Some Comments on Modern Physics.

Jeremy Dunning-Davies,
Institute for Theoretical Physics and Advanced Mathematics (IFM) Einstein-Galilei,
Via Santa Gonda,
14 - 59100 Prato,
Italy
and
Institute for Basic Research,
Palm Harbor, Florida, U.S.A.
email: j.dunning-davies@hull.ac.uk

Abstract.

Considering the manner in which many students are introduced to some of the accepted pillars of perceived scientific wisdom, it seems appropriate, in view of recent developments associated with the theories of both Special and General Relativity, to look at the present basis for this accepted educational approach.

Introduction.

Students are often introduced to branches of so-called modern physics, especially relativity, by having it explained that, towards the end of the nineteenth century, many scientists felt that most problems had been solved and all the necessary theory was in place to deal with any remaining. In the event, three of those remaining problems:

(i) the advance of the perihelion of Mercury,

(ii) the passage of light in moving media,

(iii) the interaction of matter with radiation,

are claimed to have been solved eventually by recourse to the general theory of relativity, the special theory of relativity and quantum theory respectively. However, as time has passed, it has become apparent that these theories seem to have spawned more problems than they have solved.

Comments on General Relativity.

As far as General Relativity is concerned, students are told that there are several tests which may be carried out and actually show the theory to be correct. The red shift phenomenon which provides the basis for one of these tests has been shown on numerous occasions to be derivable independently of General Relativity but the reason this is still being shown to be the case is that it still heralded to students as one of the three 'crucial tests'. More recently, the other two tests have been shown to be derivable without recourse to General Relativity as well. This was shown quite clearly by Lavenda[(1)] in 2005 when he set out to try to explain the time delay in radar echoes from planets as well as the bending of light rays and the shift of the perihelion of Mercury via Fermat's principle and the phase of Bessel functions. It has to be expected that the techniques employed by Lavenda in this work might be extended to cover any other tests that might be dreamt up to justify General Relativity. Of course, it should be remembered that, as far as the shift in the perihelion of Mercury is concerned, the correct expression had been derived in 1898[(2,3)] by a German schoolteacher, Paul Gerber, but, although his article announcing this result appeared in a prestigious academic journal, it was either overlooked or ignored. Historically, this seems surprising, considering the need to explain the observed added shift in the perihelion. Subsequently, Gerber's work was found to contain a flaw but even that wasn't either publicised too widely or addressed. Hence, as far as the 'crucial tests' are concerned, the need for the General Theory of Relativity, beautiful though it is mathematically, must be in some doubt. Also, it might be noted that Schwarzschild's solution to the Einstein field equations has sparked widespread controversy which continues to this day[(3)]. Much of this, of course, surrounds the notion of a black hole. The question which really does require an answer here is 'Is the modern relativistic idea of a black hole merely a mathematical entity or does it have real physical significance?' There are two very definite fields of thought here but little genuine open-minded discussion between them. It is important to remember that the relativistic notion of a black hole, which is effectively the assigning of a physical meaning to a mathematical singularity, should not be confused with Michell's dark body which is the result of a purely Newtonian investigation into the properties of a body which possesses an escape speed equal to, or in excess of, that of light[(3)]. It is not without interest either to note that the relativistic notion of a black hole is confused quite frequently with Michell's dark body. One clear example of this occurs in Peter Bergmann's semi-popular book *The Riddle of Gravitation*[(4)]. This seems a surprising mistake for such an eminent scientist unless it is a way of persuading people of the physical correctness of the theoretical idea of a black hole. However, none of this affects the validity of General Relativity; it merely indicates that many, if not all, of the well-known results associated with this celebrated theory may be obtained in alternative ways. However, all this is well documented as indicate here but, although the problems associated with the Special Theory are well-known, the discussion of them is not very widespread and usually seems to follow the route of attempting to provide a real physical explanation for some purely mathematical results.

Comments on Special Relativity.

