The Farce of Physics

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Mathematical Magic

There is a tradition of brown-bag lunch in the foyer of the Science auditorium at Eckerd College. Most of the Natural Science Collegium faculty tend to observe this tradition, and it is not unusual to have faculty from the other Collegiums or even the President or Dean of the College to attend the lunch as well. The well upholstered easy chairs and sofas are dragged over the carpet to form a circle, and the lunch becomes an informal discussion group, with wide ranging topics from sports to philosophy. Many of the arguments presented in this book have evolved from the discussions and debates at this lunch, and even the book itself has become a topic of discussion, as I've passed out copies of the material as it has developed to interested faculty members, in an effort to obtain input from the group. One of the topics that was discussed was the question of the nature of mathematics. It was interesting to find that the Math faculty had no simple well defined definition of Mathematics! My Grolier Encyclopedia states that the word was derived from the Greek word for learning *mathema*, and that Mathematical scholars disagree upon a definition of mathematics. The article goes on to state under HISTORY:

As a recognizable discipline, mathematics is found first among the ancient Egyptians and the Sumerians. In fact, the Egyptians probably had considerable mathematical knowledge as early as 2900 B.C., when the Great Pyramid of Gizeh was built. A handbook upon mathematics, known as the Ahmes Papyrus, written about 1550 B.C., shows that the early Egyptians could solve many difficult arithmetical problems. Some modern scholars believe that the Sumerians, who were the predecessors of the Babylonians, may have had a system of arithmetic as early as 3500 B.C. The Sumerians and Babylonians applied arithmetic and elementary geometry to the study of astronomical problems and to the construction of great irrigation and other engineering projects.

The Greek philosopher-mathematician Thales is usually regarded as the first to realize the importance of organizing mathematics upon a logical basis. Such a tradition was carried on and further developed in early times by Pythagoras, Plato, Aristotle, and especially by the mathematicians of the Alexandrian School. The famous University of Alexandria, between 300 B.C. and 500 A.D., had upon its staff such distinguished mathematicians as Euclid, Archimedes, Apollonius, Eratosthenes, Ptolemy, Heron, Menelaus, Pappus, and Diophantus.

For nearly a thousand years before the 15th century little original work was done in the field of mathematics except that produced by the Hindus and the Arabs. In the 16th century

Tartaglia, Cardan, and Ferrari in Italy and Vieta in France laid the foundations of modern algebra. The 17th century produced many outstanding mathematicians including Descartes, Newton, Leibnitz, Fermat, Pascal, Desargues, Napier, and Kepler. During the 17th century mathematics was extended in many directions, and modern analysis was born with the invention of the calculus. The 18th, 19th, and the first half of the 20th centuries have seen a tremendous growth in the development of mathematical theory, and mathematical techniques have been introduced into virtually all branches of pure and applied science.

I presented the argument that mathematics was a language. My view on this matter was based on the following statement by Dr. Robert B. Fischer, in his book "Science Man and Society":

The language of mathematics, which consists of its symbols and their relationships, is very much at the heart of the practice of virtually all fields of science. [40]

My view was also shaped by various statements made by Prof. Albert Einstein such as the following sentence:

It demands the highest possible standard of rigorous precision in the description of relations, such as only the use of mathematical language can give. [39 p.225]

Prof. Richard Rhodes II, a member of the Physics faculty, and a graduate of Yale University, told a story in support of my argument. The story concerned a statement made by Prof. Josiah Willard Gibbs, Yale's first professor of mathematical physics. With regard to Gibbs, the following was taken from an article on him entitled "A loner's legacy":

Gibb's work was so advanced that one of his great admirers, Albert Einstein, complained about one of his papers that "it is hard to read and the main points have to be read between the lines." However, Einstein also termed it "a masterpiece." Scientists have been reading between the lines since Gibbs first laid out the fundamental equations of thermodynamics and reshaped the study of relations between energy and the composition of matter into a modern field with implications still being found. [41]

The story came from a biography on Gibbs by Dr. Muriel Rukeyser, and goes as follows:

A story is told of him, the one story that anyone remembers of Willard Gibbs at a faculty meeting. He would come to meetings - these faculty gatherings so full of campus politics, scarcely veiled manoeuvres, and academic obstacle races - and leave without a word, staying politely enough, but never speaking.

Just this once, he spoke. It was during a long and tiring debate on elective courses, on whether there should be more or less English, more or less classics, more or less mathematics. And suddenly everything he had been doing stood up - and the past behind him, his father's life, and behind that, the long effort and voyage that had been made in many lifetimes - and he stood up, looking down at the upturned faces, astonished to see the silent man talk at last. And he said, with emphasis, once and for all:

"Mathematics *is* a language." [42]

Following Rhodes' story about Gibbs, everyone seemed to agree, that yes, mathematics is a language.

