SUBPARTICLES AND REALISM IN QUANTUM THEORIES

ROBERT A. HERRMANN*

Received 26 August 1984; Revised 11 April 1985

Abstract

This is the first article in the series entitled Nature: The Supreme Logician. I describe how new methods in mathematical logic automatically yield the logical existence of subparticles. The necessity for subparticles follows from the most basic logical operator that produces a describable change in the behavior of a natural system. Subparticles apparently yield a mediating structure for all quantum transitions, provide an actual substratum for relativistic and cosmological theories and may be the physical bases for a pregeometry. It is shown that subparticles, their applications and their production by a describable supermind process restore a universal causality and determinacy to systems that are describable by means of a quantum mechanical language, among others.

Introduction

The formulation of various quantum theories has involved continually two interesting aspects—realism and positivism. Certain physical language descriptions are almost always formulated prior to translating partially such a physical description into a mathematical language. Then, as is often the case, the physical language is expanded beyond those terms that correspond to mathematical entities in the hopes of developing a meaningful description for the causes of observed natural phenomena. Statements vary from those in which almost all of the physical terms correlate directly to mathematical objects such as (A) "a photon is emitted when an atom makes a transition from an excited state to the ground state"[1] to extended statements such as (B) "The most fascinating applications of our rules are, however, not to any material substance but to immaterial fields, the excitations of which appear to us as elementary particles."[2] (C):

> The picture of the world we have finally reached is the following: Some 10 or 20 qualitatively different quantum fields exist. Each fills the whole of space and has its own particular properties. There is nothing else except these fields; the whole of the material universe is built of them.[3]

Then there are applications of discipline language terminology that do not, except in a few cases, correspond to specific mathematical objects such as "every quantum transition taking place on every star, in every galaxy, in every remote corner of the universe is splitting our local world into myriads of copies of itself."[4]

A major philosophical question is does descriptive quantum theory yield knowledge about real physical objects, causes and some probabilistic form of determinacy (realism) or is it but an imaginary scheme that is designed only to aid human comprehension and produce better predictions of how our classical apparatus will numerically behave (positivism)? Until the present time there has been no direct mathematical approach—including those methods expounded by the advocates of the so-called quantum logic[5]—that could more deeply analyze the internal structure of pure discipline language (metalanguage) statements such as those quoted above. Recent advances in mathematical logic have penetrated, for the first time, some of these realistic statements and have yielded certain interesting consequences. In particular, it is now possible to use a specialized mathematical structure to generate basic discipline language statements directly. Throughout the remainder of this article I assume that statements such as those listed above do have some realistic meaning. We note that it has been claimed that if we accept statements such as (A) then a question such as (D) "how this photon was created since it was not present before transition took place?"[6] has no meaning with respect to quantum mechanics. And, indeed, (E) "has no answer."[7] Rohrlich also states, (F) "The world of electrons, protons, and all the rest does exist out there even if we do not observe it, and it behaves exactly as QM [quantum mechanics] tells us it does [in the small velocity limit]."[8] The new results to be delineated below refute the claims that are made in statements such as (C), (E) and (F) above, among thousands of others. Our discussion is being restricted to particle language, even though it is possible to restate our results in the language of fields or simply "things"; but, it appears more useful to retain this particle terminology. In a forthcoming section of this article I discuss how the above quotations and these new results relate to causality and determinacy.

*Robert A. Herrmann, Ph.D., Mathematics Department, U.S. Naval Academy, Annapolis, MD 21402.

