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Preface to HERETICAL VERITIES*

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as a preface to the book by Thomas E. Phipps, Jr. entitled

HERETICAL VERITIES:
Mathematical Themes in Physical Description

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PREFACE

This book is written in the conservative tradition of physics, in Wheeler's sense of "radical conservatism". Wheeler's method was to take the best established principles of current physics and follow out the conclusions they entail. Some of the radical conclusions Wheeler has reached would have read him out of the profession, were it not for his previous successes. Phipps is more *radically* conservative than Wheeler. Wheeler is a theorist, while Phipps is a experimental physicist. He knows how to produce and examine data that have to be accepted as *fact* by the experimental physics community. He also knows that "theory" is of no consequence if it cannot be grounded in "rugged" experimental fact. He takes up his critique of relativity and quantum mechanics at roughly the point where Bridgman left off. His conclusions are startling, and well worth pondering.

The principles on which Phipps bases his analysis are a) that the successive approximations to physical prediction should be "rugged" in the sense that each order of approximation is defined separately in terms of successive powers of some small parameter, b) that any generalization intended to lead to new physics should be based on "form invariance", and c) that the resulting new theory must be a covering theory in that all the experimentally valid results of the older theory are already contained as some well defined approximation. Clearly Phipps' prescription for scientific revolution differs fundamentally from Kuhn's "paradigm shift". A further point which Phipps emphasizes is that the new physics *must* predict results that are incompatible with experimental predictions derived from the older theory and therefore lead (after sufficient effort) to definitive experimental test, – a "trial by combat" that at most one of the theories can survive. Again this is a powerful conservative stance.

I have benefited greatly from professional encounters with Phipps. I was brought up to date on his thinking c. 1962 when he wrote Panofsky (Director of SLAC) about the possibility of repeating an experiment on "time dilation" performed with π-mesons (pions) during the early days of pion exploration at

Berkeley. Pief passed the letter on to me, and I soon established that what Phipps wanted was an experimental realization of the "twin paradox" – the "time travellers" being the fast unstable mesons returning again and again in circular orbits (due to a magnetic field) to the position where their "stay at home twins" are observed to decay more rapidly. I soon found out that no new experiment was needed at SLAC because the experiment on the anomalous magnetic moment of the μ-meson (muon) then in progress at CERN would satisfy Phipps. The version he cites in this text shows that the "stay at homes" decay 29 times faster than the returning "twins", – a "rugged" result that Phipps accepts and builds on in this book.

Special relativity cannot be used to discuss, let alone calculate, the time dilation encountered in the "twin paradox". Special relativity is "fragile" in Phipps' sense because it cannot deal with accelerated frames of reference; according to the received wisdom only "general relativity" can meet this problem. A related difficulty is that there is no generally accepted way to define rigid bodies in "special relativity". To quote a standard text by Goldstein* "It must not be thought from these considerations that all of the aspects of nonrelativistic mechanics have unequivocal correspondencies in a relativistic theory...... In particular rigid body constraints do not fulfil this requirement [of Lorentz covariant formulation] as they involve only the space parts of the position four-vector. Hence the entire field of rigid body dynamics is without a relativistic analog." As the reader will learn in due course, several of the attempts to make an "unequivocal" correspondence between special relativity and rigid body rotation have been experimentally disproved by Phipps by measuring a discrepancy between these predictions and experiment of around 1000 times the standard deviation in the experimental results.

Phipps accepts "time dilation" for decaying particles as experimentally established, but his basic principles force him to use a metric definition of spatial

⋆ H.Goldstein, *Classical Mechanics*, Addison-Wesley, Cambridge (1951), pp.210-11.

distance which reduces to the usual "rigid rod" measurements for velocities small compared to the velocity of light and accelerations up to several thousand times the acceleration due to gravity at the surface of the earth. This means that he must meet the problem of "clock synchronization" in a space-proper time metric. He does this in an ingenious way, to say the least. I accept his construction as valid, and profound, – particularly because I have recently been forced by my own work to require a related, and as rigid, separation between (conserved) 3-momentum and invariant mass in momentum-energy "space". I urge the reader to follow Phipps' construction in detail. Perhaps each of us has missed a critical point for reasons that will have to be disconnected on the surface and hence could be of great importance at a deeper level of thought.