The major problem with mathematics, is that for the average person, it is a foreign language. To illustrate this point, I will cite several paragraphs taken from a very interesting article published in Physics Today, entitled "Math anxiety and physics: Some thoughts on learning 'difficult' subjects":

However, students bring more than Aristotelianisms to class. They consider science in general and physics in particular "hard" subjects to learn. As Robert Fuller of the University of Nebraska points out, professors intentionally and unintentionally contribute to this reputation. In a proposal, since funded by Exxon, for AAPT workshops to help teachers develop student confidence in physics, Fuller notes that "Opening lectures often describe the *high* standards maintained by the department, the *firm* math prerequisites, the poor grade records of previous classes." Even when they do not make such explicit statements, teachers convey the message that physics is a particularly difficult subject, says Fuller, and this damages student confidence.

How significant, then, is apprehension in discouraging nonscience undergraduates from attempting physics? Might the anxiety-reduction techniques that proved useful in treating fear of mathematics work for the physics student? While it remains to be seen whether the sources of physics anxiety and math anxiety are the same, one thing is clear to someone who has dealt with fear of mathematics in college-age students: The two have similar manifestations. Hence, even though the discussion in the first half of this article focuses on obstacles to learning mathematics, I think readers will find that it rings true for physics as well. ...

Instead, what appears to link students of very diverse mathematical "ability" is a collection of what might be called ideological beliefs or prejudices about the subject. Students' early experiences with mathematics typically give them false impressions not only of the nature of the subject, but also, and more perniciously, of the kinds of skills required to master it. They think, for example, that speed is more important than persistence. Even more humbling, most come away from their exposure to mathematics believing they do not have the *sine qua non* of mathematics success, namely, a "mathematical mind."

When the students that I interviewed - particularly the woman students - decided to stop taking mathematics, they explained this in terms of their feelings: They felt helpless and out of control in confronting mathematics; they were easily bewildered and found themselves humiliated in class; they were uneasy solving or analyzing problems under time pressure, and they had become distrustful of intuitive ideas that had not been formally introduced in the text. Because of all this, the students felt compelled to memorize solutions to individual problems. [43]

Mathematics forms the foundation of the technical jargon that the average physicist uses to confuse the issues and enhance his status by over publishing his work. The same basic equations, or algebraic variations of them, are repeated over and over in the literature. If the unneeded equations were eliminated, the articles would be easier to understand, and the inflated volume of the physics journals would be reduced by at least 90%. To illustrate the problem, I will make several quotes from an article by Prof. N. David Mermin entitled "WHAT'S WRONG WITH THESE EQUATIONS?":

A major impediment to writing physics gracefully comes from the need to embed in the prose many large pieces of raw mathematics. Nothing in freshman composition courses prepares us for the literary problems raised by the use of displayed equations. Our knowledge is acquired

implicitly by reading textbooks and articles, most of whose authors have also given the problem no thought...

Admittedly sometimes an equation is buried so deep in the guts of an argument, so contingent on context, so ungainly in form that no brief phrase can convey to a reader even a glimmer of what it is about, and anybody wanting to know why it was invoked a dozen pages further on cannot do better than wander back along the trail and gaze at the equation itself, all glowering and menacing in its lair... Indeed, is the equation itself essential? Or is it the kind of nasty and fundamentally uninteresting intermediate step that readers would either skip over or, if seriously interested, work out for themselves, in neither case needing to have it appear in your text?...

We punctuate equations because they are a form of prose (they can, after all, be read aloud as a sequence of words) and are therefore subject to the same rules as any other prose... Most journals punctuate their equations, even if the author of the manuscript did not, but a sorry few don't, removing all vestiges of the punctuation carefully supplied by the author. This unavoidably weakens the coupling between the math and the prose, and often introduces ambiguity and confusion. [44]

Dr. Oliver C. Wells is a research scientist at the IBM Thomas J. Watson Research Center, and concerning the difficulty in understanding the mathematics and technical jargon in physics, writes:

On the subject of writing style, I am frequently horrified to discover that I quite simply cannot understand even the first paragraph of a technical article on a subject quite close to my own major area of interest. [45]

The Executive Director of the scientific research society Sigma Xi, has published a booklet on scientific ethics. [50] On page 11 of Chapter 3 which is titled "Trimming, Cooking, and Forging" Dr. Jackson starts with:

Charles Babbage (1792-1871) is generally remembered as the prophet of the electronic computer, because of his "difference engine" and the uncompleted "analytical engine." But he had a much more extensive influence on scientific development. As professor of mathematics at Cambridge University, he published a book entitled *Reflections on the Decline of Science in England.* Since the year was 1830, the same year that Charles Lyell began to publish his *Principles of Geology* and shortly before Charles Darwin set sail on the "Beagle," the title may seem as premature as his calculating devices. Babbage's book, however, is generally given credit as a catalyst in the creation of the British Association for the Advancement of Science, and indirectly of similar associations in the U.S.A., Australia and elsewhere.

Babbage, the "irascible genius," was also concerned with how science should be done, and the same book describes the forms of scientific dishonesty that give this chapter its title. The definitions used here are phrased in contemporary English; otherwise not much seems to have changed in 150 years.

