imponderable, cannot be analysed, and is synthetic - and ordered (ponderable) elements. On every occasion, as a direct result of analysis, that ordering principle disppeared. We accordingly concentrated our attention on the ordered elements, which seemed to be of a more stable nature. These in turn yielded to analysis, sacrificing a fresh order and being reduced to sub-elements. And so the process continued. Thus we have left the statue to study the grain of marble - the sensation of light to retain the vibration of the ether - cellular life to fasten onto chemical combinations, etc. In doing so, we believed that we were making

> our way towards what was more solid, to something that would be a non-ordered prime element.[83]

The parts have a prior disposition for higher unity, but it is only when the disposition is activated that a specifically new disposition is formed[84]. The new capacity cannot biologically exist prior to unification, since it originates in that exact interrelationship of the elements, designated a 'natural unity'. Furthermore, as is the case, for example, of the cerebreal cortex, a part (and its attendant capacity) once formed, may alter the behavioural capacities of its constituents,

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83. __________, "Science and Christ or Analysis and Synthesis", in Science and Christ, London, Collins (1965), p. 29. In a later work, he makes much the same point by saying, "This evident variation of life as a direct function of synthesized large numbers can readily be explained if we admit the more matter is organized, the more it is centred (and in consequence, the more conscious it is....in the case of high complexities, the centre gains in depth, as an effect of organization, and thereby, too, the phenomena of consciousness and spontaniety appear....". In "The Rise of the Other", in Activation of Energy, p. 67. Also, in view of Teilhard's assertion that "all energy is psychical in nature", in The Phenomenon of Man, p. 64, there is no reason to assume the scientist had altered an earlier stated view where he asserts that psychic force is the synthesizing factor. Teilhard writes...."Because these psychic forces constitute the co-ordinating factor of various determined, the totality of which forms the animate world, the successive transformations of this world cannot be explained without recourse to some imponderable forces of synthesis". In "The Transformist Paradox" (1925), in The Vision of the Past, p. 96.

84. About this, Teilhard writes, "....all we have to do is slightly ....re-touch the picture which is normally drawn of the primordial grain of energy itself....we define it as possessing the three following properties:
1. A rudimentary 'within' (or immanence)
2. A radius and effective angle (both as narrow as you please) of self-determination.
3. A psychic polarization, producing a fundamental tendency to associate with other particles in such a way as to form with them progressively more complex units: the effect of this complexity being (in virtue of a primordial and essential property of cosmic being) to increase simultaneously the degree of immanence in the particle which develops it and its possibilities of choice". In Activation of Energy, p. 133.

out of which reciprocal interaction a new further capacity may be formed. It is in this sense that some understanding of the behaviour of the elements may be partially understood by considering the properties of the whole. The previous points may be explained in a less abstract way through the following examples. One contemporary biological text asserts that,

> Central to the mind-body problem is the question of consciousness; indeed consciousness may be the only possible means of achieving appropriate regulation of large brains and may represent the most elaborate of a general biological regulatory mechanism concerned with the control and direction of action.[85]

The cerebral centres of higher mammals represents a development from, and is structurally composed of, simpler elements, yet once it is formed, it alters both the morphologically intrinsic and extrinsic activity of the organism of which it is a part. Internally, for example, the central nervous system is thought to control "1) The reproductive cycle, sexuality and sexual behaviour; 2) The basal metabolic level, appetite and thirst, and associated appetitive behaviour; 3) Water and electrolyte metabolism and hydrogen ion concentration; 4) Cardiac output and

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85. Biology and the Future of Man, p. 370. Teilhard writes about this, "There is nothing....to forbid the notion that a choice quantum represents an invariable cosmic quantum - the same in an atom and the human brain", and he continues in a footnote by saying, "....it would be better, in the case of complex centres to say that the 'choice quantum' makes itself felt in a control (organic and centred) exercised by each complex centre on the sum total of all elementary 'choice-quanta' which that complex centre integrates in its complexity. From that point of view, the human 'choice-quantum' would be co-extensive with the global totality of the human body - the control levers being moreover collected and distributed in the system of nervous determinisms (mechanisms)". In The Analysis of Life", in Activation of Energy, p. 135.

peripheral resistance and, thus, the rate of blood flow through the tissues and organs; 5) Respiratory rate and volume and thus tissue oxygenation and CO^2 concentration"[86]. The various extrinsic behavioural activities of mating, mobility, and so forth are consequent of higher cerebral organization and consequent greater subsystematic control over all functional capabilities[86a]. The question of external behaviour introduces another level of difficulty. The capability of an organism to demonstrate a specific range of behaviour appropriate to the survival and growth of the organism, often with no previous exposure to that environment, has been termed teleological or purposive. Teilhard is aware of this type of system as can be seen from the following lines in which he writes,

> Among animals, the life of the individual is clearly controlled, dominated even, by what one might call 'the sense of the species'. Under the complex action of automatic mechanisms and instinctive reflexes, the animal, untiringly and without understanding, never ceases working to ensure the integrity and survival of the zoological group to which it belongs: not, it is true, that one cannot already distinguish in it (at least in the case of the highest forms) a self-centred tendency in the

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86. "As well as what has been previously asserted about higher cerebral organization, that the dog, the cat or the bird train their young in countless ways to hunt, to fly or build a nest....how are we to explain the remarkable behavioural patterns of the beaver, or of insects, except as the outcome of accumulated and transmitted experiences and discoveries? Such phenomena become apparent to us only where the creature under study has attained a sufficient degree of spontaneity....education is nothing less than an essential and natural form of biological addivity....". In "Social Heredity and Progress" (1938), in The Future of Man, pp. 28-29.

86a. Biology and The Future of Man, p. 374.

> individual to 'save his own skin'. This, however, occurs only as an exceptional or secondary manifestation. On the whole, and predominantly, the animal behaves as a link in evolution.[87]

For Teilhard, these inherited dispositions are accounted for by genetic mechanisms and consciousness[88]. However, he also mentions that, for an adequate understanding it is necessary to reconstruct an organism's surroundings. The purpose for this is clear, since no disposition

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87. __________, "The Sense of Species in Man" (1949), in Activation of Energy, p. 199. Ernst Mayr, quoting Julian Huxley, says that the term 'teleonomy' in biology designates "the apparent purposefulness of organisms and their characteristics". In "Cause and Effect in Biology", in Science, Vol. 134, Nov. 10, 1961, p. 1504. Mayr also says, "The purposive action of an individual, insofar as it is based on the properties of the genetic code,...is no more nor less purposive than the actions of a computer programmed to respond appropriately to various imputs. It is....a purely mechanistic purposiveness". In "Cause and Effect in Biology", in Science, Vol. 134, Nov. 10, 1961, p. Teilhard clearly recognizes such systems. He says for example, that "Even the most primitive "cosmic nuclei" has "a disposition to cause" a 'within' to appear but no with "deliberate intention". In "Centrology" in Activation of Energy, p. 105 . All material corpuscles of the natural unity type are then 'pre-programmed' to respond automatically to favourable environments by centrering. It is only with man, true purposiveness (intent) appears.

88. Teilhard writes on the mechanism of evolution, that, "....the greatest possible richness and variety of inherited properties accumulates in the phylum under the repeated influence of each generations cross-fertilization. In short, the two factors combine as a direct encouragement to the operation of centro-complexity....Since a centre of consciousness is essentially....closed in, how can we conceive the passage and communication of a 'within' from mother cell to daughter cell? The only way out of this deadlock....is to imagine two sorts of ego....first a nuclear ego, and secondly, a peripheral ego; this latter is....divisible - after separation, it can develop by producing buds and isolate in itself a new nucleus of incommunicable ego". In "Centrology" (1944), in Activation of Energy, pp. 108-109.

can be activated in the absence of the appropriate stimuli. To rephrase this, it can be seen that many structural and behavioural traits could not be understood, or in the case of the latter, discovered, in the absence of the environmental conditions which produce them[89]. A tiger, for example, even with a tiger's teeth and 'soul', cannot be seen to eat meat where no meat is environmentally present.

12.3 Environment and Indeterminacy

Extrinsic environmental factors introduce another level of varying degrees of randomness, for while the behaviour of animals to other animals may be fairly constant, due to genetic programming, and other intrinsic factors, there need be no such constancy with external stimuli. Earthquakes, volcanic erruptions and several ice ages testify to this last point. As a consequent, it is sometimes difficult to a biologist to establish whether an animal's behaviour is a result of some alteration of intrinsic factors or the result of an interaction with some factor which was previously not present in the environment. Teilhard writes on this,

> Nothing proves....that biology....may not achieve....what physics is already achieving....in the nuclear field. Because of the great mass of factors that condition it, anthropogenesis is assuredly dependent on sidereal, planetary and biospherical

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89. On the reconstruction of environment, Teilhard says, "For a natural scientist worthy of the name, to class an animal or vegetable is to find it its true natural place....to understand a being....it is necessary....to have reconstituted its organic history, explained its biological surroundings and accounted for its geographical distribution." In "The Natural History of the World" (1925), in The Vision of The Past, p. 105.

energies, the workings of which we shall never know.[90]

Setting aside the problem of chance or random events until a later passage and focusing again on the notion of 'wholes', certain implications about conditions can be derived.

Biologically, a natural core is viewed as a composite unity whose parts and growth states interact in such a way that an alteration, disruptive or dispositional, modifies or disrupts the structure and functioning of the other parts and, consequently, of the whole. Each state and each stage in the growth and maintenance of an organism has a specific and non-interchangeable role. Methodologically, the investigation of the various structures and functions of the parts requires a variety of physical techniques and conceptual methods running the gamut from the exacting observational techniques of the morphologist to the intricate calculations of the mathematical probabilities of the geneticist and it is only when the various products of their investigations are brought together that anything resembling a representation of internal organic morphological functioning may be derived.

12.4 Method, Explanatory Levels and Conditions

Behaviourally, organisms demonstrate capacities for a variety of responses to multiple environmental situations and even, as is the case with some of the more complex life forms, a capacity for a variety of

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90. __________, "The Phyletic Structure of the Human Group" (1951), in Activation of Energy, p. 164.

responses to similar environmental stimuli[91]. These capacities for dispositional behaviour offer another range of cognitive difficulty, for the biologist can no longer restrict his questions to 'how', that is, to a description of mechanism, but must also ask 'what for', that is, the question about the functional utility of organ or process relative to the survival and maintenance of the organism as a whole. Where the organic function concerns the external environment, another range of difficulties appears; for, unlike the case with interactions between organs, where structure and function is relatively stable, influential environmental factors introduces methodological considerations outside the biological disciplines themselves, yet relevant to the investigation of organic behaviour (e.g. meteorology, geology, geography, cosmology, all contribute

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91. On this point, it is stated in one biology text that, "Behavioural biology is continuously trying to apportion those aspects of behaviour that are spontaneously generated by the organism, and those that are under more or less direct control by environmental stimuli". In Biology and The Future of Man, p. 416. If there is a case where the control is predominantly environmental and the environmental influence occurs rarely or even only once, then the behavioural response may occur rarely or even once. Hence, the behavioural disposition for the development of a disposition may not be activated or observed.

to the understanding of animal behaviour)[92]. As long as it is the behaviour of organisms that is the reference point, despite the varying disciplinary techniques, both sorts of explanations, mechanistic and teleonomic, may occur in organic explanation.

Although Teilhard does not develop any exact way what, in detail, the reconstruction of natural core entails, it seems quite reasonable to assume the process of relating structure to function, that is, bringing the two types of explanation together[93]. This is described by another

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92. Teilhard writes that, "Following the convergent paths of genetics, biochemistry, endocrinology, cerebrology, and the new psychology, man associated with all other men, feels....he will succeed in putting his finger on the most basic springs of his own organic development". In "The Phyletic Structure of the Human Group" (1951), in The Appearance of Man, p. 164. This 'interdisciplinary' approach is necessitated by the fact that the multiple physical factors studied by the various sciences all come together (conditions) for the genesis of man. Teilhard writes, "....let us decide that the multiple factors (ecological physiological, psychic...) combining to assemble and firmly unite living beings in general (and human beings more especially) are merely the extension and expression on this level of the forces of complexity/consciousness, always working, as we have said, to construct (as far back as possible and everywhere possible in the universe), in opposition to entropy, corpuscular combinations of an ever higher order". In "The Phyletic Structure of the Human Group" (1951), in The Appearance of Man, p. 156.

93. Teilhard says, "The universe....converges upon itself. How then is it....we see life developing plurality and ramifying - each phylum splitting up into a continually more densely packed fascicle of individuals races and species. The first answer I would give is that this is no more...than the manifestation....of a method of groping in which there is a....combination of the play of chance (which is physical) and of finality (which is psychic). This assumption is reasonable then, on the grounds that it is only through behaviour (and structure) that the psychic may be discerned". In "Centrology" (1944), in Activation of Energy, p. 124. Certainly it is the case for this scientist that, "....since in man....evolution becomes both self-conscious and....self-operative at the same time, it automatically develops the power to forsee its own future". In "The Reflection of Energy" (1952), in Activation of Energy, p. 333. A theory of evolution must incorporate explanations that entail both goal oriented and intended behavioural activity.

paleontologist, G.G. Simpson, as involving a method of composition which includes at least part of what Teilhard means by synthesis. Simpson says, in describing this process,

> 'How' means how does a thing work? What makes it go and how does it function? The functional biologist examines at varying levels such things as the mechanical working of the bones and teeth, the digestive action of his enzymes....almost inevitably the direction of research is reductionist, and as that direction is followed the answers tend more and more in physical and chemical terms.[93a]

However, Simpson claims further, that it is only "one form of explanation or a partial explanation"[94]. He states,

> 'What for'?, also relates to function but in a different sense or in the opposite direction. It means what function or purpose does this serve....In this sense the function of the digestive enzymes is to provide material and energy for cells (and hence the whole organism); the function of bones and their muscles is to permit behaviour adapted to the needs of the organism and so on.[95]

This correlating of the mechanics of organic structure and functioning, with the appropriate responses of organic entities to a complexity of environmental stimuli[96], through the use of a variety of

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93a. Simpson, G.G., <u>This View of Life</u>, p. 111.

94. ________, <u>This View of Life</u>, p. 111.

95. ________, <u>This View of Life</u>, p. 112.

96. Simpson continues, "Almost inevitably the direction of research is compositionist, proceeding from lower to higher levels of organization. Like "how" the question is appropriate at all levels, but it has an opposite tendency. The answers tend more and more to be in terms of whole organisms, populations and communities. Ultimately the investigator has no direct concern with the physical sciences but is dealing with phenomena that are exclusively biological". In <u>This View of Life</u>, p. 112.

complimentary disciplinary techniques is very likely what Teilhard had in mind when he spoke of his reversal of method, but only in part. Teilhard was not, of course, investigating general biological phenomena relative to specialized biological problems, or at least some such considerations appear only indirectly, but rather in a context of a postulated general biological trend, certain specific phenomena (e.g. consciousness and the previously mentioned hypothesis about the direction in which the solution would be found). Such a question as "Why does a zebra eat grass?"[97], in itself would be of only secondary interest to him. It, in some way, represented some particular manifestation of the general development of consciousness. For the same reason, the totality of organic structure and function of animals was of secondary importance. Teilhard states that,

> Guided by orthogenesis affecting the coloration and nervation of wing, the disposition of limbs, or the shape of the teeth....classification sorts out the fragments or even skeleton of a structure in the living world. But because the lines thus traced correspond only to the secondary harmonics of evolution, the system as a whole has neither shape nor movement.[98]

It was the development of the central nervous system[99] and its

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97. __________, This View of Life, p. 122.

98. Teilhard de Chardin, The Phenomenon of Man, p. 145.

99. This 'pre-programmed' ability of 'autocentration' is clearly for Teilhard a result or reciprocal of cephalization; for example, speaking about the arthropods and insects, Teilhard writes, "From group to group and age to age, these forms, psychologically so far removed, display like ourselves the influence of cerebralization. The nerve ganglions concentrate; they become localized and grow forward in the head. At the same time instincts become more complex: and simultaneously the extraordinary phenomena of socialization appear...." In The Phenomenon of Man, p. 145.

concomitant functions, where the meaning of function entails both the 'how?' and 'what for?' sort of answers, that he concentrates on. These, for him represent the most significant data for the solution of his problem.

13. Historical Reconstruction and Temporal Reason for the Problem of Conditions

While, in a sense, the immediately previous paragraph is a speculative reconstruction based on references by Teilhard on the way he regarded the unities which made up the families whose spatio-temporal growth manifests the rise of consciousness, when another form of explanation is considered, the grounds are much safer. This is the historical form of explanation, whose answers correlate with, as one biologist puts it, the 'how come?'[100] type of question. This question can be asked of both the mechanistic and purposive structure and functions of animals, since both are the products of development. Teilhard writes that it is

> ....a fundamental condition of beings that they cannot be perceived except in combination with the whole past....what is most important for our argument is that it first of all expresses a law of our perceptual experience....Around us countless things arise, grow and cross the ontological corridors that give them access to higher levels of being....All things are

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100. G.G. Simpson says, "...."How come"? means how did this originate? What course has it followed through time and what were the causes of that historical development? This question is equally appropriate at all levels and answers need not inherently be either reductionist or compositionist". In <u>This View of Life</u>, p. 112. Nevertheless, Simpson observes, "Confronted by any intricately organized system, anyone inevitably asks both "What for?" and "How come?" and feels that these are mutually dependent problems". In <u>This View of Life</u>, p. 113.

born from what existed before them.[101]

Developmental biology or evolutionary biology was Teilhard's general area and, according to him, it is only when the overall genesis[102] of life is regarded that the effects, products and mechanisms of consciousness may be discerned. This being the case, it is not surprising that it is the macro-development of life, viz varieties, species, families rather than the micro-development, that is, individuals, on which his theory focuses. Nevertheless, certain inferences about the characteristics of the individuals which compose the elements of history may be made. It is, of course, the changes in organs and organisms which for Teilhard make up the natural history of the universe, at least in its

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101. Teilhard de Chardin, P., "Basis and Foundations of the Idea of Evolution" (1926), in The Vision of the Past, pp. 129-130. Teilhard, too, accepts the proposition that the historical method is appropriate to all levels. He writes, "Our science of empirical reality today (whether applied to living organisms, ideas,....languages or the constituent elements of matter) tends, in its inquiries and theories, invincibly to adopt the historical method, that is to say, the point of view of evolution, of becoming." In "Basis and Foundations of the Idea of Evolution" (1926), in The Vision of the Past, p. 128.

102. About this, Teilhard says, "If we follow paleontology over time-spans of the order of millions of years, it unambiguously teaches us in its turn that this phenomenon of morphological granulation is not confined to a simple diversification of characteristics. It does not terminate with a simple fanning out of fixed types dispersed along different azimuths. But either (this is not an established fact but seems probable) by direct accentuation of certain forms within themselves-or (which is abundantly proved) by a succession of mutations relaying one another by addition always in the same direction, a central axis of morphological progression (a trend, as the English say) is formed, both statistically and selectively, in the complex of related lines: an axis which may reveal either a 'Preference' or, on the contrary an 'inertia' of a special type in living matter - the case is arguable - but an axis of which we can invariably see the existence in 'groups of related species', provided that we can observe the history of these groups over a sufficient length of time". In "The Singularities of the Human Species" (1954), in The Appearance of Man, p. 218.

vital states.

13.1 History, Stages and Genetic Mutations

What Teilhard means by 'history' is revealed by him in a number of passages. He says, for example, that "all empirical reality is by nature, historical, capable of narration".[103] What is being narrated? Teilhard explains this in the following lines,

> One may say that the fundamental structural law, in a universe in a state of evolution, is that everything is born, that is to say that everything appears in the function of an antecedent (and yet we must add, in the case of life) more or less by way of addition.[104]

But, Teilhard contends, "with the following modifications and qualifications", that, "first and in one manner or another, every birth corresponds to a discontinuity or jump (quantum) of a nature and extent that varies with each case"[105]. Teilhard continues by saying that,

> The 'quanta of birth' as I have just said, may be of very different kinds.
>
> In genetic biology, we know simple individual jumps (simple recombinations of genes by fertilization) and true mutations

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103. __________, "What Should we Think of Transformism" (1930), in The Vision of the Past, p. 152.

104. __________, "The Phyletic Structure of the Human Group" (1951), in The Appearance of Man, p. 136.

105. __________, "The Phyletic Structure of the Human Group" (1951), in The Appearance of Man, p. 136.

(inner re-groupings - as by isomerism? - of certain genes).[106] Teilhard argues further that, "Only under pressure (and the pressure increases) does vitalized matter react in order to survive by ultra-organizings; such is the general primary condition of the cosmic tendency toward Improbability"[107]. The reconstruction of stages from "dispersed heterogeneous (lacking unity) to organic (unified) heterogeneous"[107a], through the concrete cataloguing of 'families of natural unities' according to degrees of complexity, is an initial stage in the historical

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106. __________"The Phyletic Structure of the Human Group" (1951), in The Appearance of Man, p. 137. Teilhard, in part, answers his own question elsewhere. He writes, "Chromosomatic characteristics are not the inert 'grains' and 'isotropes' that geneticists suppose, but, in fact elementary vectors, consisting of very short orientated segments, reacting additively, always in a single favoured direction to the complex 'topography' of the geographical and biological milieu in which they find themselves". In "A Defense of Orthogenesis" (1955), in The Vision of the Past, p. 272. The 'sum' of these 'vectors' provides the primary orthogenetic series and it is the result of either radially produced genetic recombinations or radially preserved random recombinations. Teilhard does not specify the mechanisms by which this occurs.

107. __________, "The Phyletic STructure of the Human Group" (1951), in The Appearance of Man, p. 159.

108a. __________, "Centrology" (1944), in Activation of Energy, p. 103. It is interesting to notice that, prior to his formulation of the complexity-consciousness law, this second stage did not exist for Teilhard. He writes, "Scientifically....transformism merely sets out to recount a history, that is to say, to plot a combination of facts and links of a photographic kind (a film): before the living form N, it says there was the form N-1 which was preceded by the form N-Z and so on....". In "What Should we Think of Transformism?" (1930), in The Vision of the Past, pp. 153-154. However, by the time Teilhard writes The Phenomenon, the evolutionary 'film' is made scientifically explicable by "'psychic' or 'radial' energy working beneath and within the mechanical....called 'tangential'". In The Phenomenon of Man, p. 143.

method, while the explanation of their characteristics, the reason for their sequence of appearance through a description of causative mechanism and forces, represents a second stage. Concretely, the genetic and environmental factors of the Neo-Darwinians[108] supply Teilhard with the reason for the continuous modifications in complexity-consciousness as secondary conditioning factors. The operation of consciousness is, of course, the primary condition for the continuous rise in centro-complexity. More specifically, without alterations in the external milieu, environment and the internal milieu, that is genetics, there could be no new materials for radial energy to arrange and, hence, no further alterations in consciousness. Also, without the secondary arrangements or configurations produced by the genes and the environment, Teilhard would be without a reason for regressive and static phyla in which there is a loss or no rise in consciousness. It was said that consciousness rises continuously and continually, for the operation of consciousness is, as it

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108. Teilhard writes, "Neo-Darwinism at present holds the ascendency in the eyes of biologists, owing to a clearer and more statistically substantiated definition of the 'fittest', but principally because of the immense part, now recognized by modern genetics, played by the action of large numbers in the formation of species". In "The Human Rebound of Evolution", in The Future of Man, p. 199. It should be noted at this point, that because of his notion of the within, the relationship of determinism to indeterminism is not the same for Teilhard as for other biologists. For Teilhard, psychė must exercise a preference or inertia, that is, the radial must centre. Environmental factors condition when and in what manner the radial centres. Nevertheless, the primary necessary conditions for perseverence and development of the individual or phylum is psyche. It is the accumulation of these choices which produces the primary orthogenetic 'curve'. For the biologist working within the mainstream of biology, on account of the postulated mechanisms of evolutionary theory, in an explanatory sense, randomness is primary.

has been stated, environmentally relative, and all environments, it may be inferred, were for Teilhard conducive to positive alterations in consciousness. However, due to the multiplicity of environmental changes, somewhere at some historical points, situations occur which are conducive to better arrangements and such arrangements, once they occur, are retained. This retention allows what Teilhard calls 'addivity', for over the course of many generations, characteristics favourable to the rise of consciousness accumulate. It must be mentioned here, of course, that it is not only positive characteristics which may accumulate but secondary and consciousness limiting factors as well. Teilhard was clearly aware of this. He says,

> Many of the difficulties encountered in the paleontological application of the law of irreversibility arise from a confusion between irreversibility and orthogenesis. The two ideas are patently very different. Irreversibility does not always take the form of development in one direction (orthogenesis). Far from it. On the contrary, it admits in the history of the forms which it obeys all sorts of counter-currents and circuitousness (for example, a tooth with pointed caps may grow smaller, then become very big and take a molar form)....[109]

14. Historical Stages, Indeterminacy and Method.

The concept of history implies the discernment of change. The changes that Teilhard was principally interested in were those which

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109. __________, "On the Law of Irreversibility in Evolution" (1923), in The Vision of the Past, p. 49. Relative to the observations made in the first chapter, on Teilhard's biological model, the irreversibility postulate offers an excellent example of a concept directly derived from paleontology and incorporated in the orthogenetic theory.

concerned a) non-repetitive, reversible, accumulative alteration; b) repetitive, accumulative alteration; c) non-reversable alteration. The notions of reversibility, accumulation and orthogenesis, as was suggested in a previous quote, are distinct notions. The mere accumulation of characteristics[110], even if the same accumulation of characteristics were to occur in separate time spans, was for Teilhard not necessarily the product of consciousness. Teilhard did allow for the possibility of the production and retention of organic characteristics, under the influence of extrinsic (random) environmental factors. Orthogenesis only involved the accumulation (addition) of those organic characteristics which involved an increase of the 'quanta ' of choice and consciousness. These may be discerned through the various levels of behavioural and structural complexity. The questions entailed in the Teilhardian notions of 'quanta ' of choice and freedom, bring together several considerations of logical, epistemological, and physical natures. The problem of organic wholes, emergent properties, reductionism and determinism, while distinct problems, may be, for example, considered in a composite way and in a fashion, relevant to the Teilhardian notion of history. Ever since Heisenberg's statement of the Uncertainty Principle, there have been certain doubts voiced by various scientists, about the possibility of purely objective description of physical processes. Epistemological and physical considerations intermesh here. For historical reasons, it was

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110. The wings of reptiles and mammals. These concern, as was discussed in the first chapter, "The secondary harmonics of evolution". Teilhard de Chardin, P., in The Phenomenon of Man, p. 145.

believed that to describe physical systems objectively was almost synonomous with being able to describe physical systems deterministically. According to Heisenberg, and this Teilhard was aware of, the analysis of physical micro-systems entails a eliminatable interference by the instruments of measurement, such that it becomes impossible to describe, in a rigidly deterministic way, how the system would behave in the absence of measurement[111]. This implication of the Uncertainty Principle has its analogue in the biological world. The study of an organic thing involves, for example, the utilization of techniques which destroy its vitality. Much more significant, however, are the multiplicity of factors or variables usually involved in the investigation of biological phenomena. Several important epistemological considerations issue from this variable complexity.

It was previously mentioned that the fact of parallel cases in nature does not represent a logical necessity but, rather, an empirically observed occurrence. Given a system in which the number of factors is

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111. This is what Teilhard is referring to when he says, "As a result of a very natural psychological illusion, our great modern science was born and developed under the exclusive sign of objectivity....on the one hand the objectivity of physicists pushed to its extreme...is now tending to reverse. Not only does the disturbing effect of the observer on the thing observed appear on the lower frontier of the experimentable in the realm of material phenomenon". In "Human Energy" (1937), in Human Energy, p. 113.

astronomically large, parallel series might never occur[112], or occur so infrequently as never to be observed. In such a system, the only knowledge open to the observer would be that involving a record of the unique terms, the non-repetitious antecedents and consequents of the series. Science, of the Newtonian type, would be impossible. However, unlike the hypothetical system postulated here, events which occur in the biosphere are not made up of a virtually infinite number of variables, but rather a vast number among which there are parallel instances and patterns. However, as a consequent of the number of variables, and the intricacy of the patterns, the scientific knower is often in a position to establish some of the relevant causatory factors (necessary conditions) for the occurrence of events, but not all. This knowledge gap renders the prediction, even where some parallel of events exists,

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112. Teilhard writes, "One may say that the fundamental structural law in the universe (in a sense the sole law) in a universe in a state of evolution, is that everything appears in the function of an antecedent (and....in the case of life), more or less, by way of addition". In "The Phyletic Structure of the Human Group", in The Appearance of Man, p. 136. In saying this, he would appear to suggest that parallel systems and, hence the laws that describe them, are an evolutionary development.

only weakly deterministic[113]. Rephrased, it could be said that a biologist's knowledge of events is, where parallels exist, more or less probable, relative to the completeness of his knowledge of the factors involved. Incomplete knowledge of biological events is generally the case for the evolutionary biologist and of this fact Teilhard was well aware[114]. Beyond the probability or indeterminacy due to lack of knowledge about the complex conditions which produce events, there has been the suggestion that there is an intrinsic structural indeterminancy about the biological events. This is to say that biological organisms show the capacity for a variety of responses to constant or periodic

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113. Teilhard writes, suggesting that the increase in indeterminacy is itself determined, "From the foregoing analysis of energetics, it emerges that, in any case, the evolutionary complexification and arrangement of matter (or, which comes to the same thing, the interiorization, followed by the reflection, of energy) appear to us experientially as a cosmic process just as determined, in its own way, as the entropy on which they are grafted. Along the axis OY, it is just as though, as a result of the controlled play of chances, the <u>elementary indetermination</u> of the physicists necessarily accumulated and expanded within special structures (progressively larger and more fully living particles) until it ultimately assumed the form of '<u>reflective choice</u>'. And, once that peak has been attained, we cannot say (very much the opposite, in fact) that determinism tends to disappear from the rest of the operation". In "The Reflection of Energy" (1952), in <u>Activation of Energy</u>, p. 332.

114. For example, Teilhard writes, "The future, I mean the human future, certainly contains an element of the unpredictable in itself. Because of the enormous number of physical variables on which it depends, and even more on the growing predominance of the physic (individual choice) over the statistical....it would be an error deserving of vigorous denunciation to talk as if biology in its forcasts can behave like astronomy". In "The Directions and Conditions of the Future", in <u>The Future of Man</u>, p. 227.

environmental stimuli. There have been several reasons offered for the real or apparent dispositional potentiality of organisms, among which are those proposed by Teilhard.

14.1 History, Addivity and Irreversibility

It was suggested at a previous point that, besides the random or chance interaction of many factors as the source of biological indeterminacy, Teilhard posited the emergence of organisms with novel capacities for action arising out of the centred composition of more primitive elements. Teilhard, in fact, posits more than this. He postulated that the capacity for spontaneous action belongs to every natural core or unity, no matter how primitive, at least to some degree. Teilhard writes,

> Strictly speaking, if matter is defined as 'something with no vestige of consciousness or spontaneity', it does not exist. Even in pre-living particles, we saw, we must conceive some sort of curvature which prefigures and initiates the appearance of a freedom and a 'within'. In fact, physical determinisms ('laws') are simply the effects of large numbers, in other words, of materialized freedom. This statistical materialization of the 'Weltstoff' is, of course, most marked in the zone of 'fragmentary centres' (infinite in number and infinitely spontaneous); but it is still perceptible among centres that are higher in order, and even in the noosphere, where cases of mechanization. in the very core of human energy, are still distressingly frequent. From this point of view, there is nothing in the universe except spirit, in different states or degrees of organization or plurality.[115]

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115. __________, "Centrology", in Activation of Energy, p. 125. Teilhard continues, "Nevertheless, this should not be understood as though spirit were gradually formed simply as an effect of polarization or mathematical summation. During the process, centres that are truly new emerge from successive synthesis or segmentations under the influence of centro-complexity". In "Centrology", in Activation of Energy, p. 127.

Considered spatio-temporally, the history of the universe is marked, according to Teilhard, not only by an increase in consciousness but also by an increase in the disposition for multiple arrangements. This is to say that the history of the universe involves the appearance and accumulation of unique (as a class), biotic structures, functions and capacities for behaviour[116]. For Teilhard, just as the emergent properties of an organic whole cannot be reduced to the perceived properties and dispositions of its component parts, the characteristics of a subsequent class cannot be simply reduced to the properties of an antecedent class. However, and Teilhard cautions this, no simple analogy may be drawn between the irreducibility of a whole from its parts and the non-reversibility of evolutionary stages. The mechanism in the latter case, according to Teilhard, is often different and of a more complex nature. While the emergent properties (some higher degree of cerebral cortex development), transmitted through a class, which appear in a phylum, are part of the components of stages, the unifying link of stages, and between states, are not identical to the composite arrangement of an organic whole. For Teilhard, the 'product' of addivity is not a centred complexity but a phylum which contains many disjuncts (viz. lack of connections, randomness, disorder). The connections between organisms, and organic

116. Teilhard writes on this, saying, "In the older universe of La Place, the quantity of contingence, once initially posited, remains indefinitely the same in any subsequent state of the system, whatever may be its indefinite transformations. In the universe of Einstein.... or Heisenberg, the quantity of indetermination (because it is continually fed by the action of each corpuscle) varies and a better arrangement of the system may cause it to increase". In Man's Place in Nature, p. 35.

groups often generate disruption, not order. The accumulation of characteristics does not necessarily entail selection for Teilhard, nor are all 'additions' necessarily irreversible[117]. The problem of the irreversibility of general biotic processes and orthogenetic processes is distinct, since the mere accumulation of characteristics (even if environmentally favourable), is not equivalent to orthogenesis in the Teilhardian sense. In neither case does Teilhard completely eliminate the possibility of reversion, and, as the two types of addivity are related (the accumulation of characteristics conducive to the rise of consciousness could be looked on as a special case of the more general accumulation of types of characteristics of organisms), it is convenient to treat them together in conjunction with the topic of irreversibility.