Basic Methods and Results

Before proceeding, it should be understood that the methods utilized to obtain these "D-world" results are not related in any manner whatsoever to the methods used within the discipline called quantum logic. Further, the "D-world" is one of the general names given to a mathematically generated description for the production (i.e. creation) of natural phenomena, objects or events, the development of natural systems and other interesting scientific concepts. This description utilizes a new discipline language that will be disseminated slowly by means of these articles. Recall that quantum mechanics yields many simple discipline language descriptions that are but slight extension of the terminology used within the mathematical formalism. Let $h \geqslant 0$ be a fixed real number and $\mathbf{N}$ be the set of positive integers. For an elementary particle free in space consider the following set of sentences: G_A = {An elementary particle $\alpha(n)$ with total energy $h + 1/n \mid n \in \mathbf{N}$}, where the measure is with respect to a fixed unit of energy. The G_A is embedded into the mathematical structure called the "Extended Grundlegend Structure" (EGS) and the EGS is embedded into a nonstandard model for a superstructure based on the real numbers.[9] Let ${}^*\mathbf{N} - \mathbf{N}$ be Robinson's set of positive infinite natural numbers.[10] In a completely rigorous manner,[11] without any ad hoc forcing, the EGS generates the set of statements: $G_{A'}$ = {An ele-

mentary particle $\alpha(\gamma)$ with total energy $h + 1/\gamma \mid \gamma \in {}^*\mathbf{N} - \mathbf{N}\}$. Assuming that mass and energy are but manifestations of the same physical quality[12] and that the total energy within such a system of particles is additive then this immediately implies the possibility that such objects as those being described by the set of statements G_A', where we let $h = 0$, exist in reality. We call these objects "subparticles." If the original elementary particle utilized in statements G_A has nonzero mass (as a nonrelativistic concept), then by the exact same modelling procedure the subparticles would have nonzero mass. The numbers $1/\gamma$ are Robinson infinitestimals—the now rigorously obtained "ideal" numbers of Leibnitz—and they may be assumed to represent the mass of such subparticles. On the other hand, other infinitesimal energy quantities characterize the zero mass particles — assuming that such things exist.

In this theoretical investigation I do not assume that simply because the EGS generates automatically the set of statements G_A' that subparticles are realistic objects. Unless there is some other strong and compelling reason, then we do not postulate the ad hoc existence of subparticles as is done for such objects as tachyons, among others. Recall that tachyons as postulated by Feinberg[13] are assumed to have a rest mass that is measured by a purely complex number $m_0 i$. This trivial assumption implies that such particles would have a real relativistic mass $m = (m_0 i)/(1 - v^2/c^2)^{1/2}$, when we let $v > c$. Articles have been published recently that continue this so-called research. I shall leave it to the reader's judgement whether or not the assumption that a particle can have a purely imaginary "rest mass" is worthy of the vast public monies spent to develop the "theory of tachyons."

After developing approximately 120 pages of mathematical machinery,[14-16] the following can be established. (1) If we assume that particle behavior varies in time (i.e. particles develop like any natural system) and that the simplest form of human logic—propositional logic S—is a meaningful logical process for our comprehension of such behavior, then within the EGS there exists a supermind logical operator, ${}^*\mathbf{S}(\{w\})$, that generates automatically the following statement relative to a background or substratum world—a world that takes on various names (nonstandard physical world, NSP-world or D-world) depending upon the application

(G) There exists a uni-word D-world process, ${}^*\mathbf{S}$, such that the (objects being described by) G_A are produced by ${}^*\mathbf{S}$ and during this production there is an *additional* simplistic and necessary process that directly yields numerously many of the pure D-world objects (being described) in G_A'.[17]

Since the presuppositions that determine statement (G) (i.e. the hypothesis of statement (1)) are fundamental to particle physics, among other disciplines and the operator ${}^*\mathbf{S}$ is a direct necessary and sufficient consequence of these presuppositions, then the assumption that such subparticles exist is not a simple mathematical or theoretical convenience. Indeed, if care is exercised to ensure the consistency of collections of G_A statements, then the use of a single mathematical structure to generate sets of such statements as (G) guarantees that such (G) collections form the most consistent descriptions available. Please note that statements such as (G) describe the behavior of a developing natural system in an extended language—the language of the D-world—that includes the standard scientific discipline languages. Further descriptions for the terms used within statement (G) will be given in the analysis section of this article.