Trimming:
the smoothing of irregularities to make the data look extremely accurate and precise.
Cooking:
retaining only those results that fit the theory and discarding others.
Forging:

inventing some or all of the research data that are reported, and even reporting experiments to obtain those data that were never performed.

Dishonest deceptions are not unusual in the history of physics. They began with Galileo Galilei, the man who laid the foundations of modern physics. My insight into this matter came from a book titled "The Birth of a New Physics" by Dr. I. Bernard Cohen. [51] On page 66 we find:

...Galileo was born in Pisa, Italy, in 1564, almost on the day of Michelangelo's death and within a year of Shakespeare's birth. His father sent him to the university at Pisa, where his sardonic combativeness quickly won him the nickname "wrangler."

And then on page 111:

Galileo's originality was therefore different from what he boastfully declared. No longer need we believe anything so absurd as that there had been no progress in understanding motion between the time of Aristotle and Galileo. And we may ignore the many accounts that make it appear that Galileo invented modern dynamics with no debt to any medieval or ancient predecessor.

This was a point of view encouraged by Galileo himself but it is one that could be more justifiably held fifty years ago than today. One of the most fruitful areas of research in the history of science in the last half century began chiefly by the French scholar and scientist Pierre Duhem has been the "exact sciences" of the Middle Ages. These investigations have uncovered a tradition of criticism of Aristotle which paved the way for Galileo's own contributions. By making precise exactly what Galileo owed to his predecessors, we may delineate more accurately his own heroic proportions. In this way, furthermore, we may make the life story of Galileo more real, because we are aware that in the advance of the sciences each man builds on the work of his predecessors...

More than any other man, Sir Isaac Newton set the tone for scientific dishonesty in modern physics by his skilled use of "Mathematical Magic." My insight into this came from a very interesting article titled "Newton and the Fudge Factor" by Dr. Richard S. Westfall. [52] To advance my argument I start with the following paragraph from the article:

And having proposed exact correlation as the criterion of truth, it took care to see that exact correlation was presented, whether or not it was properly achieved. Not the least part of the *Principia's* persuasiveness was its deliberate pretense to a degree of precision quite beyond its legitimate claim. If the *Principia* established the quantitative pattern of modern science, it equally suggested a less sublime truth - that no one can manipulate the fudge factor quite so effectively as the master mathematician himself.

In explaining Newton's motives in fudging his work, I present the following paragraph from Westfall's article:

The second edition of the *Principia* was at once an amended version of the first edition and a justification of Newtonian science. The battle with the continental mechanical philosophers who refused to have truck with the occult notion of action at a distance still raged. The second edition made its appearance framed, as it were, by its two most important additions, Cotes' "Preface" at the beginning and Newton's "General Scholium" at the end, both of them devoted to the defense of Newtonian philosophy, of exact quantitative science as opposed to

speculative hypotheses of causal mechanisms. By 1713, moreover, Newton's perpetual neurosis had reached its passionate climax in the crusade to destroy the arch-villain Leibniz. Only a year earlier the Royal Society had published its *Commercium epistolicum*, a condemnation of Leibniz for plagiary and a vindication of Newton, which Newton himself composed privately and thrust upon the society's committee of avowed impartial judges. In Newton's mind, the two battles merged into one, undoubtedly gaining emotional intensity in the process. Not only did Leibniz try to explain the planetary system by means of a vortex and inveigh against the concept of attraction, but he also encouraged others to attack Newton's philosophy. His arrogance in claiming the calculus was only a special instance of his arrogant presumption to trim nature to the mold of his philosophical hypotheses. In contrast, the true philosophy modestly and patiently followed nature instead of seeking to compel her. The increased show of precision in the second edition was the reverse side of the coin stamped *hypotheses non fingo*. It played a central role in the polemic supporting Newtonian science.

The term "fudge factor" is of course, just a polite way of describing Newton's dishonest ways of Trimming, Cooking, and Forging the data. The following is taken from one of the examples of Newton's fudging in the article:

In examining the alterations, let us start with the velocity of sound since the deception in this case was patent enough that no one beyond Newton's most devoted followers was taken in. Any number of things were wrong with the demonstration. It calculated a velocity of sound in exact agreement with Derham's figure, whereas Derham himself had presented the conclusion merely as the average of a large number of measurements. Newton's assumptions that air contains vapor in the quantity of 10 parts to 1 and that vapor does not participate in the sound vibrations were wholly arbitrary, resting on no empirical foundation whatever. And his use of the "crassitude" of the air particles to raise the calculated velocity by more than 10 percent was nothing short of deliberate fraud.

Interesting additional information with regard to Newton's lack of scientific integrity can be found in an article published by Dr. I. Bernard Cohen in the journal Scientific American. [53] The article is titled "Newton's Discovery of Gravity" and contains the following paragraph:

A decisive step on the path to universal gravity came in late 1679 and early 1680, when Robert Hooke introduced Newton to a new way of analyzing motion along a curved trajectory. Hooke had cleverly seen that the motion of an orbiting body has two components, an inertial component and a centripetal, or center-seeking, one. The inertial component tends to propel the body in a straight line tangent to the curved path, whereas the centripetal component continuously draws the body away from the inertial straight-line trajectory. In a stable orbit such as that of the moon the two components are matched, so that the moon neither veers away on a tangential path nor spirals toward the earth.

