Rethinking the Laws of Gravitation

To best appreciate the significance of Prof. Maurice Allais's report in this issue on his experiments with the paraconical pendulum, it is helpful, and even essential, to look back at some of the now little known work on gravitation carried out by leading figures in 19th century physics. Only in that way, by re-examining the origin and history of the subject, can the widespread prejudices and misperceptions embedded in contemporary thinking be uprooted.

The first thing one must know in approaching this subject, is that Newton's formulation (there exists a force of attraction between all bodies in the universe, whose strength is inversely proportional to the square of the distance between them), was always contested by a leading current within scientific thought. Almost a century before Newton, Johannes Kepler had recognized the inverse square law of attraction; he regarded it only as a minor mathematical consequence of his seminal discoveries concerning the arrangement and motions of the bodies in the solar system.

'Occult Forces'

In Newton's own time, Gottfried Leibniz, as spokesman for the leading faction of continental physicists, criticized Newton (a notorious practitioner of alchemy and the black arts) for reintroducing, with his concept of gravitation, the scholastic conception of "occult forces" into science. The hegemony of Newton's view, over that of Kepler and Leibniz, was established only after a concerted and politically motivated effort by the British Royal Society to discredit Leibniz, by falsely attacking his original discovery of the infinitesimal calculus. (Leibniz was the likely candidate for British Prime Minister before the accession of George I of Hanover.) Even so, further advances in mathematical physics were accomplished by the students and collaborators of Leibniz, such as the famous Bernoulli brothers. British science, meanwhile, labored in the darkness of the Newtonian "method of Fluxions" for more than a century, until the collaboration of John Herschel and Charles Babbage brought enlightenment to Cambridge in the 1830s.

For those who had grown to accept Newton's "occult force," the mathematical formulation of the laws of physics appeared, by the early 19th century, to have gained a certain symmetry and elegance around the conception of "central forces." The attractive, and repulsive, forces between the presumed elementary particles of static electricity and magnetism had been shown to obey the same *inverse square law* as did the gravitational attraction hypothesized by Newton.

Ampère's Revolution

André-Marie Ampère's work between 1820 and 1826 put all that in doubt. Following on Oersted's 1819 discovery that electricity from a battery had the power to change the orientation of a magnetic compass needle, Ampère went to work to determine the law governing the relationship between two almost infinitesimal elements of electrical current. He came to the inescapable conclusion, that the force between two current elements is solely dependent on the inverse square of the distance *only* in the special case that the line connecting their centers make angles of 90 degrees with the direction of each of the elements. In every other case, the angle between the current elements must be taken into account in determining the force, according to a law which Ampère deduced from careful experimentation. It even results that, at a certain critical angle, the attractive force may become repulsive, and *vice versa*, giving rise to what is now referred to as the Ampère *longitudinal force*.

A whole branch of mathematical analysis, known as potential theory, which rested on the assumption of a central force obeying the inverse square law, was now in need of revision. Recognizing the deep implications for mathematical physics, Carl Friedrich Gauss, with the assistance of Wilhelm Weber, undertook an experimental program, beginning 1829-1830, to verify the Ampère deductions. The results were positive. In an 1846 paper, Weber subsumed the phenomenon of induction (not known to

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Ampère) in his conception of electrodynamic action, and reformulated the fundamental electrical law in a form in which the force between electrical particles was shown to be dependent on their distance, their relative velocities and acceleration, and a constant, *c*.[1]

Since matter was thought to consist of electrical particles, the Weber law implied that the relative motions of large bodies, such as planets, with respect to the Sun, might generate a force of attraction or repulsion beyond the already known gravitational effect. Among the anomalies in planetary motions not fully explicable by the postulate of gravitation, the advance of the perihelion of Mercury was high on the list. In 1864, the astronomer C. Seegers of Göttingen published a paper deriving the anomalous variation of Mercury's orbit from Weber's electrical law.[2] This work was continued by Schiebner in Leipzig and Tisserand in France.[3]

The 'Mossotti Force'

Weber himself took a different tack. In a posthumously published work, probably dating from the 1880s, he examines the relationship of his electrical law to gravitation. His point of departure was the hypothesis of O.F. Mossotti (about 1830), that the gravitational attraction results from a very slight excess in the force of attraction between unlike electrical particles, over the force of repulsion between like electrical particles. Assuming bodies to consist of equal numbers of positively and negatively charged electrical particles, this would result, according to Coulomb's Law, in a net attractive force, proportional to the mass of the bodies and the inverse square of their distance.