Additional Investigations and Implications

Under the presumption that there are in reality such objects as those being described by G_A and since statements such as (G) are generated by the EGS if and only if G_A is embedded into the EGS then further theoretical investigations are warranted. The first and most obvious possibility is to consider the set of all subparticles to be a substratum or a possible pregeometry that mediates all particle transitions including creation and annihilation. With this in mind the next goal is to consider various consistent methods by which subparticles can combine and yield statements such as (G). One of these methods is the logical basis for all applied classical analysis—the 2200 year old corrected logical process called infinitesimal reasoning—as it is modelled by the EGS. Applying these rigorously appears likely that a special process called "hyperfinite composition" would be the most appropriate to consider. However, due to the difficulties in comprehending the properties of hyperfinite composition a meaningful description as to how subparticles actually mediate such quantum transitions has not as yet been formulated completely.[18] On the other hand, a mathematical process is being developed that gives a very promising but partial description for such mediation. Moreover, it has been shown that the pool of all subparticles may be considered a "real" substratum for various cosmological theories as well as the special theory of relativity.[19]

Once again I point out that statements such as (G) are generated by the EGS if and only if G_A is embedded into the EGS. These facts tend to refute such claims as expressed by statements such as (C), (E) and (F).

Causality and Determinacy

Intuitively a general definition of a causal process is that it is a named "process" that has associated with it a describable set of properties that distinguishes it from all other processes within a given set of describable processes. These distinct processes may or may not be numerically characterized in whole or in part. The causal process must apply to specific, describable and identifiable objects, phenomena or events that may or may not be numerically characterizable in whole or in part. The result of a causal process must be a specific, describable and identifiable object, phenomenon or event that also may or may not be numerically characterizable in whole or in part. Of course, originally a (scientific) phenomenon was supposed to be an "observed" event that was, hopefully, describable in a consistent (scientific) discipline language. Since nothing in the micro-physical world is observable directly, then this concept has been extended to include *accepted* descriptions for an *assumed* unobserved object or event—descriptions that usually aid comprehension and prediction.

It is absolutely false to state that science only deals with causes that have numerically measurable characteristics since one of the most basic and often cited "causes" is philosophical or absolute "randomness." It was well known that there are NO numerical characteristics for the concept of absolute randomness. Mark Kac has recently written an article in which he restates these facts.[20] In a future article in this series where I discuss the fact that "scientific randomness" is language dependent, it will be *proved* that almost all of what we call modern cosmology deals with unmeasurable and purely speculative causes that cannot be even indirectly established.

With respect to the describable properties of a cause, some additional questions often arise. Has the human brain been able to describe enough of the causal properties in order to even conceive of reproducing the causal process? Can human beings completely reproduce, in the laboratory, the causal process even if it is assumed that we have a complete description? For many scientific causes the answer to these two questions is a resounding no. For example, it is claimed that some of the major illnesses that inflict mankind at the present time have no completely describable causes. Then even if one believes that the "Big Bang" description is the cause that has produced an apparent textual expansion of our universe, human beings have not, as yet, completely reproduced its properties and created their own personal "toy" universes.

As to determinacy, this term seems to have as many distinct definitions as there are philosophers or scientists who have ever thought about the concept. This concept varies from the strong statement that "certain describable or measurable qualities associated with one event determine totally the describable or measurable qualities of a second identifiably different event" to such paradoxical statements as "there are *no possible* determinacy statements as to how individual objects affect the behavior of other individual objects but there are determinacy statements that predict how large aggregates of such objects will behave and how these aggregates affect the behavior of other such aggregates." It is claimed that this second type or determinacy characterizes totally the atomic of mirophysical domain. We define *determinacy in the broad sense* to be any description for system behavior that is not considered to be philosophically random.

In 1935, Einstein, Rosen and Podolsky[21] correctly proved[22] that if one is allowed to analyze the precise details of the fluctuations that exist during the measurement of certain numerical quantities within this microscopic world as they are predicted by quantum mechanics and ascribe certain predictions to disturbances of one object by the observing apparatus (the cause), then quantum mechanics is not a complete theory. This incompleteness would mean many things including the result that there could be physically meaningful qualities for particles that could not be predicted.

