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SOME IMPORTANT NEGLECTED EQUATIONS OF PHYSICS

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ABSTRACT

Following massive changes in the direction of thinking in physics towards the beginning of the twentieth century, it is beginning to seem that some articles which should have been seen as providing potentially significant developments were effectively consigned to the archives to be buried for posterity. Others appearing much later in the century appear to have suffered a similar fate by being published in obscure journals. Here four such articles – two in each category – are examined briefly to highlight the dangers of such action.

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INTRODUCTION

Following the adoption of the ideas associated with special and general relativity, as well as those of quantum mechanics, some articles which should have been regarded as being significant – and probably still should – were relegated to the archives and forgotten. How many there are is unknown but here attention will be focused on two, together with some other more modern writings which have received far too little publicity and acclaim. Possibly the crucial point in all this is the abandonment of an aether and all notions dependent on it. In many ways this is understandable, especially given the dubious interpretation of the results of the Michelson-Morley experiment designed to establish once and for all the existence, or otherwise, of such a medium. Nowadays, however, scientists are ascribing more and more properties to the vacuum in attempts to explain known physical effects. Once these properties are ascribed, though, the resulting medium becomes more and more akin to the aether of old and the important results hidden in the archives assume more and more importance – provided, of course, the existence of the original papers is known. One of the more important of these long-forgotten papers is due to the eminent mathematician and scientist Edmund Whittaker. The name of Edmund Whittaker is familiar to many. Countless students have learned much from the book he co-authored with Watson on Modern Analysis (Whittaker and Watson, 1935) while his two-volume work on a history of the theories of Aether and Electricity (Whittaker, 1931) has proved of inestimable value to many scientists both as a reference text and as a source of inspiration for researchers and historians of science alike.

The work of Whittaker

However, although a well-known and well-respected member of the academic community, some Whittaker's important papers have seemingly been ignored or conveniently forgotten. Among these is his wonderfully detailed work on solutions of partial differential equations of mathematical physics (Whittaker, 1903), a piece all the more worthy of investigation given the author's extensive knowledge of the topic as evidenced by his aforementioned book on modern analysis. Although the entire paper is, or should be, of interest to all, it is the final section in which he considers the explanation of gravitation and electrostatic attraction as modes of wave disturbance which is of the utmost relevance here. Earlier in the article he has shown that any solution of the following equation:

$$\frac{\partial^2 V}{\partial x^2}+\frac{\partial^2 V}{\partial y^2}+\frac{\partial^2 V}{\partial z^2}=k^2\,\frac{\partial^2 V}{\partial t^2}$$

may be analyzed into simple plane waves. He goes on to point out that this throws new light on forces, such as gravitation, which vary via an inverse square law. This is due to the fact that such forces have a potential which satisfies the following equation:

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$$\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = 0$$

and must, therefore, satisfy the first equation written above, where k is any constant. He goes on to point out that this potential may be analyzed into simple plane waves. He then proceeds to comment that it is not difficult to construct systems of coexistent simple waves possessing the property that the total disturbance at any point varies from point to point but does not vary with time. He illustrates this by considering a particle emitting spherical waves such that the disturbance at a distance r from the origin at time t due to those waves whose wave-lengths lie between $2\pi/\mu$ and $2\pi/(\mu+d\mu)$ is represented by

$$\frac{2d\mu}{\pi\mu}\frac{\sin(\mu Vt - \mu r)}{r}$$

where V is the velocity of propagation of the waves. After the waves have reached the point r, so that $(Vt - r)$ is positive, the total disturbance at this point is

$$\int_0^\infty \frac{2d\mu}{\pi\mu}\frac{\sin(\mu Vt - \mu r)}{r} = \frac{1}{r}$$

that is, the total disturbance at any point, due to this system of waves, is independent of time and is proportional everywhere to the gravitational potential due to the particle at the point.

He continues by making it clear that this indicates that the field of force due to a gravitating body may be analyzed into an infinite number of constituent fields and, although the whole field of force does not vary with time, each of the constituent fields has an undulatory character consisting of a simple wave disturbance propagated with uniform velocity. In each of the constituent fields the potential will be constant along each wave front and consequently the gravitational force in each constituent field will be perpendicular to the wave front – that is, the waves will be *longitudinal*.

Further, he points out that such an undulatory theory of gravity would require gravity be propagated with a finite velocity but one which need not be the same as that of light but could be hugely greater. He also stresses that his investigation does not explain the *cause* of gravity; it merely shows that, to account for the propagation across space of forces which vary as the inverse square of the distance, it is necessary only to suppose the medium capable of transmitting, with a definite, though large velocity, simple periodic undulatory disturbances, similar to those whose propagation by the medium constitutes the transmission of light according to the electromagnetic theory. It might be noted also that in the second paper by Whittaker (1904), Whittaker shows that the electromagnetic field due to electrons may be expressed purely in terms of two scalar potential functions and this too is an article which could well prove significant. However, while both articles are relatively unknown, they have been publicized in several books but, unfortunately, the authors of these and advocates of the importance of Whittaker's work fall into the category of people labelled either 'cranks' or 'fringe scientists'. It is a worrying thought that this attitude could be denying science access to some potentially vital results.

Thornhill's contribution

One objection to some of these ideas is that longitudinal, or scalar, waves are involved and some claim that, if such waves exist, they would not be electromagnetic. This objection is totally unfounded and indicates a lack of knowledge of the work by Thornhill (1984a). In the cited article, Thornhill points out that, in a gas-like aether, the duality between the oscillating electric and magnetic fields, which are transverse to the direction of propagation of electromagnetic waves, becomes a triality with the longitudinal oscillations of motion of the aether, if electric field, magnetic field and motion are coexistent and mutually perpendicular. Before this article, he had shown already (Thornhill, 1984b) that Planck's energy distribution for black-body radiation may be derived for an aetherial medium which behaves as a gas under Maxwellian statistics. He points out that electromagnetic waves may propagate in such an aether and the oscillating electric and magnetic fields in such waves are seen to be transverse to the direction of wave propagation. However, these two fields and motion are observed to be mutually perpendicular and coexistent. This suggests that such waves must also comprise longitudinal oscillations of motion of the aether, accompanied by longitudinal oscillations in pressure and density. Hence, such waves would possess the triality of being electromagnetic-condensational waves and, interestingly, their condensational aspect would be analogous to that of sound waves in a material gas. This Thornhill may be seen to have justified in the cited article (Thornhill, 1984a). Note that all Thornhill's work, including the two cited papers above, is available at www.etherphysics.net. It is also of interest to note that in all this, Thornhill brings to bear all his undoubted mathematical ability combined with an extensive knowledge of the behavior of physical systems often dismissed as being purely classical. Thornhill's work shows quite clearly that it is dangerous to dismiss and/or forget results from classical physics – such can often point the correct way forward.

CONCLSION

Here four articles dating from the early 1900s (Whittaker, 1903, 1904) and the mid-1980s (Thornhill, 1984a, 1984b) have been highlighted as particularly good examples of mathematically powerful and physically accurate papers which have either, as in the case of the first two, been buried in the archives to avoid them receiving too much publicity or been published in a less than well-known journal for the same reason. Especially with the case of the Whittaker work, it is left to ponder how much similar work, generated at the end of the nineteenth century and beginning of the twentieth, has been buried for reasons of academic politics? This is a provocative question but one which, especially in the light of the Whittaker papers, deserves an answer. How many more important gems are buried in the archives?

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