Weber attempted to measure the "Mossotti force" experimentally, using strongly charged spheres, but was unable to come to a definite conclusion. Nonetheless, his speculations on the subject led him to conjecture an electrical *aufbau* principle for the periodic table, much in advance of his time.[4]

At the beginning of this century, the Swiss physicist Walther Ritz, a pioneer in the study of atomic spectra, proposed that the orbital motion of electrons would generate an attractive force, according to the Weber law, which would not be cancelled out by the random average orientation of atomic axes. However, Ritz suffered a tragic early death, and was unable to follow through on these ideas.

In the *Philosophical Fragments* of Bernhard Riemann, the brilliant student of Gauss and Weber, we find a different and entirely unique approach to the problem. Riemann makes a fundamental, ontological critique of Newtonian gravitation, echoing Leibniz. The reductionist concepts of self-evident extension (space), and elementarity (mass), must be superseded by a hylozoic concept: A "particle" is the place in space where matter flows into, and out of, existence, by a process somewhat analogous to the pulling up of a thought from memory.[5] These ideas were not pursued. Riemann died early in 1866, after which a flood tide of reductionism, empiricism, and positivism overwhelmed, and nearly drowned, his intellectual legacy.

Although we touch on some of the leading thinkers of the last century, we can only scratch the surface. Our point is not to offer a complete review of the theories of gravitation, but to demonstrate the impoverished level to which our theory has fallen today. Already in 1826, Ampère's work had both demonstrated a fundamental flaw in the theory of gravitation, and opened the way to a solution unifying our conceptions of gravity, electricity, and the atom. Today, nearly two centuries later, we are further than ever from such a unifying conception. We not only do not know; we virtually forbid that the question be asked.

We thus welcome in this issue the contribution by Prof. Maurice Allais, who dared to challenge the deadly complacency on the subject of gravitation with a careful experimental research program carried out from 1953 to 1958. Although the results were published in a U.S. journal in 1959, at the request of rocket scientist Wernher von Braun, they have become virtually unknown today. They are too important to remain thus ignored. The reader will gain a deeper appreciation of Prof. Allais's work in physics by reference to his contribution in the Spring 1998 issue of *21st Century*, particularly Allais's summary statement, "On My Experiments in Physics, 1952-1960," which appears on pages 32-34.

—*Laurence Hecht*

Notes

1. When in 1855, Weber and Kohlrausch, with the assistance of Bernhard Riemann, determined the value of that constant (thenceforth known as the *Weber constant*) to be correlative with the velocity of light *in vacuo*, the essence of what contemporary textbook wisdom today presents as the work of Lorentz and Einstein was already known.
2. *De motu perturbationibusque planetarum secundum legem electrodynamicam Weberianam solem ambientium* (On the motions and perturbations of the planets in the solar system according to Weber's electrodynamic law).
3. *Sur le Mouvement des Planètes autour du Soleil d'apres la loi electrodynamique de Weber.*
4. Already in 1870, Weber had shown that his electrical law led to the conclusion that the "Coulomb repulsion" of like particles is overcome at a certain critical length, which, for negatively charged particles, he showed to be equal to the expression now known as the *classical electron radius*. This is most interesting in view of the common assertion by today's experts that the electron was only *discovered* several decades later by J.J. Thompson at Cambridge. (See Laurence Hecht, "The Atomic Science Textbooks Don't Teach: The Significance of the 1845 Gauss-Weber Correspondence," *21st Century*, Fall 1996, p. 21.)
5. An English translation of Riemann's "Philosophical Fragments" appears in *21st Century*, Winter 1995-1996, p. 50.

On average, his temperature is fine.

Letters

Review Miller's Work to Combat Relativity Virus

To the Editor:

I just finished your Spring 1998 cover story ["The Experiments of Dayton C. Miller (1925-1926) and the Theory of Relativity," p. 26] by Maurice Allais.

I am one of those who has been of the opinion that the evidence supporting the wave theory of light should not be so lightly dismissed, although the phenomena that helped create quantum theory can not be lightly dismissed either.

Until I read your articles I was not aware of the Miller experiments. Now I am of the opinion that you are correct in urging a complete review of Miller's work, to combat those who are infected with the Relativity Virus! Further, the experiments should be run under different conditions, as the nature of an "ether"-type medium would certainly lock the medium into the surrounding environment. Embedding the experiment in concrete would yield null results, just as an air-motion detector imbedded in the ground would not detect the presence of a hurricane outside the room!

Unfortunately, it will take more than Miller's experiment to convince some, just as simple observations were insufficient at the turn of the century when Plate Tectonics was first proposed by serious geologists. It just seems to show that some people, educated though they may be, are still afraid of standing up and being counted, for fear of losing their position. It is no wonder that progress has been so slow in some fields.