14.2 Irreversibility, Positive and Negative

Teilhard's conception of irreversibility, as it applies to biotic processes, is based primarily on empirical

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117. On the point that not every biological change results in higher consciousness, Teilhard writes for instance, that, "As I pointed out, for one form of synthesis that brings freedom there are hundreds of others that lead only to the vilest forms of bondage. We are only too conscious of this; but how can we come together _in such a way as to free ourselves_? In virtue of the laws of moleculization, the problem obviously consists in finding the way of grouping ourselves together not 'tangentially', in the nexus of an extrinsic activity or function, but 'radially', _centre to centre_; how to associate in such a way as, by synthesis, to stimulate deep within ourselves a progress that is directly _centric_ in nature." In "The Atomism of Spirit" (1942), in _Activation of Energy_, p. 47.

postulates[118]. In the first place, 'the heat death of the universe' implication of the second law of thermodynamics provided Teilhard with a negatively progressive time line. This to say that, if the implications of the second law of thermodynamics are accepted, no two events no matter how similar, may be considered identical. For, in order to occur, one event must utilize energy, a portion of which is irretrievably lost to any other further organization. Hence, given any two events, one of which is earlier than the other, the earlier occupies a different position relative to the totally available energy of the universe than the latter (there is less energy available).

Positively, the alterations that Teilhard was concerned with were those structural alterations which had increased consciousness

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118. As seen in Chapter I entropy "Explains a historical current as an algebraical formula". In Teilhard de Chardin's "Phenomenon of Man" (1930), in The Vision of the Past, p. 168. Entropy is an empirical postulate and another argument Teilhard advances is based on observation. Teilhard writes for example that, "The irreversibility of the stream of life is proved, to a certain degree, by its very success: why should it go back since, as a whole, it has done nothing but grow since its beginnings? One may add (and this proof is very strong if we can understand it) that in the case of man in whom it becomes reflective, life seems to require, for its very functioning, that it shall be irreversible. In fact if we should ever discover that the animate universe is moving towards total death, the desire to act would be killed, *ipso facto* in our hearts; that is to say that by becoming conscious of itself life would destroy itself. And this seems absurd". As found in a footnote in "The Phenomenon of Man" (1930), in The Vision of the Past, p. 170.

correlates[119]. Teilhard's non-reducible 'secondary properties' are difficult to deal with in the abstract; however, the notion of addivity becomes more intelligible when certain concrete biological mechanisms are considered. Within, for example, an interbreeding organic population, any genetic alteration (that persists) may alter or transform a whole genetic pool. A subsequent genetic change which produced some reversal effect, would, nevertheless, not produce a true reversal since the previous alteration is still present within the genetic population. This may be illustrated schematically. Given a biological class Q whose members are characterized by a series, A B C....X Y Z, where A B C represents genotypic determinants and X Y Z some phenotypic properties, and given an alteration of genotype C to (Cd), which alteration is transmitted throughout the class Q so that Q has genotypic characteristic and then given some further subsequent alteration of genotype C (d) so that Q acquires genotype Z, class Q does not and has not reverted to its initial

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119. Teilhard writes, "....among living creatures, the brain was the sign and measure of consciousness....Among living creatures, the brain is continually perfecting itself with time....so that a given quality of brain appears essentially linked with a given phase of duration." The Phenomenon of Man, p. 140. Teilhard admits of a type of reversibility which occurs or could occur when a higher unity, "with no support to rest on a head of it....is structurally bound up with a precarious arrangement of particles that are all, by nature, completely and fundamentally liable to disintegrate". In Man's Place in Nature, p. 120. Nevertheless, short of complete distruction, for Teilhard, evolution becomes necessarily irreversible with self-reflection. Teilhard writes about man, that, "....because he thinks, it is now to some extent impossible for him to stop thinking more and more and more....Evolution becomes....self-operative....At the same time it....develops the power to forsee its own future". In "The Reflection of Energy" (1952), in Activation of Energy, pp. 332-333.

genotype; rather, its genotype is a A B C d C.

Of course again, it is only the retention of certain characteristics that Teilhard is interested in. He nowhere explains in any detail the mechanisms of 'centric-inheritance', but in a series of important passages, he does suggest that such a retention and accumulation does occur, as well as the outline of its mechanism. He says, for example, that "phyletic segmentation and ramification have obvious advantages"[120]. This is because, "as a result of them, a maximum density of particles with a corresponding maximum of tentative groupings....is produced on each biosphere"[121]. At the same time,

> ....the greatest possible richness and variety of inherited properties accumulates in the phylum under the repeated influence of each generation's cross-fertilization. In short, the two factors combine as a direct encouragement to the operation of centro-complexity.[122]

The multiplication of additive characteristics through many species (ramification) makes it more and more improbable that any event or series of events (although not impossible) would be so cataclysmic as to reduce biotic processes and entities to a primitive or initial state.

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120. __________, "Centrology" (1944), in Activation of Energy, p. 107.

121. __________, "Centrology" (1944), in Activation of Energy, p. 107.

122. __________, "Centrology" (1944), in Activation of Energy, p. 107-108. The result of this is described by Teilhard in a general way when he writes, "The essence of the real could....be represented by the 'interiority' contained by the universe at any given moment. In that case, evolution would be....the continual growth of 'psychic' or 'radial energy' beneath and within the mechanical energy I called tangential". In The Phenomenon of Man, p. 143.

Even if this were to happen, it would be even more improbable that the initial state would be a reduplication of all the initial conditions of primitive life. In G.G. Simpson's words,

> There are no known cases in which a structure of any noteworthy complexity, at least, has reverted precisely to a distinctly different ancestral condition. With less qualification, there are no known cases in which a type of organism that had become extinct or considerably modified, was ever reduplicated.[123]

The preservation of characteristics through many changes is a prerequisite for their accumulation through time. For Teilhard, those characteristics directly and indirectly conducive to increase of complexity-consciousness are the ones maintained. Reversion for Teilhard, as for Simpson, becomes increasingly improbable, since such a reversion would entail the reappearance of conditions at a time point subsequent to the accumulation, yet independent of it.

15. The Problem of Conditions and its Implications for Method

The foregoing discussion of some of the consideration surrounding

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123. Simpson, G.G., <u>This View of Life</u>, p. 186. Simpson suggests the reasons for this in the following lines, "....the influence of past configurations is not whollyy lost in the course of evolution: it continues indefinitely as part of the historical causation. Another and more widely known aspect of the principle is the irreversibility of evolution....If the ancestral condition is itself part of the cause, why should not the replication of that condition be a possible effect? The answer is that later configurations started in the principle to be different from the ancestry, are also part of the cause and preclude subsequent identity of effect". In <u>This View of Life</u>, p. 244.

the discernment of biological causation allows a brief return to the topic of method. The term 'method', as it has been used throughout this thesis, refers here and elsewhere primarily to the set of conceptual attitudes, habits and beliefs which are held by an investigator as a necessary approach to natural processes, in order to render such occurrences intelligible, rather than to any given technique, by which the conceptual set is rendered operational or physically manifest. Scientific analysis, for example, may be carried out, depending on the domain of research, by using everything from the most elaborate electronic equipment (e.g. in spectral analysis or radio carbon dating) to the skillful employment of an anatomist's scalpel. Analysis and analytic techniques apply as well to every area of biology, from genetics to ecology, and analysis again implies reduction. The presence of organic levels and organic stages, correlated with instrumental functionality, introduces the necessity for compositional or synthetic methodology, which entails more than the mere bringing to bear of diverse analytic techniques and a common biological object. It requires as well, the synthesis of distinct explanatory categories.

While a biologist working within a theoretical framework other than Teilhard's might only be interested in constructing the organic utility of function, relative to an environment, or in explaining the alteration of the structure and functions of organs and organisms over the course of time, for Teilhard, it was the investigation of alteration of structure and functioning, relative to cerelration, that was the prime concern. In reconstructing the record of such changes, Teilhard was also reconstructing the basis for the statement of the conditions (or manifested instances) under which the complexity-consciousness law could be applied. Teilhard writes on this,

> ....life is apparently nothing but the privileged exaggeration of a fundamental cosmic tendency (as fundamental as entropy or gravitation) which may be called the 'Law of complexity/consciousness', and which can be expressed as follows:
>
> 'Left long enough to itself, under the prolonged and universal play of chance, matter manifests the property of arranging itself in more and more complex groupings, and at the same time in ever-deepening layers of consciousness; this double and combined movement of physical unfolding and psychic interiorisation (or centration) once started, continues, , accelerating and growing to its utmost extent'.
>
> This tendency towards complexity-consciousness (leading to the formation of more and more astronomically complicated corpuscles) is easily recognisable on the atomic plane, and it is confirmed on the molecular. But it is patently on the plane of life that it is revealed in all its clarity - and all its additiveness; and here it can, at the same time, be translated into a convenient and simplified formula: <u>the tendency to cerebration</u>.
>
> In the growing perfection and cephalisation of the nervous system, we seem really to have a concrete and precise parameter which allows us to follow, through the jungle of living forms, the absolute and effective variation of cosmic corpuscularity.[124]

While other factors are perhaps important to the question of the application of the complexity-consciousness law, there appear to be enough elements related in the previous sections, at least to indicate the difference between Teilhard's statement of the complexity-consciousness as a law or generalization related to particular conditions and the relation of many other scientific laws, with their statement of application (conditions).

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124. Teilhard de Chardin, P., "The Phyletic Structure of the Human Group", in <u>The Appearance of Man</u>, p. 139.

15.1 Reconstructing the Past

The most obvious initial point to be made is that explanation and retrodiction are not symmetrical in the Humean sense. Initially, unlike the case with many laws of physics, the pattern of complexity-consciousness is itself expected to evolve. This is to say that the pattern is expected in principle to change from one point in time to the next. If the pattern is expected to alter from one stage to the next, so are the particular instances or conditions subsumable to the complexity-consciousness law.

Knowledge of these conditions and hence the possibility of reconstructing the operation of the complexity-consciousness law is governed by three distinct but interlocking sets of considerations which may be termed respectively, physical (biological), methodological, and logical. Physically, and in this Teilhard clearly recognizes as being vastly complex, the number of factors affecting biological processes are virtually infinite. The presence of such a multiplicity of factors makes it reasonable to suppose that any given event need not be repeated or only repeated rarely, despite a constancy of antecedents, because there is always the possibility that some factor, not discernable, may be present or absent in a similar case. This renders retrodiction probabilistic and not rigorously deterministic. Furthermore, Teilhard believed that, for peculiarly biological reasons, biological occurrences were subject to alterations which were sometimes retained and transmitted through duration. Over a sufficiently large period of time, such alterations were accumulated[125].

The consequences were that, considered as a whole, no consequent state of the history of an organism can be exactly like an antecedent one, since the consequent stage includes alterations not present in the previous stage[126]. In order to return to the previous stage, there would have to be an alteration of the alteration which itself entails an alteration not present in the prior state. Beyond the indeterminacy resultant of the lack of knowledge due to a multiplicity of factors (the traces of which have often disappeared from the record of the past), Teilhard postulates a true indeterminacy and multi-potentiality of organic beings. There is, according to Teilhard, not only an accumulation of morphological traits, but a growth of a capacity for action.

The potentiality or indeterminism of organisms can be recognized

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125. Teilhard writes, "....let me remind you, in regard to a sort of 'ballasting' (or gravity) of a special type, which gives priority to the best centred and best interiorized corpuscular groups, evolution considered....is....scarcely to be distinguished from the play of large numbers. And only slowly, by the progressive building up of true _machines for accumulating_ and multiplying indeterminacy, does life, partially escaping from chance, show a definite skill, not merely in seizing on the wing such opportunities as are offered for better self-arrangement, but also in actively encouraging the construction of systems in which complexity/consciousness assumes constantly increasing values". In "The Singularities of the Human Species" (1954), in _The Appearance of Man_, p. 253.

126. Teilhard writes that, as a function of the operation of centro-complexity, "A living being has a twofold complexity: spatial, deriving from the number of sub-centres it embraces, and temporal, from the number of 'trails' of which, through its ancestors, it represents the total sum". In "Centrology" (1944), in _Activation of Energy_, p. 108.

by the appearance and record of novel or emergent behaviour. The full range of potentiality of an organism, however, is dependent on factors both internally[127] and externally environmental which may not be present at any given time and so the full potentiality cannot be assumed completely determinable. Some behavioural trait may appear once, many times or not at all, depending upon the presence or absence of determining stimuli Teilhard writes about this, saying,

> If a living (or even non-living substance) is to release, 'to actuate' its potentialities, it must....be appropriately capable of stimulation.
>
> And be in fact stimulated....what proportion of this potential is going, in each case, to be brought effectively into action? And in what direction? And at what speed? That is something which is impossible to determine without introducing a whole series of imponderables which are tied up with the psychism of the individual in question. The animal (one particular animal) behaves in an entirely different way, depending on whether it has a full belly or is starving, is left in peace or hunted, and so on....[128]

From the logical point of view, the supposed necessity of the two categories of explanation, not utilizable in a historical science (e.g. pure physics) introduces another area of difficulty in the reconstruction of the organic past. For example, the particular use that an organism

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127. According to Teilhard, 'psychic nuclei' have the capacity for "radial solidarity" by which they tend to move all together.... towards omega, arriving themselves at or giving birth to an isosphere of higher order (N + 1)". In "Centrology" (1944), in Activation of Energy, p. 104. Part of the defining characteristic, as it has been seen from previous texts, is a greater capacity for action and interaction. It is in this sense at least that N+1 can be considered less determined than (N).

128. __________, "The Activation of Human Energy" (1953), in Activation of Energy, p. 390.

might have relative to an animal's survival, might be very different at one time point from that of another. Yet, establishing such differences and their reasons is necessary for an adequate understanding of organic change through time. All these factors, physical, logical and epistemological, conjointly contribute to a knowledge involving the recording of differences, of unique events and classes of events.

Methodologically, the reconstruction of the past entails the amalgamation of many techniques from many different disciplines; techniques as different as the potassium-argon test of the physicist and geologist to the dissecting skills of the comparative anatomist may be related in such a reconstruction. The difference between one state or stage and another, and the difference involved in discovering the difference, result in the assymetricality of explanation and retrodiction. The complexity-consciousness law cannot be applied to the past without a prior reconstruction of the past. Teilhard says it is not possible to move from one level or stage to another by a simple change of coefficients. By this he means the properties and characteristics, that is the level itself, must be defined before the law can be applied. However, such reconstruction involves the assumption that no level is like another. The reconstruction also entails techniques, modes of explanation and secondary inference, which go far (qualitatively) beyond the operations of establishing conditions typical of an historical science.

15.2 Reconstructing the Past and Future

Despite the focus on difference and uniqueness implied by the utilization of the historical method, for Teilhard there is a constant. Matter (mass-energy), under the proper circumstances (and varying circumstances) and because of radial energy, will always complexify. The presence of consciousness in man is explicable by the universality of radial energy throughout the universe; the specific arrangement of radial energy (self-consciousness) of man is accounted for by the history of consciousness. Furthermore, unlike the case of the far past, the ongoing process of complexification through the operation of consciousness is more directly perceptible in present human society.

Concerning the future, it has been said that Teilhard's extrapolation of the complexity-consciousness law is probabilistic. Excluding entirely the topic of the Omega point, the reason for the indeterminacy of the future is immediately apparent.

Unlike the case of the past, where knowledge about determining factors or the factors themselves may be absent, the future determining factors cannot be present. Nevertheless, certain predictions are possible about the likelihood of primary and secondary determinants.

In a sense, the complexity-consciousness law may be regarded as an open-ended genetic generalization, that is to say, a statement about a process in which there has been an intelligible alteration through time, a discerned reason or reasons for the alteration, and a rationally supported belief in a unique subsequent state. Teilhard has every reason to believe (inductive) that Radial Energy will continue to operate and increase in the future. He also has some knowledge of the present state, whose conditions set a definite or a certain predetermination on the future state of the cosmos. This in turn allows a certain extrapolation to the most general features of the future, as entailed by his vertical constructs. Nevertheless, there is a radical indeterminacy about the future which his theory entails (and hence inferrable from it), which goes beyond that involved with a lack of knowledge about necessary and sufficient conditions, or even that entailed in some mechanical physical indeterminacy. Teilhard would appear to suggest that it is scientifically impossible to extrapolate to the future with certainty. By virtue of the fact that the 'quality of contingence' alters for Teilhard, the very basis for computing odds alters in a non-determinable fashion. If the quantum of indeterminacy or spontaneity is defined as the ability to react in diverse and novel ways to constant stimuli, then the depth of the problem of extrapolation can be seen. Initially, not all the conditions of the future may be discerned; hence, novel activity is possible on the basis of alterations of conditions, but more than this, if the external determinants could be discerned, the possibility of spontaneous and novel interaction or a series of interactions make any exact extrapolation of the consequence of the operation of the complexity-consciousness law. truly difficult. The situation is one in which there exists the equi-possibility of the occurrence of one of the five events. However, given the actuality of one particular outcome (emergent), there are ten (more or less) further possibilities. The outcome of any two or more of these possibilities will lead to a further and non-determinable alteration of outcomes, as conditioned by future factors. In fact, for Teilhard, there is no assumption of equi-probability. The arrangements which have occurred in the past (e.g. the rise of life, the rise of self-consciousness), weigh the odds towards certain outcomes and away from others. Concretely, Teilhard maintains that there will be a probable future convergence of mankind and an emergence of a new species of man because,

1) there is no reason to believe that the secondary patterns of divergence, convergence and emergence have been suspended on the human level;

2) there are reasons to believe that in fact, with self-consciousness, the process is accelerated.

3) mankind is perceptibly in a convergent phase.

Nevertheless, while Teilhard says that,

> If any point emerges with full clarity from all that we have seen so far, it is without doubt the fundamental and complete inability of human plurality to escape the forces that tend organically to concentrate it upon itself: the general forces of cosmic convolution that make themselves more directly and sharply felt (at the zoological and historical level we have attained) under the influence of 'the entry into convergence'.....[129]

He also says,

> ....does the fact that we are situated at the heart of things justify us in concluding that the experiment of which we are the objects must necessarily be successful? In concluding, that is, that we can be certain, in any event, of in fact one day attaining the unity towards which we find ourselves impelled? In other words, does the universe concentrate itself above as assuredly and infallibly as it "entropises" itself below?
>
> The answer is............. "No": by its nature and in every instance, synthesis implies risk. Life is less certain than death.[130]

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129. __________, Man's Place in Nature, p. 117.

130. __________, Man's Place in Nature, p. 117.

The reasons for this, he continues, "....it is one thing for the earth, by its pressure to force us into the mold of some form of ultra-hominisation--and quite another for the ultra-hominisation to result[131]. Because, Teilhard say, "....if the planetary evolution of consciousness is to reach its term, in us and through us, two series or types of conditions are necessary external and internal respectively: and none of these is absolutely guaranteed by the progress of time[132].

While interpolation to the past involves a supplementary explanatory framework (historical) in order to allow deduction, deductive extrapolation to the future entails the narration of both recurrent and unique events (emergents), plus an analysis of the present. In both cases, the alteration of the ubiquitous pattern of complexity-consciousness is charted through the hypothetical reconstruction of conditions.

16. A Schematic Reassessment of the Elements of the Orthogenetic Theory

Without trying to specify the exact logical relations of all the elements, but merely trying to indicate what their relational positions might be, according to degrees of generality,(that is their overall explanatory pattern), what is to follow is an attempt to describe the relationship as Teilhard would have, if he had been interested in such a schematization.

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131. ________, Man's Place in Nature, pp. 117-118.

132. ________, Man's Place in Nature, p. 118.

(L.L. = law-like statement)

L.L.1 Psychic Energy, as a capacity for centred arrangement, is the fundamental Energy of the universe. (Non-explained Explainer)

L.L.2 Radial Energy, as manifested in various levels of consciousness, is the direct extension of the historical activation of Psychic Energy. (Explained-Explainer)

L.L.3 Tangential Energy and its patterned expressions is a by-product of Psychic Energy[133]. However, the exact relationship between the two energies is undefined. Nevertheless, the operations of psychic energy is more general than that of Tangential Energy and its effects are 'covered' or explained by the presence and the operation of Radial Energy. (Explained-Explainer) Tangential Energy has for its effects three types or levels of regularity.

L.L.3.1 Recurrent physical patterns

L.L.3.2 Recurrent chemical patterns

L.L.3.3 Recurrent biological patterns

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133. This interpretation is rendered plausible by the following Teilhardian passages. Teilhard says in a footnote, "....could not physical energy (and its over-all conservation) be interpreted as the statistical 'by-product' of a great number of elementary psychic energies (energies of atoms) which combine tangentially (section 6) and peripherally (cf. section 12), with practically no variation in number - just as the regularity of physical laws (the determinism of matter) is explained by the statistical play of a great number of infinitesimal, inorganic, free impulses". In "Centrology" (1944), in Activation of Energy, p. 121. And elsewhere, "....Léon Brillouin has recently suggested that the physical case still defined at present would only be a 'degradation of' (I would rather say 'a first approximation to') the biological". In "The Singularities of the Human Species", in The Appearance of Man, p. 260.

L.L.4 The exchange between the two forms of energy[134] (and the products or results) allows the discernment of the complexity-consciousness law.

L.L.4 The complexity-consciousness law may be formulated as stating that on every level and at every stage of the evolution of the universe, under the operation of Radial Energy, matter can be found to be arranged in a scientific way. Higher consciousness has always been the eventual result of such arrangements.

(H.S. = Historical or narrative statement)

H.S.1 Concrete instances of the operation of the complexity-consiousness law through time, resulting in varying non-homogeneous stages and levels, classes and groups, are explained by the activation of

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134. The proposition that Tangential and Radial Energy are two distinct forms of psychic energy with separate manifestations is not only supported by the previously quoted passages but the following passages as well, suggesting that, for Teilhard, once physical energy develops from psychic, it functions differently from non-granulated Radial Energy. "Following a first direction under the force of gravity, matter .... collects....

Following a second direction, and in apparent dependence on the forces of electro-magnetism, matter arranges itself in little closed systems more and more complicated and centred...." In "The Singularities of the Human Species" (1954), in The Appearance of Man, p. 212. And elsewhere, in the same essay, Teilhard writes, "....it would be possible for us to conceive that where the interiorisation of corpuscles is sufficiently developed, the axial consciousness....escapes the peripheral servitudes of physico-chemical complexity". In "The Singularities of the Human Species", in The Appearance of Man, p. 212. Also, "....the radial nucleus of consciousness never ceases to become individualized within its (peripheral) electro- or thermo-dynamic envelope, until it reaches the point of reflecting upon itself". In "The Stuff of the Universe" (1953), in Activation of Energy, p. 378. Suggesting electrical and magnetic forces are proper tangential effects while radial energy 'centres' these effects.

Radial Energy together with secondary tangential effects[135] (recurrent patterns). Every event is then explained by the operation of Radial Energy as well as the secondary forces (tangential and Radial Energy) configurations which compose its present structures and its antecendent states.

H.S.1.1 On the level of pre-life, according to Teilhard, there has been a gradual organization of more complicated unities (sub-atomic particles, atoms, molecules) and a gradual increase in their capacity for interaction (physical laws being the statistical result of such interactions).

About this, Teilhard writes,

> Strictly speaking, if matter is defined as 'something with no vestige of consciousness or spontaneity', it does not exist. Even in pre-living particles, we saw, we must conceive some sort of curvature which prefigures and initiates the appearance of a freedom and a 'within'. In fact, physical determinisms ('laws') are simply the effects of large numbers, in other words, of materialized freedom. This statistical materialization of the 'Weltstoff' is, of course, most marked in the zone of 'fragmentary centres' (infinite in number and infinitely spontaneous); but it is still perceptible among centres that are higher in order, and even in the noosphere, where cases of mechanization, in the very core of human, are still distressingly

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135. Teilhard remarks on this, "It is an odd fact....no one seems to suspect that, beneath the complex of historical accidents into which the event may be reduced by analysis, a certain force is undoubtedly at work: a force as primoridal and general as nuclear forces or gravity, but one which tells us much more perhaps about the physical nature of the universe". In "The Reflection of Energy" (1952), in Activation of Energy, p. 321.

frequent. From this point of view there is nothing in the universe except spirit, in different states or degrees of organization or plurality.[136]

H.S.1.2 On the phyletic level (living), there has been the development of very complex organisms and organic interaction from unicelled biota to man.

H.S.1.3 On the eucentric level (thought), there has been a gradual development of society and social constructs (physical tools, symbolic, ideational e.g. mathematics).

H.S. 1.1, 1.2, 1.3, define the operation of the complexity-consciousness law. L.L. 3.1, as it was said, involves the recurrent patterns in quantum mechanics, relativistic physics, astronomy and the various branches of chemistry.

L.L. 3.2, Mendel's laws of Inheritance and the recurrent processes and their effects involved in 1) mutation, 2) natural selection, 3) the Sewall-Wright effect (genetic drift) are all regularities resulting from the effect of past Tangential transformations.

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136. ________, "Centrology" (1944), in Activation of Energy, p. 125. And in the same work, "The nature of psychic energy is such that it struggles against the forces of chance which are supreme in the domain of physical energy, and it gradually eliminates them. In so doing, however, it is obliged to come to terms with them. Then, instead of running directly counter to them it makes them, one might say, serve its own ends, making use of the twofold property chance possesses of either developing constant determinisms (physico-chemical laws) through this imposition of statistical uniformity, or, on the contrary, creating improbable combinations through repeated attempts over a long period.
This explains, in the first place, the remarkable structure of living beings, whose liberty is displayed only through and by means of a closed circle of physico-chemical and physiological determinisms, a superficial study of which might well detect no more than a bewilderingly complicated mechanism - the mechanical side of centro-complexity". As above, p. 123.

L.L.313, Divergence, Convergence, and Emergence, are regularities resulting from the operation of radial energy working through tangential transformations.

In a sense, all patterned regularity on any given level is the consequent of some joint interaction of the within and the without. If for example, psychic energy had not reacted to some propitious opportunity presented by the play of large numbers on the physical level, there could have been no biological level and, hence, no possibility of biological regularity. However, setting aside the question of the joint effects (except for the ultimate explained and explaining non-explainer--man), certain effects may be attributed, on every level, to Radial Energy.

On the level of material organization studied by physics,

(E = Effect, explained-non-explainer or explained event)

<u>E1</u> The multiple and stable and persevering corpuscularity of the pre-life level, is explicable as the effects of the centering action of Radial Energy;

<u>E2</u> The indeterminism of sub-atomic particles is interpreted by Teilhard as a property of Radial Energy;

<u>E3</u> The transition from a lower state of organization to a higher (as represented in the periodic table), is a consequent of the action of Radial Energy operating on some alteration presented by the play of large numbers;

(E3 and E4 are repeated on the biotic level.)

E5 True speciation is a direct biological effect of Radial Energy which entails the emergence-divergence, convergence and continuance of radially-preferred biological characteristics and the accumulation (addivity) within a species of such characteristics ;

E6 Man is explained by the direct action of Radial Energy and the historical accumulation of previous interactions. The presence of species Man (awareness of awareness), explains nothing in the sense of deductively covering some other particular event, but insofar as Man represents the latest expression of complexity-awareness, and gives further definition to the direction of evolution, the appearance and properties of Man further explain the 'meaning' of radial energy.

The previous characterization of laws and explained events merely cites elements according to their degree of generality from L.L.1 to Event 6, where the first has the highest degree of generality and the last, the lowest. This, however, does not provide a very exact picture of the possible logical inferences which might be made on the basis of degrees of generality, nor does it make explicit the overall relationship of theoretical elements. This includes the statement of conditions and other auxillary supportive hypotheses as well as the statement of laws and the events that they are supposed to explain. The actual Teilhardian basis for logical inference is discoverable in the manner in which he applies the notion of periodicity to biological events.

17. Periodicity as the Basis for Logical Inference and Extrapolation

Teilhard writes,

> We have insisted....on the general orthogenesis of corpusculation on the basic 'orthogenesis' which....draws all matter towards the more complicated and the more conscious. Here now, in the case of living substance, is a second drift (an under-drift) taking shape: the orthogenesis of speciation oriented, though following an incredible number of different directions, towards the most differentiated in all its forms.[137]

The basic orthogenesis analogy to the chemical periodic table provides Teilhard with his fundamental basis for inferences to the past, in the present and to the future. More basically, it is the complexification series itself that allows retrodiction and prediction.

Teilhard says,

> ....in apparent dependence on the forces of electromagnetism, matter arranges itself in little closed systems, more and more complicated and centred, in which each element functionally superindividualises (accentuates) itself as incorporation takes place.
>
> The whole atomic series, first of all, is much longer than we think; and yet (despite its isotopes and its transuranians) relatively limited in its combinations of electrons, protons and neutrons. The whole molecular series, in which on the level of organic chemistry, the number of atoms associated in each particle (not to mention the number of their interrelationships) rapidly achieves astronomical figures.
>
> And, lastly, inevitably connected by way of the largest proteins, the whole zoological series formed by living beings: since, to the observant, the cell (and so, stage by stage, man on the whole) is nothing else but an enormous supermolecule.[138]

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137. __________, "The Singularities of the Human Species" (1954) in The Appearance of Man, p. 219.

138. __________, "The Singularities of the Human Species" (1954) in The Appearance of Man, p. 212.

On the basis of the series alone the following inferences can be derived. Grounded on the pattern of complexification series alone, the extrapolation could follow the manner of the subsequent schema [139]. In every instance, a natural unity has been preceded (or followed by) a more primitive natural unity (or higher consciousness type). This (a natural unity with consciousness correlate) was itself preceded (or followed by) a higher consciousness type.

Of course, matters are not quite so simple, for, unlike the periodic table, the elements of biota level are myriad. Also, unlike the properties and determinates of the chemical elements whose structure and processes are, to all intents and purposes attributable to their antecedents, the configuration of biota, as was discussed in the previous section on the problem of conditions, is not strictly determined by temporal and structural antecendents, but through random factors and extrinsic causality as well. For these reasons, highly detailed or rigorously determined inference becomes, itself, improbable.

Nevertheless, according to Teilhard, the continuous activity of the antichance factor has made it the case that despite a variety of antichance factors with their effects on the 'second properties of biota' and species survival, complexity-consciousness perseveres and

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139. One contemporary chemistry text expresses the periodic law in this way, "If the elements are arranged in the order of their atomic number, a periodic recurrence of properties is obtained." In Cragg, L. H. and Graham, R.P., The Elements of Chemistry, p. 205. Teilhard describes complexity-consciousness in "Introduction to Centrology", in Activation of Energy, p. 99: "As an experiential law of recurrence which can be checked in the phenomenal field and can appropriately be extrapolated into the totality of space and time".

increases. This is the basis of extrapolation. About this, Teilhard writes that,

> Beneath the superstructure of mechanical and physiological links which evolution has progressively added to the elementary range of intra-cellular links, we do not immediately recognize in man the natural extension of the atom. Nevertheless, once we have drawn the curve followed by a world which is advancing, along one of its axes, towards large complexes, it becomes clear (and dazzingly clear) that in each one of us the same movement is being continued: however enriched it may be, it is still the same primordial movement from which, millions of years ago, there emerged the first elementary compounds of oxygen, nitrogen and carbon.
>
> Hominization then, is the particular and final term (so far as we can see at present, remember!) of universal moleculization. Thus we find a natural, a genetic, explanation of the simultaneous presence in man of three fundamental characteristics whose co-existence always used to be inexplicable: extremely high degree of complexity, of consciousness, and (though small, indeed, in comparison with what is found among lower forms of living beings) of number.[140]

As well as this primary basis for extrapolation, and as with the periodic table there are secondary periodicities providing the basis for other forms of extrapolation. Teilhard writes that,

> ....below 'living matter'....in the vast domain of the organic, physics is now disclosing to us a veritable genesis of 'simple bodies'. True, it is an 'a-phyletic' type of evolution, in which each particle is formed, coalesces or disintegrates on its own account (without....going beyond the boundaries of an ontogenesis); but it is nevertheless a true evolution since, in one way or another, we can....be certain, atomic additivity exists from nuclear elements and electrons onwards.[141]

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140. _______, "The Atomism of the Spirit" (1941), in Activation of Energy, p. 103. In the same work, Teilhard continues by saying, "At the same time, we have an answer to the key-riddle we asked ourselves at the beginning of this essay: why, we wondered, is man plural--plural just as are stars and molecules? We can now answer, quite simply, because man is precisely the most recently elaborated, the youngest, and hence the most complex and most fully centred, of molecules". As above, p. 103

141. _______, "The Energy of Evolution" (1953), in Activation of Energy, p. 363.

It is the 'fact' of additivity that allows Teilhard to derive inferences concerning the incorporation of characteristics conducive to consciousness of a more primitive entity into a higher entity, but it is the 'phyletic' patterns predictable of organic beings, he believes, which allow him to make secondary inferences concerning the 'position of species or phyla, relative to the possibilities and rate of growth toward increases in complexity-consciousness. Teilhard writes, "The 'old' zoological evolution....was mainly automatic, chromosomic and divergent...."[142]. What constitutes 'divergence' offers little difficulties; it is a phenomenon universally recognized by biologists. G.G. Simpson, for example, writes that fossil records demonstrate that,

> After long obscurity during which the basic complexity of cellular organization was developed, there came a time, extending over several millions of years, during which fundamental divergence produced most of the broadest structural and functional types of living organisms that were ever to exist....the total number and variety of organism existing in the world has shown a tendency to increase markedly....[143]

This tendency in itself follows the inductively founded hypothetical prediction that, if the conditions operative in the past which produce divergence remain constant, there is and will be a continuing tendency of divergence.

Following and anteceding divergence, another phenomenon: the phenomenon, of convergence or evolutionary parallelism, can be observed to

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142. __________, "The Energy of Evolution" (1953), in Activation of Energy, p. 364.