Bohr appears to have come to the rescue of quantum mechanics by a simple extension of his *complementarity principle* to pairs of predictions.[23] Bohr claims that this extension is consistent with quantum mechanics and invalidates the incompleteness argument since as Bohm states it (H):

> because the process in which a quantum is transferred from one system to another cannot be subjected to a detailed rational analysis [using the quantum mechanical language], there is no way to describe precisely the properties and qualities that characterize the system under observation, as distinguished from those of the observing apparatus.[24]

However, Bohr then extends this principle into the philosophical domain. Bohm describes this philosophical extension in the following manner. (I):

> No rational concept of the details of the [atomic] process can ever be obtained . . . one is no longer able to describe or even to think about any well-defined connections between the phenomena at a given time and those at an earlier time. . . . We have no way to express precisely the qualities and properties that might define the modes of being of individual micro-objects.[25]

Bohr called this the "irrational trait"[26] and he then renounced causality on the atomic level entirely. (J):

> in the usual interpretation of quantum theory, the precise magnitude of the irregular fluctuations in the results of *individual measurements* at the *atomic level* are not supposed to be determined by any kind of causes at all, either known or unknown . . . the precise result that will be obtained is completely arbitrary in the sense that it has no relationship whatever to anything else that exists in the world or that ever has existed.[27]

Notice that statement (J) implies that the prohibitions expressed by statement (I) are not confined to the language of quantum theory. Phrases such as "can ever be obtained," "no longer able to" and "we have no way [no language at all] to express" are extended philosophically to include all possible descriptions utilizing all possible languages.

A recent investigation *formally* argues that Bohr's extension of his complementarity principle to predictions, if adjoined to the quantum theory, would make quantum theory *inconsistent*.[28] Thus Bohr's rejection of the incompleteness of quantum theory is invalid and the prohibitions expressed by statements (H), (I) and (J) are meaningless if they are added as additional requirements of the quantum mechanical method. Unfortunately, except for a change in the language used within quantum field theory where the concepts of *virtual* transitions and *virtual* objects are paramount, certain types of discipline language descriptions for micro-physical events are rejected philosophically through application of various insidious devices. The major device is to suppress these new rational descriptions by either ignoring them, or by refusing to communicate these new descriptions either to the general public or the majority of the scientific community for no other reason except a philosophical bias. The rejection of causality and determinacy within the microphysical world has absolutely nothing to do with quantum theory as a formal discipline. It is based upon philosophical bias and the irrational belief that (K):

> we can only conceive of what we meet in everyday experience, or at most in experience with things that are in the domain of classical physics . . . any effort at conceiving of a sub-quantum

> level is foredoomed to failure, . . . [we could] never hope to imagine what these entities might be like.[29]

Finally, we point out that Bohr's logical error, the correctness of the Einstein, Rosen and Podolsky conclusion and the new concepts that do allow for a deep descriptive analysis of the atomic domain are unrelated to the famous von Neumann theorem on local hidden variable—a theorem that suffers from other philosophical restrictions.[30]

An Analysis

As argued in the preceding section, statement (E) and the last sentence in statement (C) are not rationally deducible from quantum mechanics nor from quantum field theory since they are but naive carry-overs of the irrational Bohr philosophy as stated in (H), (I), (J) and (K) and are thus an inconsistent extension of quantum theory. For this reason we must reject such descriptive restrictions as meaningless.

In a previous article[31] the discreteness paradox of quantum mechanics is solved by partially describing the behavior of quantum transitions in terms of the new D-world concepts and language. These D-world concepts *do not* follow our everyday experiences, even though they may follow partially from some of our more unusual experiences. Also as explained in this previous article many of the properties of the D-world concepts are described as best as is possible at the present time and the difficulties of comprehending these notions without some specific training or reflective investigation is fully delineated. These *facts* totally contradict statements such as (K).

In this present series of articles I will introduce these property descriptions and their conceptual meanings *slowly*, so that the reader will have time to investigate and reflect upon their significance.