What is needed is an experiment that directly detects the ether in such a way as to be nearly irrefutable. The following experiment I dreamed up some years ago might qualify:

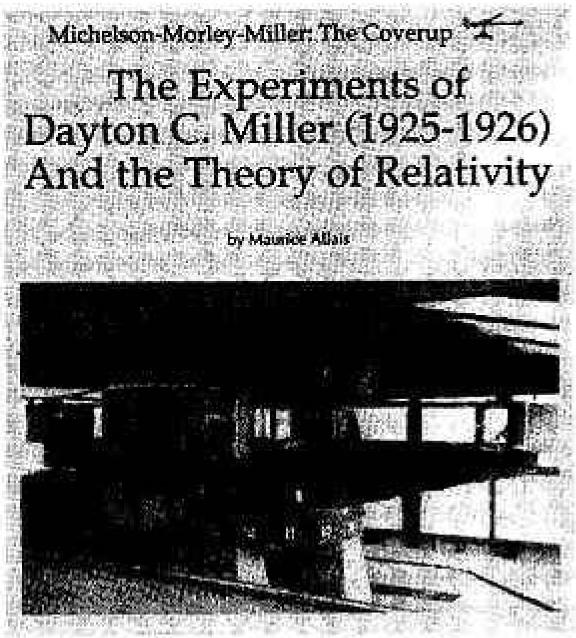
Using a *fiberoptic* "cable" looped around, and very near, a flywheel, check the attenuation of the transmitted light with the flywheel running versus the flywheel stopped.

The beauty of this is that air currents from the flywheel would not affect results, as they might in other such experiments. Also, great sensitivity can be achieved by using several miles of fiber in circular loops. What might happen is that the light path in the fibers will be altered to hit the side wall with a greater incident angle, thereby increasing the attenuation, and resulting in a measurable loss of light intensity.

At one time, I had hopes of performing the experiment myself, but have not been able to do so. Besides, no one pays attention to engineers, right?

If, in fact, a spinning flywheel is throwing off the ether—it is in effect pumping! If it is pumping, then it can be deflected. If it can be deflected, then it might be channeled and create a "drive" through what is currently called a vacuum!

B.E. Johnson
Issaqauh, Washington



Michelson-Morley-Miller:

In Defense of Special Relativity

To the Editor:

I subscribed to *21st Century* magazine because of its good articles on the history of science, a subject matter of my special interest, since I am a physicist, now retired (age, 71). Unfortunately, with the Spring 1998 issue, I felt a deception. Why? When I was in active research at the Physics Department of the Instituto Tecnológico de Aeronáutica (São José dos Campos, SP, Brazil), I had published several papers on relativistic cosmology in international scientific journals. (I am a member of the American Association for the Advancement of Science, the American Physical Society, and the New York Academy of Sciences.) Thus, as a theoretical physicist, I disagree strongly with the French economist Maurice Allais, who thinks he can discredit Einstein's theory of special relativity. Allais's viewpoint of the genesis of the special theory of relativity is completely wrong.

First of all, the Michelson-Morley experiment is not the experimental basis of Einstein's ideas. In his celebrated paper of 1905 ("On the Electrodynamics of Moving Bodies," in *Principles of Relativity*, Dover, 1923), Einstein formulates two fundamental hypotheses, which afterwards became cornerstones of relativistic dynamics: the principle of relativity, and the light principle. These two axioms were formulated by Einstein after a theoretical analysis of the unsatisfactory status inherent to classical electrodynamics, in relation to space reference frames. Einstein was then informed of several experiments (not only Michelson's) dealing with attempts to measure the motion of the Earth relatively to the ether. However, he made no description or analyses of those experiments. In Einstein's words:

"Examples of this sort, together with the unsuccessful

The Coverup

attempts to discover any motion of the Earth relatively to the 'light medium,' suggest that the phenomena of electrodynamics, as well as of mechanics, possess no properties corresponding to the idea of absolute rest."

Note that *Einstein doesn't mention the experiment of Michelson-Morley*. From his conjectures on that *unsatisfactory theoretical situation* of electrodynamics, he *postulated* the two fundamental principles of special relativity. From the two principles, he *deduced* the laws of transformation between inertial reference frames. Now, these laws, deduced from his two fundamental postulates, are exactly the Lorentz transformation equations obtained by the latter through a completely different way from Maxwell's field equations. Einstein had then no knowledge of Lorentz's feat, which was done some months before. M. Allais's statement that "following Lorentz, Einstein developed his Theory of Relativity," is highly erroneous.