Later in the article Cohen writes this paragraph:

In his letter Hooke ventured the suggestion that the centripetal force drawing a planet toward the sun varies inversely as the square of the separation. At this point Hooke was stuck. He could not see the dynamical consequences of his own deep insight and therefore could not make the leap from intuitive hunch and guesswork to exact science. He could go no further because he lacked both the mathematical genius of Newton and an appreciation of Kepler's law of areas, which figured prominently in Newton's subsequent approach to celestial dynamics. The law of areas states that the radius vector from the sun to a planet sweeps out equal areas in equal times.

With regard to Newton's philosophy as to the cause of the gravitational force, we find the following paragraph:

Although Newton at times thought universal gravity might be caused by the impulses of a stream of ether particles bombarding an object or by variations in an all-pervading ether, he did not advance either of these notions in the *Principia* because, as he said, he would "not feign hypotheses" as physical explanations. The Newtonian style had led him to a mathematical concept of universal force, and that style led him to apply his mathematical result to the physical world even though it was not the kind of force in which he could believe.

With regard to Newton's dishonest attempt to claim full credit we find:

In 1717 Newton wanted to ensure his own priority in discovering the inverse-square law of gravitation, and so he invented a scenario in which he made the famous moon test not while writing the *Principia* but two decades earlier in the 1660's...

And in this same regard, Cohen states this paragraph:

Newton never published his invented scenario of the early moon test. He included it in the manuscript draft of a letter to the French writer Pierre Des Maizeaux but then crossed it out. Newton also circulated the familiar story that a falling apple set him on a chain of reflections that led to the discovery of universal gravitation. Presumably this invention was also part of his campaign to push back the discovery of gravity, or at least the roots of the discovery, to a time 20 years before the *Principia*.

With Newton as a role model, it's no wonder that modern physics is riddled with an almost complete lack of scientific objectivity and integrity! Additional insight into this matter comes from a very interesting book by Dr. Rudolf Thiel. [54] The insight starts on page 183 with the following paragraph:

René Descartes dominated the first half of the seventeenth century in his dual capacity of mathematician and philosopher. He had developed mathematical analysis, which wiped out the boundary between geometry and algebra, in which curves became functions. By comparison, Euclidean thinking seemed pedantic and limited. Then he attempted to explain the entire mechanism of the world by ether eddies. These supposedly transmitted light, and at the same time set the celestial bodies in motion. He succeeded in reducing all the phenomena of nature known at the time to this single cause, which transmitted its effect tangible from one thing to another; thus everything was connected in a chain with everything else. Descartes's contemporaries hailed this triumph of reasoning which seemed to explain every detail of the entire Creation.

Then Newton came along with his mathematical proofs of gravitation, which could not be explained by ether eddies. Gravitation was a mystery working over great distances in some inconceivable manner. Such a thing was repugnant to Europeans, who wanted to see the interlocking cause and effect with their own eyes. Newton's version of nature therefore seemed to be a descent from the heights attained by Descartes, retrogression to an outmoded stage of philosophy.

Worse still, in Newton's mighty system there was no room left for the ether. This also undermined the wave theory of light, which Huygens had recently presented to the world.

Newton himself regretted this, for the wave theory was essential to his theory of color. There still remained the problem of explaining the spectrum: why were the rays of primary light arranged in the particular order of red, yellow, green, and violet? Why did light consist of many colors; what were colors? According to Huygens they were simply waves of differing lengths, differing frequencies, just like different pitches. The spectrum represented a scale, a gamut of light.

This explanation seemed to emerge again from another of Newton's experiments. If light is passed through a lens pressed upon a plate of glass, a wreath of colored rings is produced. When monochromatic light is sent through such an apparatus, the rings of each color appear at different distances from one another. Newton measured the distances and was in effect measuring the wave lengths of light. But he would not accept this explanation; light waves could not exist because there was no medium, no ether, to transmit them. So impossible, nonsensical a concept as that of the ether had no right to existence. Anything that did not follow from observations was a hypothesis, he maintained, and hypotheses had no place in experimental science.

Newton therefore concluded that light consisted of corpuscles passing through empty space. The differing distances of the colored rings proved only that the corpuscles were affected by their passage through the lens and the glass, that their character was affected in some way, to what degree depending on their color.

Only Newton with his incredibly sane and all-embracing system, could have succeeded in putting across so absurd a conception. He won the battle completely. The wave theory vanished, and with it Descartes's ether eddies. The whole triumphant world-view of the Baroque Age had been shattered. In its place Newton offered the inexplicable, remote force of gravitation which was, admittedly, a mystery to himself. When he was asked what accounted for it, he flatly refused to venture any opinion: "I do not invent hypotheses."