Phipps' clock synchronization schema is equivalent to Einstein's in the region of overlap between Phipps' covering theory and special relativity, but has further consequences when applied to macroscopic electromagnetic field measurements. Phipps has discovered (as have others) that a long time ago Hertz realized that the proper way (in essentially Phipps' sense) to enforce Galilean invariance on the Maxwell equations to first order in (v/c) is to include in the theory both radiation detector motion and radiation source motion as parameters. Phipps develops this "neo-Hertzian" theory as a covering theory for conventional macroscopic electromagnetic physics. He has investigated some of the experimental consequences, and concludes that it will take more resources than he has at his command to settle the empirical difference between Hertz and Einstein. It is hard to come by, and expensive to construct, macroscopic situations in which the relative velocities of source, detector, and "observer" provide *measurable* distinctions between the different predictions of the contending theories expressed as power series in $\frac{v_s}{c}, \frac{v_d}{c}, \frac{v_o}{c}$. Remember that since Phipps has constructed a "covering theory" all the usual tests of "special relativity" have already been passed.

The second part of this book starts with the mechanics of unstructured masses at high velocity. Phipps invokes here an appropriate (and historically known) single particle mechanics where m_0c^2 is the invariant reflecting in 3-momentum

+ energy space the "proper-time" invariant Phipps uses to discuss 3-distance + time space in Part I. He shows how to generalize this single particle dynamics for a system of N "free particles". Unfortunately Phipps has not been able to provide more than a single, idealized example of the *interacting* relativistic multi-particle problem. His approach is certainly well worth pursuing. The development of hypercomplex function theory, which he discusses in Part III, will aid such study, and deserves pursuit in its own right.

With this mechanical background established, Phipps goes on to deal with quantum mechanics. It is here that "form invariance" becomes the most important of his principles. He opts for the preservation of the Hamilton-Jacobi formalism in making the transition to quantum mechanics, rather than following the Poisson Bracket route used by Dirac. Phipps' approach has the advantage of establishing a "Formal Correspondence" that works both ways, thanks to preserving the "initial state parameters" of the classical theory in the transition; in contrast Dirac throws these away. It should be no surprise that conventional quantum mechanics gives results that never allow the classical regime to be recovered. So far as I know, Phipps was the first one to point out this obvious asymmetry between classical and quantum mechanics in such a way that the major problem of "measurement theory" dissolves. The parameters he retains make it clear that each phase severance corresponds to the start of a new problem with new boundary conditions, and is in no way mysterious. There is no "collapse of the wave function".

This was the second point in my career at which I came into active and fruitful contact with Phipps. He made me aware of this work (which I had read in emasculated form in the *Physical Review*[⋆] much earlier) by sending me a reprint of his paper in *Dialectica*[†]. I was not ready then to understand in any deep way what he meant by "The Relativity of Physical Size"; in fact his understanding of this idea has only started to work on me as a consequence of

⋆ T.E.Phipps, Jr., *Phys.Rev.* **118**,1653 (1960).
† T.E.Phipps, Jr., *Dialectica* **23**, 189 (1969).

reading this book. What I seized on then was the "phase severance" so neatly introduced into quantum mechanics by Phipps' Hamilton-Jacobi generalization. As the reader will discover, both classical (Type I) and quantum mechanical (Type II) theories are covered by Phipps' Type III theory. Since I saw then (and still see) quantum phenomena as a symptom of the need for a paradigm shift (i.e. a radical *break* with the past) rather than as a need for a "covering theory", I clung to this aspect of his work. I wrote a paper called "Fixed Past-Uncertain Future" based on Phipps' insight. When I had occasion to discuss this paper with Peierls, long before publication, he had only one objection: that I had called this discussion an "interpretation of quantum mechanics". He said, "This *is* quantum mechanics." Unfortunately he was not chosen by *Physical Review Letters* to referee the paper. The eventual publication occurred in a journal that takes "speculative" papers[*] .