Maurice Allais invokes the famous Dayton Miller experiment of 1933, a version of Michelson's test, in order to dethrone the theory of special relativity, as if it rested on that laboratory verification. First, let me recall an epistemological principle: A single laboratory experiment is not a serious argument against a theory whose different predicted effects are corroborated with high accuracy through a constellation of laboratory experiments. This reminds me of the Portuguese saying, *"uma só andorinha não faz verão"* ("a single martin-bird doesn't produce summer").

Miller's experiment is that single martin-bird, for a galaxy of scientific experiments fulfills with high precision several predictions of relativistic dynamics. Modern physics of high energy processes, quantum field theories, and particle theories are unthinkable without relativistic dynamics. There is an overflow of experiments washing away Miller's solitary experiment.

Let me remind you that 12 experiments from the 19th century to the Kennedy-Thorndyke experiment of 1932 (*Phys. Rev.*, Vol. 42, p. 400), were consistently interpreted by Einstein's predictions. Several of those experiments were tentatively interpreted at the beginning by ad hoc hypotheses. But it happened that whenever one of those hypotheses seemed to render an experiment understandable, nonetheless it entered into contradiction with another of those hypotheses. The considered hypotheses such as the partial ether drag, total ether drag, Lorentz-Fitzgerald contraction, and so on, were completely discredited (Panofsky-Phillips, *Classical Electricity and Magnetism*, Addison-Wesley, 1962).

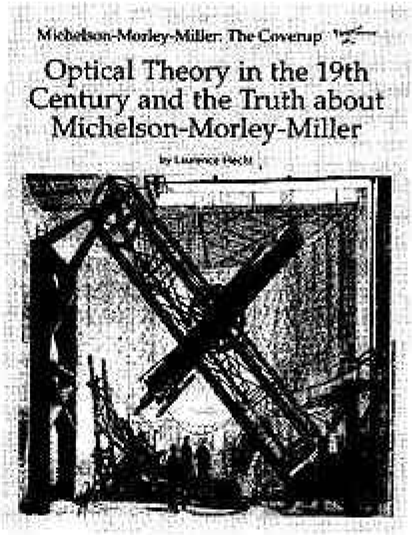
Only Einstein's theory was able to put order in that chaos of experiments, badly tackled with isolated ad hoc hypotheses. A theory was needed, not isolated hypotheses, and Einstein's was that theory.

We must be suspicious of people without scientific education, who adventure to criticize highly specialized scientific subject matters. Unfortunately, *21st Century* accepted an economist Nobel Prize winner, not a physicist, to discredit a physical theory of the highest importance in modern physics. If Maurice Allais's arguments possessed really sound scientific status, it could have been published in a physics *journal*. But he published his ideas against Einstein in a *magazine*, *Aero/Space Engineering*, not devoted to science, but to technological matters.

Laurence Hecht's scope to deny the scientific seriousness of the Shankland, McCuskey, Leone, Kuerti paper (*Rev. Mod. Phys.*, Vol. 27, p. 167, 1955) is also unfortunate. When those four experimental physicists did their work, nobody in the physical community had doubts as to the solidity of Einstein's scientific achievement. The four American physicists, in effect, proved that Miller's experiment was a lonely martin-bird that could not produce summer, and it was flawed.

May I add the following: New technological devices in the last years have given, through the highest accuracies, more empirical corroboration to the theory of special relativity. Examples:

A group of experimental physicists at CERN during 1964 and 1965, using



high-energy neutral pions, verified with an accuracy of 1.3×10^{-2} percent the second postulate of special relativity (*Science*, Vol. 251, p. 359, 1991). In other words, a precision of 130 parts per million. In 1985, improving the Ives-Stillwell test, which corroborates relativistic aging, a group of physicists from Denmark and Colorado State University obtained a precision of 4×10^{-3} percent, that is, 40 parts per million. Also in 1985, an updated Kennedy-Thorndyke experiment by Hall and Hils yielded a precision of 7×10^{-3} percent. This result is accurate by 300-fold over the previous experiment by Kennedy-Thorndyke (*Science*, Vol. 242, p. 1207, 1990).

The increasing sophistication and accuracy of measurement in physical laboratories have reduced the Miller experiment to the category of a prehistoric event. Hence, no "coverup."

It seems to me that an epistemological error looms over Allais's lucubrations—this: scientific theories are extracted from experiments. The opposite is true. A scientist, especially a theoretical physicist, imagines conjectures at the start, passing to formulate hypothetical propositions from which a theory is deduced. A good theory is predictive of unknown physical processes and, as such, allows the possibility of