143. Simpson, G.G., In the Epilogue to the Meaning of Evolution, pp. 176-177.

occur within the history of life. This tendency, too, has widespread recognition among biological scientists. While, however, for biologists like G.G. Simpson, convergence represents no more than a variety of tendencies, attributable to 'evolutionary opportunism' and a similarity of environmental conditions[144], 'this secondary or the genetic phenomenon' represents much more for Teilhard. It is part of a law-like pattern. Teilhard contends, however, that "when observed in their numerical distribution of a given moment, the individuals composing a single species group themselves around a median type representative of species"[145]. However, Teilhard continues, "when the various species are regarded over a considerable period of time, the "daughter species"[146] are found not to be "distributed purely by chance equally in all directions"[147].

According to Teilhard,

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144. G.G. Simpson writes, "The development of the same sort of evolutionary opportunity by different groups of organisms produces the evolutionary phenomena known as parallelism and convergence....In parallelism, groups already adaptively and structurally similar independently undergo changes in the same direction....It certainly has no grand and uniform plan, nor any steady progression toward a discernible goal....; it shows continued trends and a neat interlocking of the various sorts of organisms so that they interact systematically and fill out the possible ways of life....The history of life is an odd blend of the directed and the random...." In The Meaning of Evolution, pp. 67, 70.

145. Teilhard de Chardin, P., "Note on the Present Reality and Evolutionary Significance of a Human Orthogenesis", in The Vision of the Past, p. 249.

146. ________, "Note on the Present Reality and Evolutionary Significance of a Human Orthogenesis" in The Vision of the Past, p. 249.

147. ________, "Note on the Present Reality and Evolutionary Significance of a Human Orthogenesis", in The Vision of the Past, p. 249.

> Observed in a sufficient number of cases and over a sufficient interval of time, repeated speciations give birth throughout the ages to general alignments: the effect we say of phyletization or....orthogenesis: the latter word meaning.... within related species, a statistically oriented distribution.[148]

He also maintains that the notions of phyletization and orthogenesis, although biologically related, have been mistakenly confused as identical processes while in fact they are not. According to Teilhard, following phyletization or occurring within diverging species, there appears a second phenomenon, that of a convergence towards morphology conducive to cerelreation (true orthogenesis). This, then, allows or forms the foundation for the generalization that for any X(phylum), if a divergence occurs

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148. __________, "Note on the Present Reality and Evolutionary Significance of a Human Orthogenesis", in The Vision of the Past, p. 250. Teilhard makes the following distinction. He says of the "speciation that it leads to the birth of increasing divergent and differentiated forms", while complexification produces "along all aximuths of specialization (with more or less success) but in every case, zoological types increasingly centred and cerebralized". In "Note on the Present Reality and Evolutionary Significance of a Human Orthogenesis", in The Vision of the Past, pp. 250-251. Although he phrases it as if it were a question on his essay "Note on the Present Reality and Evolutionary Significance of Human Orthogenesis", Teilhard, in fact, distinguishes between ortho-selection and or-tho-election. The first occurs in a particular structure of the external milieu within which the successive mutations operate: passive orthogenesis "and" non-internal (conscious or unconscious) preference of living beings to follow one direction....active orthogenesis". In "Note on the Present Reality and Evolutionary Significance of a Human Orthogenesis", in The Vision of the Past, p. 250. As early as 1928, Teilhard was making a similar distinction. In his essay for example "The Movement of Life", he writes that evolution occurs through dispersion where "creatures....differentiated in every direction within their type....by radiations where new variations, instead of scattering, follow a limited but progressive number of directions, clearly determined by conditions of existence and surroundings and by canalization when the very strongly polarized changes of form converge as "probably nothing but a directed series of small and numerous mutations". In "The Movements of Life" (1929), in The Vision of the Past, pp. 145-146.

within that phylum, there will also occur a convergence towards morphological traits conducive to consciousness.

The phenomenon of emergence, too, is recognized by eminent working biologists. Ernst Mayr, for example, writes that, by 'evolutionary novelty', he includes or means "any newly arisen character structural or otherwise that differs more than quantitatively from the character that gives rise to it"[149]. For Teilhard, again, the emergence which is important to him concerns that of higher consciousness and consciousness correlates. He definitely distinguishes two major thresholds whereby completely new sets of properties and capacities are acquired; the first entails the jump from pre-life to life. About this he says,

> Unless the science of tomorrow is able to reconstruct the process in the laboratory, we shall probably never find any material vestige of this emergence of the microscopic from the molecular, of the organic from the chemical, of the living from the preliving....By analogy with all we have learned from the comparative study of natural developments, we must postulate of this particular moment of terrestrial evolution, a coming to maturity, a threshold, a crisis of the first magnitude, the beginning of a new order.[150]

The properties acquired with the coming-to-be are those of phyletic addivity, sexual reproduction and so forth. The second critical point involves the jump from biotic consciousness to human self-consciousness

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149. Mayr, E., The Emergence of Evolutionary Novelties in the Evolution of Life, Soltax Ed., Vol. L, Chicago, University of Chicago Press, 1960, p. 350. Mayr writes elsewhere as well, that "when two entities are combined at a higher level of integration, not all the properties of the new are necessarily a logical or predictable consequence of the properties of the components". In Cause and Effect in Biology in Science, p. 1505.

150. Teilhard de Chardin, P., The Phenomenon of Man, p. 79.

about which Teilhard states,

> Man not only 'a being who knows' but a being who known he knows, possessing consciousness raised to the power of two.... Do we sufficiently feel the radical nature of this 'difference'? Under the impact of this passage from simple to squared numbers, we all become aware of the entrance for hominized consciousness into a new inner world: the world of the universe as thought.[151]

The appearance of man and his products does not cancel out or supercede the forces of divergence and convergence[152]. The initial appearance of man occurs through the intensification of cerebral complexity within the "anthropoid patch in the pliocene"[153]. In the absence of conditions promoting primary emergence (radically new consciousness capacities), species continue to divide and canalize but always toward higher complexity consciousness. According to Teilhard, however, there did occur within the anthropoid, due to a 'canalization',[154] such a primary emergence "in a chain of

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151. ______. "The Singularities of the Human Species" (1955), p.224.

153. Teilhard writes in Man's Place in Nature, that, "....hominization initially operated in accordance with the general law of all speciation which is to bring about the emergence of living groups ramified in their overall appearance, and in a state of active division". p. 65.

153. ______. Man's Place in Nature, p. 38.

154. Teilhard alternatively describes convergence and divergence as grouping and cleavage. For instance, in his essay "The Singularity of the Human Species", he writes about grouping that "taken statistically, the various element forming a single population at a given moment are not distributed at a homogeneous density. But like shots of a target the group around a certain medial type" and he says about 'cleavage' that "By well established effect of mutation, a second stage of grouping....finally appears....a phenomenon leading to the formation and preparing for the isolation of another 'species'. Then a third stage comes in its turn, to start a new dividing of the population in question. And so on". p. 217. Part of this grouping, as was said, "involves a notable advance in....cephalization or cerebration". p. 220.

neurones"[155]. Once the initial point has been reached or the threshold of reflection reached, species man exhibits a set of novel properties. Teilhard writes that,

> 1. In the eyes of science, the appearance of man followed essentially the same mechanism (geographical and morphological)
> 2. Nevertheless, we find in man certain special properties that denote in him a higher vitality than we meet in other species[156].

Considered as species properties (as apart from the capabilities that self consciousness accords to an individual), these special properties arising from emergence allow homo sapiens to incapsulate divergence and convergence within a single species. According to Teilhard, below the level of self consciousness, a process occurs, where after a species creating convergence takes place, a subsequent divergence happens fracturing the unity of the species. However with man, after a divergence, there occurs a convergence, reuniting the previously separated varieties[157]. Considering the patterns of divergence,

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155. __________, Man's Place in Nature, p. 48.

156. __________, Man's Place in Nature, p. 63. Teilhard writes elsewhere, "Agreed that the morphological distance between man and the other primates seems disquietingly small", however, he says, "at this epoch of the world's history....all events suggest that the living wave of 'complexity/consciousness' is present with all its strength, along its principle axis on the anthropoids. Within this privileged area, consciousness has in some way come close 'to its point of reflection'. Under such conditions, who would dare to limit a priori the psychically explosive effects of this or that particularly fortunate modification operating in the cortical zones of the brain?" In "The Singularities of the Human Species", in The Appearance of Man, p. 226.

157. Teilhard writes that "upon analysis man demonstrates the following capacities: an extra-ordinary power of expansion, an extreme rapidity of differentiation, a surprising persistence of germinative power and....a capacity, hitherto unknown in the history of life, for interconnection between branches within a single fascicle". In Man's Place in Nature, p. 73.

convergence and emergence together, along with the primary periodicity of complexity-consciousness itself, all the elements of Teilhard's basis or extrapolation are present. This may be illustrated diagramatically as follows: If the elements of the biotic world are arranged in a series $C\text{-}c^1$, $C\text{-}c^2$, $C\text{-}c^3$, $C\text{-}c^4$, $C\text{-}c^5$, it can be inferred there will be a $C\text{-}c^6$ which will be both consequent of, and more complex than, its antecedent. If the dual forms of orthogenesis are considered conjointly, the following series can be obtained:

Pre-Life E^1 ..... D^1 ..... C^1 ..... E^1 ..... D^2 ..... C^2 ..... E^3, etc.

Cc^1 . . . . Cc^2 . . . . Cc^3, etc.[158]

Of course, a biological schematization would be far more complex than this logical one. In a biological representation, not every series leads to a higher consciousness type nor survives to perpetuate the divergence-convergence type; nevertheless, according to Teilhard's argument, it has always been the case that some phyla have survived and persevered to continue in the future, given the proper conditions.

Teilhard writes that,

> The recognition that in virtue of his very nature, man tends to co-reflect himself, is precisely the admission that, in evolving, he converges upon himself. Now, to converge entails two things for human energy. The first is that it never ceases

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158. Where E^1 means E (Life) E^2 (self-consciousness) E^3 extrapolated emergence. Phrased verbally, this could read: In every instance in the past, a higher-consciousness follows a lower and within the domain of life this has occurred according to a pattern of divergence and convergence where emergence under the proper condition follows convergence".

> to intensify and differentiate, with the passage of time, through concentration upon itself. And the second is that it can distinguish, at a certain finite distance ahead of it, a peak. This can only mean that hominization, as witnessed by us in its operation, can only end (provided it win through) in a higher critical point of escape from space and time: in other words, that it may be exactly the issue which we found we must have if we are to have the heart to press on.[159]

For Teilhard, the elements (natural cores) of the universe may be arranged according to a criterion (complexity) in ascending order wherein secondary periodicities are discoverable as is the case with the chemical periodic tables. For Teilhard, too, as with the periodic elements, the phenomenal periodicity is a manifestation of more general structures and forces. While for chemists the properties of the elements of the periodic table[160] are reflections of underlying electro-chemical forces, the properties of the complexification series are for Teilhard only secondary manifestations of electro-chemical forces and primarily the consequent of the centering activity of radial energy. Teilhard writes,

> The periodicity in chemical properties is a consequent of, or a reflection of, a periodicity in electron arrangement. Just as in the example of a river tracing its bed, there....is some gravity acting everywhere and always on the flowing water, so in the case of speciating matter, is there not, must we now inevitably

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159. __________, "The Activation of Human Energy" (1953), in The Activation of Energy, p. 392. As it can be seen from this quotation, on the human level convergence and divergence occur concurrently but unequally as the overall effect is further convergence leading to the ultimate emergence.

160. One major difference between the complexification law and the periodic law is that the chemical elements need not be interpreted as having anything more than a structural relationship while the correlation of structural and historical antecedents is an integral part of Teilhard's notion of complexification.

postulate, the existence of a single basic factor in operation.[161] The answer for Teilhard is, of course, that we must and this factor is radial energy. It is radial energy as manifested in the consciousness and choice activity of individual biota. Considered collectively over a period of time, that produces the convergence towards morphological traits conducive to consciousness and the sometimes subsequent intensification of these traits (except on the level of man whose collective arrangement is primarily socio-cultural) that results in emergence, with the postulation of radial energy as the major force underlying the various orthogenetic manifestation. Teilhard employs the hypothetical-deductive mode of explanation illustrated by Hempel's paradigm as well as narrative explanation. When the two modes of explanation are considered separately and together, the basis is formed for the following further possible inferences schematically expressed.

Divergence is a result of the choices made relative to environmental situation and the other factors of indeterminancy generally recognized by biologists.

17.1 Other Possible Teilhardian Kinds of Logical Inference

One fairly straightforward type of inference which might occur in the Teilhardian context, given his statement of regularities, could be the following:

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161. ________, "A Defense of Orthogenesis" (1955), in The Vision of the Past, p. 272.

(1) For every natural unity (NU), there is a characteristic consciousness property (CP), which is correlated with behavioural properties (bb), (bc), and (bd), if (NU) is exposed to environmental stimuli.

(2) For every (NU), these factors are x, y, z.

(3) L is a natural unity of kind (NU).

(4) L is exposed to environmental factors x, y, z.

(5) Therefore, L exhibits behavioural properties (bb), (bc) and (bd) and correlative (cp).

In this inference, the first two statements could be construed as laws, while (3) and (4) are statements of necessary and sufficient conditions for the application of the laws to concrete physical events. Interpreted another way, the events may be seen as manifestations of general pervasive natural patterns, or again, as the conclusion of a hypothetical deductive inference. However, as it has been implied by previous passages, the type of inference that occurs in the structure of a scientific theory involves more than empty logical forms. Supposing the previous inference was meant to predict event E, rather than merely explain it. It is quite possible, in the biological domain, that not only do the predicted events occur, but also properties which have not been predicted. L for example, when exposed to x, y, z, might exhibit not only (bb), (bc), and (bd), but also (be), (bf), and (bg), which no previous (NU) has exhibited. Then utilizing perhaps this kind of analogical inference, it could be argued that since L, with characteristic consciousness property (cp), can be observed to exhibit behavioural properties (bb), (bc), (bd), (be), (bf) and (bg), when exposed to x, y and z, and since L differs in no significant way from any other L of type (NU), every L of type (NU) must at least have the potential of exhibiting (be), (bf) and (bg) as well as (bb), (bc), and (bd) when exposed to x, y and z.

In this way, two forms of inference involving narrative as well as deductive explanation are brought to bear in order to explain, adequately, a complex event. Moving beyond this purely hypothetical example of logical derivation, it is probable that, as can be inferred from his various writings, Teilhard did, in fact, consistently use this dual form of inference. The postulation of the universality of consciousness on the basis of its presence in Man does not, by any means, appear to exhaust the Teilhardian use of analogy. Simply building up the gradations of complexification involves an inferential motion from the known to the partly known and to the unknown.

The postulated universal presence of psychic energy is not sufficient to account for any given specific kind of consciousness, or any given specific effect of the activation of psychic energy. While radial energy is, according to Teilhard, a uniquely necessary condition for centric forms of energetic transformations, it is not sufficient for the explanation of any concrete instance of such transformations. As was previously suggested, inferences about specific types of consciousness, on the basis of a knowledge of radial energy, together with a knowledge of all the relevant past activations of radial energy, as manifested in a historical series and structural levels, are jointly necessary for the explanation of any given event. Knowledge of the series, that is, about its constituent members, can rarely be deduced but must be reconstructed stage by stage using historical methods of one form or another. Knowledge of radial energy does not provide the means of grading and grouping classes and series of natural cores. Rather, it provides the ultimate reason[162] for the appearance of classes and series of central complexes, past, present and future. Once having established this complexification series (in part), Teilhard, utilizing the notion of consciousness as a universal entity, could plausibly have employed any one of the following deductive inference forms, referring to past, present or future states of the universe.

17.2 Logical Inference and the Past

1. The Past

a) According to the complexity-consciousness law,

Every alteration of centred complexity is followed by an alteration of

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162. Teilhard argues, "....we should....reverse the values.... We should consider the whole of thermodynamics as an unstable and ephemeral by-effect of the concentration on itself of what we call 'consciousness' or spirit.

An interior energy of unification (true energy) gradually emerging, under the influence of organization, from the superficial system of actions and reactions that make up the physico-chemical....There are two different energies - one axial, increasing and irreversible, and the other peripheral or tangential, constant and reversible, and these two energies are linked together in 'arrangement', but without nevertheless being able either to form a compound or directly to be transformed into one another because they operate at different levels....A duality (which is no dualism)...". In "The Activation of Human Energy" (1953), in Activation of Energy, p. 393.

consciousness manifested by an alteration in behaviour.

X^2 of type L was structurally altered by a factor of 1 from its antecedent X^1, under environmental stimuli U,V,W and an activation of radial energy RE.

In other instances of such alterations (1) in type L, it was found that X^2, manifested behavioural properties, BP^1, BP^2, and it was inferred X^2 has consciousness property CP^2.

This X^2 under stimuli U,V,W and RE, manifested BP^1, BP^2, and has consciousness CP^2.

b) For every alteration consciousness property of type E, given a series of a...b...c...d...this alteration of consciousness of type E occurred.

It was preceded by a series a...b...c...d...

c) Under the influence of radial energy, every case of an emergent property was preceded by an accumulation of properties, relative to the emergent level.

This Ee was an example of emergent property.

This Ee was preceded by accumulation of properties a,b,c,d,e,f, relative to level L

2. The Present

a) Any consciousness alteration is followed by a structural alteration, Y.

This is consciousness alteration Z

It is followed by structural alteration Y

b) Any present complexity-consciousness NU^1 is a consequence of a series

$S^1 \ldots S^2 \ldots S^3$.

This is a complexity-consciousness NU^1

It is a consequent of series $S^1 \ldots S^2 \ldots S^3$.

c) A present structure Z of type NU is the product of Emergence (E), Convergence (C), and Divergence (D).

This is a structure Z of type NU

It is a product of (E), (C) and (D).

d) In any given series, $S^1 \ldots S^2 \ldots S^3 \ldots S^n$ on level X, the difference between S^1 and S^n are to be looked for in environmental factor U,V,W and an activation of radial energy (RE).

This is a series $S^1 \ldots S^2 \ldots S^3 \ldots$ with a difference in complexity of +1

This $S^1 \ldots n$ is a product of U,V,W and (RE).

3. The Future

a) Under the influence of the complexity-consciousness law, every convergent series of type Ce, given factors (w,x,y), leads to emergence.

Mankind represents such a series, Ce and factors (w,x,y) are operative.

Z extends and reinforces (w,x,y)

There will be an Emergence.

With the exception of the last inference form and excluding the problem represented by the notion of series (history), each of these forms is interchangeable with a simple change of tense. These inference forms by no means exhaust the possibility of logical inference on the basis of the complexity law, but they do indicate the range of such logical derivation.

As it was previously maintained, a scientific theory is more than some hierarchical organization of elements and more than empty logical relations. There is the articulated arrangement of empirical assertions, and logical relations supported by auxillary connectives. If a partial overview of these elements of the orthogenetic theory were taken, it is proposed that such a conceptualization would appear as follows.

18. Orthogenetic, Internal Principles, Bridge Constructs and Logical Relations

The orthogenetic theory, as is the case with any scientific theory, has what must be described as internal principles. These are statements which characterize regularities (and in Teilhard's case, assymmetricalities of process). of processes and entities (forces), with which physical events are posited to conform. Within the orthogenetic theory, it can be discerned, there are two distinct types of such internal principles: a) those that make reference to hypothetical entities and processes which are relatively non-observable and which cannot be understood outside of the context of the orthogenetic theory; b) those that make reference to phenomena which either occur on a relatively observational level or are postulated by confirmed theories other than Teilhard's or both.

Psychic energy, with its dual manifestations, Radial Energy and Tangential Energy, is a definite example of (a). While Tangential Energy, as a concept, contains the notions of a capacity to do 'work', where work is defined as a product of force and displacement (action and interaction), and while for Teilhard, Tangential Energy is manifested in electrical, mechanical, gravitational forms in potential and kinetic states, as is the case for orthodox physics and chemistry, the relationship that Teilhard postulates that Tangential Energy has to Radial, is uniquely his own construction. Tangential Energy, for Teilhard, is derivative of Radial Energy and the latter was believed by him to 'center' through utilizing the 'stuff' and relations of Tangential Energy. As it was seen as well, every scientific theory contains bridge constructs (auxiliary postulates, translation statements) which function to connect the observable postulated theoretical entities with occurrences on a more indirectly observable postulated entities and processes made antecedently available to the scientist through the postulates of other theories, or to interrelate previously non-related structures and processes occurring on the same level.

Even on the underlying non-observational domain of psychic energy, Teilhard introduces a number of such postulates. Teilhard, for example, 1) correlates the centering or radial effect of Radial Energy with the corpuscles, subatomic particles, atoms and molecules, pictured by other theories; 2) states that, under proper conditions, Radial Energy always acts to produce more complex higher arrangements and these past 'acts' are reflected in the physical levels (i.e. atoms, molecules, etc.); 3) postulates that a greater consciousness always entails a higher capacity for further arrangements and this postulate is reflected by the capacities for the relation of the ascending levels of corpuscles. Teilhard writes,

> There has been born the sense of a universal absolutely specific movement, in virtue of which the totality of things is shifting, integrally and as a whole, from top to bottom, not simply within space and time, but in a (hyper-Einsteinian) space-time, whose special bias is to introduce an even higher degree of arrangement into that which moves within it. It is what I often have called a movement of 'complexity-consciousness' or of corpusculization, or of centration, or interiorization, in as much as the arrangements it produces rise up in the direction of groupings that are at once more astronomically complicated, more physically organic and more psychologically free from determinism.[163]

4) As well as these postulates which explicitly define or assign empirical meaning to the activity of Radial Energy, there are supporting auxiliary hypotheses about matters of fact. On the micro level, for example, according to Teilhard, the reason that only the mechanical effects of Tangential Energy may be discerned (excluding the actual conserving centering function that Teilhard assigns to psychic energy) is that in the past the actual altering activity (viz. the activation that produces a shift in levels), occurred statistically very infrequently, while, in the present, the activity of Radial Energy is also, in terms of measurable physical effect, very slight, particularly at the lower levels of organization[164]; 5) While the alterations of consciousness are conditioned

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163. __________, "From Cosmos to Cosmogenesis" (1951), in Activation of Energy, pp. 256-257.

164. In Teilhard's words, "What happens is that, on the one hand, in virtue of the play of large numbers, the orderless multitude of elementary consciousness, taken as one mass, behaves exactly as though it were devoid of any 'within'. In other words, it develops exactly the same overall determinisms as those produced by the primordial granular energy of the physicist". In "The Analysis of Life" (1945), in Activation of Energy, p. 134.

by the random configurations of Radial Energy, there have always in the past, been enough alterations (produced by the play of large numbers) to allow a continual formation of higher levels.

Generally, as was discussed in the beginning of the chapter, the bridge between the theoretical 'entity', Radial Energy, from the structurally most primitive corpuscle or temporal stage, to the most complex and developed organism, is supplied by Teilhard's notion of complexity. Nevertheless, between and among theoretical entities and processes, there are secondary and auxillary postulates. Concepts involving such notions as,

1) survival of the fittest or, more, generally the processes evoked by Neo-Darwinian theory,

2) genes and genetic processes,

3) phylum, species and organisms,

4) irreversibility on the biological level,

5) species, man and society,

6) convergence, emergence and divergence,

7) development of the cerebral cortex,

8) consciousness and self-consciousness,

are, in the cases of one to four, constructs which are derived from other theories and hence may exist independently of the orthogenetic theory. These concepts make reference to entities and processes which are more or less on an observational level, while five to eight refer to structures and processes which do occur, with qualifications, on the macroscopic level, or at least are claimed by Teilhard to do so.

Just as Teilhard utilizes notions derived from other theories, such as atomic number on the microscopic level to give operational definition to his notion of complexity, he uses notions such as the phylum to establish the broadest limits to which he applies his specific criteria for the definition of complexity. The notion, for example, of cerebreo-complexification as the consciousness indicator, is contextually dependent for its application on previously defined biological genera and species. It is the case as well that, just as with the hypothetical internal principles, there occurs with the observational internal principles, reinforcing auxillary postulates.

Between the processes of Divergence and Convergence, for example, there is Teilhard's 'addivity' postulate. According to this postulate, given a divergence from a common ancestor, it will be noticed that certain of the diverging types (varieties) or characteristics, are retained and accumulated (under the influence of Radial Energy). This accumulation, under proper conditions, leads to true phylum (convergence) and if the radially favoured characteristics are accumulated long enough, an emergence will take place.

Teilhard's partially epistemological 'suppression' of the first postulate is another example of the type of auxiliary postulate. According to this postulate, since the first terms of a series or emergent stage lack the reinforcement involved in addivity, they are the weakest, have the least effect on their surroundings, and are the least likely to leave traces. Without these bridge constructs, there could be no explanation since there could be no interconnection between empirical multiple events and postulated pervasive structure and pattern. Without bridge constructs as well, deductive inferences, referring to structures and processes beyond the phenomenal level could not be made to possible future or past events and hence there could be no possibility of theory confirmation.

While this statement of bridge constructs and internal principles is by no means complete, it does note aspects of the orthogenetic theory necessary for the critique of the following chapter and, thus, may be considered adequate.

THE LOGICAL STRUCTURE

SUMMARY AND CONCLUSION

In the first segment of this chapter, it was argued that Teilhard used hypotheses, both in the formulation of his problem, the place of man in nature, and in his statement of the facts which must be regarded as relevant to its solution. Teilhard believed that Man must be regarded as the most significant phenomenon in the universe and that it is only by selecting those data which have to do with psyche and the conditions of consciousness that man's true place, as a physical and biological event among the multiplicity of cosmic events, might be discovered.

Teilhard, it was argued, hypothesized that the way in which the presence and operations of consciousness could be rendered physically meaningful, or dealt with in a spatio-temporal context, was through classification, according to the conceptual category of complexity.

The following section attempts to show how the notion of complexity functions as an element of the orthogenetic theory. However, this was not done directly but by a comparision with what many contemporary philosophers of science identify as major of scientific theories in general. It had been stated that every scientific theory employs a logical framework involving a set of terms and relations, statements about empirical events and a further set of statements interrelating and correlating the 'theoretical vocabulary' with statements in the language of observation, these latter being sometimes designated as 'correspondence rules' or bridge constructs.

It was stated in this chapter that Teilhard's notion of complexity could be regarded as a translation statement, rendering the logical schema of the orthogenetic theory conceptually meaningful, and, as a correspondence rule, rendering the theoretical construct, Radial Energy, physically meaningful. Since Teilhard did not start from an abstract calculus but from a model, this second function, it was argued, has an explicitly demonstrative role within the orthogenetic theory. Teilhard, at least to some extent, takes the notion of 'complexity' as a tightly organized unity containing multiple elements and gives it an operational meaning by stipulating that the term 'complex' or complexity, may be accorded to unities in the pre-life domain on the basis of atomic number and to unities from the carbon molecule to the monocellular biota, on the basis of observable behavioural properties such as replication, and to biota from the multi-cellulars to Man on the basis of the nervous system development.

This section that follows explores the explanatory pattern which exists between Teilhard's statements about his theoretical agency, Radial Energy and its effects. Radial Energy, it is asserted, is Teilhard's non-explained explainer, and, between the postulated transformations brought about by the activations of Radial Energy and the phenomena of the observational world, Teilhard employs statements about what kind of empirical events and patterns, existing among and between complexes, indicate the operations of universal consciousness. It was argued that Teilhard's statement of complexity-consciousness as a law, was, in fact, a short form expression of a multiplicity of constant relationships, all deriving out of the constant conjunction of structural complexity and that the continuation of any organic complexity is the result of the centering activity of consciousness. Further, it was maintained that Teilhard implicitly asserted that any organic complexity is always the partial result of the radial activity of a temporally antecedent centre and there has been, and will likely continue to be, an increase in the quality and rate of complexification. Following this initial exploration of the complexity-consciousness law, it was noted that Teilhard's notion of complexification allows him to reinterpret phenomena and Darwinian reconstructions of phenomena in such a way that these derive a law-like significance which they do not have in their original theoretical context. This consideration of the reinterpretations of the data provided by observation and other previous theories led to a renewed discussion of the complexity-consciousness law and its conditions of application. The point was made by an example, that with the adoption of suitable auxillary assumptions, certain of the sub-generalizations implied in Teilhard's statement of the complexity-consciousness law could be given an operational meaning. However, despite this possibility, there are problems, both with the total formulation of the complexity-consciousness law and with the statement of its conditions of application.

Before considering the problem of conditions as this relates to biological events, an exploration of the structural parallels which exist between the complexity-consciousness law and the universally accepted chemical periodic law were established. This discussion serves as a basis for a subsequent development of Teilhardian extrapolation.

The next section deals in some detail with the problems associated with the complexity-consciousness law's application. It was asserted that part of the problem is a direct result of working within the biological domain. It was said that the biologist often works with systems that contain so many variables that it becomes virtually impossible for him to know, with any certainty, which one or which combination of factors are relevant to his problem. The example offered by genetics is a case in point. The intrinsic elements operative in the mechanisms of inheritence contain millions of factors, the possibility of true spontaneous alteration of genetic material and the indeterminacy of operations of extrinsic factors related to the transmission of chromosomic material. These jointly and others make accurate explanations and predictions about particular events, virtually impossible.

As well as the reasons for indeterminacy known to orthodox biologists, there is the theoretically postulated potentiality of the orthogenetic theory. Teilhard posits that the quanta of indeterminacy increase with the increase of complexification. It is, according to him, the specific organization of biota which allows the level of spontaneity observable in organic systems and any increase or decrease of the organization alters potentiality. It is only on the basis of the comparison of similar wholes that behavioural capacities can be predicted and where the alterations of possibility represents a "first", accurate prediction on the basis of natural kinds, becomes even more difficult. The multiplicity of external conditioning factors offers a third reason for the real or apparent randomness of biological events. If, as according to Teilhard, there is no theoretical limit to the influence of any given occurrence, it also follows that there is no theoretical limit for accidental interaction.

Despite the fact that it is usually the case that the major environmental conditioning factors of biological events are those which are most approximate, it is possible that an interaction occurs which is a consequence of an extremely spatially or temporally remote event. It is reasonable to suppose as well, that the more spatially or temporally remote the origin of an originating event is, the more unlikely it will be taken into account in any general attempt to explain or predict biological occurrences.

It was argued in the subsequent sections that, not only do biological phenomena present epistemological and methodological difficulties due to the usual complexity of factors involved in any given event, but also because of the complexity of explanatory type. It was stated that biological phenomena present patterns of activity to the investigator which are at most only minimally present on the pre-living levels of physical organization. According to G.G. Simpson and other biologists, Teilhard implicitly , states that organisms manifest behaviour which cannot be adequately explained or even properly methodologically investigated, using the explanatory categories of physics. Simpson argues that the biologist must not only recognize the mechanistic 'how' sort of explanation of the physicist, but must use another 'what for' or teleonomic type of explanation. The structures and functions of organisms must not only, according to Simpson, be described in terms of regular sequences of interaction, but also according to the use the structures and functions have in allowing organisms to survive in actual and possible environments.

Teilhard would appear to implicitly accept the role of teleonomic explanation as part of his concept of consciousness-derived behaviour. Both Simpson and Teilhard explicitly accept yet another explanation type, the historical explanation. To both biologists, encompassing both teleonomic and mechanistic categories of explanation is another answer to the question 'how come'. All structures and functions are derived out of temporal antecedents,(past events) and according to both men, what is present can only be fully understood by reconstructing the past. All the epistemological and methodological problems existing for the biologist working in the present are to be found manifest in the past. For extended periods of natural history, similar factors to those contributing to the present state of biological indeterminacy were operative in the past. Genetic variation and, if Teilhard is correct, emergent organic wholes with their multipotentialities, were operative in the previous states of the world. The reconstruction of the past brings distinct problems of its own. According to Teilhard, history is made up of a series of non-repetitive events or classes of events, the accumulation of and retention (addivity) of which contributes to the structures and functions of the present state. It is stated further in the subsequent passages that Teilhard distinguishes between addivity and orthogenesis. Addivity for him entails the accumulation of any biotic characteristics, while orthogenesis involves the accumulation of properties conducive to the rise in consciousness. Teilhard maintains that, for both types of addivity, there exists the possibility of a limited reversion to a simpler state; however, there can be no such overall reversion for two main reasons. The first reason entails the implications of the second law of thermodynamics. The second entails mechanisms involved in the process of orthogenesis itself. According to Teilhardian interpretation of the first, since the amount of available energy necessary for tangential transformation is continuously decreasing, no consequent event occupies the same position relative to the total amount of energy available to it as an antecedent event, no matter how similar. About the second he says, since the amount of radial potential continuously increases as a consequent of past transformations, a total reversion would imply a paradox, because the reversion would be identical despite having a non-identical past.

Having explored some of the difficulties involved in establishing necessary and sufficient conditions for applying the law, some further implications about the Teilhardian statement of the law itself are discussed. The major point made, concerning the complexity-consciousness law, is that there exists no practical possibility of applying it in a totally symmetrical way to the past, present and future. For a complex of physical, methodological and epistemological reasons, despite the fact that the operation of Radial Energy and some of its resultant patterns are invariant, its configural effects are historically dependent and, in some instances, specifically indeterminate.

The following passages attempt to show that when the complexity-consciousness law is considered with reference to its overall explanatory pattern, its explanatory schema includes historical statements, as well as the expected law-like hierarchy of statements, arranged according to their extent of generality. The implications of this, for the type of scientific inference that might occur on the basis of the orthogenetic theory,are explained through a series of examples. It is demonstrated that, while there are explanations involving the assumption of a particular event under a law, there are also examples of inference which involve historical statements. In the latter kind of inference, there is a kind of reciprocal explanation which was pointed to in the first chapter. Here, since the statement of conditions involves the statement of alterations through time, the operations of Radial Energy are explained by what occurs in the context of the particular time segment within which it is observed to be acting. Secondarily, while a present event or configuration is explained by the continuous operation of Radial Energy, as well as its historical antecedents, the possibilities inherent in previous configurations are explained by past operations of Radial Energy, their own antecedents and by what arises from them.