I thought (and still think) that Tom Phipps and I were on to something which could indeed lead to new physics. As an interim measure to get the paper before the professional community, I sent the paper to John Bell for comment, and put together his reply, my response to his reply, and Phipps' comments on what we both had said as an informal, but available, document[‡] . The relationship I claimed to have established between Phipps' phase severance and my way (then) of looking at S-Matrix theory also achieved formal publication[♮] . Meanwhile I had been hard at work trying to get more prosaic physics out of this approach by applying it to relativistic quantum scattering theory for systems with finite particle number. One focus I then chose was "Three Body Forces", where these ideas gave clues as to what was needed to give definite shape to this idea[◇] . Since a conference devoted to this problem in the specific context of the three nucleon

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* H.P.Noyes, *Foundations of Physics, 5*, 37 (1975) [Erratum *6*, 125 (1976)].

‡ P.Noyes, J.Bell, and T.E.Phipps, Jr., *Fixed Past and Uncertain Future; an exchange of correspondence*, SLAC-PUB-1351, December 1973 (unpublished).

♮ H.P.Noyes, *Found. of Phys., 6*, 83 (1976).

◇ H.P.Noyes, "Three Body Forces", in *Few Body Problems*, I.Slaus, et.al. eds, North Holland, Amsterdam, 1972, p.122.

system has just been held, the reader can consult the conference proceedings* to decide for himself whether or not the professionals have succeeded in meeting these obvious criteria during the interim period. I know that it has taken *me* over a decade to come to grips with the insights I gained from Phipps at that time; I am only now starting on computing the numerical consequences.

Phipps' route into what he calls "nuclear physics", or what is more conventionally called these days "elementary particle physics" is more conservative than mine, – in the "radical" sense already explained. His covering law principle takes him beyond both classical relativistic mechanics (Type I theories) and quantum mechanics (Type II theories) into his Type III which includes both *and* must predict new phenomena, if he is to meet his own principles. Unfortunately he has not had the resources to work out detailed predictions that could lead to quantitative confrontation with experiment. He makes a good case that most of the phenomena encountered in high energy particle accelerator experiments have at least qualitative connections with specific aspects of his theory; it is up to the reader to decide whether these are worth pursuing.

The third (mathematical) part of the book is less central to his main theme. Hypercomplex function theory badly needs to be developed further – both physicists and engineers should agree enthusiastically. Such development would aid the task of getting Phipps' classical relativistic many body theory off the ground. Thanks to the hard work he has done, such a development would lead on directly into relativistic quantum mechanics. Phipps' treatment of discrete, infinite processes is eminently practical and well worth studying. His covering law approach to entropy and inference is again sound, at least from my perspective.

What are we to make of this book? To begin with it is the life work of a very talented, dedicated and profound scholar and physicist; it should be respected on that ground alone. The audience he addresses in first instance are those "amateurs" and "dilettantes" concerned with the foundations of physics

* *Three Body Forces in the Three Nucleon System*, B.Berman, ed., Springer-Verlag (in press).

and mathematics who have not been blinkered or blinded by a narrow professional education, – in fact the modern counterpart of the audience Galileo addressed at the start of *the* scientific revolution. They should be able to take delight in Phipps' "anti-establishmentarianism", while imbibing refreshing new perspectives.

My own hope is that this work will also be read by "professionals" who sincerely profess that they are open to new ideas and try to put that profession into practice. They will need tough hides to get through this book, – but the rewards can be great. I have tried to indicate above how contact with Phipps' ideas revitalized my own work at a critical point; the same thing seems to be happening again as I try to evaluate the corpus of his work presented here. I have more confidence in high energy particle physicists than Phipps does. I believe that, after many false starts, they could well be on the verge of a "reduction" or "unification" that would do much of what is needed,– and which Phipps would probably not accept. However, if this happens within the framework now used by most physicists, the criticisms of relativity and quantum mechanics made in this volume will remain unanswered. His basic claim is that both relativity and quantum mechanics have departed in dangerous ways from the methods that had led to steady progress over the years, and that much of the current theoretical confusion results from this fact. For the professional who would like to see the new physics encompass, rather than reject, three centuries of the practice of physics, Phipps provides much to ponder.

Pierre Noyes

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