Referring back to description (G) we further discuss the terms utilized. First, we are dealing with concepts that are analogous to those that appear in the discipline known as Logic. Natural science deals with communicating *descriptions* for the behavior of natural systems. Once descriptions are stated then it is the individual—through experience and comprehension of the technical terms involved within the descriptions—who must then mentally associate them with what is claimed to be reality. Within the D-world this mental association is modelled by means of a relation termed a *realism relation*. This is the reason why we have placed parentheses about the phrases "objects being described by" and "being described" in statement (G). For many of the following D-world interpretations the realism relation is applied and these additional phrases are omitted. The *standard world* is interpreted as the "natural" world that the human being can comprehend, sense, imagine and usually describe using all previous standard world languages and symbolic alphabets. We, of course, exclude from these standard world descriptions all terms that specifically apply to the D-world or terms that compare the pure D-world with the natural world.

Please recall that a mathematical theory and a physical theory are not equivalent in content. A mathematical theory usually has infinitely many conclusions (i.e. theorems) and it is never assumed that all such conclusions can or should be interpreted within a physical theory. For example, in elementary calculus when we consider the ladder of smallest length that extends from the ground over a fence and contacts a building behind the fence, we are led to a differential equation solution that may yield a negative distance measure. This solution is rejected since it does not appear to correspond to that portion of "reality" under investigation. For this reason, we never assume that all of the conclusions established by a D-world structure have or should be interpreted within the *descriptive* D-world theory. The "art" of descriptive mathematical modelling within the N-world (i.e. natural world) is exhibited by selecting or rejecting as extraneous, various mathematical conclusions and, from this, building a descriptive physical theory that yields a consistent and, hopefully, predictive collection of sentences that accurately depicts the behavior of a natural system. It is a subset of the descriptive theory that then correlates to a subtheory of the original mathematical theory. The same procedure must be used when we attempt to mathematically model a descriptive theory for D-world behavior.

The entity $^*\mathbf{S}$ operationally behaves, in a partial manner, like ordinary N-world propositional deduction.[32] Moreover, there exists within the D-world a superconsistent set (w) that contains one and only one object such that $^*\mathbf{S}(\{w\})$ (a uni-world process) generates deterministically the objects G_A and the numerously many $G_{A'}$.[33] However, within the N-world there cannot exist any finite and consistent set X of N-world objects such that the entire set G_A is generated by S(X) and there is no set Y such that any member of the set $G_{A'}$ is generated by S(Y).[34] The N-world operator S can be shown to behave in a set-theoretically continuous manner. However, within the D-world the operator $^*\mathbf{S}$ when applied to w behaves in a *supercontinuous* manner. No logical operator within the N-world can behave in a supercontinuous manner.[35] Supercontinuity can be thought of as an extremely refined "infinitesimal" step-by-step process as compared to a much coarser step-by-step continuity process. Within the D-world the object w is composed of hyperfinitely many objects that are hyperfinitely combined. The objects of which w is composed are N-world objects, and pure D-world objects that cannot be utilized directly within the N-world.[36] However, the generation of the hyperfinite set of particles and subparticles is the direct result of $^*\mathbf{S}$ applied to w.[37] Operationally, hyperfinite combinations formally behave within the D-world in the same manner as finite combinations behave within the N-world. However, within the N-world most hyperfinite combinations cannot be reproduced with N-world processes. The additional simplistic and necessary process required to produce the hyperfinitely many particles and subparticles is modelled after the process of N-world translations that write one language in terms of another language. However, this additional process is a hyperfinite translation that takes place within the D-world only. From our previous definition it is clear that the production of the hyperfinitely many particles and subparticles being partially described within this analysis is D-world strongly deterministic. Notice the evidence that we have that something like elementary

particles may exist in reality and that the human being does exhibit describable logical processes is indirect evidence that subparticles and supermind processes exist.