It is then argued that, despite this indeterminacy occurring on every biological level, there exists a fundamental determinacy for Teilhard which results in the complexity-consciousness series. It is on the basis of this series that Teilhard makes his primary extrapolation to the future, an extrapolation similar in kind to that allowing the reconstruction of the properties of previously unknown elements of the periodic tables. Having discussed the overall explanatory pattern of the statements which are inferred to compose the orthogenetic theory and having explored some possible inferences which could be derived from the interrelation of deductive nomological statements describing particular circumstances, these various elements are looked at in conjunction with the natural events that are described by them.

Using Hempel's descriptive categories of internal and bridge principles, an attempt is made through analysis, to indicate the way that the various statements about pervasive natural patterns, individual events and classes of events and supporting assumptions are interrelated to form a systematic conceptual reconstruction of physical events. It is asserted that, although this description is far from complete, it is believed sufficient to establish a critique of the structural elements of the orthogenetic theory. This is part of the task of the following chapter, for, although a limited description of the vocabulary and structure was attempted in this chapter, no attempt was made to evaluate the quality of the structural connections or the cogency of the terms. This, along with an explanation of Teilhard's own views on theoretical validation and an estimation of some central Teilhardian concepts, not previously discussed, constitute the subject matter of the third chapter.

AN EXPOSITION AND CRITIQUE OF THE LOGICAL STRUCTURE AND BIOLOGICAL BASIS OF THE ORTHOGENETIC THEORY OF PIERRE TEILHARD DE CHARDIN

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CHAPTER II - APPENDIX A

Reason for 'Man as the Problem'

Teilhard chooses (hypothesizes) the phenomenon of Man as the significant datum for the key to universal explanation because of the sort of reasons he advances in the following passages,

> Let us look more closely in the light of the latest data supplied by the combined ingenuity of an army of research workers. As we are beginning to realise, there are probably tens of thousands of atoms grouped in a single virus molecule. There are certainly tens of thousands of molecules grouped in a single cell. There are millions of brains in a single anthill....
>
> What does this atomism signify except that Cosmic Matter, governed at its lower end (as we already know) by forces of dispersal which slowly cause it to dissolve into atoms, now shows itself to be subjected, at the other end, to an extraordinary power of enforced coalescence, of which the outcome is the emergence, pari passu, of an ever-increasing amount of spiritual energy in matter that is ever more powerfully synthesised? Let me note that there is nothing metaphysical in this. I am not seeking to define either Spirit or Matter. I am simply saying, without leaving the physical field, that the greatest discovery made in this century is probably the realisation that the passage of Time may best be measured by the gradual gathering of Matter in superposed groups, of which the arrangement, ever richer and more centralised, radiates outwards from an ever more luminous fringe of liberty and interiority. The phenomenon of growing consciousness on earth, in short, is directly due to the increasingly advanced organisation of more and more complicated elements, successively created by the working of chemistry and of Life. At the present time I can see no more satisfactory solution of the enigma presented to us by the physical progress of the Universe. In what I have said thus far I have been looking at Life in general, in its entirety. We come now the particular case which interests us most - the problem of Man.
>
> The existence of an ascendant movement in the Universe has been revealed to us by the study of palaeontology. Where is Man to be situated in this line of progress?
>
> The answer is clear. If, as I maintain, the movement of the cosmos towards the highest degree of consciousness is not an optical illusion, but represents the 'essence of biological evolution, then, in the curve traced by Life, Man is unquestionably situated at the topmost point; and it is he, by his

emergence and existence, who finally proves the reality and defines the trajectory - 'the dot on the i'....

Indeed, within the field accessible to our experience, does not the birth of Thought stand out as a critical point through which all the striving of previous ages passes and is consummated- the critical point traversed by consciousness, when, by force of concentration, it ends by reflecting upon itself?

Prior to Galileo science thought of Man as the mathematical and moral centre of a World composed of spheres turning statically upon themselves. But in terms of our modern neo-anthropocentricity, Man, both diminished and enlarged, becomes the <u>head</u> (terrestrial) of a Universe that is in the process of psychic transformation - Man, the last-formed, most complex and most conscious of 'molecules'. From which it follows that, borne on the tide of millions of years of psychogenesis, we have the right to consider ourselves the fruit of a progression - the children of progress.[1]

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1. Teilhard de Chardin, P., "Some Reflections on Progress", in <u>The Future of Man</u>, pp. 66-67.

CHAPTER III

A CRITIQUE OF ORTHOGENESIS, THEORETICAL COGENCY AND THE LOGIC OF CONFIRMATION

INTRODUCTION

This chapter presents a critique, an evaluation of the structure of orthogenesis and Teilhard's own criteria of validation.

It begins by defending his general heuristic and the notions of wholes, 'emergents' and historical explanation. It describes and defends his usage of the terms 'phenomenon' and 'ultra physics'. It establishes his intentions to produce a scientific theory of orthogenesis and his realization that the statement he did produce was incomplete. It shows that, while Teilhard was not guilty of logical fallacy, his failure to provide conceptually and physically adequate definitions jeopardizes the scientific cogency of his theory. It argues further that Teilhard did not supply the prerequisite structural connective 'correspondence rule' between the explanatory levels of his theory, that even taking into account his own criteria of coherence and fertility, his failure to provide these connectives and definitions makes several of his claims about the presence and generality of structure and processes in the world non-testable and so, scientifically unacceptable. Finally, it is argued that there appears to be no reason why these links could not be supplied.

1. An Assessment of Central Teilhardian Concepts.

D'Abro writes in The Rise of the New Physics, that,

> According to Planck, the two fundamental canons of natural philosophy are,
> 1. There is a real outer world which exists independently of our act of knowing.
> 2. The Real or outer meaning is not directly Knowable.
>
> The first of these statements cannot be proved or disproved, either by a priori argument or experiment. The stand of the solipsist is unassailable....[1]

Insofar as Teilhard accepts these two propositions, on the assumption that Planck is correct, the observation holds good for Teilhard's ultimate epistemological assumptions. However, there still remain his other key notions such as his concept of History, 'wholes', 'physics', 'hyperphysics', 'phenomena' which can be analyzed and assessed.

1.1 Historical Explanation

Perhaps the best argument for the cogency of Teilhard's notion of the necessity of the concept of history is that other major working biologists, one of which being G.G. Simpson who is in fact generally opposed to much of Teilhard's thought, have, independently of Teilhard, arrived at roughly the same position concerning this concept. For this reason, arguments concerning the question of whether or not biological systems could in principle be described in the same manner as non-organic physical systems are misconceived. The problems entailed with

1. D'Abro, The Rise of the New Physics, New York, Dover, 1939, p. 14.

the description of biological systems is not merely logical but epistemological and methodological. The difficulty inherent in the question of the pattern of biological systems is not whether or not it is logically possible to explain all biological systems according to the deductive nomological pattern of explanation, but whether or not such a description would be adequate and whether or not there is some alternative mode(s) of description which more adequately describe, at least some biological phenomena, than state descriptions[2] employing mechanical state variables. The answer given by many of the important biologists in the field is that biological explanations cannot be adequately described in the mechanistic manner and that other types must be used. For example, such notable biologists as Ernest Mayr, Theodosius Dobzhansky and G.G. Simpson, all accept the necessity of historical explanation as a necessary adjunct to other forms of biological explanation[3]. When it is remembered that the mechanistic form of explanation previously described was adopted for pragmatic and historical reasons, the statements

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2. As Nagel contends, "Although the analytical mechanics of point-masses dominated the minds of physicists for two centuries as the most qualified candidate for the role of a universal science of nature, only in astronomy was this theory employed with all strictness and practical success. The Laplacian ideal of a rigorously deterministic science, in which the mechanical definition of state is an essential feature, proved to be either unrealizable or too difficult to realize in most other domains. Physicists continued to pay lip service to that ideal. But in actual practice, they found unavoidable the adoption of different or at least modified definitions of physical states in most branches of science - even in physics". As found in The Structure of Science, pp. 285-286.

3. See Appendix A, "Reductionism, Levels and Historical Explanation".

of these men working in the field of biology carry some weight. This type of argument, however, only holds for that part of Teilhard's concept of history which does not directly derive its meaning from the Orthogenetic Theory itself. This latter must be asserted separately. Thus, as it seems to be the case, if what Teilhard means by 'historical process' is a sequence of events, often dissimilar, related by temporal antecedents and posteriority, then his concept of history, since it accords with Simpson's, may be considered as independant in its meaning in the Orthogenetic Theory. However, since Teilhard postulates the reason for the historical process as a partial result of the continual activity of Radial Energy, the cogency of that part of his general notion of history is dependant on the cogency of his theory.

1.2 Wholes, Emergents and Reduction

The same overall argument holds good for Teilhard's concept of 'wholes', 'emergents' and its inverse 'reducibles'. G.H. Waddington, for example, contrasts atomic theories with what he calls a continuum theory. About this latter he writes,

> Continuum theories attempt to account for phenomena in terms of sets of relations. Any elementary factors which enter into the expression of such a theoretical structure are no more than nodal points within sets of relations, and their properties depend on and arise from the relations into which they enter.[4]

Waddington also maintains that there are few biologists who would claim either type of explanation alone is sufficient. Biologists have "to

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4. Waddington, C.H., The Nature of Life, New York, Atheneum, 1962, p. 22.

utilize both atomistic and continuum modes of approach simultaneously"[5].

Dobzhansky gives further credence to this claim when he says,

> There is....an influential school of thought among scientists which contends that if one concentrates all attention and all the research support on molecular biology and molecular genetics, then all organismic biology and genetics will somehow explain itself without need of research on the organismic level. I can hardly imagine a contention more misconceived. The laws of Mendel, of gene segregation and recombination, are not deducible from any glorious achievements of chromosomic and gene chemistry and not need be so deduced. Mendel's laws and much else in biology have been discovered through studies on the organismic level. Biology moves both downwards and upwards - from organismic to the molecular and from the molecular to the organismic levels.[6]

G.G. Simpson is even more emphatic in his rejection of reductionism. He says, for example, that this position "falsifies" the very nature of biology and of science through a supreme acceptance of the dictum that all science is in essence a physical science. Once again, however, aspects of Teilhard's notions of 'emergents', 'levels', 'spheres' and 'stages' are theory dependent.

Unfortunately, Teilhard does not provide any complete account of what he means by 'level', 'sphere' or 'biosphere'; however, certain inferences may be made as to his meaning. Teilhard writes for example, that,

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5. __________, The Nature of Life, p. 24.

6. Simpson continues by saying,

"In fact the life sciences are not only much more complicated than the physical sciences, they are also much broader in significance and they penetrate much farther into the exploration of the universe that is science than do the physical sciences. They require and embrace the data and all the explanatory principles that are no less - that are, in a sense, even more scientific". As found in This View of Life, p. 104.

> If there is one thing clearly brought out by the latest advances in physics, it is that in our experience, there are different orders of 'spheres' or 'levels' in the unity of nature. Each of them distinguished by the dominance of certain factors which are imperceptible or negligible in a neighboring sphere or on an adjacent level.[7]

1.3 Emergents, Levels and Stages

From a variety of Teilhardian texts, the following provisional definitions may be given for the terms 'emergents', 'levels' and 'stages'.

In general, on the level of the individual natural core, an 'emergent' phenomenon is a property (or an individual possessing such a property), structure, function or capacity for function, not previously observed, predictable to a centro-complexity (or group), the appearance of which is attributable to the relationship of some properties but not attributable to any elemental properties considered individually. In interorganic relationships, one such set of properties is considered higher than another when one set of properties manifests all the functions of the other plus another range of functions.

A 'sphere' or 'level' occurs when an emergent property is multiplied through a number of individuals. This property becomes primarily defining. One level is considered higher than another level when it encompasses all the functions of the other and displays its own unique functions as well, or when it incorporates the structure and functions of another sphere in order to manifest its own. A level which is earlier

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7. Teilhard de Chardin, P., The Phenomenon of Man, p. 54.

or later than another level is known as a 'stage'.

In the development of the individual, a stage which is consequent is nearly always more complex than an antecedent stage. In the development of the phylum, one stage is usually more complex than an earlier stage because the earlier stage plus its changes are incorporated into the later stage. Furthermore, according to Teilhard, in the development of life, there was always one consequent stage which did incorporate an earlier stage. These definitions do not contradict in any way, the statements of other biologists as such, but again it must be remembered that the property Teilhard was mainly concerned with is that of consciousness[8]..

The veracity and special meanings of these terms are then also dependent upon the general veridicy of Teilhard's theory. The essential point is that Teilhard's theory cannot be ruled unscientific on the basis of these general notions alone.

2. The Teilhardian Phenomenology

Teilhard's use of the term "phenomenon" is both farily straightforward and shares much in common as to its meaning with the main stream usage in the history of science. Teilhard says in an essay written about ten years before in his book of the same title that "By the expression 'The Phenomenon of Man' we mean here the empirical fact of the

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8. For Teilhard of course, consciousness does not emerge per se as it is a universal 'property', rather it is types and dispositions of consicousness that occurs through arrangements.

appearance in our universe of the power of reflection and thought"[9] and from this statement as well as others it may be inferred that for Teilhard a phenomenon is whatever appears to human consciousness and is perceived to be situated in a web of physical connections. A phenomenon is, then, any unexplained empirical event whether entity, property, effect or system which must be explained. According to Teilhard, to explain or "to know a thing scientifically (whether being or phenomenon), is to place it in a physical system of temporal antecedents and spatial links"[10].

The concept of phenomenon is a relativistic notion. Every event has some perceivable inter-relationship with other events and so cannot be considered a pure datum; conversely, since no explanation of any event may be considered final or total, every event or system of events must be considered phenomenal relative to some possible further knowledge of connection. A phenomenon is any event which can be investigated empirically. This is to say, any event which is observable or at least has empirical consequences.

Teilhard says on this,

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9. Teilhard de Chardin, P., "The Phenomenon of Man", in The Vision of the Past, p. 161. Strictly speaking, for Teilhard, an absolutely discreet event is impossible. Teilhard says on this, "Either you must admit that nothing can enter the realm of experience without being introduced by some precursor, in which case you are entirely an evolutionist. Or else you believe that a thing can appear without being born, and then you are starting an impossible battle with the very structure of the perceptual world".

10. __________, "The Natural History of the World", in The Vision of the Past, p. 103.

> Everything is classifiable, that is to say, everything finds its natural place....spatial and temporal in the general history of the earth. This is an enormous fact: the veritable proof that the sensible appearance and progressive stages of life obey an empirical law that is to say, can be treated by science as a phenomenon.[11]

and when speaking of his theory, Teilhard says, "In what follows I am expressly and rightly taking my stand on the grounds of the facts, that is to say, in the field of the tangible and photographable"[12].

The only major source of difficulty concerning Teilhard's notion of phenomena involves the fact that, at some time between the years 1928 and 1933, there is a shift in his epistemology with a reciprocal

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11. __________, "What should we think of transformism", in The Vision of the Past, p. 152.

12. __________, "Man's Place in the Universe", in The Vision of the Past, p. 217. This Teilhardian usage is quite similar to the third sense of the term phenomenon described in the Dictionary of Philosophy and Psychology, which reads,

"(3) It is also used in what we may term a naturalistic or positivistic sense: it is the object or event in space or time, and as such, capable of accurate observation and description; reflection based upon it is verifiable.

This third sense is also derived from Kant, but is used without any reference to the subjective factor - to the part played passively by our sensibility and actively by our understanding in the constitution of the phenomenon. The reconciliation of this third sense, which makes phenomena the data of positive science and thus objective, and the second, which defines them through reference to impressions made upon our senses were different), constitutes the chief problem of the concept of 'phenomena'. To meet the difficulty, Kant employed his distinction of matter and form; but since, according to modern science, 'matter' of objects throughout, down to its last sensuous detail, is subject to quantitative laws - since, indeed, it is just this 'matter' which is the real object of science - the distinction of phenomena as related to us, in distinction from objects in themselves, seems practically to fall through.

(4) It is used in a colourless philosophic sense, as equivalent to 'fact', or event - to any particular which requires explanation". As found in Volume II (James Baldwin, ed.), New York, Smith, 1940, p. 289.

alteration in his conception of explanation. Prior to 1933 as it appears, for example, in his essay "The Natural History of the World", Teilhard seemed to view phenomena as that which could be perceived (measured, observed, quantified) either directly or indirectly. Indirect perception entailed postulated structures and processes about which, for some reasons not specified by Teilhard, it could be expected some future advance in instrumentation would bring the objects of investigation into man's extended purview. Teilhard writes in this period that two very different elements can be discerned in scientific constructions. These are, "(a) Mathematical expressions relating measures applied to phenomena and (b) The physical entities (properties in the first place but afterwards the natural cores) progressively discerned and discovered by a network of laws and calculations"[13]. He provides a physical example of what he means by this through the electron. Teilhard writes, "Clearly the mathematical laws regulating the distribution and movement of electrons are liable to great changes. But the electrons themselves, once seen directly, will no more depart from the heaven of human experience, than Neptune, once seen through a telescope or the sun"[14].

In this framework, hypothetical knowledge of suspected entities is derived through conceptual techniques such as mathematical deduction but validated or verified when brought into the range of microscopes,

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13. __________, "The Natural History of the World" (1925), in The Vision of the Past, p. 111.

14. __________, "The Natural History of the World" (1925), in The Vision of the Past, p. 111.

telescopes or some other form of instrumentation which extends human senses. However, by the time Teilhard posits the complexity-consciousness law, his view of what constitutes phenomena has altered. A phenomenon such as consciousness need not be perceived directly, even potentially, but only through its effects, except in the case of self-reflection. Concomittantly as it will be developed in a subsequent section, one important test of the existence of a hypothetical entity or process is whether or not it can be harmonized in a large body of facts[15]. It need not necessarily be directly or indirectly sensed in itself to be validated or confirmed.

It is quite clear from what Teilhard says that he had only a very scant acquaintance with philosophical phenomenology. His basic notion is derived directly from the science he was familiar with and the term refers to that which can be observed, measured or spatio-temporarily located. He writes for example,

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15. Teilhard says, for example, "Spirit is neither a meta nor epiphenomenon, it is the phenomenon....to establish the value of this viewpoint....my only form of argument will be the argument of coherence. As found in "The Phenomenon of Spirituality", in Human Energy, p. 94. It is doubtful that consciousness in the state of "as....no true within but only the 'disposition' to cause one" ("Centrology", in Activation of Energy, p. 105) would ever in Teilhard's eyes achieve the status of a phenomenon. Nevertheless, at least from the time of the Phenomenon of Man onward, even in its most primitive state, it becomes a scientifically acceptable construct which is evoked to explain the centering of matter upon itself, prior to the complexity-consciousness law, while Teilhard believed that "Energies of a psychic nature, everywhere control the development of Life" in "What Should we think of Transformism" (1930), in The Vision of The Past, p. 159. This postulate was, for Teilhard, philosophical, not scientific, for he writes, "....by virtue of what inner power and with a view to what 'ontological' growth does this birth take place? Pure Science does not know and it is philosophy's taks to decide", in "What Should we Think of Transformism?", in Vision of the Past, p.154.

> I recognize that my "phenomenology" is not that of Husserl and Merleau-Ponty. But where can I find another word to define a Weltanschauung based on the study of the development of the Phenomenon? We are forced to use the word "evolution" for theories which are very much different from one another. In fact, if I understand them properly, the "phenomenologists" rather usurp their title in so far as they appear to ignore one of the most essential dimensions of the Phenomenon; this consists not only in being perceived by an individual consciousness, but also in making it clear to that consciousness, at the same time, that it is included in a universal process of "noogenesis". I do not understand how anyone can call himself a "phenomenologist" and write whole books without ever mentioning or touching on cosmogenesis and evolution.[16]

It is apparent, as well, from his actual usage of this term in the context of his works that his meaning has little affinity with twentieth century philosophical European phenomenology.

3. Physics and Ultra-physics

Quite closely connected with the Teilhardian notion of phenomenon is his conception of 'physics'. Physics, for Teilhard, does not entail exclusively the concept of matter in motion of the nineteenth century mechanists but a science which includes this study as a subset of the general set of complexity-consciousness. Illustrating this point, Teilhard says, in a series of letters quoted by Claude Cuenot, that

> It strikes me, at the moment, that there are two kinds of knowledge, (the world of ideas and of principles and this kind I mistrust instinctively), and a "real" knowledge, (which consists in the conscious actuation, (that is, in the extended creation) of the universe around us). The first of these two kinds of knowledge changes neither the world nor the knowing subject. The second coincides with both a perfecting of the world and an ontological growth in the knowing subject (this

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16. Cuenot, Claude, Teilhard de Chardin, (Vincent Colimore, transl.), London, Burns and Oates, 1965, pp. 255-256.

> is especially the case with mystical knowledge)....I mistrust metaphysics (in the customary sense of the term) because I feel it is a sort of geometry. But I am ready to recognize another kind of metaphysics, which would really be a hyper-physics--or a hyper-biology.
>
> ....I should be happy to see you do what I am trying to do, that is, penetrate still further into spiritual and human questions by the use of the methods of science, substituting for the metaphysics of which we are dying, an ultraphysics (the real phusike of the Greeks I imagine) where matter and spirit would be embraced in one single coherent and homogeneous explanation of the world.[17]

And so, this is what constitutes his generalized phenomenology, anthropogenesis, hyper-physics or hyper-biology. At first it might appear to be, as a program, a sharp departure from any orthodox notion of physical science but when it is remembered that many scientists including Einstein viewed the role of science to be the rendering of datum of the senses intelligible by situating them in ever expanding universal patterns,

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17. __________, Teilhard de Chardin, p. 213.

then Teilhard's goal[18] does not appear so alien to the scientific enterprise. Naturally, since Teilhard did not believe that the major unifying patterns of the universe were to be found in those properties and forces of the world studied by physicists, but rather in a simple law of psychic concentration, he did not devote very much of his exploration to the primary properties of matter. This, however, of itself, cannot a priori render the orthogenetic theory invalid, since there is no logically necessary reason for supposing those structures and processes studied by physics are, in fact, the sole and primary properties of the universe.

Two ancillary questions connected with Teilhard's notion of

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18. Teilhard writes, "But what exactly is the phenomenon of man? That is to say, in rather more precise terms: 'What is the place and purpose of this extraordinary power of thought in the development of the world of experience?' Let us repeat: Man today is scientifically known and recognized by a great number of detailed properties or connections. But, perhaps because some are afraid of lapsing into metaphysics and others of desecrating the 'soul' by treating it as a simply physical object, man, in his special and most revealing characteristics, that is to say in what are called his 'spiritual' properties, is still left out of our general pictures of the world. Hence this paradoxical fact: there is a science of the universe without man. There is also a science of man as marginal to the universe; but there is not yet a science of the universe that embraces man as such. Present-day physics (taking this word in the broad Greek sense of a 'systematic understanding of all nature') does not yet give a place to thought; which means that it still exists in complete independence of the most remarkable phenomenon exposed by nature to our observation.

We should like, in these pages, to combat this very anti-scientific situation by sketching in very broad outline the possible features of a universe in which the specifically human characteristics (reflexion and thought) will be introduced as a sort of new dimension. This attempt is of course quite provisional. It is in danger of appearing to some a poetic invention rather than a system of solidly assembled facts. But who can say that an attractive harmony may not to some extent, be the birth-charm and precursor of a stricter truth?". As found in "The Phenomenon of Man" (1930), in The Vision of the Past, p. 162.

physics and phenomenology concerned the reasons for the apparent lack of the type of research methodology usually associated with a biological science and the other question concerns what Teilhard intended to accomplish through his theory of orthogenesis. Beginning with his latter point first, it can be stated unequivocally that Teilhard intended orthogenesis to be a scientific theory and he wanted it to be recognized as such. Teilhard states that, "Willingly or unwillingly, pale ontology is and cannot help becoming increasingly the science of orthogenesis, which it must consider both in its general, fundamental drift and in the various branches into which it divides in the course of its route"[19]. This is not to say that Teilhard saw the sole function of orthogenesis as providing scientific explanation or that his motivation was exclusively to furnish a description of previously undescribed facts. His obvious preoccupation with the content of his religious beliefs is

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19. __________, "A Defense of Orthogenesis" (1955), in The Vision of the Past, p. 273. And elsewhere, in a letter dated February 11, 1952, produced by Claude Cuenot, Teilhard writes,

"....what strikes me more and more is the evident necessity of conceiving and of building a new anthropology. Since the time of Darwin, evolution has passed beyond the narrow limits of zoology and become a general process covering the atom as well as the cell. And, during the same period, while successfully attacking the roots of nuclear and cellular evolution, Man has at the same time learnt that he is both the maker and the subject of some sort of ultra-evolution.

For these two main reasons, the science of Man can no longer be left in the hands of the "writers" or "humanists" for whom Humanity is only a type of isolated and self-sufficient microcosm in the universe - nor in the hands of pure anatomists, whose only interest is to search for osteological differences between Man and the anthropoids, without ever being aware of the frightening power, which suddenly emerged in a Pliocene primate, to change the whole face of the earth in the course of a million years...." As found in Teilhard de Chardin, p. 348.

paramount. Nevertheless, he felt it necessary to ground those beliefs in the empirically established context of orthogenesis. If this is not the case, his concern with demonstrating the complexity-consciousness law as experimental and verifiable, as well as the program he suggests in the following passages, becomes completely unintelligible. He says that,

> The notion of critical thresholds is commonly accepted today in physics, in chemistry, and in genetics. The time surely had to come for us to make use of it in order to reconstruct the entire fabric of anthropology on a new and solid foundation. By pure 'anatomical' routine, man is still inexplicably regarded by the majority of biologists as a mere filament (or sub-filament) in the fascicle of zoological forms....
>
> And yet, as a matter of sound science, is it not time for us to recognize that such a view is certainly mistaken?[20]

The initial statement of the new anthropology entails Teilhard's description of the complexity-consciousness law[21].

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20. __________, "The Convergence of the Universe", in Activation of Energy, pp. 284-285. He says that the view of man as an "utterly insignificant leaflet" is "radically transformed by the discovery of an exact parameter (I mean the rise of reflection) which allows us to distinguish and estimate, in terms of absolute value, a certain drift inherent in life". As found in "The Convergence of the Universe", in Activation of Energy, pp. 285, 289.

21. Teilhard writes about this saying,

"At present the science of man is vegetating because it is still no more than a branch of humanism equipped with technical terms. But on the other hand, in order to escape the humanists, it requires only one perfectly possible condition: the final establishment of a relationship of an energizing nature prevailing all along the line, between physics and the human phenomenon.

I have already suggested on several occasions that such a relationship is furnished by the visible process of complexity/consciousness which, 'at right angles' to entropy, irresistibly by the play of great numbers, draws a fraction of matter simultaneously to arrange and interiorize itself on itself; human socialization being, from this point of view, merely the highest phase of the 'complexification' and 'growth into consciousness' of the biosphere". As found in "Hominization and Speciation" (1952), in The Vision of the Past, p. 264.

Teilhard says about the complexity-consciousness law;

> In order to estimate the degree of organicity attained by an arrangement in the universe, we must now realize, it is not directly the variation of the constituent elements that we have to consider--nor even the rigidity of the links that ensure the permanence of the system. It is the irreversible appearance or growth, within the assembly, of certain fundamental properties, of which the most significant, in the organic series, is the gradual emergence of the effect of indetermination and preferential choice...[22]

The description of the regularity of growth is the law itself and the description of the effects of the overall growth is orthogenesis. It must also be recognized, however, that, simply because Teilhard intended a scientific theory, or perhaps even a completely new branch of scientific theorizing, does not mean that he effectively produced one. Whether he did, in fact, succeed can only be answered on the basis of an assessment of the structure of the theory itself and its evidence.

3.1 The Problem of Teilhardian Research Methodology

However, returning for the moment to the problem represented by Teilhard's research methodology, that is, the reasons he did not use or even mention to any extent the analytical techniques or more unusual research procedures, the following point can be made. Teilhard says, "What we most urgently need in order to appreciate the convergence of the universe is much less new facts (there are enough and even more than

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22. __________, "The Convergence of the Universe", in <u>Activation of Energy</u>, pp. 287-288.

enough of these in every quarter) than a new way of looking at the facts and accepting them"[22a].

Teilhard, then, is not seeking new data for the construction of his theory and so does not use the procedures followed by experimentalists to derive new data; rather, he is looking for a new unifying concept which can only come out of the creative imagination of the scientist. As was previously seen, in this. there is nothing scientifically unacceptable. In Norwood Russell Hanson's words,

> A theory may change not because of its inadequacy to deal with yesterday's facts, nor because of its incapacity to cope with today's new discoveries. New ideas alone may force its revision. Asking after the operational cash value of the expression; simultaneous events; when these events may be separated by thousands of light years, was, for Einstein, an idea which served to relocate all astrophysical thinking.[23]

For Teilhard, such a set of concepts as those involving the place of human psyche in the universe and its connection with complexification was precisely that sort of idea which, for him, would force a radical revision of biological and physical theories.

4. Incompleteness

Whatever Teilhard's intentions were, when the theory itself is analyzed, there can be found /laxities in its statement which are indeed damaging to its scientific status. One of the major sources for the

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22a. __________, "The Convergence of the Universe", in Activation of Energy, pp. 295.

23. Norwood Russell Hanson, "The Language of Theories", in The Philosophy of Science, 1959, p. 80.

critique of orthogenesis can be had through an assessment of its theoretical incompleteness.

One of the keys to understanding the form and content of the orthogenetic theory, as well as some possible grounds for objections to it, is its incompleteness. There are at least three possible areas of investigation corresponding to three senses of lack of theoretical completeness which can be distinguished.

In the first instance, a theory might be considered incomplete because the description it gives of the phenomena it purports to explain lacks a full statement of necessary and sufficient conditions for its application or the fullest possible refinement of expression (quantification or incomplete nomological description). It is these types of explanatory insufficiency which make scientific theories approximations.

In the second instance, a theory might be held to be incomplete because it lacks certain structural elements which allow physical confirmation. Thirdly, there is incompleteness of evidential or confirming theoretical support[24].

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24. Teilhard recognizes this form of incompleteness when he says, "It seems, then, that we have two opposed evaluations of this process of the in-folding of Humanity upon itself; a process which is clearly apparent and which nothing can prevent.
a) That the planetary collectivisation which confronts us is a crude phenomenon of mechanisation or senescence which will end by dehumanizing us;
b) That, on the contrary, it is a mark and an effect of biological super-arrangement destined to ultra-personalise us.

I maintain that, of these two judgements, it is the second which is far more likely to fit the reality. That its validity has not yet been finally demonstrated or verified may be admitted. Nevertheless, it is solid enough for us to feel, considering the moment of history in which we live that the time has come when we may, indeed must, resolutely stake our future on it". In "Does Mankind Move Biologically Upon Itself" (1950), in The Future of Man, p. 254.

Even though these three areas are by no means mutually exclusive, it is with the second and third senses of incompleteness that the following pages are mainly concerned.

It can be observed that Teilhard was aware that his theory was by no means a finished product. He says, for example, in the Phenomenon of Man that "The true physics is that which will one day achieve the inclusion of man in his wholeness in a coherent picture of the world"[25]. Elsewhere he states,

> In the nineteenth century the theory of evolution (transformism) was simply a problem of animal speciation. Today, it extends to the general problem of 'the corpusculization of energy' throughout time, from the atomic elements up to the individual man....[26]

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25. __________, Foreword, in The Phenomenon of Man, p. 36. And elsewhere, Teilhard writes, "The views that I present are still.... only at their birth. Do not, therefore, take them as universally accepted or definitive. What I am putting before you are suggestions, rather than affirmations...." In "Man's Place in the Universe: Reflexions on Complexity" (1942), in The Vision of the Past, p. 217. It is also clear by the following lines that Teilhard was aware that his 'picture' of the world was not accepted by the majority of biologists. He writes,
"Of itself, and in itself, a cosmogenesis may have all sorts of forms. It could, for example, be conceived *a priori* either as an orderless turmoil in process of dissipation (pseudo-cosmogenesis) - or on the contrary as a *directed* process (eu-cosmogenesis): this latter again, in turn, might either spread equally in all directions (like a ray in an amorphous medium), or (as light in an anisotropic medium) become polarized along certain favoured axes.
In the experimental reality of things, the question is, "With which of these various types of evolution are we in practice concerned?"
Although before long an answer must inevitably be found to this important question, it does not seem that science has yet *explicitly* come to any definitive conclusion". In "Reflections on an Ultra-Human" (1951), in Activation of Energy, p. 273.

26. __________, "The Reflection of Energy", in Activation of Energy, p. 324.

The physics as it was previously discussed is one in which consciousness is accounted for as well as the tangential transformations of orthodox physical description. This is, of course, what his complexity-consciousness law is meant to do but, even in Teilhard's view, the description of his law is not equivalent to having provided the full statement of a new science but rather a tentative explanation of certain phenomena previously unexplained on the basis of which a science of anthropogenesis or hyperphysics could be built. Teilhard provides some indications of the areas in which a biogenesis could be developed and one of these involves quantification. He says, for example, about the transformations occurring between the within and without, that "it can in all probability only be expressed by a complex symbolism in which terms of a different order are employed"[27]. As well as developing or expanding the language (mathematics) of description, Teilhard believed that his statement of the conditions under which the complexity-consciousness law operates as well as the law itself needed further definition. He says, for instance, that "From a thermo-dynamic viewpoint, I do not feel myself equipped to discuss the nature and laws of what one might call the specific energy of arrangement in nature. Perhaps cybernetics will help us to do so"[28].

Finally, Teilhard suggests the need for new criteria for accepting facts as well as an accumulation of facts to verify or confirm the

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27. __________, The Phenomenon of Man, p. 64.