Until recently, any concerns surrounding some results associated with Special Relativity which appeared to contradict common-sense were either regarded as suitable topics for light hearted conversation over coffee or led to very heated confrontation, such as occurred in the case of Herbert Dingle. It should be noted that Dingle's highly lucid account of all that happened is contained in his book *Science at the Crossroads*(5). However, more recently, the puzzlingly neglected work of J. P. Wesley(6) has come to light and this throws a different light on the entire topic. Rather than take a list of mathematical axioms as starting point, Wesley took the experimentally verifiable equivalence of mass and energy. It may be argued by some that he was taking an end-point of Einstein's reasoning to begin his own investigation but this would be an unfair assumption. Firstly, the equivalence of mass and energy had been known and used before it became associated with the name of Einstein. This can be seen, for example, by reading Thomson's book *Electricity and Matter*(7), although much older references may be found. As has been shown by Wesley(6) and highlighted more recently(8), this formula may be used to show that the true expression for the total kinetic energy is precisely that normally associated with Special Relativity:

$$T = mc^2(\gamma - 1)$$

where $\gamma = (1 - v^2/c^2)^{1/2}$, as usual. Hence, Wesley has shown that one of the more important, and practically useful, expressions of Special Relativity may be obtained without recourse to the equations of the Lorentz transformation but rather by utilising a well established result of experimental physics. It follows that, if this approach is followed, all the problems and paradoxes associated with traditional approaches to Special Relativity disappear since a moment's examination shows that all originate with the equations of the Lorentz transformation.

It should be pointed out that it is still necessary to examine the whole question of time but, as has been pointed out by Tom Phipps(9), provided GPS corrected clocks replace proper time clocks, the Galilean transformation will replace the Lorentz transformation. In fact, as he points out, 'correcting the running rate of clocks is really the key to rectifying the whole business. In thermodynamics we do not take the raw readings of thermometers to signify "temperature," and in relativity we should not take the raw readings of clocks to signify "time."'

One final separate point should be mentioned at this juncture and that concerns the form of the so-called relativistic mass, whether obtained in the usual manner or via Wesley's more physically realistic approach. This relativistic mass is a function of the speed. However, recently it was shown that the normal derivation of Lagrange's equations of motion depends crucially on the mass being a constant(8). It was shown how the derivation could be modified to take account of changing mass but only in the case where that mass is a function of time did the resulting Lagrange equations assume their well known form. In other cases, particularly when the mass is a function of speed, this was not so. Hence, it follows that great care must be taken when attempting to use Lagrange's equations of motion in relativistic circumstances.

Some General Comments.

Many of the ideas associated with the theory of both Special and General Relativity have been communicated to the general public in numerous popular and semi-popular books by eminent physicists. Hence, that public has been made to feel it has some real knowledge of these highly abstruse topics and this has, in turn, helped make the theories seem almost owned by that public. However, all these books have one thing in common and that is that they convey what is conventionally felt to be the situation concerning these theories. As has been alluded to above, when someone who originally supported and, indeed, promoted relativity became disillusioned with the subject matter and publicly said so, he was 'cast into outer darkness' by the scientific establishment. One book which well illustrates many of the problems faced by those who harbour concerns about relativity is *The Riddle of Gravitation* by Peter Bergmann(4). Admittedly, this may be described only as a semi-popular science book but the fundamental ideas are presented without any formal mathematics or an acquaintance with notions of modern physics and should be accessible to anyone with a genuine interest in the topic and the perseverance to wade through some fairly complicated arguments. However, it is admitted that 'a fair knowledge of mathematics would be a great support' and it is doubtful many without some advanced mathematical knowledge would derive too much benefit from the fairly detailed discussion of curved space-time and parallel transport. However, this latter discussion does illustrate extremely well how the public is coerced into accepting so much in science without question. The technique is to purport to write a piece for general popular consumption but, in fact, to make it quite technical. A great many people will accept the conclusions of such a piece rather than admit they don't really understand the arguments employed.

Again, the comment re the use of mathematical knowledge might refer to the seeming obsession with discussing all the nuances of frames of reference for large parts of the book. Scientists know only too well the importance of frames of reference in their work but they also know that these are simply theoretical tools introduced to enable them to explain many of the natural phenomena they encounter in their work. In this book, as in many other popular books on the subject, frames of reference, transformations, space-time and other theoretical concepts seem to be elevated to positions almost of reality; it becomes extremely difficult for even the specialist to separate theoretical ideas from physical reality. This has become more and more apparent as one sees media coverage treating space-time as if it is an actual physical entity, rather than a theoretical abstraction introduced to help explain ideas and theories. The end result is that many members of that general public, whose taxes pay for scientists' careers and their expensive toys, genuinely believe in space-time as something akin to the three-dimensional space in which they exist; they do not realise that it is just a mathematical abstraction developed to help scientists in their theoretical attempts to understand the reality surrounding them. Space-time itself is *not* a physical reality; it is merely a tool to help theoreticians in their efforts to explain the wonderful world around us.