This attitude of his became a model for future natural philosophers. Henceforth scientists considered it more important to recognize where the limits of science lay than to satisfy the urge for knowledge by unproved speculations, no matter how pretty they might be.

The incomprehensibility of gravitation Newton considered a divine dispensation. The Almighty had denied man ultimate insight into the mystery of His Creation. A Christian must be able to reconcile himself to this fact and Newton was a devout Christian...

With regard to Newton as the role model for the corrupt politics of modern physics, we find on page 185:

In his mid-fifties there came a radical change in Newton's way of life. He was appointed master of the Royal Mint, an office equivalent to what would now be governor of the Bank of England. He exchanged his modest lodgings at Cambridge for a palace in London, entered society, kept horses, carriages, and servants. His income shot abruptly from sixty to five hundred pounds a year, besides various perquisites; he was able to indulge his taste for philanthropy. He was knighted, and became an influential personage at court. Most important of all, he became president of the Royal Society.

This celebrated association of scientists was about the same age as Newton himself. At the time he was given his professorship, the society became "royal," and was provided with special privileges, robes of state, a mace, and a seal bearing the motto: "Let no one's word be

law." But the motto went by the board once Newton was elected with absolute regularity to the presidency. His word was sacred. An excellent model for a cannon was unanimously rejected because Newton declared: "This diabolic instrument will only multiply mass killing." In London the Royal Society was generally known as Sir Isaac's Parliament.

This parliament became the platform for Newton's world fame. But it also embittered the closing days of his life by its frenetic partisanship, in connection with his fourth great contribution, the calculus of fluxions, which has become the core of modern mathematics. This time, however, Newton was not the sole discover of the method. It was simultaneously developed, under the name of the differential calculus, by the German philosopher Leibnitz...

Most of the technical terminology of modern mathematics derives from Leibnitz. All of Europe learned the differential calculus from his textbook. He described the new art of reckoning in such lucid terms that a veritable race began among mathematicians, each trying to outdo the other in elegant solutions of hitherto unsolved problems. Mathematicians posed each other riddles, and sent each other the results in code to be sure that no one copied. The period immediately after Leibnitz was an exciting and glorious era in the history of mathematics. And all the newest discoveries were made by means of Leibnitzian differential quotients. No one had ever heard of Newton's counterpart, his fluxions. Newton had created the method for his own private use, and hesitated to publish it because it was so difficult to grasp. For his *Principia* he therefore invented a less difficult, more geometrical method of proof...

The most remarkable aspect of the whole barren struggle was this: no participant doubted for a moment that Newton had already developed his method of fluxions when Leibnitz began work on the differential calculus. Yet there was no proof, only Newton's word. He had published nothing but a calculation of a tangent, and the note: "This is only a special case of a general method whereby I can calculate curves and determine maxima, minima, and centers of gravity." How this was done he explained to a pupil a full twenty years later, when Leibnitz's textbooks were widely circulated. His own manuscripts came to light only after his death, and then they could no longer be dated.

Though Newton's priority was not provable, it was taken for granted, while Leibnitz was always asked to prove that he had not plagiarized - a charge as humiliating as it was absurd. This grotesque situation demonstrates most vividly the authority Newton enjoyed everywhere. He was truly the monarch of all he surveyed, a unique phenomenon. To Western science he occupied the same place that had been held in classical antiquity by Pythagoras - whose disciples were wont to crush all opponents with the words: "Pythagoras himself has said so."

In our time, Einstein has replaced Newton as the monarch of physics. Einstein's disciples tend to crush all opponents of his relativity theories by citing chapter and verse of articles he has published. The main problem with this is the fact that Einstein tends to be a moving target, and his arguments are not consistent from paper to paper, and often within the same paper. Louis Essen has published a booklet titled "**The Special Theory of Relativity** A Critical Analysis" in which he examines this question in great detail. [55] Essen is a prominant English physicist who built the first caesium atomic clock in 1955 and determined the most accurate value for the velocity of light by using a cavity resonator. Skipping around the math, I present the following excerpts from the booklet:

Perhaps the strangest feature of all, and the most unfortunate to the development of science, is the use of the thought-experiment. The expression itself is a contradiction in terms, since an

experiment is a search for new knowledge that cannot be confirmed, although it might be predicted, by a process of logical thought. A thought-experiment on the other hand cannot provide new knowledge; if it gives a result that is contrary to the theoretical knowledge and assumptions on which it is based then a mistake must have been made. Some of the results of the theory were obtained in this way and differ from the original assumptions...

A common reaction of experimental physicists to the theory is that although they do not understand it themselves it is so widely accepted that it must be correct. I must confess that until recent years this was my own attitude. I was, however, rather more than usually interested in the subject from a practical point of view, having repeated, with microwaves instead of optical waves(Essen 1955), the celebrated Michelson- Morley experiment, which was the starting point of the theory. Then with the introduction of atomic clocks, and the enormous increase in the accuracy of time measurements that they made possible, the relativity effects became of practical significance...