28. __________, "Reality and Significance of Human Orthogenesis", in The Vision of the Past, p. 254.

complexity-consciousness law. About this he says

> To effect this verification one would obviously do well to find out by all possible means, whether there might not.... be some physical or psychic way of detecting and measuring at every moment (in such a way as to express it in a curve) the noosphere's degree of reflection (or, if we may use the phrase, its psychic temperature).[29]

However, even after having seen that Teilhard himself recognized, to some extent at least, the incompleteness of his theory from an emperical standpoint, it will be argued in the following pages that the structural incompleteness, which he did not seem to recognize, is extremely damaging to the scientific status of his claims relative to their cogency and statement of generality. However, before considering the topic of structural incompleteness, it seems useful to consider some logical fallacies that Teilhard might be considered to have committed in the statement of his theory but, in fact, did not.

5. Orthogenetic Generalization and the Logic of Confirmation

According to some accounts of logical fallacies, Teilhard might appear to have committed the fallacy of hasty generalization or illegitimate extension. Certainly on the basis of the 'discovery' of one conjunction of properties, complexity-consciousness, in one class of events (species man), he intends the consciousness property and the complexity-consciousness correlate to include many classes of natural events throughout the whole of cosmic duration. However, the complexity-

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29. __________, "A Major Problem for Anthropology" (1951), in Activation of Energy, p. 317.

consciousness law cannot be assailed from this position, or if it can, so may many, if not every other, scientific theory - just as any theory cannot be judged scientifically illegitimate simply on the basis of proposing to delineate some universal or pervasive trail of nature, on a relatively narrow empirical base.

What makes a theory a theory is that the patterns that it proposes to be discerned or explained (presence or generality in the exclusive sense of 'or'), are proposed on the basis of a supposition or guess. That is to say, on the basis of an imaginative conceptual leap and on the basis of little empirical support. It is also evident that, even where a theory's statement postulates some universal mechanism and that theory has received some type of confirmation or evidential support, the theory's claim will always outstrip its verifying instances. This is a consequent of the nature of the claim. Teilhard, for example, asserts by implication that Radial Energy everywhere and always exerts force on the Tangential Energy to form natural cores; however, even on the supposition that this proposal can be in some fashion empirically confirmed, it is virtually impossible that every instance of the activity of Radial Energy or Tangential Energy in the present and in the past may be discovered, and logically impossible that every future instance can be known. Furthermore, no matter how many confirming instances of the operation of Radial Energy are discovered to hold in the future, there always exists the chance that some future disconfirming instance will occur. Nevertheless, Teilhard postulates that Radial Energy operates always in the same way. As it was stated, in respect to its postulated generality at least, Teilhard's claim shares an identical epistemological status with many of the proposals that science puts forward. The chemist, for example, who proposes that under constant pressure, the volume of a fixed weight of gas is directly proportional to its temperature on the absolute scale (Charles' Law), or that at room temperature Bromine is a dark red liquid, has not and cannot check every instance of a volume of a fixed weight of gas or of Bromine at a room temperature. It is the same case with the physicist who asserts that the relationship involved in measuring the amount of radiant thermal energy falling on a unit area, in a unit time, is one in which the intensity varies inversely as the square of the distance from the source; or the biologist who contends, as a statistical genetic law, that in any inter-breeding of animals of the same variety, where there is a recessive and dominant genetic load (hetro zygotes), the resultant generation is one half hetro-zygote, one fourth homozygotic recessive (no dominant factor present) and one fourth homozygotic dominant.

If the attempt to label Teilhard's theory as fallacious on the basis of the utilization of an illegitimate extension would appear to be inappropriate for the previously given reasons, so too would the attempt to assert that Teilhard, in his use of his Complexity-Consciousness Law, commits the formal fallacy of 'affirming the consequent', for the following reasons. According to formal deductive logical rules, any propositional schema of the following kind is invalid,

1. If P then Q
2. It is the case that Q

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3. therefore it is the case that P,

since it is logically possible that Q might have happened, or be implied by some antecedent other than P. However, the physical world does not always allow itself to be described in deductively valid patterns, and the criteria of deductive logic are rarely suitable for assessing the soundness of scientific inference. It is often the case, for instance, that the antecedents of an event are, for a variety of reasons, hidden. In any case, where a pattern or set of conditions are postulated, either because the antecedent events occurred in the non-observed past, or might occur in the non-observable future, or beyond the perceptual range, a scientist is often in the position of having to affirm the consequent. This contention may be partially supported through the following examples. Any aqueous solution containing hydrogen ions will react to litmus paper by turning blue litmus paper red. This blue litmus paper, when dipped in an aqueous solution, turns from blue to red. Therefore, this aqueous solution contains hydrogen ions. The antecedent term here makes reference to a theoretical entity (hydronium or hydrogen ions) which can only be observed through its effects, while the consequent is one of the effects that occurs on the observational level. It is only thus indirectly, through multiple instances of affirming the consequent, that the presence of the hypothetical entities can be tentatively known. Rational belief in the presence of the postulated hydrogen ions in the solution increases with the number of confirming instances of the solution reacting with the litmus in the expected way. This type of situation is by no means unique to chemistry. It is found anywhere an antecedent is postulated.

The multiplication of confirming instances, whether brought about experimentally or through repeated observations, functions to increase the belief in the strength of the hypothetical antecedent. It is the case, however, that no number of favourable outcomes or test corroboration will allow the certain affirmation of the antecedent. The confirming instance always lacks deductive certitude. On the other hand, one disconfirming instance may be sufficient to cast doubt upon the presence or reality of the entity postulated as antecedent[30].

There are many instances, within the orthogenetic theory, of Teilhard affirming the consequent. This may be illustrated by the following example. Teilhard implicitly argues throughout his statement of the orthogenetic theory that,

> Every entity which is centered is preceded by an activation of Radial Energy (structurally and temporally)
>
> Entity X is a centered entity
>
> ---
>
> Entity X is the consequent of an activation of Radial Energy

Here the antecendent is hypothetical, while the observed effect, supposing the entity is a multicelled organism, on the level of observation, just as in the case of the hydrogen ion and its acidic effect. Teilhard's theory, then, cannot be ruled unsound on the basis of

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30. If, for example, litmus paper did not change colour, the conclusion would be expressed in the following as 'this solution does not contain hydrogen ions' and, as a schema, it would assume the deductively valid modus tolens logical form following sentential symbolism:

$$\begin{array}{r} P \supset Q \\ \sim Q \\ \hline \sim P \end{array}$$

this logical fallacy at least.

Unfortunately, the cogency of a scientific theory is not based on the logical validity of its inferential schema. It must be judged too, as was suggested in the previous chapter, on the presence and quality of the bridge constructs or translation statements, which give his logical schema , empirical implication. Without a consideration of these, it is not possible to decide about the cogency of Orthogenesis and its evidence.

6. Complexity-Consciousness, Periodicity and Definition.

It can be noticed in the chemical example of 'affirming the consequent', mentioned in a prior section, that the consequent, the 'effect', has a relatively sharp operational meaning. Given the number of physical tests available, it is unlikely that a chemist would mistake an acid solution for a solution containing ions of another type. The same observation cannot be made about Teilhard's conception of 'organic complexity'. From the chordate onwards, Teilhard categorizes natural centres by the development of their nervous systems. He says in an early chapter in The Phenomenon of Man, that

> We are seeking a qualitative law of development that from sphere to sphere should be capable of explaining first of all the invisibility then the appearance and then the gradual dominance of the within in comparison to the without of things. This law reveals itself once the universe is thought of as passing from state A, characterized by a very large number of simple material elements, that is to say, with a very poor within, to state B, defined by a smaller number of very complex groupings, that is to say, with a much richer within.[31]

31. Teilhard de Chardin, P., The Phenomenon of Man, p. 51.

The law, of course, is the complexity-consciousness law and the 'spheres' refer to the 'quasi-measurable' centro-complexes.

One of the most immediate obvious differences between the periodic series and the complexification series, apart from the methodological and epistemological considerations, generated out of the multiplicity of biological constituents, concerns the lack of definition of centro-complexes.

Despite claims to the contrary, there seems to be no logical reason why there cannot be a valid historical or genetic law. It is a question of empirical fact rather than logical necessity that the known genetic laws to date are of a finite rather than practically infinite nature. There is no inherently logically necessary reason why there could not be a series composed of unique events, yet where the configuration is determined by its antecedent and where no event is necessarily the terminus of the series. In the case of Teilhard's notion of complexification, the end of the series is postulated to occur somewhere in the distant future. The series itself is made up of mostly non-reccurent elements within which there are non-reccurent elements. Nevertheless, the joint epistemological and methodological difficulties which render most of contemporary orthodox evolutionary theory non-predictive, underscore the difficulty entailed in postulating some overall general evolutionary law, genetic or otherwise, such as Teilhard's theory of orthogenesis. According to Ernst Mayr,

> It is now evident that the terms teleology and teleological have been applied to two entirely different sets of phenomena. On the one hand is the production and perfecting throughout the history of the animal and plant kingdoms of ever-new programs

> and of every-improved DNA codes of information. On the other hand, there is the testing of these programs and the decoding of these codes throughout the lifetime of each individual. There is a fundamental difference between, on the one hand, end-directed behavioural activities or developmental processes of an individual or system, which are controlled by a program and....the steady improvement of genetic codes. This genetic improvement is evolutionary adaptation controlled by natural selection.[32]

And elsewhere he says that while "the development of behaviour of the individual is purposive, natural selection is not"[32a]. If, according to Mayr, the individual members of the evolutionary process sometimes display determined sequential and teleonomic patterns of growth and behaviour, there are no such patterns which can be attributed to the overall sequence of biological events. Michael Scriven, in speaking about the Darwinian notions of struggle for survival and survival of the fittest, says,

> Tendency statements like this are explanation-indicators; they justify no more than very weak hypothetical predictions with unspecified conditions ("if everything else was the same, then...."), for they tell us nothing about the likelyhood of conditions of struggle of the strength of the tendency. Perhaps the best way to express their empirical content is to say that they suggest that certain future states of affairs are very unlikely - namely, equilibrium of a mixed population when there is competition for survival.[33]

G.G. Simpson, taking an even stronger position, says, as previously quoted, "The biological subject most obviously and directly historical

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32. Ernst Mayr, "Cause and Effect", in <u>Biology in Science</u>, p. 1504.

32a. __________, "Cause and Effect", in <u>Biology in Science</u>, p. 1504.

33. Scriven, Michael, "Explanation and Prediction", in <u>Evolutionary Theory in Science</u>, p. 481.

is paleontology which is also a part of the subject matter of historical geology"[34]. Simpson also maintains that prediction is possible in historical science, but only to a limited extent and under certain conditions. While Simpson's position itself is fraught with difficulties, the fact remains that there are presently law-like statements in the sciences containing reference to historical stages which are comparable in their statement of generality to Teilhard's notion of complexification.

Excluding the more theoretical reasons such as those for the non-symmetricality of explanation, prediction or retrodiction in the evolutionary theory, the major reasons for the non-acceptance of an overall historical law, given by this scientist and philosopher of science, is that no such general pattern of events has been perceived. This, in turn, could be due to the fact that there is no such overall pattern, or there is, but that it has not been made intelligible because of such reasons as the multiplicity of variables in biological systems.

If the first is the case, then Teilhard is simply mistaken when he claims that there is. If the second is the case, he must demonstrate that he has at least approximately identified that pattern, despite the difficulties entailed in doing so. While the presence or absence of

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34. Simpson, G.G., This View of Life, p. 123. Simpson distinguishes between immanent and configurational in this way. He says, "The unchanging properties of matter and energy and the likewise unchanging processes and principles arising from them are immanent in the material universe. They are non-historical, even though they occur and act in the course of history. The actual state of the universe, or of any part of it at any given time, its configuration, is not immanent, it is constantly changing". In This View of Life, p. 122.

such a pattern is a problem of biological investigation, since Teilhard does claim that he has discerned a universal law, it can, on the basis of the structural criterion previously discussed, at least be provisionally decided whether or not Teilhard provides the prerequisite expressions of the structural connections necessary for an adequate scientific theory. The following sections, partly through comparative analysis, show that Teilhard did provide sufficient support for some of his more significant and general claims, but failed to do so in the case of others. This becomes evident when a detailed analysis of his definitions and bridge constructs is carried out, as well as comparison with a generally recognized scientific law.

6.1 Definition

There is a very definite and precise set of physical operations which allow the properties and behaviours of the elements of the periodic table to be determined[35]. The same is not the case with the elements of Teilhard's complexification series. It is extremely important

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35. An element, for example, is defined as a substance made up of atoms, all of which have the same atomic number, 'protons', and this number can be established by measuring the frequency of X-Rays produced by a substance. The properties of chemical compounds and elements may also be established by a multitude of other physical tests (operations) both quantative and qualitative. Oxygen for example is known to be odourless, tasteless and colourless in a gaseous state and to become a solid at (-219°C) and to boil at (-183°C). This allows of repeatable physical techniques by which an element believed to be oxygen can be defined.

that it be noticed that Teilhard never defines natural unities in any complete, intentional, extensional or operational way. What is meant by this may be demonstrated in the following fashion. If, for instance, this statement of definition to read 'the term, 'natural unity' (central complex) is to be interpreted as designating the following things....', it is immediately obvious that Teilhard nowhere provides a complete list of all and only those things to which the expression applies, nor of where or how the full range of central complexes are to be discovered or known[36]. More seriously, Teilhard does not fully list the defining properties of all levels of natural cores and, as a consequence there are grave difficulties with his definition of complexity as it applies to the subatomic level. It is difficult to see, for example, what operational meaning Teilhard's notion of an arrangement of parts has when dealing with electrons or any of the other subatomic particles.

Generally, though Teilhard does provide examples or at least mentions the type of entity to which the expression centro-complex applies, concepts in contemporary science are typified by much more than this. They are typified by the relative completeness of their operational definition.

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36. In fact, what Teilhard does do is to rely on the sort of indentifications produced by the morphologist. It is possible for him to do this because many of the biotic entities that he works with occur on the phenomenal plane and, as such, can be known and defined ostensively. This procedure, however, is no substitute for refined contextual and operational definitions, as it becomes evident when he moves beyond events occuring on the observational plane.

Much of what should appear in the formal statement of Orthogenesis does not[37]. Even beyond the level of pre-life, there is not to be found a single complete definition of any given central complex. Biological definitions, chemical definitions and physical definitions are assumed by Teilhard, or barely mentioned and are made to do the same sort of work that the sharply defined postulates, given the fullest possible explicit statement, are expected to do in contemporary theory. This is one of the bases of the major structural weakness in orthogenesis. For it is precisely on the foundations of highly refined operational definitions that the possibility of establishing test implications are formed. Also, it is on such definitions that the systems of higher order (more general) explanations, whose bridge constructs are held to connect the statements of underlying universal structures and processes with quasi-operational phenomena become possible with some 'degree' of empirical approximation.

Teilhard is, then, to be faulted for relying on simple ostensive definition in defining his elements when it was often both possible and necessary for him to provide much more explicit definitions. This

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37. Teilhard, whether he is talking about the centres in the domain of pre-life or of life, consistently emphasizes only those aspects of his theory which diverge or digress from orthodox biological theory. But, at the same time, he leaves understated or unstated the postulates and concepts which form the stuff of his theoretical explanation, but which are derived from other theories. While there may be 'more than enough facts' as he states, he ought to have mentioned more of them, at least in order to give his theory more definition (physical).

contention is particularly well illustrated when the consequences of this lack are considered- not only with reference to his elements, but also with reference to his primary categorizing or ordering criterion. A centro-complex is more than just a complexity. It has definable, physical properties of various kinds, but nevertheless it is with those specific properties having to do with complexity that the members of Teilhard's are grouped. Since he does not provide a fully operational definition of complexity, in the pre-vertebraic level, or on the post-hominid level, it is difficult to establish what should count as a higher or lower complex. This considered together with the lack of elemental definitions. seriously damages the structural soundness, as it concerns his higher order explanatory postulates, as will be shown.

Teilhard says, in Activation of Energy,

> In this case (as in that of gravity for example) it is interesting to see how successfully a mere common sense intuition, if it is scientifically developed, more profoundly can be transformed into a general explanation of things.
>
> Let us then decide to recognize not simply an occasional or accidental character in the link between complexity and consciousness that can be seen everywhere in nature, but one that is genetic and functional: in other words, let us hypothetically attribute to the Weltstoff in virtue of a sort of anti-entropy, the property of directing itself by preferential choice, under the play of chance toward progressively more complicated and more fully centred arrangement - this increasing contro-complexification having the effect of producing a constant rise in the psychism of the system.[38]

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38. Teilhard de Chardin, P., "A Major Problem for Anthropology" (1951), in Activation of Energy, p. 315.

7. Definition and Bridge Constructs

The essential problem here, besides that involved with lack of sufficient definition, is whether or not Teilhard provides the necessary bridge principles, in order to give the anti-entropic 'property' a scientifically acceptable connection with the structures and processes occuring on the phenomenal plane. The problem of definition and bridge constructs are not completely separate problems. It is evident that the clearer and more complete the definition (or quantification) of events occuring on the observational plane are, the more possible it becomes to describe the activities (effects) of the theoretically evoked, underlying structures and processes on the observational level. It is evident as well, that bridge constructs which interconnect the basic entities and regular processes (law-like processes), where the experimental events are sharply defined, are of more theoretical significance than those that do not, since error in theoretical description is detectable or more easily detectable. where the specific operations of theoretical entities are well defined in relation to their corresponding macroscopic features. It can be seen, for example, that, while such a statement as 'the radial activation of energy of entity X produces the centricity of Y' has no operational meaning, such statements as 'the radial energy of X manifested in structural and behavioural features bx, by, sx, sy,((where these 'variables' represent well-defined physical properties) under environmental conditions, ec, eg, ef, (where these conditions are also well-defined (temperature, geography)) activates to produce the complexity-consciousness of Y,'(where Y has well defined properties bx^1 by^2); present a description that can be physically verified. This is precisely the kind of statement which is absent, as will be shown, in much of Teilhard's theoretical description. As a single operationally establishable meaning, the concept of complexity varies in 'strength' depending upon the area of the world to which Teilhard applies it. It must be realized, in the first instance, that the knowledge of the events to which the complexity criterion could be applied is far from complete. Particularly in the range of living things, the record of the types as transitional forms is often completely absent. This has important concomitant epistemological implications concerning the possibility of establishing, with any degree of certitude, the ordered series that Teilhard attempts to derive. But even more important from the structural point of view, when the very criterion for categorization lacks a full definition, the very possibility of attaining the theoretical programme is seriously compromised. Teilhard mentions the possibility of using atomic weights to establish degrees of complexity on the molecular and pre-molecular levels. Teilhard provides the most minimal statement of what constitutes the operational criterion of complexity on the level of the mono-cellular and the statement of 'Ariadnes thread', chordatic development allows of the most grossly morphological applications. In more exact terms, using Nagel's adoption of Holder's axioms of measurement, the criterion of quantity and arrangement of the nervous system would allow, in the biotic domain, perhaps the following first five sets of judgements,

Of an asymmetrical transitive nature.

1) Either $a > b$ or $a < b$ or $a = b$

2) If $a > b$ and $b > c$ then $a > c$

3) For every a there is an a' such that $a = a'$

4) If $a > b$ and $b = b^1$, then $a > b^1$

5) If $a = b$ then $b = a$ [39]

When the relations ($< = >$) are to be translated as more complex, and so forth. It is quite clear that, although Teilhard's criterion as it applies to multicellular entities might allow judgements to the effect that organism A is more complex than B but less complex than organism C and might as well allow a one to one correspondence to be established between the complexes and a number series, there is no possibility on the basis of what he says alone, to derive full numerical quantification from his qualitative spectrum. In other words, even if the judgement can be made that centre A is more complex than centre B, there does not exist the possibility, without much further definition that Teilhard actually gives, of establishing how much more complex A is than B. Teilhard's quantities cannot be arithmetically manipulated, they are 'not additive'.

Teilhard's statement, then, of orthogenetic complexification is seriously deficient in three main ways:

a) Physically and epistemologically the statement of the objects of his investigation was seriously incomplete. Considering the scope of his claims, the absence of so much data, despite the positive accumulation, at least renders it possible that with further knowledge, some trend other

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39. Nagel, Ernst, Measurement in Philosophy of Science, (ed. Danto), New York, Meridion, 1960, p. 123.

than complexity-consciousness might emerge as a major feature of evolution, or a falsifying counter instance. While a counter instance or falsifying instance is always possible with any scientific theory, considering the universality and certainty with which Teilhard forwards his suppositions, the very real absence of positive supporting evidence renders his claims suspect.

b) Systematically, there is, as it was argued, a paucity of formal explicit and contextual definitions of the elements of complexification and an inadequate definition of Teilhard's systematizing conceptual category.

c) There is also a scarcity of expressed examples of Teilhardian utilization of systematic classification. Apart from diagramatic representations, such as the tree of life, which are evidentially ambiguous, Teilhard provides very few examples of his use of the criterion of complexification. This poverty of example contributes substantially to the impression of the incompleteness of his statement of orthogenesis.

8. Structural Incompleteness and Consciousness

Teilhard was not merely interested in providing a series of complexes. He wanted to demonstrate Man's place in nature as a consequent of a process of accumulated alterations directed towards higher consciousness under the agency of a universal centering force, Radial Energy. It is on this basis, he claims, that, if the B of a series is more complex than an A, the higher complexity of B is at least partially conditioned by the consciousness activity of A. In other words, A does not merely antecede B, it is a partial condition or cause of it[40].

> The remarkable coordination of many processes in developing organisms which act as though following a predetermined pattern leads to the formation of a mature individual.[41]

Hempel's criticism of neo-vitalist views occurs along the following lines. He maintains that "the assumptions made by a scientific theory about underlying processes must be definite enough to permit the derivation of specific implications concerning the phenomena the theory

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40. Teilhard writes on this,
"Activation. By this word activation, I mean the special power possessed by certain factors (called activising) of releasing by contact reserves of energy which would remain dormant without this impulse.
In physical chemistry, such releases or sensitisations of power are habitually observed and used, in the case of catalysts and certain rays, for example. But much more important for the views I am developing here, is the fact that certain similar phenomena constantly appear in living beings. Here, however, they no longer depend only on physical but on psychical means of excitation". In "The Singularities of the Human Species" (1954), in The Appearance of Man, p. 260. Teilhard fails, however, to supply any statement of what a 'psychical means of excitation' is, of the circumstances under which any given psychical factor activates and of what quantity of psychism antecedes any specific effect. If it is accepted that activized radial dispositions are manifested in individual biotic psychic factors, then the failure to supply these statements (connectives, bridge constructs) represents a failure to provide the concept of radial energy with empirical meaning.

41. Hempel continues, "According to neo-vitalism, such phenomena do not occur in non-living systems and cannot be explained by means of the concepts and laws of physics and chemistry alone; rather, they are manifestations of underlying teleological agencies of a non-physical kind, referred to as entelechres or vital forces. Their specific mode of action is usually assumed not to violate the principles of physics and chemistry but to direct the organic processes within the range of possibility left open by the physico-chemical laws...." In Philosophy of Natural Science, p. 77.

is trying to explain"[42]. But Hempel also argues that neo-vitalism does not do this. He maintains that it does not indicate "under what circumstances entelechies will go into action and, specifically, what way they will direct biological processes....no particular aspect of embryonic development....can be inferred from the doctrine....nor does it enable us to predict what biological effects will occur under what specified experimental conditions"[43]. Hempel also argues that, since neo-vitalistic theoretical assumptions cannot account for any specific organic development, that "when a new striking type of organic directiveness is encountered, all that the neo-vitalistic doctrine enables the scientist to do is to make the post factum pronouncement: "there is another manifestation of vital force"[44]. Having seen this critique of the neo-vitalistic position, it seems useful to review Teilhard's position on his underlying force[45]. In an essay entitled "The Reflection of Energy", Teilhard says,

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42. __________, Philosophy of Natural Science, p. 71.

43. __________, Philosophy of Natural Science, p. 72.

44. __________, Philosophy of Natural Science, p. 74.

45. Teilhard speaks of Radial Energy in this way. He says, for example, in the introduction to his essay "The Reflection of Energy", "No one seems to suspect that beneath the complex of historical accidents into which the event may be reduced by analysis, a certain 'force' is undoubtedly at work: a force as primordial and as general as nuclear forces or gravity but one which tells us much more perhaps about the physical nature of the universe". As found in "The Reflection of Energy", in Activation of Energy, p. 321. And Teilhard says in the same essay, "Complexification occurs through a play of chances....which are selected by a sort of polarity or preference inherent (like sort of higher gravity) in the Weltstoff itself". In Activation of Energy, p. 332.

> In order to solve the fundamental contradiction between physical entropy and biological 'orthogenesis', the nineteenth century vitalists have tried to develop the notion of certain (measurable) forces peculiar to organic substances: a position that was soon to become untenable, both experimentally and theoretically, in as much as it involved the co-existence of two independent energetics in the same universe; one for what was called inert matter and the other for vitalized matter.[46]

Teilhard believes that he overcomes this objection to orthogenesis on the basis of postulating a fundamental energy, existing in two distinct states. The variations in actualized potentialities or the appearance of emergents, then, are not the consequent for him of the appearance of some fundamentally new forces but rather novel expressions of the same basic energy whose varying manifestations are due to historical circumstances.

However, even if this were not the case, according to Hempel's critique of neo-vitalism, the postulation of a novel non-material agency does not in itself disqualify a theory as being scientific. In Hempel's words,

> The inadequacy of the neo-vitalistic doctrine does not stem from the circumstance that Entelechies are conceived as non-material agencies which cannot be seen or felt. Both accounts involve non-material agencies, one of them vital forces, the other gravitational ones. But Newton's theory includes specific assumptions, expressed in the laws of gravitation and the laws of motion which determine (a) what gravitational forces each of a set of physical bodies of given masses and positions will exert upon each other, and (b) what changes in their velocities and, consequently, in their locations will be brought about by those forces. It is this characteristic that gives the theory its power to explain previously observed uniformities.[47]

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46. ______"The Reflection of Energy", in Activation of Energy, p. 329.

47. Hempel, Carl J., Philosophy of Natural Science, p. 72.

Returning for a moment to the example of the periodic table, it can be seen that Hempel's observation about acceptable theory is born out here too. Just as with gravitational effects, the qualitative and quantitative periodicities of the chemical elements are explained as manifestations of universally pervasive interactions of electrons (and periodicities in electron arrangements) where the binding electronic forces are not explained. With the periodic table, as with Newton's theory also, there are specific sets of constructs providing definite measurable and experiential effects. It is precisely the absence of such assumptions, correspondence rules or bridge constructs between Teilhard's postulated theoretical agencies and his observational manifestations, as well as among the elements of his observational series, that renders much of his theory scientifically suspect. Teilhard does say,

> Consciousness increases and grows deeper throughout the series of cosmic units, in proportion with the organized complexity of those units. While it is completely imperceptible to our observational methods below an atomic complexity of the order 10^5 (the virus), it can be plainly detected when we reach that of the cell (10^{10}); but it enters into its major development only in the brains of large mammals (10^{20}), in other words when we have atomic groupings astronomic in order.[48]

And, in saying this, he provides, at least in principle, of an experimental basis for making assertions about consciousness and behavioural

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48. Teilhard de Chardin, P., "Centrology", in <u>Activation of Energy</u>, p. 102.

properties[49]. On the basis of his complexification criterion, Teilhard can make inferences of the following type: any increases in the complexification are correlatable with an increase in consciousness manifested in an increase in organic behavioural capabilities. This generalization is supported by a set of special assumptions which might read that complexification in the vertebrates must be looked for in the development of the olfactory lobes (where development corresponds to increases in the number of cells and their relationships), cerebral hemispheres, cerebelum and so forth, as a measurable gradient[50] (relative to the vertebrates). As was asserted in the previous chapter, on the basis of these connections, certain particular biological events could be explained and predicted. More specifically, Teilhard's bridge constructs should make it possible to establish whether or not an increase in complexity does lead to an increase in the capabilities of organisms' environmental

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49. Although, again, practically the only example Teilhard provides of concretely using, as opposed to merely mentioning his complexification criteria, is where he cites and provides examples of Tilly Edinger's studies concerning cerebrealization in the equidae family and the development of the brain from Devonian fish to Man as in Man's Place in Nature, pp. 52-54.

50. Teilhard says, "In virtue of the notion of central complexity, there are as many degrees of centricity in the cosmic nuclei as there are degrees of complexity. What we have so far in the case of the lower zones of life, called centres, cannot be compared to geometrical points, but rather to limited circular surfaces which become progressively smaller but at the same time retain an appreciable centric diameter". As found in "Centrology", in Activation of Energy, p. 109. Teilhard never specifies what is to count as a degree of complexity at this level, and hence there is no possibility of specifying a degree of consciousness as in indirect quantity. He only, in fact, generates a qualitative series which is so crudely approximate that only the broadest judgements of assymetrical serial gradation obtain and, hence, to speak of a degree in this context is positively misleading.

interaction. On the basis of these assumptions too, it should be possible, according to levels of consciousness and consciousness correlates, to grade natural unities as well as make predictions and retrodictions about increases and decreases of consciousness and behavioural properties.

8.1 Structural Incompleteness and the Teilhardian Statement of Evolutionary Mechanisms

As was suggested previously, Teilhard wished to grade organisms according to differences in consciousness and behavioural flexibility as well as make predictions and retrodictions about increases and decreases of consciousness and behavioural properties. However, despite the presence of some empirically connecting assumptions, Teilhard introduces other postulates which have no such physical warrant.

It can be noticed that the complexification criterion, as Teilhard states it, only allows very imprecise approximate estimation of the consciousness property. Despite, for example, the structural similarities between human cerebral development and the other primates, structural complexification alone could not allow explanation of the behavioural dissimilarities and concomitant psychic variation existing between homo-sapiens and the other primates. Structural complexification, then, alone, allows only the weakest estimation of consciousness correlates and, concomitantly, of functional correlates. It is only when complexification is considered together with secondary criteria that something approaching an accurate estimation of a probably level of consciousness can be derived. Again, this sort of complete statement in Teilhard hardly ever occurs. This, considered in itself, would only mean that Teilhard's theoretical statement remained undeveloped; however, there are other assertions in Teilhard's theory to which Hempel's criticism of neo-vitalism seems applicable.

Teilhard appeared to believe that it is the consciousness property that allows every natural unity to interact with and form the specific relationships that it does with what surrounds it. The presence of consciousness is the necessary condition for a monad's openness to the environment and its powers of action on what is around it. Also, consciousness per se, according to Teilhard, can only be recognized but not analyzed or essentially defined[51]. However, even if it is the case that the presence of consciousness can be accepted as a primitive undefinable property, in order to be scientifically viable, its activities and manifestations must be explicable in the fashion previously mentioned. Teilhard does not provide statements of:

a) The precise conditions under which consciousness acts to provide a higher centre. The type of internal factors concerning such things as genetic loads and the kinds of physical factors such as other organisms' climatic conditions, geographical location, necessary for the production of higher consciousness, are all missing from his theoretical statement.

b) Missing, too, are statements about mechanism by which consciousness centres.

Teilhard recognizes this to an extent when he says:

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51. According to Teilhard, the evidences of consciousness and freedom are primordial and defy analysis.

> ....there is complexity in the variety of assembled mechanisms. The multitude of chemical elements concentrated in living or pre-living particles does not represent a homogeneous swarm. On the contrary, practically the whole series of simple bodies gradually becomes involved and used in the building up of organic bodies; and this in a state that entails combinations whose differentiation and hierarchically ordered interlocking are still beyond our methods of analysis and understanding. At the lowest level these combinations are molecular, but at a higher level there are 'micellar', granular, cellular, histological, etc., combinations of every order; and all these arrangements built up on top of one another combine in geometric progressions, the mere idea which baffles our minds.[52]

However, it must also be recognized that Teilhard claims that the primary binding force for all natural unities from subatomic particles to man is consciousness and not merely the physio-chemical agencies postulated by other theories. If, therefore, this assertion is, in all its generality, to be considred not scientifically gratuitous, such statements of mechanism have to be provided. Even granting the difficulties involved, as discussed in the previous chapter, with discovering the necessary and sufficient conditions for any biological event, Teilhard would have to establish some at least of those necessary conditions attributed to the activity of consciousness itself, if his statements about the activity of consciousness are to have empirical content.

For Teilhard, consciousness is an 'effect of complexity' but complexity is also an 'effect of consciousness'. The question remains as to how consciousness type is generated out of the growth of structures and how consciousness controls the growth of structures.

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52. Teilhard de Chardin, P., "The Atomism of the Spirit", in <u>Activation of Energy</u>, p. 27-28.

Again, in line with the interpretation taken throughout this thesis, Teilhard says:

> To speak of 'complexity' in the true sense we acknowledge in relation to living matter it is necessary to imply a multitude of unified elements. The fantastic stucture represented by the smallest animate particle forms a whole: in other words, were it not to some degree radially organized, it would fall back in to dust. . By its very nature an organism would not subsist, as it becomes more complex, nor would it function, if it did not structurally form a system that is centred.[53]

In other words, what Teilhard does not say is what type of structure is necessary for the appearance of a given kind of consciousness, under what conditions any given specific internal structure appears. He does not say what properties any given consciousness must have to act as a determinant on the growth or maintenance of any organism, nor does he state the conditions for the activations of the organizing capabilities of any such consciousness. While it would be unreasonable to expect Teilhard to have specific detailed answers to these questions, some statement of the general connectives between consciousness as a centering agency and what it centres on, ought to be apparent and such statements are notably lacking.

c) Teilhard does not, as well, provide the necessary bridge constructs in his descriptions of the mechanisms of the transmission of consciousness. Such statements about the mechanism of transmission are merely suggestive.

He poses the question: "Seen from the outside, cellular division, which is the fundamental operation of reproduction, seems simple enough...