Is it possible that the hyperfinite set of particles and subparticles described above could be deterministically selected "prior" to the application of *S to the object w? It is a well-known experimental fact that no human being can make a finite choice from a potentially infinite set, such as G_A, in a philosophically random manner.[38] Even though we may not, at present, be able to successfully predict many finite human choices beforehand, science does not consider such a choice method as philosophically random. Finite human choice is modelled by means of a finite choice operator that is extended to hyperfinite choice within the D-world. It follows immediately that the above set of particles and subparticles can be obtained by a hyperfinite D-world supermind choice process that is not philosophically random. Moreover, as shown elsewhere,[39] the set of N-world particles G_A is also a direct result of a D-world hyperfinite supermind choice process. Thus from the D-world viewpoint the set G_A is itself broadly deterministic and can even be considered independent of the *S operator. If we re-interpret G_A as describing the behavior of a *single* elementary particle and let H be the collection of all such G_A sets as they vary over all such elementary particles, then it is a remarkable fact that *any actual* combination of elementary particles and/or subparticles is directly produced by a hyperfinite D-world choice process applied to H and consequently such combinations of elementary particles are not D-world philosophically random; but, rather, they are produced by a broadly deterministic supermind process.[40]

It is obvious that we are now able to describe some of the behavior of various natural systems not only in terms of an N-world language but also in terms of distinctly different D-world concepts. It is highly significant that we can obtain these new D-world descriptions only because we are able to characterize natural system behavior in terms of a natural language. As an immediate rational conclusion, it follows that we can logically consider such (describable) N-world behavior as the direct result of (partially describable) D-world behavior and, indeed, this yields indirect evidence that the D-world might actually exist. If we could neither perceive nor characterize within a discipline language the behavior of a natural world object, phenomenon or event, then we could know nothing about how the D-world could have produced such behavior. Thus it is what we directly detect and describe that is leading to a partial understanding of the unusual behavior of this "invisible" but knowable deductive world—a world that in future articles in this series will be shown to produce *all* of the natural "reality" that human beings perceive and that science attempts to characterize.

Finally, I do not apologize for the fact that the D-world model can be *consistently* embedded into a Scriptural model for the production of natural phenomena, objects and events. Moreover, even though the D-world model was not constructed originally for application to the natural sciences, it has been discovered that by a simple specific and literal interpretation of certain nonspecific (i.e. primitive) terms the D-world model yields statements that actually predict or parallel numerous statements within Scripturally-based Christian doctrine. Some of these predicted or parallel statements will be presented in the final article in this series.