One point that has been made several times over the years but which no-one seems to have taken to heart is that, while mathematics is a beautiful study for many and deserves to be examined in isolation in its own right, once it is used to aid the solution or explanation of physical phenomena, it becomes merely a tool in the hands of the theoretician. When used in this way, mathematics must become subservient to the physics. After all, it is observable physical situations which are being examined. There is no way any sensible person could wish to attempt to make the physics fit the mathematical model constructed. However, in much of modern physics that is precisely what has happened; people have tried to make the physics fit their model, rather than the other way around. There are several glaring examples of this which are very much in the public domain. Possibly the most obvious is black holes which have been foisted on all as a result of a probably incorrect form of a solution to Einstein's field equations. Such esoteric objects have never been 'seen'; their existence has been claimed via an interpretation of observational data but, since that interpretation has been made on the basis of questionable theory, it is difficult to allow it any real credence. Nevertheless, careful publicity has ensured that the public – especially those interested in science fiction – is convinced of, and excited by, their existence.

It is possibly somewhat surprising that theories as abstract as those of Special and General Relativity should have been taken to heart by so many ordinary members of the public and in so many countries. Much of this is due to books such as the one mentioned here and to the continual one-sided media coverage of so much in science, as well as to a fascination with such science fiction entities as black holes. Nevertheless, there are many questions remaining to be answered about relativity and other areas of physics. It is to be hoped that Lavenda's work in the area associated with General Relativity and the ideas of Wesley in the area of Special Relativity will ignite an interest to re-examine both those fields in a more critical fashion.

Conclusions.

It seems obvious that there are some really serious questions surrounding the seemingly pre-eminent positions afforded the theories of both Special and General Relativity in present day science. However, no mention has been made of quantum mechanics in this discussion. This is another theory which has proved extremely successful in numerous calculations but, to some at least, doubts have always remained over its range of validity. These doubts have arisen for a variety of reasons and amongst many scientists, some highly eminent, others less so. This note makes no claim to address any of these concerns but concerns itself solely with commenting on the present position associated with the Special and General Theories of Relativity.

However, in that context, much has been made of statements contained in the book [(4)] by Peter Bergmann. These have been used as illustrations and have not been intended to constitute a review of that book. Indeed, the book contains a great many statements to which attention could have been drawn if reviewing the book had been the intention. It is possibly worth looking at, and reflecting on, the final sentence of the book though:-

> "*The conception of geometry as an ever-changing aspect of the real world rather than an abstract mathematical structure is a contribution that will survive the specific aspects of Einstein's laws of the gravitational field*."

Is this so, or did the said conception really elevate at least a section of mathematics to a position where its importance transcended that of the actual physics? If the latter, it could well be a contributor to many of the problems faced in physics at the present time and be responsible, even unintentionally, for the current situation in so many areas of science where mathematical theory seems to be being regarded as more important than the actual physical facts requiring explanation.

References.

1. B. H. Lavenda; 2005, Journal of Applied Sciences, **5**(2), 299
2. P. Gerber, 1898, Zeitschrift f Math. u Phys., **43**, 93
3. J. Dunning-Davies, 2007, *Exploding a Myth*, Horwood, Chichester.
4. P. G. Bergmann; 1969, *The Riddle of Gravitation*, John Murray, London
5. H. Dingle; 1972, *Science at the Crossroads*, Martin Brian & O'Keefe, London. (still readily available on the internet)
6. J. P. Wesley; 2002, *Selected Topics in Scientific Physics*, Benjamin Wesley, Germany.
7. J. J. Thomson; 1904, *Electricity and Matter*, Constable, Westminster.
8. D. P. Allen & J. Dunning-Davies; 2013, *Neo-Newtonian Mechanics with Extension to Relativistic Velocities*, Create Space.
9. T. Phipps; 2013, private communication,
   2006, *Old Physics for New*, Apeiron, Montreal.