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53. __________, "The Atomism of the Spirit", in Activation of Energy, p. 30.

however, how can we explain the psychic fission it entails?"[54]. He answers by saying,

> The only way out from this deadlock, I believe, is to imagine two sorts of ego in each phyletic centre. First a nuclear ego (more or less complete or rudimentary according to each case), and secondly a peripheal ego; this latter is incompletely individualized and is therefore divisible-after separation, it can develop by producing buds and isolate in itself a new nucleus of incommunicable ego.[55]

This statement is not scientifically descriptive since it does not convey any operation by which the senses of 'complete', 'peripheral', 'nuclear', can be given empirical expression nor any statement of conditions under which division or transmission takes place.

This by no means exhausts the criticisms of Teilhard's statements about the relation of consciousness and complexity considered on the level of the individual organism. It does, however, suggest the sort of statement which is lacking and should be present. In fact, this lack of connectives has definite negative implications for some of Teilhard's statements of greater generality. It might be argued that the cogency of the orthogenetic theory is not dependent on the description of the mechanism of complexity-consciousness, that, in fact, Teilhard derives his evidence from considering the evolutionary process in its major features. There is no doubt that Teilhard does this. He says for example,

> ....when observed through a sufficient depth of time (millions of years) life can be seen to move. Not only does it move but it advances in a definite direction....Research shows that from the lowest to the highest level of the organic world there

54. __________, "Centrology", in Activation of Energy, p. 108.

55. __________, "Centrology", in Activation of Energy, p. 108.

> is a persistent and clearly defined thrust of animal forms towards species with more sensitive and elaborate nervous systems. A growing 'innervation' and 'cephalization' of organisms: the working of this law is visible in every living group known to us, the smallest no less than the largest.[56]

Even if such trends could be unequivocally demonstrated and even if it were shown, that multiple trends amount to a continual trend, the explanation of the statistically probable trend could vary. In other words, Teilhard makes a series of empirically confirmable statements when he says a) there has been a gradually increasing complexification of matter. As Teilhard says it,

> Placed symbolically in a single diagram, the innumerable phyla today recognized by paleontology invariably distribute themselves under all circumstances along a multitude of radii pointing in all directions: each phylum therefore is conceivably capable of definition by a certain azimuth marking its position and orientation in relation to the system as a whole. From this point of view one might say that life, in its fumbling advances.... seems to have tried everything....But is it not more remarkable still, when one thinks of it, that along any of the azimuths under consideration, it has been constantly trying in a single direction, that is to say towards greater arrangement and psychism, one by means of the other, simultaneously?[57]

b) that, within the living range of matter, this complexification manifests itself through developments of the nervous system.

c) and that developments of the nervous system can be correlated with the development of consciousness. However, without a series of connecting links, which are absent, the series itself does not confirm that the total development occurred through the agency of radial energy. It does not scientifically demonstrate that, in Teilhard's words,

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56. __________, "Some Reflections on Progress", in The Future of Man, pp. 64-65.

57. ______, "A Defence of Orthogenesis", in The Vision of The Past, pp. 272-273.

> But just as, in the example....of a river tracing its bed, there is (whatever the breadth and form of the basin under consideration), the same gravity acting everywhere and always on the flowing water; so in the case of 'speciating' matter also (that is to say in order to explain the formation of any phylum), is there not - must we not inevitably postulate - the existence of a single basic factor in operation?[58]

For without the statement of what alterations in radial energy produce speciation, and of what structures and functions for any set of biological entities are the conditions for the formation of a phylum[59], the radial energy postulate has little empirical meaning. It is for this reason that statements of secondary regularities, on the assumption that an empirically accurate identification has been made, must be regarded at best as unexplained - explainers and at worst as accidental generalizations.

8.2 The Problem With Teilhardian Auxiliary Principles

Teilhard, for example, seems to mistake suggestive metaphorical description in some instances for scientifically legitimate statements and he utilizes 'ad hoc' hypotheses which give his theory no support. He uses the following kind of inference as an argument for the cogency of his notion of emergence. He says,

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58. __________, "A Defence of Orthogenesis", in <u>The Vision of The Past</u>, p. 272.

59. If Teilhard's theoretical statements about biological phenomena are defective due to absent bridge constructs, then his statements concerning secondary regularities (change of state) are at least as defective for the same reasons.

> Physical science has made us familiar with the idea that certain magnitudes amount to universal properties that are perceptible only in certain conditions. We know that the mass of a body varies with its speed, but the change is perceptible only when great speeds are attained....Why should we not apply the same idea for life,....if the particle is extremely simple, the consciousnesss is so small that we cannot perceive it; if there is an increase in complexity, this consciousness comes out into the open and we have the world of life?[60]

Of course, the change of 'property' in one domain of the universe is suggestive of the possibility that the same sort of change could occur in another. However suggesting the possibility of such a change is no methodological substitute for demonstrating that in fact the change did occur in the region under investigation and that it did occur under a certain set of specified conditions.

This, as a statement of necessary and sufficient conditions, is again not adequate since Teilhard does not introduce any statement of concrete circumstance and the relationship between radial and tangential energy remains undefined - and so the secondary regularities are not explained. An example of the use of 'ad hoc' hypothesis is Teilhard's stated reason for his belief in the future emergence of a higher man. He says in a footnote,

> I recognize that I am introducing a postulate that, in virtue of its construction, the universe cannot disappoint the consciousness it engenders. But I maintain that if this postulate ('of the maximum activance of the conscious by the real') is not accepted, the world automatically comes to a halt.[61]

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60. __________, "The Place of Technology", in Activation of Energy, p. 156.

61. __________, "The Reflection of Energy", in Activation of Energy, p. 335.

Teilhard offers, then, no empirical evidence or theoretical support for this proposition[62]. Teilhard would, in fact, seem to propose this postulate solely on the basis of needing some psychological support for the certitude with which he extrapolates a future human convergence and emergence. Since the regularities occurring within the complexification series do not allow prediction to the future with any epistomic certitude, Teilhard attempts to reconcile the difference between his fundamental thesis and the supporting physical evidence he should have through an illegitimate auxillary hypothesis[62a]. This criticism does not apply, however, to two other Teilhardian propositions, one of them previously identified as auxillary, the other an assertion about the ultimate reason for empirical events.

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62. Hempel says on this, "there is, in fact, no precise criterion for ad hoc hypothesis, though the questions suggested earlier provide some guidance: is the hypothesis proposed just for the purpose of saving some current conception against adverse evidence, or does it also account for other phenomena, does it yield further significant test implications?" As found in The Philosophy of Natural Science, p. 30. It is difficult to see what test implications Teilhard's hypothesis yields and, further, it is introduced in the face of no evidence.

62a. Kahane, in his book Logic and Philosophy, makes the claim that, "In actual practice, we rarely encounter examples in which the observational or experimental result....follows from a single categorical generalization (plus antecedent conditions). Instead, we find that the observational results follow from the hypothesis being confirmed plus one or more other hypothesis, generally called auxillary hypothesis, where the auxillary hypothesis already are well confirmed, and already accepted as part of the body of scientific knowledge". As found in Logic and Philosophy, Belmont California, Wadsworth, 1969, p. 300. If this is true, then Teilhard's postulate of maximum activance is certainly illegitimate.

The latter concerns the Teilhardian conception of the Omega point. Teilhard does accord the Prime Mover Ahead a causal role in the occurrence of evolutionary process; however, from the scientific point of view, this proposition's cogency need not be considered, as Teilhard himself disqualifies it in this regard. He writes:

> Resembling....Lemaîtres primitive atom, Omega point, so defined, lies strictly speaking outside the scientifically observable process....the reason being, that to attain Omega (by the very act, indeed, of attaining it) we step outside space and time.[63]

Strictly speaking then, all Teilhard can legitimately say is that there has been a continual complexification wherein there arethe observable secondary periodic patterns of Divergence, Convergence and Emergence and Species Man. He can say also on the assumption that his identification is correct; Species Man, which is presently in a convergent stage, has also followed the pattern, so there should be a future emergence.

The other postulate is the following one, previously described as auxillary or supportive. He says,

> In the case of simple or relatively simple particles, the centration is low and the psychism is accordingly imperceptible. By contrast, in the case of high complexities, the centre gains in depth and concentrates, as an effect of organization: and thereby, too, the phenomena of introspection and spontaneity appear and become more marked.[64]

And elsewhere he notes that self-consciousness becomes unequivocably present

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63. Teilhard de Chardin, P., Man's Place in Nature, p. 116.

64. __________, "The Rise of the Other", in Activation of Energy, p. 67.

in man[64a]. In this, Teilhard is essentially saying, 'If consciousness is present everywhere, its presence will become discoverable given a particular degree of organization represented by Man (or anything structurally similar to Man)'. Even if he does not state what aspects in particular of Man's structure generate self-consciousness, he at least provides a roughly approximate statement of some physical conditions necessary to the appearance of self-consciousness. The situation here is somewhat similar to that described as paradigmatic by Hempel who says:

> Surely, we cannot expect to be given operational rules for determining whether the word 'electron' applies to a given object i.e. whether that object is an electron. What can be formulated, however, are contextual interpretations for certain kinds of statements containing the term 'electron' .... ' this condensation track in the cloud chamber marks the path of an elecyton,' ....[65]

Teilhard, in stating that the presence of consciousness is to be looked for in a specified kind of complexity and the presence of self-consciousness is to be looked for in structural and behaviour characteristics similar to those of man, does provide such general contextual definitions and the possibility of empirical

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64a. He says, "....if, until we come close to man, the deterministic driving force of natural selection may, at a pinch, be sufficient to account externally for the progress of life - yet at least from the "threshold of reflection" - certainly not later - we must add to it, or substitute for it, the psychic power of invention: only thus can we explain the ascending progress of cosmic corpusculation right up to its higher termini". As found in Man's Place in Nature, p. 35.

65. Hempel, C., Philosophy of Natural Science, p. 99. In general it can be seen that Teilhard could provide such statements for some of the propositions of his theory....viz. This level of consciousness (x) is manifested in this level of complexity (y) or this activity of consciousness is manifested by this kind of behaviour, e.g. building bridges. Expressed as a correspondence rule, the first might read as follows, whenever (x) is referred to, look for structural complexity (y).

interpretations for this aspect of the complexity-consciousness relation, even though he does not provide operational criteria for most of the given objects to which the term complexity-consciousness applies and in this he is not violating any canons of scientific inquiry as such. Hempel provides a concrete example which parallels[66] Teilhardian theory. He says, speaking of magnetic and electric fields that,

> Operational criteria can be formulated for ascertaining the structure of such fields and their strengths in given areas; such criteria will refer to the behaviour of probes, to the paths of particles moving in the field, to the flow of currents in wires on moving through the field and so on. But such tests will be available only for certain special, experimentally favourable kinds of field conditions, such as a homogeneous field in a sufficiently large area, or strong gradients over certain distances, or the like; a statement expressing some theoretically possible, but highly intricate field condition (involving, perhaps strong charges over very short distances) may have no specific "operationally testable" implication....the conception of the terms of a theory being individually interpreted by a finite number of operational criteria has to be abandoned in favour of the idea of a set of bridge principles that do not interpret the theoretical terms individually, but provide an indefinite variety of criteria of application by determining an equally indefinte variety of test implications for statements containing one or more of the theoretical terms.[67]

Nevertheless, the point remains that concerning certain sets of Teilhardian postulates such as those dealing with specific radial energy of arrangement such bridge principles are completely absent. However, the fact that, in many instances, for physical and epistemological reasons, operational definitions cannot be provided for each individual use of a

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66. Only in major outlines, one important dissimilarity involves the fact that the operational rules which are available in field theory correlate theoretical terms with precise quantitative terms.

67. Hempel, C., Philosophy of Natural Science, pp. 99-100.

theoretical term does not change the fact that, the more operational rules that can be provided for theoretical terms, the more precise, from the physical point of view, is the meaning of those terms. Teilhard must be faulted again for not providing such definitions, even when given the contemporary state of knowledge. There existed the possibility to do so, to a considerably greater extent than he did.

9. Verification and Coherence as a Principle of Theoretical Validation

It might be objected to, in the previous critique, that Teilhard himself recognized that not only was his theory evidentially lacking but structurally incomplete. There are, in fact, passages which bear out this contention. Teilhard does say that this theory has not achieved full verification and he does suggest in several places that several of the propositions of his theory could be quantified to a much greater extent. The major thrust of the previous critique, however, does not involve directly questions of degrees of quantification or amount of supporting evidence but rather structural elements which are completely missing and ought to be present if orthogenesis is to be judged scientifically adequate. A more serious objection might be that that sort of criteria used by Hempel and other philosophers of science accustomed to analysing theories of physics, is inappropriate to a biological or hyperbiological theory; that, in fact, Teilhard's criteria of coherence and fertility are far more suitable for assessing and validating the range of phenomena Teilhard was working with.

There are, in fact, there separate issues here: a) the meaning of

Teilhard's criteria, b) the legitimacy of the criteria, c) the actual extent to which Teilhard used it. The answer to this last issue cannot be given without explicating a) and determining the extent to which Teilhard successfully explained the phenomena which his theory proposes to situate in an intelligible empirical pattern.

Concerning the criterion of coherence, Teilhard says,

> To establish the value of this new viewpoint, my only form of argument will be that universally employed by modern science, that and that alone: by which I mean the argument of 'coherence' In a world whose single business seems to be to organize itself in relation to itself that is by definition, the more true which better harmonizes in relation to ourselves a larger body of facts.[68]

The statement of Teilhard's criterion, as it stands, is broad enough to admit of several interpretations. However, if it is considered in conjunction with certain other Teilhardian propositions, negatively, it is practically certain Teilhard would not unqualifiedly accept any type of explanation, no matter how coherent or scientifically sound. It is theoretically possible, for example, that all the facts in the universe, if they were known, could be bound together in a theological or magical explanation, where the only criterion for the soundness of the supposed connecting links might be psychological satisfaction. It is most unlikely that this is the sort of coherence that Teilhard has in mind. The kind of coherence he does have in mind may be discovered in the qualifications implied in some of his statements. In one often quoted passage,

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68. Teilhard de Chardin, P., "The Phenomenon of Spirituality", in Human Energy, p. 94.

Teilhard says,

> ....I am so bold as to offer here, in the form of a series of linked propositions, an essay of universal explanation - not an a priori geometric synthesis starting from some definition of being but an experimental law of recurrence which can be checked in the phenomenal field and can appropriately be extrapolated into the totality of space and time.[69]

What Teilhard means by coherence, then, is quite unextraordinary as it entails statements referring to uniform connections between events which can themselves be directly or indirectly spatio-temporally situated. Of course, Teilhard's statements also make reference to non-recurrent historical successions of antecedents and consequents, which entail a special set of epistemological problems. The exploration of these problems will, however, further the intelligibility of Teilhard's notion of 'coherence'.

The criterion of truth held by some contemporary philosophers of science depends upon the recurrence of patterns of events. This is to say that according to them, the veridicy of an event or sequence of events cannot be established experimentally or experientially if a similar event does not happen or cannot be made to happen. There are

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69. __________, "Introduction to Centrology", in Activation of Energy, p. 99. In another, expressing a similar statement of intention he says, "....what I have tried to do is this, I have chosen man as the centre and around him I have tried to establish a coherent order between antecedents and consequents. I have not tried to discover a system of ontological and causal relations between elements of the universe, but only an experimental law of recurrence which would express their successive appearance in time. Beyond these purely scientific reflections, there is obviously ample room for the far reaching speculations of the philosopher and theologian." As found in The Phenomenon of Man, p. 29.

good reasons for believing, however, that this criterion, while it might entail the most complete form of scientific validation, is inappropriate and over-restrictive if applied to every area of scientific enterprise. It is inappropriate because it would eliminate as scientific much of what is presently recognized as legitimate scientific theory[70]. The question remains, however, as to how a theory can be validated if the symmetry of explanation with retrodiction and prediction are held not to be germane, at least in their usual sense, as is the case with the Teilhardian statements of overall historical process. A relatively clear, if incomplete, answer to the implied question which fits Teilhard's meaning of coherence is provided by Simpson who says in one passage that,

> ....post diction....involves the self-testing essential to a true science....perhaps its simplest and yet most conclusive test is the confrontation of theoretical explanation with historical evidence....a crucial historical fact or event may be deduced from a theory and a search may subsequently produce

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70. This is supported by Michael Scrivens for example, who says,

"The most important lesson to be learned from evolutionary theory today is a negative one: the theory shows us what scientific explanations need not do. In particular, it shows us that one cannot regard explanations as unsatisfactory when they do not contain laws, or when they are not such as to enable the event in question to have been predicted. This conclusion, which is contrary to the usual view of scientific explanation, has important consequences for research in those subjects in which serious errors are known to arise in the application of the available regularities to individual cases. These subjects include a great part of biology, psychology, anthropology, history, cosmogony, engineering, economics, and quantum physics". As found in "Explanation and Prediction in Evolutionary Theory", in Science Volume 130 no. 3374, August 28, 1952, p. 477.

evidence for or against its actual prior occurrence.[71] This type of 'post diction' is possible with certain of the Teilhardian propositions concerning events in the past. Teilhard, for example, asserted that there is a continuous trend towards cerebration and it ought to be possible to establish this from the record of the past. In this regard, the idea of what structures and processes occurred in the past corresponds with what did occur in the past, and because of the special relationship holding between postulate and discovered confirming instance, can be known to be an actually coherent relationship.

A more central meaning of self-testing consistency given by Simpson, which accords with Teilhard's meaning of coherence is expressed in what Simpson says about organic evolution.

> Although some quite limited predictions can be deduced from the theory, the theory was not in fact established by prediction and not sufficiently tested by it. An enormous number of observations, enormously varied in kind, are all consistent with no other theory that has been proposed. We therefore can, and if we are rational, must have an extremely high degree of confidence in the theory....[72]

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71. Teilhard de Chardin, P., This View of Life, p. 143. Teilhard says, "The truth is nothing but the total coherence of the universe in relation to each part of itself". As found in "A Sketch of a Personalistic Universe" (1936), in Human Energy, p. 92, thus implying a correspondence theory of truth since human representations of the universe can only be considered coherent with the structure and processes of the cosmos, to the extent that there is an approximate relationship of formal similarity. Nevertheless, the existence of such a relationship between any given representation and those parts of the universe it represents can only be known to hold, at least on the scientific plane, by means of something similar to Simpson's confrontation. By the very fact, Teilhard suggests a program of verification. His notion of 'coherence' entails more than the position of a subjective idealist.

72. ________, This View of Life, p. 96.

It can be seen immediately from several passages that this is precisely the principal reason Teilhard presents as the major ground for accepting his orthogenetic theory[73]. This is to say, according to him, orthogenesis relates a multiplicity of previously unrelated facts and forms as well as provides a basis for framing rational expectations about the past and the present and, for Teilhard, the future as well, with the implication that it should be accepted on the grounds that it makes a scientifically intelligible arrangement of phenomena previously not understood. As Scrivens argues about evolutionary theory and by the principles of parity, the same argument may be extended to orthogenesis. "Its great committment....is to be found in its application to the lengthening past....in the tasks of explanation...."[74].

9.1 Fertility as a Validating Principle

Even, however, assuming Simpson and Scrivens are correct, if the

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73. Teilhard maintains,"for the idea put forward here of a world that is psychologically convergent has....a remarkable property.
Of such an hypothesis we may say not only that it works....by explaining and co-ordinating for our intelligence, better than any other, the whole body of known facts". As found in "A Major Problem for Anthropology", in Activation of Energy, p. 317. And, in another work, Teilhard contends, "In science (and elsewhere) the great test of truth is coherence and productiveness. For our minds, the more order a theory imposes on our vision of the world and, at the same time, the more capable it shows itself of directing and sustaining the forward movement of our powers of research and construction, the more certain that theory is. (True theory = the most advantageous). As found in "Man's Place in the Universe" (1942), in The Vision of the Past, p. 227.

74. Scrivens, Michael, Explanation and Prediction in Evolutionary Thbory, p. 481.

criterion of 'coherence' is accepted on the grounds that it accords with actual scientific practice, the question remains as to how coherent Teilhard's theory actually is. However, before attempting to answer this question, the subject of Teilhard's second criterion of theory validation 'Fertility', may be usefully developed.

Teilhard's second explicit criterion for theory validation, 'fertility'[75], offers fewer problems than does the notion of 'coherence'. In speaking of an aspect of his theory, Teilhard says,

> Far from being verbal and confusing as its enemies suggest, this equality (or identity) undoubtedly brings a coherent and fertile simplicity to our perspectives. On the one hand, rather like the famous equations of Lorenz and Einstein in physics, it defines the evolutionary unity of the universe from the biological point of view.[75a].

Here, by 'fertility', he would seem to mean that the identification made by his theory provides a physical explanation of phenomena not previously explained, besides suggesting areas of research for future investigation. This in itself would appear to be unobjectionable[76]. Whether, in fact, a

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75. Teilhard writes in his work "The Natural Units of Humanity" (1939), that "Coherence and fertility" are "the two inim table touchstones and the two irresistible attractions of truth". As found in The Vision of the Past, p. 206. Of his three infinities postulate he contends that if accepted, "Everything falls into place....from the lowest to the highest, in the present and the past of the universe in which a generalized physics succeeds in embracing without confusing the phenomena of radiation and spiritual phenomenon coherence....in addition, everything is illumined....in the direction of the future fertility". As found in "Man's Place in the Universe" (1947), in The Vision of the Past, pp. 228-229.

75a. __________, "Hominization and Speciation", in The Vision of the Past, p. 263.

76. See Appendix C "Waddington's Views on the Fertility Heuristic".

scientific theory, which had no experiential import beyond some single set of data which it attempts to explain, would have any value at all is doubtful. Teilhard's theory is 'fertile' in the sense that it raises questions about the role of consciousness in natural processes and in the sense that it does suggest possible areas for scientific research, homeostasis for instance. Nevertheless, the question still remains as to how consistent with empirical data and scientific practice concerning theory formulation. Teilhard's statement of orthogenesis is.

It can be noticed immediately, concerning the latter point, that, even after adopting the coherence criterion, the previous criticism of the structural inadequacy holds. In the first instance, where Teilhard posits such temporally invariant patterns as Emergence, Convergence, and Divergence, as the results of Radial activation, the demand for statements of necessary conditions is appropriate and these, as it was seen, are lacking. In the second instance, where an assymmetrical temporally variant process is posited as a consequent of some observational agency, there still remains the scientific onus of providing a statement of what sort of connectives could have held between the underlying processes proposed in the theoretical vocabulary of the theory. and the antecedently available occurrences that the theory purports to explain.

Having considered Teilhard's criteria of coherence and fertility as well as the difficulties inherent in the absence of theoretically necessary translation statements and explicit definitions, it is possible to present a final, but tentative, overalll critique of his theory and its inference concerning the past, present and future, as well as its evidences.

10. Coherence, Complexity-Consciousness and Evidence

While it is maintained by some philosophers of science that every proposition composing a theory cannot be individually verified, but that the composite set of statements must be confirmed or disconfirmed as a whole[77], this observation does not dispense with the scientific necessity of providing a translation statement or set of bridge constructs from the expression of theoretical structures and processes to the observational level. While this is considered by the majority of contemporary philosophers of science to be necessary for theory cogency, and while it is logically possible that at some future point philosophers of science will have a very different view of theoretical structures, it is difficult to believe that viewpoint will change so much that the necessity for something like bridge constructs will be completely abandoned. However, this may be, according to the contemporary view, since Teilhard did not supply such connecting links between his radial energy postulate and his explained explainers or between these and his explained non-explainers, there can be little warrant for accepting that complexification did occur as an effect of the hypothetical force, radial energy.

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77. Mario Bunge, for example, writes that, "Conceptual connectedness, or sharing of basic concepts among the postulates of the theory, is a more important trait of scientific theory than the economy of basic concepts. The concepts of a theory must, as it were, hang together if the theory is to be a conceptual whole and if it is to face the trial of experience as such, i.e. as a system". As found in The Myth of Simplicity, New Jersey, Prentice-Hall, 1963, p. 101.

This does not demonstrate, of course, that Teilhard could not have made the radial energy construct operational, but only that he did not render it so. It does not demonstrate either that Teilhard nowhere provides a theoretical connectives. In fact as it has been argued throughout the thesis, Teilhard does provide some of his propositions with operational definition.

Teilhard, as it has been seen, does provide the possibility and some degree of confirmation of his claim that there has been a continuous increase in consciousness through successive sub-phyla of vertebrates[78]. However, it should be noticed immediately that Teilhard's bridge constructs do not support the generality of his claim for, according to him, the association of complexity-consciousness is a universal character of all the materials of the universe[79]. Moreover, the appeal

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78. See Appendix B "On Evidence".

79. It is Teilhard's contention that "Every element contains, at least to an infinitesimal degree, some germ of inwardness and spontaneity....of consciousness". As found in "Man's Place in the Universe" (1942), in The Vision of the Past, p. 225, and that "....cosmic energy taken in its most primordial....form....appears already granulated photons....in the singularities of the human species (1954), and that this corpusculization, (at least from the photon onwards), is due to the Complexity-Consciousness Law, valid....for all particles...in the universe. "The Singularities of the Human Species", p. 241. However, without more direct empirical evidence than Teilhard evokes for the universality of consciousness, his radial energy postulate is only one possible explanatory principle existing among a set of alternative postulates which are more scientifically acceptable. Harold F. Blum, for example, in the Appendum to Chapter X, maintains that "....the more we study mechanisms that operate in the living organism, the more satisfactorily are we able to explain them in terms of physical principles...." As found in Time's Arrow and Evolution, New York, Harper, 1951, p. 178a. Here physical means 'tangential' only.

to the acceptance of universal corpuscularity as an effect of radial energy provides just the weakest justification for his claim since there are so many other logical and empirical possibilities open to account for this phenomenon. The strongest part of his complexity-consciousness claim, then, is that part which he relates to the biotic world.

The same observations holds true for his notions of divergence, convergence and emergence. Relative at least to as large a biological category as the phylum, the Teilhardian proposition that there have been such secondary cycles occurring within the overall descent with modification, ought to be, in principle, at least demonstrable as occurring in the past. However, the veracity of Teilhard's explanation of the present particularly the fact of self-consciousness in man, is contingent upon his establishing that this description of past structures and processes is both accurate and complete. Even if it is proposed that Teilhard's explanations of the present and extrapolations to the future be accepted on the basis of coherence, it can be seen that there has to be some way of discovering and establishing the commonality of structures and mechanisms of past events in order that they may be grouped under a unitary explanation. With orthodox evolutionary theory, for example, it was the multiple instances of groups of biota sharing common characteristics together with varying amounts of formal and functional differences as catalogued in the asynchromic Linnaean system (among other reasons) that lead Darwin to suppose a common ancestry and evolutionary development. It was the same sort of established occurrences of similarities and differences that lead other biologists to concur with the Darwinian description. For Teilhard, the case is that if he or someone else working within the framework of his theory were to or did demonstrate that there are, in fact, multiple instances of complexity-consciousness observable on every level of the world, even if this evidence was quantitatively slight, his claim that orthogenesis has happened throughout history could be similarly provisionally accepted on the grounds of the same sort of coherence that Darwin's theory was accepted on. Again, however, the links that Teilhard does not provide in his generality thwarts the possibility of supporting orthogenesis in this way.

If Teilhard had provided the prerequisite logical links, it might have been concluded that, structurally, his theory is a hypothetical deductive one employing unrestricted, universal, statistical generalizations in 'sublaws' and only deviant from the expected norm for theories of physics, by employing as well narrative and historical statements. But, since Teilhard did not provide these connectives, the status concerning its validity in his inference to the future presents many more difficulties.

It is of very little help to say that Teilhard's inference to the future is non-mathematically probabilistic. In fact, all scientific theories, mathematical or not, if they make inferences to the future and whatever their form, are epistemologically probabilistic. There cannot be, from the scientific point of view, any absolutely certain knowledge that any given structure or process will continue, as it is not even certain that the universe will continue. Whether mathematically formulated or not, the question is what sort of rational basis is there, warranting an inference to the future. Teilhard states,

> In the absence of, or marginal to, these direct but as yet ill-explored proofs of a human drift towards some ultra-human, a vast field of indirect verification leading to the same result if indisputably open to us; it lies in the direction of a deeper analysis of the structure of the noosphere. One of the first tasks of the commissions appointed to bring out and keep under observation the symptoms of a psychogenic convergence of the universe, would be to design and forward the construction of certain characteristic curves....which would express in terms of absolute value the chronological division of the levels crossed by life in order to become hominized....[80]

Teilhard continues this passage by saying,

> There can be little doubt but that such graphs would make abundantly clear to everyone the evidence of a process, at once qualitative and quantitative, of cosmic arrangement, whose explosive behaviour rules ousts the hypothesis that the movement into which we are born is now slowing down and still less coming to a halt.[81]

As Teilhard states his theory, however, all that can be concluded is that, if Teilhard has accurately identified a periodicity of Emergence, Divergence and Convergence which occurs within the complexification series, for reasons not known, under conditions unspecified, and if this process continues, there might be a future human Emergence. This kind of probability statement represents no alternative to a mathematically expressed form of probablistic inference but at least, as it is presented, represents an inference about the future which occurs in the pre-scientific realm. Again, Teilhard's statement about the future shifts from human to ultrahuman, is only coherent if it is a statement about processes (or

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80. Teilhard de Chardin, P., "The Convergence of the Universe" (1951), in Activation of Energy, p. 294.

81. __________, "The Convergence of the Universe" (1951), in Activation of Energy, p. 294.

termination of such processes) which have and indeed will occur. Otherwise, while it might be coherent with the processes postulated to be the case in some logically possible universe, and if those processes have in fact not occurred, his conception of possible events and the actuality do not cohere. It is for this reason that there is a need for modes of confirmation besides that of coherence.

It should be noticed as well that, even if it were possible to demonstrate through statistically designed programs that an ultrahuman emergence was to be the terminus to a periodic terrestial process, there would still be a need for more and other kinds of evidence to show that hominization represents the end of a cosmic process. This claim Teilhard does not successfully support.

11. The Problem of Orthogenetic Interpretations

Two other minor criticisms which can be leveled at Teilhard's presentation concern this scientist's disregard of possible viable alternatives to his own position and a certain exaggerated emphasis or overstatement concerning the certitude of certain of his central postulates. Teilhard says for example,

> Let us be done once and for all....with the naive conception of the 'evolutionary hypothesis'....taken sufficiently broadly, evolution is no longer and has not been for a long time a hypothesis - nor merely a simple method. It is, in fact, a new and common dimension of the universe, and consequently affects the totality of the elements and the relations of the universe. Not a hypothesis, therefore, but a condition which all hypothesis

must henceforth fulfill.[82]

While at least one historically important physicist contends that the concept of 'history' might be very well incorporated in the conceptual framework of some future physics[83], it was the case in Teilhard's time, and it still is the case, that some of the central theories of physics, relativistic physics for instance, make no theoretical use of the concept of history and there is nothing as yet which suggests that they must. Hence, Teilhard's claim is somewhat exaggerated. The same sort of objection may be brought to bear on his interpretation of quantum mechanics. Teilhard says for example in his essay "The Reflection of Energy",

> From the foregoing analysis of energetics, it emerges that, in any case, the evolutionary complexification and arrangement of matter (or, which comes to the same thing, the interiorization, followed by the reflection of energy) appear to us experientially as a cosmic process just as determined, in its own way, as the entropy on which they are grafted....It is as though as a result of the controlled play of chances the elementary indetermination of the physicists necessarily accumulated and expanded within special structures (progressively larger and

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82. __________, "Evolution of the Idea of Evolution", in <u>The Vision of the Past</u>, p. 246.

83. In fact, Werner Heisenberg, the physicist in question, asserts that one viable alternative position to that of reductionism is that "....it will probably be necessary for an understanding of life to go beyond quantum theory and to construct a new coherent set of concepts, to which physics and chemistry may belong as 'limiting cases'; History may be an essential part of it, and concepts like perception, adaptation, affection also will belong to it. If this view is correct, the combination of Darwin's theory with physics and chemistry would not be sufficient to explain organic life; but still it would be true that living organisms can, to a large extent, be considered as physicochemical systems-as machines, as Descartes and Leplace have put it - and would, if treated as such, also react as such". As found in <u>Physics and Philosophy</u>, London, Allen and Unwin (1963), p. 94.

> more fully living particles)....ultimately assumed the form of reflective choice.[84]

The indeterminisms referred to here are the "primordial granular energy of the physicist"[85], or the spontaneity property of atoms and subatomic particles. Even though Heisenberg himself suggests that the Indeterminacy Principle might be thought about as the consequent of a potentiality property of subatomic particles, other interpretations of the meaning of the Uncertainty Principle are possible. This fact Teilhard chose to ignore.

The same sort of objection can be brought against Teilhard's utilization of the implications of the Second Law of Thermodynamics. According to Teilhard, any attempt to question the heat-death implication of the Second Law of Thermodynamics. is a mathematical trick![86]

Far from being a 'mathematical trick', the rejection of time's arrow is, according to Henry Mehlberg, supported by a "comprehensive and satisfactory theory" which has postulated that,

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84. Teilhard de Chardin, P., Activation of Energy, p. 134.

85. __________, "The Analysis of Life", in Activation of Energy, p. 134. Heisenberg says, "....I believe that the language actually used by physicists when they speak about atomic events produces in their minds similar notions as the concept 'potentia'. So the physicists have gradually become accustomed to considering the electronic orbits, etc., not as reality but rather as a kind of 'potentia'. The language has already adjusted itself, at least to some extent, to this true situation". In Physics and Philosophy, p. 156.

86. Teilhard says, "In every physico-chemical change, adds thermodynamics, a fraction of the available energy is recoverably 'entropised', lost, that is to say in the form of heat. Doubtless it is possible to retain this degraded fraction symbolically in equations, so as to express that, in the operations of matter nothing is lost any more than anything is created, but that is merely a mathematical trick". In The Phenomenon of Man, p. 51.