Many of the thought-experiments described by Einstein and others involve the comparison of distant clocks. Such comparisons are now made every day at many laboratories throughout the world. The techniques are well known. It seems reasonable, therefore, to consider the thought-experiments in terms of these techniques. When this is done, the errors in the thought-experiments become more obvious. The fact that errors in the theory arise in the course of the thought- experiments may explain why they were not detected for so long. Theoretical physicists might not have considered them critically from an experimental point of view. But if one has been actually performing such experiments for many years, one is in a more favorable position to detect any departure from the correct procedure. In the existing climate of opinion, one needed to be very confident to speak of definite errors in the theory. Was there not perhaps some subtle interpretation that was being overlooked? A study of the literature did not reveal any, but even so it was familiarity with the experiments that gave one the necessary confidence to maintain a critical attitude.

The literature sometimes reveals a remarkable vagueness of expression, a lack of a clear statement of the assumptions of the theory, and even a failure to appreciate the basic ideas of physical measurement. Ambiguities are not absent from Einstein's own papers, and various writers, even when advancing different interpretations of the theory, are correct in as much as these interpretations can all be attributed to Einstein...

The contraction of length and the dilation of time can now be understood as representing the changes that have to be made to make the results of measurement consistent. There is no question here of a physical theory but simply of a new system of units in which c is constant, and length and time do not have constant units but have units that vary with v^2/c^2. Thus they are no longer independent, and space and time are intermixed by definition and not as a result of some peculiar property of nature... If the theory of relativity is regarded simply as a new system of units it can be made consistent but it serves no useful purpose... The argument about the clock paradox has continued interminably, although the way the paradox arose and its explanation follow quite clearly from a careful reading of Einstein's paper... The experiment is often expressed in the dramatized form of two twins, one of whom returns from a round trip younger than his brother; and in this form it has received wide publicity... It is illogical to suggest that a result obtained on the basis of the special theory is correct but is a consequence of a completely different theory developed some years later. It is also illogical to assume that accelerations have no effect as he does in A's picture of the events and then to assume that gravitation, which in the general theory is assumed to be equivalent to acceleration, does have an effect... It may be surprising, therefore, to find that a more critical

examination of the experiments and the experimental conditions suggests that there is no experimental support for the theory... The experiments of the Michelson-Morley type cannot be taken as supporting the theory, because the theory was developed in order to explain the null result that was obtained... The increase of mass with velocity was predicted for the case of charged particles directly from electromagnetic theory before the advent of relativity theory and was confirmed experimentally by Kaufmann...

18. Conclusions

A critical examination of Einstein's papers reveals that in the course of thought-experiments he makes implicit assumptions that are additional and contrary to his two initial principles. The initial postulates of relativity and the constancy of the velocity of light lead directly to length contraction and time dilation simply as new units of measurements, and in several places Einstein gives support to this view by making his observers adjust their clocks. More usually, and this constitutes the second set of assumptions, he regards the changes as being observed effects, even when the units are not deliberately changed. This implies that there is some physical effect even if it is not understood or described. The results are symmetrical to observers in relative motion; and such can only be an effect in the process of the transmission of the signals. The third assumption is that the clocks and lengths actually change. In this case the relativity postulate can no longer hold.

The first approach, in which the units of measurement are changed, is not a physical theory, and the question of experimental evidence does not arise. There is no evidence for the second approach because no symmetrical experiment has ever been made. There is no direct experimental evidence of the third statement of the theory because no experiments have been made in an inertial system. There are experimental results that support the idea of an observed time dilation, but accelerations are always involved, and there is some indication that they are responsible for the observed effects.

My main insight into Einstein and his work came from a book by Dr. Abraham Pais titled 'Subtle is the Lord...' The Science and the Life of Albert Einstein. [37] Pais is an award-winning physicist who knew Einstein personally during the last nine years of his life. On page 13 we find that in Einstein's own words he had been an "unscrupulous opportunist." On page 44 we learn that Einstein did not attend lectures or study, but instead used Marcel Grossman's lecture notes to pass his college examinations. With regard to the mathematics of relativity, page 152 states:

Initially, Einstein was not impressed and regarded the transcriptions of his theory into tensor form as 'uberglussige Gelehrsamkeit,' (superfluous learnedness). However, in 1912 he adopted tensor methods and in 1916 acknowledged his indebtedness to Minkowski for having greatly facilitated the transition from special to general relativity.

Since most scientists do not use or are conversant in tensor mathematics, its use has tended to obscure the intimate meaning behind the relativity theoretical arguments. On page 164 Pais asks:

Why, on the whole, was Einstein so reticent to acknowledge the influence of the Michelson-Morley experiment on his thinking?

On page 168 we find the answer to this question in the second volume of Sir Edmund Whittaker's masterpiece book entitled "History of the Theories of Aether and Electricity", where:

Whittaker's opinion on this point is best conveyed by the title of his chapter on this subject: 'The Relativity Theory of Poincaré and Lorentz.'