References

1. Rohrlich, F. 1983. Facing quantum mechanical reality, *Science* 221:1251-55. See middle column on page 1254.
2. Henley, E. M. and W. Thirring. 1962. Elementary quantum field theory. McGraw-Hill, New York, p. 154.
3. Dyson, F. J. 1983. Fields and particles. Readings from Scientific American. W. H. Freeman & Co., San Francisco, p. 21.
4. DeWitt, B. 1970. Quantum mechanics and reality, *Physics Today*, 23:30-35. See last column on page 33.
5. Beltrametti, E. G. and G. Cassinelli. 1981. The logic of quantum mechanics. Addison-Wesley, Reading.
6. Rohrlich. *Op. cit.*
7. *Ibid.*
8. *Ibid.*
9. Herrmann, R. A. 1984. Mathematics and the NSP-world. Monograph 125. Institute for Mathematical Philosophy Press, P.O. Box 3410, Annapolis, MD 21403.
10. Robinson, A. 1966. Non-standard analysis. North-Holland, Amsterdam.
11. Herrmann, R. A. 1984. NSP-world alphabets. Monograph 155. Institute for Mathematical Philosophy Press, Annapolis, MD.
12. Lawden, D. F. 1982. An introduction to tensor calculus, relativity and cosmology. John Wiley & Sons, New York, p. 46.
13. Feinberg, G. 1967. Possibility of faster-than-light particles, *Physical Review* 159(5):1089-1105. This work was partially funded by the U.S. Atomic Energy Commission and research is still being done and funded for this type of theoretical work. This is extremely esoteric research. No one should complain about our use of the 2200 year old concept of infinitesimal mass and the like since Feinberg states on page 1090 "the quantity m, or rest mass, . . . is not a directly measurable quantity. . . . We are therefore free to hypothesize." I assume that they are still trying to indirectly detect tachyons with their imaginary rest mass. Notice that I have *not* assumed at this stage in our development of the D-world model that such a concept as rest mass has any physical meaning.
14. Herrmann, R. A. 1983. Mathematics for mathematical philosophy. Monograph 130. Institute for Mathematical Philosophy Press, Annapolis, MD and *Abstracts American Mathematical Society*, 1981. Mathematical philosophy, 2(6):527. (1983), A useful *real valued function, 4(4): 318. 1984, D-world alphabets, I, 5(4):269. 1984, D-world alphabets, II, 5(5):328.
15. Herrmann. Reference 9.
16. Herrmann. Reference 11.
17. *Ibid.*, p. 12, Corollary 4.2.1 and the translation process on page 8.
18. Herrmann, R. A. 1983. Mathematical philosophy and developmental systems, *Nature and System* 5:17-36. Such concepts as infinitesimal reasoning, hyperfinite composition, the conceptual difficulties associated with these notions and an application that solves the discreteness paradox are fully discussed in this article.
19. Herrmann, R. A. 1984. Nature: the supreme logician. Monograph 145. Institute for Mathematical Philosophy Press, Annapolis, MD. This article is the outlined foundation for this present series of articles. The generation of the entire local special theory of relativity as an N-world manifestation of the D-world can be found on pages 33-37. These results are then coupled with those of S. J. Prohovnik, 1967. The logic of special relativity. Cambridge University Press, London.
20. Kac, M. 1983.. Marginalia: What is random? *American Scientist* 71:405-406.
21. Einstein, A., B. Podolsky and N. Rosen. 1935. Can quantum-mechanical description of physical reality be considered complete? *Physical Review* 47:777-80.

22. Koc, Y. 1980. A non-completeness argument for quantum mechanics (Analysis of the EPR paper), *Physical Letters* 79A:9-12. It has been shown by Aerts, D., 1984, The missing elements of reality in the description of quantum mechanics of the E.P.R. paradox situation, *Helvetica Physica* 57:421-28, that the basic argument utilized by Koc requires that one assume that quantum mechanics is capable of describing the properties of "separated systems."
23. Bohr, N. 1935. Can quantum-mechanical description of physical reality be considered complete? *Physical Review* 48:696-702.
24. Bohm, D. 1957. Causality and chance in modern physics. Harper Torchbooks/The Science Library, Harper & Brothers, New York, p. 92.
25. *Ibid.*, p. 16.
26. *Ibid.*
27. *Ibid.*, p. 87.
28. Koc, Y. 1980. A critical analysis of N. Bohr's reply to the EPR argument, *Physics Letters* 81A:436-40. Actually the additional requirements advocated by Bohr are completely in error. This can be established by application of the results in Aerts' paper (Reference 22). Quantum mechanics is incomplete not due to the analysis of the subsystems but due to the fact that it cannot describe reality for all possible *combined* systems. On the other hand, if there does not exist any separated natural systems, then such E.P.R. type arguments cannot establish its incompleteness. Subparticle theory can be interpreted to show that there are no separated systems.
29. Bohm. *Cv. cit.*, pp. 96-7.
30. Bohm, D. 1952. A suggested interpretation of the quantum theory in terms of "hidden" variables. II. *Physical Review* 85:180-93. Also see reference 24.
31. Herrmann. Reference 18.
32. Herrmann. Reference 14.
33. Herrmann. Reference 11, p. 11, Theorem 4.2.
34. The first part follows from formal propositional deduction and the second part follows from the fact that each member of G_A' has a symbol that is not a member of the language on which S is defined.
35. Herrmann. Reference 9, p. 12, Corollary 4.4.1.
36. Herrmann. Reference 11. These facts follow from Theorem 2.1 applied to general paradigms, the definition of set M and the fact that $w \in {}^*\mathbf{M} - G_A$. Simply characterize the elements in M and the fact that all "words" are formed in the N-world by finite combinations (strings) of other N-world words.
37. *Ibid.*, p. 2, Theorem 2.1 applied to general paradigms.
38. Noether, G. E. 1976. Introduction to statistics, Houghton Mifflin Co., Atlanta, GA, p. 28.
39. Herrmann. Reference 9, p. 4, Theorem 2.1. Simply replace the developmental paradigm with the set G_A where $\mathbf{T}_i$ is the single set (x), $x \in G_A$.
40. Ibid., p. 4, Theorem 2.1. In this case replace **T** with the set H.