> ....the processes under consideration have been deduced from the assumption that the micro-events which underlie the macro-processes in question exhibit no time's arrow. Ever since the failure of Boltz Mann's grandiose attempt at deriding the time assymetrical phenomenological Law of Thermodynamics from Newton's time symmetrical Laws of Motion, which were construed as controlling the sum total of thermodynamical phenomenon, there seems to be no reason for a similar treatment....of phenomenological laws whether or not the latter are in the province of thermo-dynamics.[87]

Of course Mehlberg's views need not be considered definitive, nor need any of the previous three criticisms be regarded as seriously damaging to the scientific status of Orthogenesis. Nevertheless, Teilhard's lack of care and precision on this kind of issue somewhat diminishes the credibility of his whole theory.

12. The Structural Possibilities and a Defence of Orthogenesis

Despite these several flaws and given that Teilhard has identified natural structures and processes which no other scientist has previously identified, there seems no inherently necessary reason why the forms and functions which are described by his terms and laws could not be provided with the prerequisite bridge constructs and the refined contextual definitions and a much further range and variety of evidence. This would bring his theory well into the domain of presently recognized scientific theory and that would be, for human knowledge, a highly desirable circumstance. As it is expressed by one commentator who is not very sympathetic to much of Teilhard's position,

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87. Mehlberg, Henryk, "Physical Laws and Time's Arrow", in <u>The Philosophy of Science</u>, pp. 105-138.

Perhaps the struggle which is being waged today in the field of biology over the theory of orthogenesis prevents a cool appraisal of Teilhard's beliefs in this respect. If, as I believe, in full agreement with Teilhard, orthogenesis should eventually prove to be a demonstrable pattern in the web of life, then I think his view of some 'within' (to use his own term) will have to rank for serious consideration. At this point in history the furore created by the exciting work on deoxyribonucleic acid and related matters in molecular biology has given to such aspects of evolution a kind of fustian fatuity for the new generation of workers. This is an accident of history - a veering of scientific taste and style; eventually it will pass quietly into the accepted corpus of scientific fact and the minds of yet another generation of biologists will be free once again to examine with more tolerant appraisal some of these 'fringe' views of ancient pedigree. In this respect Teilhard's may prove to wear better than many orthodox zoologists would now suppose.[88]

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88. Turk, F.-A., "The Idea of Biological and Social Progress in The System of Teilhard de Chardin", in Teilhard Reassessed, London, Danton, 1970, p. 18.

GENERAL CONCLUSIONS

The points made in the previous passsages in this chapter and, indeed, in the previous chapters can be usefully recapitulated by exploring the questions as to whether or not Teilhard's theory is a scientific theory and whether, if it is, it is a good scientific theory.

From the outset it must be stated that no definitive answer can be given, since such a definitive answer would presuppose some definite finite judgement criteria or decision procedures by means of which a theory could be assessed and there are no such definite set of rules extant.

There is, however, a certain large consensus of opinion about certain features previously discussed which do or should typify a legitimate scientific theory. This agreement is, however, not so determinate, as the following discussion will demonstrate, as to completely eliminate borderline cases and orthogenesis is clearly a borderline case.

When Teilhard's general programme of presenting a unified account of the discrete phenomena of the world, through a representation that employs natural cores and their relationships, is a typicality of the heuristic models to be found in the history of science. However, despitcthis there appears to be no necessary a priori reason to judge his programme unscientific. Also, when the special concepts which Teilhard employs, such as 'Emergence' as well as historical and teleonomic explanatory categories, are considered, there again seems no necessary reason for assuming Teilhard's theory unscientific because it employs such expressions and modes of explanation. Not even the most dedicated positivist would assert that is has been unequivocally demonstrated that a scientific theory must employ explanatory descriptions of entities which are both atomistic and reductionist and whose expressed relationships are temporarily invariant. Furthermore, Teilhard's position in his employment of these concepts, is supported in a general way by some of the most eminent scientists working in his own area today.

As it was argued, in employing imaginative guesses as to the significance of phenomena or the direction of a solution, this approach, far from being deviate, is, according to many contemporary philosophers of science and scientists, the norm. The crux, then, in assessing the status of any theory in general and Teilhard's in particular resides in its manner of presentation.

A theory, if it is to be considered scientific, must be formulated in such a way that it has empirical, observational or experimental consequences. Assuming the cogency of a historical explanatory mode, the falsifiability criterion which is contingent on the previous point is extended to cover those theories which allow expectations about the past to be framed on the basis of previously characterized types of sequences of events where the events themselves need not be recurrent nor the sequential proportionally variant. As it was argued, Teilhard did intend and, for certain of his propositions, did provide the connecting links which would allow the possibility of confirmation. It was also argued that Teilhard did not provide the prerequisite bridge constructs for certain other of his central postulates, particularly those concerning the universality and functioning of radial energy.

If it is decided that all the propositions that purport to describe the structures and processes of the world must be directly or indirectly connected to events occuring on the observational level, then Teilhard's theory, despite his intentions, is not scientific. If, on the other hand, it is decided that every central proposition should be so supported, but, that if only some are while others are not, the theory need not be ruled unscientific but merely structurally flawed and underdeveloped, then Teilhard's orthogenesis, while structurally flawed and unusually primitive (for a contemporary scientific theory), is still a scientific theory. Or again, it might be decided only those claims of Teilhard's or parts of the orthogenetic theory which have such connectives (bridge constructs). have attained a scientific status. In each of these positions there is a degree of arbitrariness, since the only basis of preference would appear to be psychological. Nevertheless, it can be seen that, even on adopting the least restrictive criterion, by contemporary standards at least, Teilhard's theory is structurally deficient.

Perhaps, while the structural connectives form the necessary condition for rendering a theory properly scientific, a good scientific theory is one in which not only are connectives present but some level of confirmation has been achieved. Only brief mention was made through this chapter of the fact that even those parts of Teilhard's theory which have testable consequences are in fact supported by only very problematic evidence. In this sense, at this point of time at least, Teilhard's theory, considered in its totality, is not a 'good' scientific theory.

Despite all these objections and criticisms of orthogenesis, however, it was suggested that Teilhard did provide a sufficiently articulated, determinate and fertile conceptual framework that there appears to be no reason why contemporary and future researchers could not render his theory scientific or science in the full sense.

Reductionism, Levels and Historical Explanation

Theodosius Dobzhansky explains his anti-reductionist position in the following words,

> The progress of biology would not be furthered by frenetic efforts to reduce organismic biology to chemistry or physics. This is not because there is anything in living things that is inherently irreducible. It is rather because a different research strategy is more expedient. Those who urge an immediate absorption of the organismic into molecular biology neglect the simple but basic fact that life has developed several levels of organization. These are levels of increasing complexity, and they are hierarchically superimposed. The elementary phenomena and regularities on each succeeding level are organized patterns of those on the preceding level. Organismic biology can be said to be a study of patterns of molecular phenomena. Such a definition of organismic biology is correct as far as it goes, but it does not go quite far enough. It is a study not only of the molecular patterns but also of patterns of patterns.
>
> Some examples should make the meaning of this clear. A gene, or at least its key constituent, is a double-stranded DNA molecule, or perhaps a part of such a molecule. A chromosome is, however, not a heap of genes, but a configuration of genes arranged in a certain way which proved to be adaptively advantageous in evolution. A cell is not a conglomeration of chromosomes but a supremely orderly contrivance consisting not of chromosomes alone but also of many other organelles. An organ and an individual body are, in turn, not simply piles of cells but beautifully designed and often highly complex machines, in which the cellular components are not only diversified but often have lost their separate identities. Mendelian populations and species of sexually reproducing organisms are not throngs or medleys of individuals; they are reproductive communities of interdependent members. Species are categories of classification, but they are not only that. Evidence is rapidly accumulating to show that the gene pool, the collective genotype of a species, is an organized system of coadapted constituents. Biotic communities or ecosystems are not miscellanies of species which happen to live side by side or in the same general region; they are structured associations of more or less mutually interdependent forms.[1]

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1. Dobszhansky, T., "Biology, Molecular and Organic", in <u>The Graduate Journal</u>, Vol. VII, no. 1, Winter 1965, p. 12.

G.G. Simpson's position on the necessity of organic or compositional explanations for biological events is even more emphatic. He writes for example about reductionism, that,

> In its extreme form, the principle would imply that, for example, the attack of a lioness on a zebra could be not only explained but also predicted from knowledge of the structure and properties of the atoms composing the lioness. Perhaps no one accepts quite so extreme an application, but the first of the statements introducing this chapter certainly approaches it.
>
> In fact, pure reductionism offers no adequate explanations and permits no sound predictions. The action of an atom, a DNA molecule, or an enzyme, can be neither explained nor predicted outside the context of the system in which it occurs. This will not be news to the biophysicists and it is, indeed, involved in my first paraphrase, but biophysicists do often underestimate its force or overlook its significance. It means that explanation by reduction simultaneously implies or must be accompanied by the opposite, which might be called composition: that meaningful biological explanation goes up as well as down the scale of levels of organization. It is just as explanatory and just as essential for understanding to say that lion enzymes digest zebra meat <u>because</u> that enables the lion to survive and to perpetuate the population of which he is a part, as to say that the digestive event occurs <u>because</u> of specific chemical reactions between lion enzymes and zebra fats, proteins, and so on.
>
> One direction of explanation goes down the scale, and because it leads into their domain it is naturally emphasized by the molecular and other lower-level biologists. The other goes up, and is as naturally emphasized by the organismal and populational biologists.[2]

Perhaps one of the best brief descriptions of the importance of historical explanation in biology is that given by Ernst Mayr, who writes,

> The evolutionary biologist differs in his method and in the problems in which he is interested. His basic question is

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2. Simpson, G.G., <u>This View of Life</u>, p. 110.

"Why?". When we say "why" we must always be aware of the ambiguity of this term. It may mean "how come?" but it may also mean the finalistic "what for?" It is obvious that the evolutionist has in mind the historical "how come?" when he asks "why?" Every organism, whether individual or species, is the product of a long history, a history which indeed dates back more than 2000 million years. As Max Delbruck (2) has said, "a mature physicist, acquainting himself for the first time with the problem of biology, is puzzled by the circumstance that there are no 'absolute phenomena' in biology. Everything is time-bound and space-bound. The animal or plant or micro-organism he is working with is but a link in an evolutionary chain of changing forms, none of whcih has any permanent validity". There is hardly any structure or function in an organism that can be fully understood unless it is studied against this historical background. To find the causes for the existing characteristics, and particularly adaptations, of organisms is the main preoccupation of the evolutionary biologist. He is impressed by the enormous diversity of the organic world. He wants to know the reasons for this diversity as well as the pathway by which it has been achieved. He studies the forces that bring about changes in faunas and floras (as in part documented by paleontology), and he studies the steps by which have evolved the miraculous adaptations so characteristic of every aspect of the organic world.[3]

The example of the acceptance of a biology of levels and of narrative historical explanation by the world's major biologists could be further documented but the preceeding passages clearly indicate at least that such an acceptance is present.

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3. Mayr, E., Cause and Effect in Biology in Science, p. 1502.

'On Evidence'

It is not always easy to make an exact separation between the reasons a scientist has for accepting a theory and the reasons he has for advancing it initially, as the following passages indicate,

> Many biologists, intent upon scientific objectivity, are reluctant to see in the development of terrestrial life anything more than unlimited proliferation of forms, all on the same level. A steady increase of living creatures and living combinations, they agree; but, despite this, not more life. What reason have we for supposing that a mammal is <u>more</u> than a polypary?
>
> Far more suggestive and convincing than this 'flat' vision of the biological world is the three-dimensional concept of a heavenly body on which, through the effect of planetary compression, the state of complexity (or, which amounts to the same thing, the 'psychic' temperature of the biosphere) is continually rising. This explains the supersession in successive stages of arthropods by vertebrates, of pisciforms by tetrapods, and finally, within the tetrapod group, the progressive predominance of the mammals, gradually forming their own primate strain, with the growth, globally irreversible and constantly accelerated along certain favoured lines, of 'cerebration' from the beginning of life up to the present time. The quantity and quality of cephalised nervous substance on earth have indeed never been as great as they are today. This 'orthogenetic' view of animal evolution is gradually becoming common ground among scientists; but it only achieves full validity, in terms of my argument, to the extent that it implies a continuous psychic 'chain' going back to the beginning of life.
>
> Looking back over the immense extent of geological time we can see that the separate links in the chain have undergone no essential change. It would seem that the principal factor making for progress is still the operation of forces of natural selection, choosing from outside the most successful and adaptable products of a process of expansion that is disorderly in itself. Where an important transformation seems to have taken place is at the level of the latest link in the chain, that of the 'acquirement of consciousness'. For it is inevitable, by very reason of the selective growth of psychism in the biosphere, that each higher element engendered by evolution must, to the extent that it is more conscious, have a wider field of action. The mere fact of its 'ultra-cerebration' causes it to take up more room. So that the compression of living matter, due in the first place simply to physical increase, is gradually heightened

by its internal psychic expansion. The chain coils in upon itself and the intensity of the phenomenon tends to rise almost vertically. Or to adopt another image, one might say that the 'psychic tint' of the earth, studied at a great distance by some celestial observer, would be seen, in the course of eons of geological time, to become gradually heightened in intensity until it reaches the peculiarly moving moment of climax when, in a spread of more active radiation covering Africa and southern Asia, a series of sparks begins to glow, foreshadowing the incandescence which is 'hominisation'.

Closely related though he is to the other major primates, among which he is biologically only one of a family, Man is psychically distinguished from all other animals by the entirely new fact that he not only knows, but knows that he knows. In him, for the first time on earth, consciousness has coiled back upon itself to become thought. To an observer unaware of what it signifies, the event might at first seem to have little importance; but in fact it represents the complete resurgence of terrestrial life upon itself. In reflecting psychically upon itself Life made a new start. In a second turn of the spiral, tighter than the first, it embarked for a second time upon its cycle of multiplication, compression and interiorisation.

This is how the thinking layer of the earth as we know it today, the Noosphere, came rapidly into being, proceeding from certain centres of reflection which apparently emerged, at the threshold of the Pleistocene Age, somewhere in the tropical or sub-tropical spheres of the Ancient World: a planetary neo-envelope, essentially linked with the biosphere in which it has its root, yet distinguished from it by an autonomous circulatory, nervous and, finally, cerebral system. The Noosphere: a new stage of Life renewed.

One may say that until the coming of Man it was natural selection that set the course of morphogenesis and cerebration, but that after Man it is the power of invention that begins to grasp the evolutionary reins. A wholly inward change, having no direct effect on anatomy; but a change, as we now know, entailing two decisive consequences for the future. The first is an unlimited increase in the aura of influence radiating from every living being; the second, even more radical, the prospect afforded to a growing number of individuals of being joined together and ever more closely unanimised in the inextinguishable fire of research pursued in common.[1]

The previous passages would appear to contain both.

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1. Teilhard de Chardin, P., "From the Pre-human to the Ultra-Human", in The Future of Man, pp. 291, 292, 293.

It is interesting to note that these passages contain two forms of validation in the Teilhardian sense. He advances this view on the basis that it brings, under one explanation, the multiple appearances of 'cerebration' but in doing so, Teilhard also forwards statements which should be in principle verifiable. It should be possible to establish the presence or absence of 'favoured lines of cerebration'.

The type of evidence Teilhard believes supports his complexity-consciousness law, is then the following,

> b In a definite direction. This is the crucial point which has to be clearly understood. While accepting the undeniable fact of the general evolution of Life in the course of time, many biologists still maintain that these changes take place without following any defined course, in any direction and at random. This contention, disastrous to any idea of progress, is refuted, in my view, by the tremendous fact of the continuing 'cerebralisation' of living creatures. Research shows that from the lowest to the highest level of the organic world there is a persistent and clearly defined thrust of animal forms towards species with more sensitive and elaborate nervous systems. A growing 'innervation' and 'cephalisation' of organisms: the working of this law is visible in every living group known to us, the smallest no less than the largest. We can follow it in insects as in vertebrates; and among the vertebrates we can follow it from class to class, from order to order, and from family to family. There is an amphibian phase of the brain, a reptile phase, a mammal phase. In mammals we see the brain grow as time passes and become more complex among the ungulates, the carnivores and, above all, the primates. So much so that one could draw a steadily rising Curve of Life taking Time as one co-ordinate and, as the other, the quantity (and quality) of nervous tissue existing on earth at each geological stage.
>
> What else can this mean except that, as shown by the development of nervous systems, there is a continual heightening, a rising tide of consciousness, which visibly manifests itself on our planet in the course of the ages?[2]

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2. ________, "Some Reflections on Progress, in The Future of Man, p. 65.

It must be noted, however, that the majority of contemporary biologists do not accept, on the basis of the physical record, any single major orthogenetic development of any type, to the present time, and that, while G.G. Simpson's or Theodosius Dobzhansky's descriptions of orthogenesis, for instance, do not aptly describe Teilhard's notion, nevertheless, the essential point remains that, for them, the fossil record does not supply evidence of any kind of universal orthogenetic movement.

G.G. Simpson, for example, writes,

> The crucial point here is whether evolution is in fact orthogenetic, whether orthogenesis is its law. There are many definitions of orthogenesis, but the pertinent one in this connection is that orthogenesis designates not only full determination of evolution but also rigid and unique predetermination. Orthogenetic evolution is supposed to proceed undeviatingly in a single direction, regardless of environment, organic activity, or such factors as natural selection. Discussion of this point has been so lengthy and extensive that it has, frankly, become boring. There is, at present, a clear consensus of paleontologists that orthogenesis, in this sense, is not real. There is no known sequence in the fossil record that requires or substantiates such a process. Many examples commonly cited, such as the evolution of the horse family or of sabertooth "tigers", can be readily shown to have been unintentionally falsified and not to be really orthogenetic. All supposed examples are more simply and fully interpreted as due to some other cause, such as natural selection. The fossil record is now usually cited in support of orthogenesis mainly by those least familiar with that record.[3]

While Theodosius Dobzhansky states,

> Since the truth or falsity of a scientific theory cannot be settled by majority vote, it is only fair that we should inquire whether any valid alternative to the biological theory of evolution has been proposed.
> Several alternative theories have, in fact, been advanced; they differ rather widely among themselves, but have in common

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3. Simpson, G.G., <u>This View of Life</u>, pp. 181-182.

the assumption of so-called orthogenesis or autogenesis. Orthogenesis is evolution following a straight line, or evolution directed by some force residing inside the organism itself. We are invited to believe that the sequence of genetic changes that constitute evolution is set by the structure of the hereditary materials themselves. The environment and natural selection can only accept or reject these changes. Ultimately, the evolutionary machine was designed and wound up, like a watch, at the beginning of life; all that has happened since is that this machine is gradually unwinding itself in a predeterminate way. Some believers in orthogenesis assume that evolutionary changes are planned and managed by some inscrutable, immaterial, or supernatural force.

Paleontologists, the students of fossils, among whom G.G. Simpson did more than anybody else to evaluate critically the theories of orthogenesis, have shown how completely unacceptable these theories are. If evolution was designed and is managed by a supernatural force, it is managed remarkably badly. Far from following any kind of straight-line progression from simple to complex body structure, from less to more perfect adaptation, or from lower organisms to man, evolution is, rather, like groping in the dark, which most commonly leads to disaster and only rarely to success. The "disaster" is, of course, death and extinction. It is one of the most conspicuous features in the picture of evolution revealed by paleontology that a majority of evolutionary lines represented by fossils in the earth's rocks have eventually become extinct, without descendants living at present. Emergence of a successful new group of organisms is a relatively rare occurrence. The panorama revealed by paleontology suggests a grandiose trial-and-error operation.[4]

The strength, then, of the physical evidence for orthogenesis can hardly be considered as unambiguously established.

4. Dobzhansky, Theodosius, Heredity and the Nature of Man, Toronto, The New American Library, 1964, pp. 148-149.

CHAPTER III - APPENDIX C

Waddington's Views on the Fertility Heuristic

The geneticist, C.H. Waddington, supports a notion of 'fertility' much like Teilhard's and his remarks could very well apply to orthogenesis itself,

> A scientific theory cannot remain a mere structure within the world of logic, but must have implications for action and that in two different ways. In the first place, it must involve the consequence that if you do so and so, such and such a result will follow....and secondly - and this is a point not so often mentioned by those who discuss the nature of scientific theories - its value is quite largely dependent on its power of suggesting the next step in scientific advance. In fact, at the growing edges of science, the stimulating and suggestive theory is often preferred to one which may be less open to criticism, but which seems to lead nowhere in particular.[1]

and he remarks further,

> Science is often quite ready to tolerate some logical inadequacy in a theory - or even a flat logical contradiction like that between the present particle and wave theories of matter - so long as it finds itself in the possession of a hypothesis which offers both the possibility of control and a guide to worthwhile avenues of exploration.[2]

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1. Waddington, C.H., The Nature of Life, New York, Atheneum, 1962, p. 12.

2. __________, The Nature of Life, p. 13.

BIBLIOGRAPHY

A. Publications of Teilhard de Chardin and available translations of the Editions du Seuil series "Oeuvres de Teilhard de Chardin"

I Books

La place de l'homme dans la nature, le groupe zoologique humain (Préf. de Jean Piveteau), Paris, Editions du Seuil, 1956, 173 p. (Oeuvres 8)translated under the title Man's Place in Nature by René Hague, London, Collins, 1955, 124 p. The most scientific of Teilhard's works in this series. This book is of particular importance for its examples of Teilhard's notion of evidence.

Le milieu divin, Paris, Editions du Seuil, 1957, 202 p. (Oeuvres 4) translated under the same title.

Le milieu divin, London, Collins, [1961] , 159 p. This book presents Teilhard's view of christianity as an extension of his evolutionary vision.

Le phénomène humain, Paris, Editions du Seuil, 1955, (Oeuvres 1) 348 p. translated by Bernard Wall under the title The Phenomenon of Man, New York, Harper and Row (ed 1951), 318 p. This book includes the most comprehensive although incomplete statement of Teilhard's theory of orthogenesis.

II Collected Essays in the Series "Oeuvres de Teilhard de Chardin

L'apparition de l'homme, Paris, Editions du Seuil, (1956), 375 p. (Oeuvres 2) translated by J.M. Cohen under the title The Appearance of Man, London, Collins, 1965, 286 p. This collection contains essays and articles written from 1913 to 1954 on the topic of the early beginnings of human prehistory.

La vision du passé, Paris, Editions du Seuil, 1957, 391 p. (Oeuvres 3) translated by J.M. Cohen under the title of The Vision of the Past, London, Collins, 1933, 285 p. This collection contains articles written from 1921 to 1955, concerned with the meaning and defence of human evolution.

L'avenir de l'homme, Paris, Editions du Seuil, (1959), 405 p. (Oeuvres 5) translated by Norman Denny under the title The Future of Man, London, Collins (1964), 319 p. Includes essays written from 1920 to 1952 on a variety of topics concerned with evolutionary developments in present and future human society.

L'énergie humain, Paris, Editions du Seuil, (1962), 222 p. (Oeuvres 6) translated by J.M. Cohen as Human Energy, London, Collins, 1969, 191 p. Contains works written from 1931 to 1939 on the presence and effects of spiritual energy.

L'activation de l'énergie, Paris, Editions du Seuil, (1963), 429 p. (Oeuvres 7) translated by René Hague under the title Activation of Energy, London, Collins, 1970, 416 p. Containing essays written from 1939 to 1955, this collection contains some of Teilhard's most important statements on the mechanism of orthogenetic evolution.

Science et Christ, Paris, Editions du Seuil, (1965), 293 p. (Oeuvres 9) translated by René Hague as Science and Christ, London, Collins (1965), 230 p. Contains essays mainly concerning Teilhard's theological beliefs written from 1919 to 1955.

Comment Je crois, Paris, Editions du Seuil 1969 , 291 p. (Oeuvres 10) translated by René Hague as Christianity and Evolution, London, Collins, 1971, 255 p. Contains essays written from 1920 to 1953 on various aspects of Teilhard's interpretations of the tenets of catholic belief.

III Volumes in the series Pierre Teilhard de Chardin, L'Oeuvre scientifique edited by Nicole et Karl Schmitz-Moormann in eleven volumes, XXXVIII, 4634 p.
Tome I, 1905-1923, 1-428 p.
Tome II, 1923-1928, 429-888 p.
Tome III, 1928-1930, 889-1428 p.
Tome IV, 1930-1933, 1429-1860 p.
Tome V, 1933-1936, 1861-2328 p.
Tome VI, 1936-1938, 2329-2796 p.
Tome VII, 1938-1940, 2797-3260 p.
Tome VIII, 1940-1943, 3261-3746 p.
Tome IX, 1943-1945, 3747-4222 p.
Tome X, 1945-1955, 4223-4598 p.
Tome XI, Charts and Maps, 4599-4634 p.

These editions contain Teilhardian works of a more scientific nature not reproduced elsewhere. For individual works contained herein of particular value, see Primary Sources.

IV Publications of Teilhard de Chardin not included in the "Oeuvres..." or "Oeuvre scientifique..."

1. Essays and Books

Construire la terre: Building the Earth (translated by Noel Lindsay), Paris, Editions du Seuil (1958), 184 p. (Cahiers Pierre Teilhard de Chardin)
A poetic expression in five parts of Teilhard's religious belief and his belief in the human future.

Ecrits du temps de la guerre, 1916-1919, Paris, Grasset, 1965, 446 p. translated by René Hague, London, Collins, 1968, 315 p.
Contains a series of works concerned with Teilhard's speculations of this time.

Hymne de l'univers, Paris, Editions du Seuil, 1961, 169 p. (Translated by Simon Bartholomew) as Hymn of the Universe, London, Collins, 1965, 157 p.
Contains four essays expressing Teilhard's religious belief.

2. Correspondence

Genèse d'une pensée, Paris, Editions Bernard Grasset (1961), 403 p. translated by René Hague as The Making of a Mind, London, Collins, 1965, 315 p.
Written to a relative, Marguerite Teilhard-Chambon, during the First World War (1914-1919). These letters show that some of the seminal ideas for orthogenesis were already held by Teilhard.

Lettres d'Egypte, Paris, Aubier, 1963, 287 p. translated by Mary Iford, New York, Herder, 1965, 256 p.
Letters written by Teilhard to his parents during the years 1905-1908. Contains little relevant to orthogenesis.

Lettres d'Hastings et de Paris, 1908-1914, Paris, Aubier, 1965, 463 p. translated under the titles of Letters from Hastings 1908-1912 by Judith de Stefano, New York, Herder and Herder, 1968, 206 p. and Letters from Paris 1912-1914 translated by Michael Mazzarese, New York, Herder, 1967, 157 p.

Letters written by Teilhard to his parents, prior to the First World War which contain little of his vision.

Lettres intimes à Auguste Valensin, Bruno de Solages, Henri de Lubac, 1919-1955, Paris, Aubier-Montaigne, 1972, 460 p. The latter letters contain some useful information on the development of Teilhard's thought.

Letters to Two Friends, 1926-1952, New York, New American Library, 1968 , XVIII, 236 p. Written to unidentified recepients in French and English with a commentary by Theosius Dobzhansky. These letters reveal many of Teilhard's personal preoccuaptions.

Lettres de voyage, 1923-1939, Paris, Grasset, 1956, 227 p. This collection and its companion piece, Nouvelles lettres de voyage, Paris, Grasset, 193 p., are translated together under the title Letters from a traveller, London, Collins, 1962, 380 p. They relate the personal reflection of Teilhard in China, Burma, South Africa and New York.

Lettres à Léontine Zanta, Paris, Desclée de Brouwer, 1965, 142 p. translated by Bernard Wall, London, Collins, 1969, 127 p. Covering a period from 1923 to 1939 written from China to a friend of Teilhard's cousin Marguerite: mostly concerning theological topics.

B. Primary Sources

Individual works derived from Oeuvres de Teilhard de Chardin and Pierre Teilhard de Chardin l'Oeuvre scientifique in translation where available

Teilhard de Chardin, Pierre

"A clarification: reflections on two converse forms of spirit" (1950), 215-227 p. in Activation of Energy. In this essay, Teilhard explores the relationship of the reflective monad with what is around it and the meaning of religion relative to unification.

"A defence of orthogenesis in the matter of patterns of speciation" (1955), in The Vision of the Past, 268-274 p. In this essay, Teilhard argues that the notion of a directed transformation must be accepted if genetics and "phyletics" are to be made coherent. He also supplies an important statement of his reasons for this belief.

"A major problem for anthropology" (1951), in Activation of Energy, 311-318 p.
Although short, this essay provides an important statement of the role of radial energy as a disposition for centro-complexification.

"A mental threshold across our path: from cosmos to cosmo genesis" (1951), in Activation of Energy, 251-268 p.
In this article, Teilhard argues for the abandonment of static points of view and explores the relationship of spirit to matter.

"A note on progress" 1920, in The Future of Man, 11-24 p.
This is an interesting essay as it shows Teilhard had already accepted growth of consciousness as an indication of progress.

"A phenomenon of counter-evolution in human biology" (1949), in Activation of Energy, 181-195 p.
In this essay, Teilhard argues the dubious proposition that a convergent universe is a psychological necessity.

"A sequel to the problem of human origins" (1953), in Christianity and Evolution, 229-236 p.
Teilhard argues in this essay that life and consciousness are the result of a specific set of conditions and that these conditions have almost certainly been duplicated elsewhere in the universe with similar results.

"Can biology, taken to its extreme limit, enable us to emerge into the transcendent?" (1951), in Science and Christ, 212-213 p.
This work is an assertion on psychological grounds, that there must be a future emergence if evolution is to continue.

"Centrology" (1944), in Activation of Energy, 97-127 p.
This essay is one of the most important of Teilhard's shorter writings as it suggests the outlines of the mechanism of the interaction of soma and psyche in biotic reproduction.

"Degrees of scientific certainty in the idea of evolution" (1946), in Science and Christ, 192-196 p.
This short essay is important as it indicates Teilhard did not regard his complexity-consciousness law as a proven fact but as a hypothesis.

"De l'arbitraire dans les lois, théories et principes de la physique" (orig. printed in Quod Libeta June 1905 No. 2 as found in L'Oeuvre scientifique, Tome I, 1905, p. 1-30).

In this essay, Teilhard demonstrates that he has at least a general conception of the nature of physical laws of the type found in classical physics.

"Does mankind move biologically upon itself?" (1949), in The Future of Man, 244-259 p.
In this essay, Teilhard asserts the socio-physical convergence of humanity as part of biological evolution.

"Evolution of the idea of evolution" (1950) in The Vision of the Past, 245-247 p.
In this brief essay, Teilhard argues that evolution must be accepted as a fact.

"Fossil men - recent discoveries and present problems" (originally published by Henri Vetch, Peking 1943) in L'Oeuvre scientifique, Tome IX, 3905-3936 p.
This essay, also published by Editions du Seuil in L'apparition de l'homme under the title La question de l'homme fossile, is a key work for the understanding of the way in which Teilhard used analogical inference as part of his conceptual method.

"From the pre-human to the ultra-human: the phases of a living planet" (1951), in The Future of Man, 289-297 p.
In this essay, Teilhard contends 'ontogenesis' is not identical to phylogenesis and the study of the mechanism of each suggests a continued growth of humanity to become an ultra-humanity.

"Geobiology et geobiologia in L'Oeuvre scientifique, Tome IX (1943-1945) with English translation, 3753-3760 p.
This discussion is important because of the fact it illustrates Teilhard's commitment to a multidisciplinary science , geobiology.

"Hominization" (1923), in The Vision of the Past, 51-79 p.
In this essay, Teilhard posits that man is the key to understanding evolution and spiritual forces" the reason for evolutionary development.

"Hominization and speciation" (1952), in The Vision of the Past, 256-267 p.
In this essay, Teilhard explores the mechanisms of evolution and their extensions to humanity relative to anthropology as a science.

"How I believe" (1934), in Christianity and Evolution, 96-132 p.
In this paper, Teilhard provides some useful background information concerned with his reason for adopting the conception of

the primacy of consciousness.

"How may we conceive and hope that human unanimisation will be realized on earth" (1950), in The Future of Man, 281-288 p. This is an important essay as it provides a statement of some of the conditions Teilhard posits as necessary for human convergence.

"Human Energy" (1937), in Human Energy, 113-162 p. An important statement of the operation of consciousness on the human level.

"La pensée dans la science" (orig."La vie catholique en France et à l'étranger," No. 203, 1928), in L'Oeuvre scientifique, Tome III, 1928-1930. This book 1099-1101 p. This book review of Edouard Leroy's L'exigence idéaliste et le fait de l'évolution demonstrates that even at this early date, Teilhard wished to see consciousness accepted as part of evolutionary process.

"Life and the planets" (1945), in The Future of Man, 97-123 p. This is one of Teilhard's most important short essays in which he provided a definition of 'complexity' and a statement of the operation of the complexity-consciousness law.

"Man's Place in the universe" (1932), in The Vision of the Past, 175-182 p. In this essay, Teilhard stresses the importance of anthropology in providing a key to man's past and speculates on the role of anthropology in the exploration of man's future.

"Note on the present reality and evolutionary significance of a human orthogenesis" (1951), in The Vision of the Past, 248-255 p. An extremely important essay as it provides a statement of Teilhard's conception of the mechanism of evolution on the level of the human species.

"On the law of irreversibility in evolution" (1923), in The Vision of the Past, 49-50 p. A brief but important early statement of Teilhard's belief in the irreversibility of the evolutionary process.

"On the necessarily discontinuous appearance of every evolutionary series" (1926) in The Vision of the Past, 114-115 p. Provides a statement of Teilhard's auxiliary hypotheses concerning the reason for the gaps in the evolutionary series.

"On the probable coming of an ultra-humanity" (1950), in The Future of Man, 270-280 p.

In this essay, Teilhard explores the growth of consciousness and some of the reasons for this growth.

"On the trend and significance of human socialisation". Paper presented for anthropologists, The Viking Fund, New York, April 9, 1948, in L'Oeuvre scientifique, Tome X, 4243-4251 p. In this paper, Teilhard posits that anthropology will develop into an operative as well as a descriptive science.

"Our most ape-like relative" (orig. from natural history, New York, 1937, Vol. XL), in L'Oeuvre scientifique, VI, 2782-2789 p.
Provides a demonstration through the example of Peking man of the way the characteristics of early man were determined and fixed.