In effect Whittaker showed that Einstein's special relativity theory was not original work, but just a clever restatement of the theoretical work of Poincaré and Lorentz. The translation of Lorentz's 1904 relativity paper [57 p.12] states:

...Poincaré has objected to the existing theory of electric and optical phenomena in moving bodies that, in order to explain Michelson's negative result, the introduction of a new hypothesis has been required, and that the same necessity may occur each time new facts will be brought to light. Surely this course of inventing special hypotheses for each new experimental result is somewhat artificial. It would be more satisfactory if it were possible to show by means of certain fundamental assumptions and without neglecting terms of one order of magnitude or another, that many electromagnetic actions are entirely independent of the motion of the system.

The translation of Einstein's 1905 special relativity paper [57 p.37] presented the argument that one could explain many electromagnetic actions by fundamental assumptions based on two postulates and that the "introduction of a "luminiferous ether" will prove to be superfluous", and his paper made no direct reference to the Michelson-Morley experiment or the work of Poincaré and Lorentz. On page 313 of Pais' book we learn that in 1920, after Einstein had become famous, he made an inaugural address on aether and relativity theory for his special chair in Leiden. In the address he states:

The aether of the general theory of relativity is a medium without mechanical and kinematic properties, but which codetermines mechanical and electromagnetic events.

So we finally find that relativity is an ether theory after all, and that this ether has arbitrary abstract contradictory physical characteristics! This illustrates the arbitrary nature of relativity, Most physicists, and for that matter, most physics text books, present the argument that relativity is not an ether theory. On page 467 we find that Einstein wrote to his dear friend M. Besso, near the end of his life in 1954:

I consider it quite possible that physics cannot be based on the field concept,i.e., on continuous structures. In that case, *nothing* remains of my entire castle in the air, gravitation theory included, [and of] the rest of modern physics.

With regard to the problem of the average physicist not understanding relativity theory, Dr. S. Chandrasekhar, a Nobel laureate physicist, writes in an article [46] titled "Einstein and general relativity: Historical perspectives":

The meeting of November 6, 1919 of the Royal Society also originated a myth that persists even today (though in a very much diluted version):"Only three persons in the world understand relativity." Eddington explained the origin of this myth during the Christmas-recess conversation with which I began this account.

Thomson, as President of the Royal Society at that time, concluded the meeting with the statement:"I have to confess that no one has yet succeeded in stating in clear language what the theory of Einstein really is." And Eddington recalled that as the meeting was dispersing, Ludwig Silberstein (the author of one of the early books on relativity) came up to him and said: "Professor Eddington, you must be one of three persons in the world who understands general relativity." On Eddington demurring to this statement, Silberstein responded, "Don't be modest Eddington." And Eddington's reply was, "On the contrary, I am trying to think who the third person is!"

This lack of comprehension of Relativity theory is not uncommon among physicists and astronomers. Over the years, in many intimate conversations and correspondence with them, I've found few scientists willing to admit to an indepth understanding of the theory, yet most of them will argue of their belief in it. I have also discovered that even the scientists that are willing to admit to full comprehension of the theory, have serious gaps in their knowledge of it. For example, Prof. William H. McCrea of England wrote the counter argument to Prof. Herbert Dingle's controversial attack on the inconsistent logic in the theory, which was published in the prestigious journal NATURE. [47] Dingle was an interesting fellow, at one time he was a leading proponent of the relativity theory, and even was a member of several British solar eclipse expeditions. He was a professor at University College in London, and the author of many books and papers on astrophysics, relativity, and the history of science. I was introduced to McCrea by Prof. Thornton Page, at the 1968 Fourth Texas Symposium on Relativistic Astrophysics. McCrea who is considered to be an authority on relativity theory, was surprised to find that Einstein considered relativity to be an ether theory. With regard to the argument that I showed McCrea that represented relativity as an ether theory, Einstein and Infeld state:

...On the other hand, the problem of devising the mechanical model of ether seemed to become less and less interesting and the result, in view of the forced and artificial character of the assumptions, more and more discouraging.

Our only way out seems to be to take for granted the fact that space has the physical property of transmitting electromagnetic waves, and not to bother too much about the meaning of this statement. We may still use the word ether, but only to express some physical property of space. This word ether has changed its meaning many times in the development of science. At the moment it no longer stands for a medium built up of particles. Its story, by no means finished, is continued by the relativity theory. [20 p.153]

There is a very interesting article on this question published in the August 1982 issue of Physics Today by Prof. Yoshimasa A. Ono. The article begins:

It is known that when Albert Einstein was awarded the Nobel Prize for Physics in 1922, he was unable to attend the ceremonies in Stockholm in December of that year because of an earlier commitment to visit Japan at the same time. In Japan, Einstein gave a speech entitled "How I Created the Theory of Relativity" at Kyoto University on 14 December 1922. This was an impromptu speech to students and faculty members, made in response to a request by K. Nishida, professor of philosophy at Kyoto University. Einstein himself made no written notes. The talk was delivered in German and a running translation was given to the audience on the spot by J. Isiwara, who had studied under Arnold Sommerfeld and Einstein from 1912 to 1914 and was a professor of physics at Tohoku University. Isiwara kept careful notes of the lecture, and published his detailed notes (in Japanese) in the monthly Japanese periodical *Kaizo* in 1923; Ishiwara's notes are the only existing notes of Einstein's talk...