BOOK REVIEWS

In the Minds of Men by Ian T. Taylor. 1984. TFE Publishing, P.O. Box 5015, Station F, Toronto, Ontario, Canada M4Y 2T1. 497 pages. $25.

Reviewed by Don DeYoung*

Ian Taylor is a Toronto-based writer and researcher with a career in physical metallurgy. He is also the producer-writer of a documentary television series on the Creation-evolution debate. The intense viewer interest generated by this series convinced Taylor that a comprehensive book was necessary. The author states that *In the Minds of Men* was written for those who feel "uneasy" about evolution. It is a 500-page compilation of the main issues, ranging from mammoths to mutations, Niagara Falls to Nutcracker Man, the Sphinx to the speed of light.

Taylor's approach is chronological, showing the historical tension between theistic and secular humanism. He begins with the Greek and Jewish foundations of belief and concludes with a warning of the dangerous movement toward one-world government. Along the way, Taylor explains such details as the recent American withdrawal from UNESCO. The author sees secular humanism as resting on a three-legged stool and he neatly knocks the legs out, one by one. These precarious legs and their founders are inorganic evolution (Lyell), organic evolution (Darwin), and sociobiology (Spencer). Taylor is a very objective and fair writer, and his personal acceptance of Scripture and belief in a recent supernatural Creation are evident.

The book is a rich reservoir of fascinating details. Taylor has done an immense amount of research on the key people and topics involved in the origins question. Lamarckism, circular reasoning, Malthusian logic, vestigial organs, sociobiology—all are explained in the clearest fashion this reviewer has encountered. The contemporary setting of Charles Darwin is given, touching on the French Revolution and Napoleon, as well as on the Anglican Church. Along with Darwin's obvious talents, the dark side of his life is also exposed like a soap opera. His deathbed conversion is thoroughly debunked. Further, Taylor gives intriguing reasons why Darwin's wife may have originally started the conversion story. Documentation is given to show that Darwin never really understood the Bible, even after three years of theological study at Cambridge (p. 120). A similar close scrutiny is given to dozens of other personalities, ranging from Lyell to Newton and even Margaret Mead. The book contains 80 portraits, 92 other illustrations, 17 Tables of data, 381 detailed footnotes, and 634 references to orthodox and original sources. *In the Minds of Men* is surely a valuable reference book and also one of the most interesting available to Bible-science readers.

A few of Taylor's comments will raise eyebrows, certainly expected in a book of such wide scope. For example he intimates that Genesis 9 supports the cursing of the black race (p. 262). In truth, Ham's curse by Noah is not, in any sense, a proof text for slavery or segregation. I am sure Taylor would agree with my statement, but his discussion is unclear. *In the Minds of Men* may also spend too much time on Setterfield's controversial "changing velocity of light" idea. Six large tables of data are dedicated to this discussion. Of course, if Setterfield turns out to be correct, then this attention to the subject would be amply justified. In describing the *ex nihilo* Creation, Taylor mentions that coral reefs may have instantly appeared (p. 313). If true, much more needs to be said about the appearance of age, since coral reefs fall in the same category as tree rings. That is, present day coral reefs bear the historical print of countless coral skeletal remains and algae secretions.

To counter these apparent minor weaknesses, let me also mention two valuable items in the book. Remem-

*Don DeYoung, Ph.D., is Professor of Science, Grace College, Winona Lake, IN 46590.