"Outline of a dialectic of spirit" (1946), in Activation of Energy, 141-151 p.
This essay is important in that it provides both a statement and an example of Teilhard's method of alteration.

"Préface pour le livre "Evolution et Finalité" de Jean Montassey, 1948, in L'Oeuvre scientifique, Tome X, 4255-4257 p.
In this introduction, Teilhard demonstrates his commitment to a finalistic position.

"Quantitative zoology", in L'Oeuvre scientifique, Tome IX (1943-1945), 3893-3895 p.
In this book review of G.G. Simpson's book of the same title, Teilhard demonstrates that he has no antipathy towards and a sympathy for the mathematical development of biology.

"Quelques observations sur le livre "Problématique de l'évolution" de François Mever, in L'Oeuvre scientifique, Tome X, 4574-4575 p.
Although brief, this paper is important because it illustrates Teilhard's conception of the reducibility of levels.

"Sketch of a personalistic universe" (1936), in Human Energy, 53-71 p.
This is an important essay as it provides a statement of Teilhard's analogical base.

"Some reflections on progress," 1945, in The Future of Man, 61-81 p.
This essay is important because it states the type of evidence Teilhard accepts as this evidence relates to the past and the future.

"The Activation of Human Energy" (1953), in Activation of Energy, 385-393 p.
This essay has important passages on the relationship of radial to tangential energy.

"The Atomism of Spirit" (1941), in Activation of Energy, 21-57 p.
In this essay, Teilhard provides a definition of 'complexity' and conveys a partial statement of the meaning of the complexification series.

"The Basis and foundations of the idea of evolution" (1926), in The Vision of the Past, 116-142 p.
In this valuable essay, Teilhard provides a statement of his conception of narrative evolutionary explanation.

"The convergence of the universe" (1951), in Activation of Energy, 281-296 p.
In this essay, Teilhard pursues the topics of critical thresholds and verification.

"The end of the species" (1953), in The Future of Man, 298-305 p.
Teilhard here discusses evolutionary mechanisms proper to the human species.

"The energy of evolution" (1953), in Activation of Energy, 359-372 p.
In this essay, Teilhard proposes a new energetic explanatory of cosmic evolution.

Teilhard de Chardin and Pei, W.C., "The lithic industry of the sinanthropus deposits in Choukoutien" (reprinted from the Bull. Geol. Soc. China, Vol. XI, 1932), in L'Oeuvre scientifique, Tome IV, 1930-1933, 1721-1764 p.
This article provides another example of Teilhard's use of analogical inference in his strict pace ontological efforts.

"The mysticism of science" (1939), in Human Energy, 113-181 p.
Among other topics in this essay, Teilhard discusses the limitations of analysis and mechanistic determinism.

The natural history of the world" (1925), in The Vision of the Past, 103-113 p.
This is one of the most important essays written by Teilhard prior to his proposal of the complexity-consciousness law as it proposes a new systematic based on a reconstruction of biotic series and also it conveys some of Teilhard's concepts concerning philosophy of science.

"The natural units of humanity" (1939), in The Vision of the Past, 192-215 p.
This includes one of the few statement of Teilhard on genetics and an important discussion of human evolutionary mechanisms.

"The phenomenon of man" (1930), in The Vision of The Past, 161-174 p.
In this essay, Teilhard situates mankind in the advance of evolution and provides some of his reasons for doing so.

"The phenomenon of spirituality" (1937), in Human Energy, 93-112 p.
In this essay, Teilhard provides a statement of some of the characteristics of 'spirit' or 'consciousness' and these may be transposed to his conception of radial energy.

"The phyletic structure of the human group" (1951), in The Appearance of Man, 132-171 p.
This is one of Teilhard's more important and scientific statements of the human evolutionary process.

"The psychological conditions of the unification of man" (1942), in The Activation of Energy, 169-179 p.
In this essay, Teilhard proposes the purported psychological conditions necessary to the continuance of evolution.

"The rise of the other" (1942), in Activation of Energy, 59-75 p.
Teilhard presents some important statements on the relationship of complexity to consciousness in this essay.

"The singularities of the human species" (1954), in The Appearance of Man, 208-273 p.
This is the most important presentation of Teilhard's theory of orthogenesis excluding Man's Place in Nature and The Phenomenon of Man.

"The spirit of the earth" (1933), in Human Energy, 19-52 p.
In this essay, Teilhard stresses the importance of life and consciousness as objects of scientific investigation.

"The stuff of the universe" (1953), in Activation of Energy, 373-383 p.
In this essay, Teilhard frankly discusses some of the religious preoccupations underlying his view of the Weltstoff.

"The transformation and continuation in man of the mechanism of evolution" (1951), in Activation of Energy, 297-309 p.
This is a highly important essay in which Teilhard explicitly

states that his notion of 'complexity' should supplement and, to an extent, supplant the Darwinian notion of 'survival of the fittest'.

"The vision of the past" (1942), in The Vision of the Past, 237-244 p.
In this essay, Teilhard discusses orthogenesis' diversification and his 'automatic suppression of first terms' proposition.

"Turmoil or genesis" (1947), in The Future of Man, 214-226 p.
In this essay, Teilhard stresses the importance of life and consciousness as the most important phenomena for scientific investigation.

"Universalization and union" (1942), in Activation of Energy, 77-95 p.
Teilhard presents the conditions for the future of mankind and comments on the nature of centred complexity.

"Un sommaire de ma perspective 'phénoménologique' du monde" (reprinted from Les Etudes Philosophiques, Nouv. série, 10e année, 1955), 4570-4572 p.
This short summary of Teilhard's illustrates unequivocally that his conception of phenomenology is situated in science.

"Variétés: Le néolithique de la Chine"(originally printed in L'anthropologie XXXVI 1926), in L'Oeuvre scientifique, Tome II, 1923-1928, 766-773 p.
This essay provides an example of analogical inference in which dating techniques and behavioural characteristics are united by Teilhard in order to establish a physical hominid type.

C. Primary Sources: Books other than those Wrirten by Teilhard

Abro, A.,d', The Rise of the New Physics, Vol. one and two, New York, Dover, 1951(1939), vii-982 p.
A classic study of the decline of mechanism and the evolution of the fundamental postulates of physics.

Baker, Jeffrey J.W. and Allen Garland E., Matter, Energy and Life, New York, Addison-Wesley Publishing Company, 1965, 132 p.
This book provides a useful primary study of the energetics and components of living things.

Buchdahl, Gerd, Metaphysics and the Philosophy of Science, Oxford, Blackwell, 1969, xii-714 p.

A useful study of the influences of the founders of modern philosophy on the methodology of science and the philosophy of science.

Blum, Harold E., Time's Arrow and Evolution, New York, Harper, 1962, x-220 p.
While paralleling Teilhard's theory to an extent, this book provides an important contrast to Teilhard's evolutionary theory.

Braithwaite, Richard B., Scientific Explanation, Cambridge, The University Press, 1968(1953), xii-376 p.
Presents an early version of the hypothetico-deductive theory of scientific explanation and a useful discussion of the role of models in science.

Bunge, Mario Intuition and Science, Englewood Cliffs, N.J., Prentice-Hall, xii-137 p.
An important analysis of the place of intuition in philosophy, science and mathematics.

Bunge, Mario The Myth of Simplicity, Englewood Cliffs, N.J., Prentice-Hall, 1963, xii-239 p.
An exposition of the major issues in the philosophy of science with some particularly helpful sections on 'analysis levels' and analogy.

Burtt, Edwin Arthur, The Metaphysical Foundations of Modern Physical Science, London, Routledge and Kegan, 1964(1924).
This book contains some useful sections on classical mechanism and method as well as a general exploration of such key scientific concepts as causality and qualities.

Darwin, Charles, The Origin of Species, New York, New American Library, 1958 (Orig. 1859), ix-479 p.
The first contemporary presentation of a theory of evolution and still one of the most essential.

Dobzhansky, Theodosius, Heredity and the Nature of Man, New York, New American Library, 1964, vii-175 p.
A study of genetics and the implications of genetics by one of the greatest living geneticists.

Dobzhansky, Theodosius, Mankind Evolving, Toronto, Bantam, 1969 (1962), xi-398 p.
One of the major contemporary studies of genetics and evolution.

Einstein, Albert, Essays in Science, (Orig. Meinweltbild translated by Alan Harris), New York, Wisdom Library (1933), xii-144 p.
This book is a compilation of Einstein's thoughts on science and scientific philosophy. It is extremely useful in establishing the background thought on the foundations of science.

Einstein, Albert and Infeld, Leopold, The Evolution of Physics, Force Village, Mass., Simon and Schuster (1938) (1960 ed), xviii-302 p.
A classic study of the development of physics and alterations in the mechanistic model.

Fehl, Edward Noah, Science and Culture, Hong Kong, Chungchi College, 1965, xxii-417 p.
An exploration of the interaction of scientific thought and other modes of thought. The sections on Newtonian method were particularly helpful.

Frank, Philipp, Modern Science and Its Philosophy, New York, Collier, 1961 (c.1941), 316 p.
A study of the philosophic basis of physics from a positivistic point of view.

Frank, Philipp, Philosophy of Science, Englewood Cliffs, N.J., Prentice-Hall, 1957, xxii-394 p.
A general presentation of the philosophy of science containing a useful discussion of causal laws.

Cohen, Bernard, The Birth of a New Physics, New York, Doubleday, 1960, 200 p.
This book provides a helpful commentary on the origins and development of classical physics.

Cragg, L.H. and Graham R.P., The Elements of Chemistry, Toronto, Clarke, Irwin, 1959, viii-312 p.

Cragg, L.H. and Graham R.P., The Essentials of Chemistry, Toronto, Clarke, Irwin, 1956, vii-606 p.
This text together with The Elements provides the primary source material for the segments on chemical periodicity.

Givetz, Harry, Geiger, George, Hantz, Harold, and Morris, Bertram Science, Folklore and Philosophy, New York, Harper and Row, 1966, xi-547 p.
A wide-ranging study on the development of western thought. The sections on classical mechanism are of particular value.

Handler, Philip, (Editor), Biology and the Future of Man, New York, Oxford University Press, 1970, xxvi-967 p. Compiled under the auspices of the American National Academy of Sciences, this work is considered by some leading biologist (eg. G.H. Waddington) as the best single survey of the whole of biology.

Heisen, Berg. Werner, Physics and Philosophy, London, Allen and Unwin, 1963, 176 p.
An important examination of the foundations of physics.

Hempel, Carl G., Philosophy of Natural Science, Englewood Cliffs, N.J., Prentice-Hall, 1966, xii-116 p.
Despite its elementary nature, this book offers a concise exposition of the structure of science by one of the most influential philosophers of science.

Hesse, Mary B., Models and Analogies in Science, London, Sheed and Ward, 1963, 150 p.
This book contains some useful material on the logic of analogy as well as the role of models in science.

Kahane, Howard, Logic and Philosophy, Belmont, California, Wadsworth, 1969, xvi-442 p.
A general surveyof mathematical logic and philosophy of science. This book provides a partial source for contemporary definitions.

Kuhn, Thomas S., The Structure of Scientific Revolutions, Vol. 2, Chicago, The University of Chicago Press, 1962, 1970 ed., xii-210 p.
An important study of the use and role of paradigms in science.

Legros, Clark, W.E., The Antecedents of Man, New York, Harper, 1959, viii-374 p.
An excellent work on evolution and the evidence for it.

Nagel, Ernest, The Structure of Science, New York, Harcourt, 1961, xiii-618 p.
A major study of the structure of science which was relied upon extensively for background material.

Newton, Sir Isaac, Mathematical Principles of Natural Philosophy, Motte translation (1929), Florian Cajori Revision, Berkeley, University of California Press, 1960, xxxv-680 p.
The foundation work on classical physics. The segments on method were of particular value.

BIBLIOGRAPHY

Nidditch, P.H., Elementary Logic of Science and Mathematics, London, University Tutorial Press, 1960, viii-371 p.
A general study of the logic of scientific theories. The segments on the observational and operational patterns of science were helpful.

O'Manique, John Thomson, Energy in Evolution, London, Garnstone 1969, xiii-113 p.
This is a particularly useful book as it deals exclusively with the scientific meaning and status of the central concepts of Teilhard's theory.

O'Manique, John Thomson, The Theory of Orthogenesis in the Synthesis of Teilhard de Chardin, Ottawa, 1966, 244 p.
This thesis, submitted to the Faculty of Philosophy of the University of Ottawa provides a considerable number of helpful insights on the meaning of Teilhardian orthogenesis.

Mill, John Stuart, A System of Logic, Ratiocinative and Inductive, Vol. I-II, 3rd ed., London, J.W. Parker, 1851, Vol. I, xvi-502 p., Vol. II, xiv-527 p.
These two volumes include writings on the logic and methods of scientific inquiry. Although one of the earlier explorations in philosophy of science, these volumes are still among the most important.

Rosental, Mark Moiseevich, A Dictionary of Philosophy, ed. by M. Rosental and P. Yudin, transl. from the Russian , ed. by Richard R. Dixon and Muran Saifulin, Moscow, Progress Publishers, 1967, 494 p.

Runes, Dagobert David, The Dictionary of Philosophy, 2nd ed., New York, Philosophical Library, 1942, vii-342 p.

Nogar, Raymond J., The Wisdom of Evolution, Toronto, The New American Library, 1963, 368 p.
This book is a defence of evolutionary theory and offers some criticism of Teilhard's orthogenesis theory.

Polanyi, Michael, Personal Knowledge, Harper and Row, 1958, xvii-428 p.
This book contains useful segments on probability, heuristics, whole levels and purpose.

Reichenbach, Hans, The Rise of Scientific Philosophy, Berkeley, University of California, 1956(1951), xiii-333 p.
A study of scientific method with a useful section about evolution.

Sanderson, R.T., Chemical Periodicity, New York, Reinhold, 1960, 330 p.
A valuable guide to the structure of the chemical series.

Simpson, George Gaylord, The Meaning of Evolution, New York, New American Library, 1951(1949), 192 p.
This book occupies a central position in the explanation and defence of the contemporary synthetic theory of evolution.

Simpson, George Gaylord, This View of Life, New York, Harcourt, Brace and World, 1964, xii-308 p.
This book represents a compilation and modification, in part, of several essays. It includes an explained version of the article "On the remarkable testament of the Jesuit paleontologist , Pierre Teilhard de Chardin" which appeared in the Scientific American, April 1960. More importantly, Simpson presents in this work some major insights in contemporary biological opinion on historical and teleonomic explanation.

Skyrms, Brian, Choice and Chance, Belmont, California, Dickinson, vii-165 p.
A text on inductive logic with a helpful segment on analogy.

Tax, Sol (Editor), Evolution After Darwin, Chicago, The University of Chicago Press, 1960, Vol. I, The Evolution of Life, viii-629 p., Vol. II, The Evolution of Man, viii-473 p. Vol. III, Issues in Evolution, viii-310 p.
Of the many authoritative articles in these volumes, the essays by Berhard Rensch "The Laws of Evolution" p. 95-116, Ernst Mayr "The Emergence of Evolutionary Novelties" p. 349-380, C.H. Waddington "Evolutionary Adoptation" p. 381-402 and T. Dobzhansky "Evolution and Environment" p. 403-428 in Vol. I were the most useful.

Waddington, C.H., Biology, New York, Barnes and Noble, 1962, ix-120 p.
Although meant as a primary survey of the various areas of biology, the importance of the author gives this book a value beyond the usual texts of its type.

Waddington, C.H., The Nature of Life, New York, Atheneum, 1962 (1961), 133 p.
Contains a general discussion of organic development and a particularly interesting chapter on innate potentialities.

Wartofsky, Marx W., Conceptual Foundations of Scientific Thought, New York, Macmillan, 1968, xii-560 p.
A general study, of issues in the philosophy of science, of

which the sections on scientific methodology and hypotheses are of particular value.

D. Primary Sources: Articles by those other than Teilhard

Deutsch, Karl W.,"Mechanism, Teleology, and Mind: the Theory of Communication and Some Problems in Philosophy and Social Science" (1963), in Space, Time and The New Mathematics (ed. Robert W. Marks), Toronto, Bantam, 1964, 218-261 p.
This paper presents a lucid discussion of such contemporary topics as artificial intelligence with a particularly helpful segment on organic and mechanistic models.

Dobzhansky, Theodosius, "Biology, Molecular and Organismic", in the Graduate Journal, Vol. VII, No. 1, Winter 1965, 9-25 p.
In this essay, Dobzhansky provides a useful discussion of the compositional nature of biology.

"Changing Man", in Science, January 27, 1967, Vol. 155, No. 3761, 409-415 p.
In this essay, Dobzhansky explores evolutionary implications for mankind present and future.

"L'évolution créatrice", extract from Diogène, No. 58, avril-juin 1967, 64-80 p.
Although holding a somewhat different view than Teilhard on evolutionary development, Dobzhansky stresses the fundamentally innovative character of the evolutionary process.

"On Genetics, Sociology and Politics", in Perspectives in Biology and Medicine, Vol. II, No. 4, Summer 1965.
In this valuable essay, Dobzhansky argues that the modern geneticist must abandon the notion of an ideal fixed 'type' for a relational or balance theory of evolutionary development.

"The Genetic Basis of Evolution", in Scientific American, January 1950, 2-11 p.
This is one of the classic essays on the relationship of genetic processes with the evolutionary processes postulated by Darwin.

"The Present Evolution of Man", in Scientific American, 102-7 p.
Dobzhansky here discusses the difficulties with the Darwinian concept of survival of the fittest and concludes, as does Teilhard, that this principle is not adequate for a full

description of evolutionary change.

Helmholtz, Hermann von, "The Aim and Progress of Physical Science" (1869), in Selected Writings of Hermann von Helmholtz (ed. by Russell Kahl, Middletown, Connecticut, Wesleyan University Press, 223-245 p.
This essay presents a clear and concise statement of the reductionist position of Helmholtz.

Hempel, Carl G., "Deductive-Nomological vs. Statistical Explanation", in Minnesota Studies in Philosophy of Science, Vol. II, editors Herbert Feigl and Grover Maxwell, Minneapolis, University of Minnesota Press, Minneapolis (1962), 99-167 p.
As well as providing a thorough exposition of the deductive-nomological paradigm of scientific explanation, Hempel provides a sketch of the statistical paradigm which it might replace in this article.

Hempel, Carl G., "Operationism, Observation and Scientific Terms" as taken from "A Logical Appraisal of Operationism" 1956, in Philosophy of Science (ed. Arthur Danto and Sidney Morgen Besser); New York,The World Publishing Company, 1960, 101-120 p.
In this essay, Hempel presents a valuable appraisal of the strengths and limits operationism.

Mayr, Ernst, "Cause and Effect in Biology", in Science, 10 Nov., 1961, Vol. 134, 1501-1506 p.
This is one of the most important essays written to date by a biologist on the meaning of explanation in biology.

Mehlberg, Henryk, "Physical Laws and Time's Arrows", in Current Issues in the Philosophy of Science (ed. Herbert Feigl and Grover Maxwell), New York, Holt Rinehart and Winston, 1961, 105-138 p.
In this essay, Mehlberg argues that there is no direction to physical processes.

Nagel, Ernest, "Measurement" reprinted from Erkenntis (1932), in Philosophy of Science (ed. Arthur Danto and Sidney Morgen Besser), New York, The World Publishing Company, 1960, 121-140 p.
Contains a section from one of the earlier and more important examinations of the logical basis of physical measurement.

Polanyi, Michael, "Notes on Professor Grünbaum's Observations", in Current Issues in The Philosophy of Science (ed. Herbert Feigl and Grover Maxwell), New York, Holt, Rinehart and Winston, 1961, 53-55 p.

This short article provides some useful commentary on the genesis of theories.

Sellars, Wilfred, "The Language of Theories", in Current Issues in the Philosophy of Science (ed. Herbert Feigl and Grover Maxwell), New York, Holt, Rinehart and Winston (1961), 57-77 p.
This article presents a good exposition of the elements of theories.

Scriven, Michael, "Explanation and Prediction in Evolutionary Theory", in Science, 28 August, Volume 130, 477-481 p.
This article is one of the first in which the philosophical forms of explanation in evolutionary biology are presented.

E. Secondary Sources: Books about Teilhard

Bravo, Francicso, La vision de l'histoire chez Teilhard de Chardin, Paris, Editions du Cerf, 1970, 448 p.
This is the most exhaustive study to date on the Teilhardian conception of history, touching on almost all aspects of Teilhard's theory. The author, however, does not fully see the explanatory significance of narrative explanation within the structure of orthogenesis.

Chauchard, Paul, La pensée scientifique de Teilhard, Paris, Editions universitaires (1965), 270 p.
Contains some interesting material on Teilhard as a paleontologist and psycho-biologist, as well as on other aspects of the orthogenetic theory.

Chauchard, Paul, Man and Cosmos, Montreal, Palm Publishers, 1965, 192 p. translated by George Courtright from L'être humain selon Teilhard de Chardin, Paris, 1959.
Chauchard presents an oversimplified view of Teilhardian phenomenology and its certitude. Nevertheless, he presents some useful material on the 'homeostatic' functions of consciousness.

Corvez, Maurice, De la science à la foi, Tours, Mame, 1964, 189 p.
This book has some useful segments on the complexity-consciousness law and about the orthogenetic theory in general.

Crespy, George, From Science to Theology, (trans. by Geroge H. Shriver), Nashville, Abington Press, 174 p.
This book is mainly concerned with the religious implications of Teilhard's evolutionary theory.

Cuénot, Claude, Nouveau lexique Teilhard de Chardin, Paris, Editions du Seuil, 1968, 224 p.
Contains some useful definitions of the Teilhardian use of terms.

Cuénot, Claude, Teilhard de Chardin (trans. by Vincent Colimore), London, Burns and Oates (1965).
This work traces Teilhard's intellectual development and it contains some very significant letters written by Teilhard as well as an extensive bibliography of Teilhard's works.

Delfgaauw, Berhardus, Maria Ignatius, Evolution: The Theory of Teilhard de Chardin (trans. Hubert Moskins), London, Collins, 1969 (c1961), 124 p.
A sympathetic presentation of parts of Teilhard's theory of evolution.

Grey, Donald P., The One and the Many, New York, Herder, 1969, 183 p.
This work is heavily weighted in the direction of the theological implications of Teilhard's theory but it does have a useful chapter on matter and spirit.

Kenney, W., A Path Through Teilhard's Phenomenon, Dayton, Ohio, Pflaum Press, 1970, xxii-284 p.
This book presents a sympathetic critique mainly of the Phenomenon of Man and it includes a useful glossary of Teilhardian terms as well as a bibliography

Murray, Michael H., The Thought of Teilhard de Chardin, New York, Seabury, 1966, x-177 p.
This book provides a sympathetic description of Teilhard's beliefs and it contains a helpful chapter on Teilhard's method.

Rabut, Olivier-André, Dialogue with Teilhard de Chardin, Sheed and Ward (1961), 247 p.
Although based on a limited survey of Teilhard's works, this book does provide a helpful limited critique of orthogenesis.

Jones, D. Gareth, Teilhard de Chardin; an Analysis and Assessment, London, Tyndale Press (1966), 72 p.
Although brief this work presents some valuable criticisms of orthogenesis.

O'Manique, John Thomson, Energy in Evolution, London, Garnstone Press, 1969, xiii-113 p.
This book is of particular interest because it is one of the few which focuses almost exclusively on the scientific

constructions, particularly that of energy, which can be found in Teilhard's theory.

Rideau, Emile, Teilhard de Chardin. A Guide to his Thought (translated by René Hague), London, Collins, 1967, 672 p.
The notes provided as textual support to chapters on Teilhardian intuition, phenomenology, cosmology and anthropology are of particular value.

Smulder, Pieter Frans, The Design of Teilhard de Chardin, (trans. Arthur Gibson), Westminster, Md., Newman Press, 1967, xvi-310 p.
Although concentrating on theological issues, this book contains a helpful chapter on the complexity-consciousness law.

Solages, Mgr Bruno de, Teilhard de Chardin; Témoignage et étude sur le développement de sa pensée, Paris, E. Privat, 1967, 397 p.
While this book touches on nearly every aspect of Teilhard's thought, its segment on method is of particular interest.

Wilders, N.M., An Introduction to Teilhard de Chardin, (trans. by Hubert Hoskins), London, Collins, 1968, 191 p.
This short introduction to Teilhard's thought contains an interesting discussinn concerning the relationship of consciousness to complexity.

F. Secondary Sources: Articles about Teilhard

Berger, Gaston, L'idée d'avenir chez Teilhard, in Revue Teilhard de Chardin, no. 54-55, mars 1973, 31-55 p.
This essay contains a commentary on Teilhard's phenomenology, some useful observations about the nature of the complexity-consciousness law.

Deely, John N., "The Emergence of Man: An Inquiry into the Operation of Natural Selection in the Making of Man", in The New Scholasticism, Vol. XL, 1966, 141-176 p.
Contains some useful material on biological emergence with a reference to Teilhard's notion.

Delcourt, Albert, "De la cellule à la pensée", in Revue Teilhard de Chardin, No. 47-48, 1971, 20-23 p.
This article claims some evidence supports Teilhard's notion of orthogenetic development.

Donceel, Joseph F., "Causality and Evolution: A Survey of some Neoscholastic Theories", in The New Scholasticism, Vol. XXIX,

No. 3, 1965, 295-315 p.
Contains some reference to Teilhard's notion of evolution as well to as other authors.

Donceel, Joseph F., "Teilhard de Chardin: Scientist or Philosopher, in International Philosophical Quarterly, Vol. V, No. 2, 1965, 248-266 p.
Donceel, in this article, maintains that there are two levels of explanation, scientific and philosophical, which Teilhard confuses. However, Donceel further claims in Teilhard the two levels are complementary.

Dyson, A.O., "Teilhard: Analogy and Dialectic", in Teilhard Reassessed, London, Darton, Longman and Todd, 1970, 33-40 p.
A general description of Teilhard's use of analogy and purported dialectic.

Elliot, Francis G., The Origin of Life and the World Vision of Teilhard de Chardin (trans. Noël Lindsay in Evolution, Marxism and Christianity; studies in Teilhardian synthesis, London, Garnstone, 1967, 11-29 p.
A technical discussion of the origins of life presented against the background of Teilhard's notion of complexity.

Elliot, F.G., "The World Vision of Teilhard De Chardin", in International Philosophical Quarterly, Vol. I, No. 4, 1961, 620-647 p.
This article contains a general account of Teilhard's theory with emphasis on his notions of divergence, convergence, and emergence.

Fothergill, P.G., "Teilhard and the Question of Orthogenesis", in Evolution, Marxism and Christianity, London, Garnstone, 1967, 30-46 p.
This essay presents a balanced and useful discussion of the meaning that the expression orthogenesis had for Teilhard.

Grey, Donald P., "Teilhard's Vision of Love", in Dimensions of the Future, Washington Corpus Books (1968), 73-98 p.
This interesting essay correlates Teilhard's notion of 'love' with his notion of energy.

Isaye, Gaston, "The Method of Teilhard de Chardin: A Critical Study", in The New Scholasticism, Volume XLI, 1967, 31-57 p.
This essay contains a sympathetic critique of Teilhard's method, with some interesting commentary about Teilhard's use of analogical inference and the 'within'.

Stock,M., "Scientific vs. Phenomenological Evolution: A Critique of Teilhard de Chardin", in The New Scholasticism, Vol. XXXVI, 1962, 368-380 p.
In this article Stock points out that Teilhard sometimes claims a certitude for evolutionary hypotheses that they do not, in fact, have.

Towers, Bernard, "Human Embryology and the Law of Complexity-Consciousness", in Evolution, Marxism and Christianity, London, Garnstone (1967), 47-57 p.
A technical discussion of morphological development usefully related to Teilhard's complexity-consciousness law.

Turk, F.A., "The Idea of Biological and Social Progress in the System of Teilhard de Chardin", in Teilhard Reassessed, London, Darton, Longman and Todd (1970), 1-32 p.
This article presents a well-balanced critique of orthogenesis

DEFINITIONS

The following four meanings of the terms 'extensional', 'intensional', 'ostensive' and 'contextual', as modifying the term 'definition' given throughout this thesis are basically those reported by Howard Kahane.

According to Kahane,

> "An extensional definition is simply a list of all the things to which a term applies."[6]
>
> "An intensional definition of a term lists a set of properties such that the term applies to all things having that set of properties and to nothing else."[7]
>
> "An ostensive definition of a term is one which indicates the meaning of that term by providing a sample of the thing denoted."
>
> A contextual definition is one in which functions or relational properties are defined through a description of the context in which they occur, not in isolation."
>
> e.g., average density of x - dx $\frac{\text{mass of x(in grams)}}{\text{volume of x (in c.c.)}}$[8]

The meaning of the phrase 'operational definition' is basically that reported (stipulated) by Phillip Frank who contends that a concept is defined operationally when a description of "a set of physical

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6. Kahane, Howard, Logic and Philosophy, Belmont, California, Wadsworth, 1969, p. 190.

7. ________, Logic and Philosophy, p. 190.

8. ________, Logic and Philosophy, p. 191.
Logic and Philosophy, p. 194-195.
Frank Phillip, Philosophy of Science, Englewood Cliffs, N.J., 1957, p. 311-312.

operations" which may be carried out, is provided so that "a uniquely determinate value" may be assigned to the concept "interpretive analysis." This is a coined phrase designating a situation where the object analysed and the conceptual techniques by which it may be analysed are not 'given' but must arrived at, to an extent, by speculation.

GENERAL APPENDIX I

Ad hoc hypothesis: the meaning of this phrase is described in the Dictionary of Philosophy as "A dubious assumption or argument arbitrarily introduced as an explanation after the fact,"[1] or by Arthur Pap as an "assumption made in order to save a theory that is apparently refuted by the facts. The assumption not being independently testable."[2]

Assumption, a conditional claim. Synonym. Hypothesis see Appendix D on method Chapter I. Auxiliary assumption, auxiliary hypothesis. The sense of this phrase used throughout the thesis is basically that conveyed by Carl Hempel, who describes an auxiliary hypothesis as a "premise which is tacitly taken for granted in an argument",[3] and functions to allow, in conjunction with a general hypothesis test implications or observational implications to be derived or inferred. e.g. Semmelweis proposed the hypothesis that puerperal fever was caused by infectious matter carried on the hands of his students from the dissecting room. He reasoned that the incidence of child birth fever would decrease if physicians would wash their hands in chlorinated lime.

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1. The Dictionary of Philosophy (ed Dagobert, D. Runes, New York, Philosophical Library, 1942, p. 5.

2. Pap, Arthur, The Philosophy of Science, New York, Free Press of Glencoe, 1962, p. 421.

3. Hempel, Carl G. Philosophy of Natural Science, Englewood Cliffs, N.J., Prentice-Hall, p. 22-23.

This, in fact, happened. His auxiliary assumption entailed his tacit hypothesis that chlorinated lime would destroy the infectious factor on the attending physician's person.

Axiom - The basic meaning for the term 'axiom' used in this thesis is in accord with that given in A Dictionary of Philosophy where an 'axiom' is described as, "a proposition, in any scientific theory, that is so constructed that it is taken as the starting point and does not have to be proved for that theory and from which or from the totality of which the remain propositions are deduced..."[4] Throughout the thesis, the term 'postulate' is used almost as a synonym for axiom, except that 'postulate' is reserved as a term for the initial propositions of a special or particular scientific theory; hence, axiom has a more general meaning. In the context of the discussion of a logical calculus (Chapt I), it has, however, a more restricted meaning than postulate. Here, it means "a basic proposition in a formal system which is asserted without proof and from which, together with the other propositions, all other theories are derived according to the rule of inference of the system."[5]

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4. Rosental, Mark Moiseevich, A Dictionary of Philosophy, Moscow Progress Publishers, 1967, p. 40.

5. The Encyclopedia of Philosophy, Vol. Five (Ed. Paul Edwards), New York, Macmillan, 1967, p.58.

GENERAL APPENDIX II

ABSTRACT OF

An Exposition and Critique of the Logical Structure and Biological Basis of the Orthogenetic Theory of Pierre Teilhard De Chardin

Many questions have been raised concerning the scientific status of the orthogenesics but there has been little attempt to isolate and reconstruct the fundamental presuppositions with which Teilhard approached the physical materials from which his orthogenetic theory was derived or about the logical and explanatory patterns employed by the theory itself, as well as the structural strength and weakness of its patterns of explanation.

In this project the basic notions underlying Teilhard's approach to nature were described. These pre-theoretical determinants composed of Teilhard's scientific goals, his methodological heuristic, his rejection of the classical mechanistic model and his adoption of an organic model, as well as his methods of analysis and synthesis, both utilizing hypothesis and his general patterns of explanation were explored.

The influence of these pre-theoretical determinants on his formulation of the problem of man's place in nature and the levels of explanation which comprise the answer to his problem, the orthogenetic theory, was tentatively established through a statement of the levels of explanation of the concepts of complexity and consciousness. The inherent problems associated with Teilhardian explanations concerning his conceptions of indeterminacy, lawfullness, compositional, teleonomic and historical explanation were situated in a biological context.

Against the background of this discussion, the explanatory levels of orthogenesis were reassessed and the meaning of Teilhardian inference delineated.

As a consequence of this exposition, it was made possible to define and defend Teilhard's general scientific goals and his anti-reductionist position. It also became possible to delineate and defend his notion of 'phenomenology' and 'physic' as well as to establish his scientific intention and the incompleteness of his theory. It was shown that, while not committing any purely logical error, Teilhard's theory lacks certain structural connectives, which ought to be present in order to relate the explanatory levels of the theory and to render theoretical confirmation possible. It was argued further that, even the adoption of Teilhard's own principles of validation, coherence and fertility, do not make up for the deficit in structural connective. It was suggested, however, that there is no inherent logical reason preventing the supplementation of orthogenesis with these connectives, thus allowing confirmation or disconfirmation of the theory itself.