Ono ends his introduction to his translation with the statement:

It is clear that this account of Einstein's throws some light on the current controversy as to whether or not he was aware of the Michelson-Morley experiment when he proposed the special theory of relativity in 1905; the account also offers insight into many other aspects of Einstein's work on relativity.

With regard to the ether, Einstein states:

Light propagates through the sea of ether, in which the Earth is moving. In other words, the ether is moving with respect to the Earth...

With regard to the experiment he argues:

Soon I came to the conclusion that our idea about the motion of the Earth with respect to the ether is incorrect, if we admit Michelson's null result as a fact. This was the first path which led me to the special theory of relativity. Since then I have come to believe that the motion of the Earth cannot be detected by any optical experiment, though the Earth is revolving around the Sun. [48]

The above information gives us insight into the nature of Einstein's relativity theory. He believes that the sea of ether exists, but he also believes that it cannot be detected by experiments, in other words, he believes it is invisible. The situation in modern physics is very much like the Hans Christian Andersen tale of "The Emperor's New Clothes", with Einstein playing the part of the Emperor. The tale goes that the Emperor, who was obsessed with fine clothing to the point that he cared about nothing else, let two swindlers sell him a suit of cloth that would be invisible to anyone who was "unfit for his office or unforgivably stupid." It turned out that no one could see the suit - not the emperor, not his courtiers, not the citizens of the town who lined the street to see him show off his new finery. Yet no one dared admit it until a little child cried out, "But he doesn't have anything on!"

In regard to Einstein's reluctance to acknowledge the influence of the Michelson-Morley experiment on his thinking, and Whittaker's argument that his special relativity theory was a clever restatement of the work of Poincaré and Lorentz, I report the following published [56] statements which Einstein made to Prof. R. S. Shankland on this matter:

The several statements which Einstein made to me in Princeton concerning the Michelson-Morley experiment are not entirely consistent, as mentioned above and in my earlier publication. His statements and attitudes towards the Michelson-Morley experiment underwent a progressive change during the course of our several conversations. I wrote down within a few minutes after each meeting exactly what I recalled that he had said. On 4 February 1950 he said,"...that he had become aware of it through the writings of H. A. Lorentz, but only after 1905 had it come to his attention." But at a later meeting on 24 October, 1952 he said, "I am not sure when I first heard of the Michelson experiment. I was not conscious that it had influenced me directly during the seven years that relativity had been my life. I guess I just took it for granted that it was true." However, in the years 1905-1909 (he told me) he thought a great deal about Michelson's result in his discussions with Lorentz and others, and *then he realized* (so he told me) that he "had been conscious of Michelson's result *before 1905* partly through his reading of the papers of Lorentz and more because he had simply assumed this result of Michelson to be true."...

With regard to the politics that led to Einstein's fame Dr. S. Chandrasekhar's article [46] states:

In 1917, after more than two years of war, England enacted conscription for all able-bodied men. Eddington, who was 34, was eligible for draft. But as a devout Quaker, he was a conscientious objector; and it was generally known and expected that he would claim deferment from military service on that ground. Now the climate of opinion in England during the war was very adverse with respect to conscientious objectors: it was, in fact, a social disgrace to be even associated with one. And the stalwarts of Cambridge of those days - Larmor (of the Larmor precession), Newall, and others - felt that Cambridge University would be disgraced by having one of its distinguished members a declared conscientious objector. They therefore tried through the Home Office to have Eddington deferred on the grounds that he was a most distinguished scientist and that it was not in the long-range interests of Britain to have him serve in the army... In any event, at Dyson's intervention - as the Astronomer Royal, he had close connections with the Admiralty - Eddington was deferred with the express stipulation that if the war should have ended by 1919, he should lead one of two expeditions that were being planned for the express purpose of verifying Einstein's prediction with regard to the gravitational deflection of light... The Times of London for November 7, 1919, carried two headlines: "The Glorious Dead, Armistice Observance. All Trains in the Country to Stop," and "Revolution in Science. Newtonian Ideas Overthrown."

Dr. F. Schmeidler of the Munich University Observatory has published a paper [49] titled "The Einstein Shift - An Unsettled Problem," and a plot of shifts for 92 stars for the 1922 eclipse shows shifts going in all directions, many of them going the wrong way by as large a deflection as those shifted in the predicted direction! Further examination of the 1919 and 1922 data originally interpreted as confirming relativity, tended to favor a larger shift, the results depended very strongly on the manner for reducing the measurements and the effect of omitting individual stars.

So now we find that the legend of Albert Einstein as the world's greatest scientist was based on the *Mathematical Magic* of Trimming and Cooking of the eclipse data to present the illusion that Einstein's general relativity theory was correct in order to prevent Cambridge University from being disgraced because one of its distinguished members was close to being declared a "conscientious objector"!