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Book Review

Newton versus Einstein: How Matter Interacts with Matter. By Peter Graneau and Neal Graneau. Carlton Press, New York, New York, 1993, 219 pp., $ 14.95 (hardcover), ISBN 0-8062-4514-X. Distributed by: UP Corp., 205 Holden Wood Road, Concord, MA 01742.

This book marks the beginning of a necessary task, the education of the general (and generally nonmathematical) public in vital aspects of physics that continue to be ignored by the community of professional physicists. To that end, although it treats highly technical subject matter, the book contains not a single equation. Such is these authors' mastery of the ideas they wish to convey that nobody will miss the mathematics and many may profit from its absence. For once, the horse is put before the cart: Ideas are allowed to come first. Those who cannot do physics without equations are advised to sample the authors' other works, which include, in addition to numerous journal articles, *Newtonian Electrodynamics* and Peter Graneau's earlier classic, *Ampère–Neumann Electrodynamics of Metals*, of which a second edition has recently been issued.

The principal topic treated in this book is that which historically has practically defined physics—namely, the continual see-saw battle between (instantaneous) action-at-a-distance and (causally delayed) "contact" or field-continuum modes of physical description. Today's physicists are hardly aware of this battle, so little have they been burdened with the history of their discipline. The first part of this book is devoted to correcting such ignorance. Aristotle began the battle by discounting the distantly-acting Gods and declaring that *matter cannot act where it is not.* This opinion prevailed for two thousand years, if we overlook the distant actions ascribed to planets by astrologers. It received brief reinforcement from Descartes' ether vortices. Then came Newton with his instant-acting gravity, his nonfeigning of (causal) hypotheses, and his all-important third law, which states that *all forces* are paired to act in a balanced way, with observable consequences such as momentum conservation. For two hundred years action-at-a-distance (despite Newton's own strongly expressed misgivings about it and merely because it worked so well) held virtually uncontested supremacy.

Then came Maxwell, who led the pendulum swing back to contact mechanisms with his field theory, and the Einsteinians, who seized upon Maxwell's mathematics (while discarding his ether contact mechanism) to generalize causal "propagation" (of what?) to all distant interactions of matter, including everything that Newton had described by instant-acting "forces." In this shuffle, Newton's third law quietly disappeared, despite its flawless and uncontested record of agreement with empiricism. History may never offer people who call themselves physicists another such opportunity to discard on no evidence a universal symmetry law that works so well (because there is none comparable—the third law being intransigently situated at the very heart of physical science). Maxwell had given impetus to the new fad by arguing eloquently for *pluralism* in the foundations of physics; but, once the field-theoretical Putsch succeeded, pluralism, having served its purpose, immediately became counterproductive... and it remains in our consensus-ruled era about as repugnant to professional physicists as it once was to dedicated Bolsheviks (those cruder, but not less ruthless, spokespersons of truth).

What is very little known today concerning electrodynamics, yet is most clearly brought out in this book, is the surprising extent to which French and German theoretical physicists succeeded, toward the end of the reign of Newtonian physics, in developing a sound mathematical basis for instant-action description of the phenomenology of electrodynamics. Ampère discovered, through that exemplary interplay of theory and experiment which well warrants his designation (by Maxwell) as "the Newton of electricity," an instant-action law for the ponderomotive force between two "current elements" that, although banished from modern textbooks, has never been faulted empirically and that rigorously obeys Newton's third law. Weber found a truly "relativistic" law of action between point charges compatible with both Ampére's law and Newton's third law.

Kirchoff, long before Maxwell's fields, applied Weber's *instant-action* law to show that signal propagation on a transmission line is causally delayed at speed "*c*"—a constant that entered Weber's law as the ratio of electrostatic and electromagnetic units. And so on: A whole electrodynamic science developed under the aegis of Newtonian presuppositions, which the modern world of physics seems eager to forget.

But, alas, these pesky authors will not let their readers forget. They recognize the cul-de-sac that the monomania of field theory has got modern physics into, and point (as did Maxwell) to pluralism of preconceptions—specifically to action-at-a-distance reformulations of physics, with reinstatement of Newton's third law—as the likeliest road to future progress. There are scores of ways by which any child (but no professional physicist) can perceive the folly of sizing all customers to fit the field-theoretical bed. For instance, to determine the magnetic field of a current loop one must integrate around the whole loop, so that all portions of the current contribute; but to find the force on a small portion of the loop one must multiply the current in that portion by the calculated "magnetic field"... so one is counting effects of the current in the portion *twice*—a typical example of bootstrap-lifting that has come to be an integral part of what these authors term "relativistic mechanics." It is certainly not an aspect of the modern trend that the trendy emphasize in their advertising.

In the Newtonian world view—supposedly valid as a zero-speed limiting case—one rejects bootstrap-lifting as a sub-freshman mistake and uses a force law such as that of Ampère, known to be compatible with Newton's third law, to calculate the action of the *rest* of the circuit on the *portion* of interest. As these authors show, that gives right answers for total force in agreement with those of the "relativistic" field theory calculations that employ the Lorentz force law... but with an important difference; namely, that the predicted distributions of *internal mechanical stresses* among various portions of the circuit are completely different for the Ampère and Lorentz laws. The Graneaus, both of them curious enough about nature to be indefatigable experimentalists, have dedicated their lives to finding out which electrodynamic predictions are right. Their answers, and those of almost all other investigators who have taken similar trouble, are not popular with the trend-setters of physics: The laboratory evidence indicates that Ampère was right about the existence of longitudinal forces, and Lorentz was fatally wrong in denying this. This has brewed a "controversy" in the literature in which the navel-contemplators have jumped all over the nature-contemplators. The Graneaus' tour of history indicates that this type of controversy was old when Galileo was a pup. There is still crushing editorial favoritism toward the academic know-it-alls who spurn empiricism's telescope.

The authors point out that a number of aspects of physical description become easier to understand if there exists a "Machian" fundamental reference system—perhaps that in which the cosmic background radiation is isotropic. For instance, Newtonian "inertial forces" (centrifugal, etc.), which appear to disobey Newton's third law, suddenly obey it, and the moment recoil forces are recognized as being taken up in a shared manner by the bulk of matter in the rest of the universe (beyond our Milky Way galaxy). Similarly, the relativity clock paradox would become intelligible if each of two clocks in relative inertial motion ran not "slower than the other" but at some rate causally determined by its history of acceleration with respect to a Machian fundamental system in which the center of mass of the universe is at rest. And so on... the world becomes a more user-friendly place. But the *price* is seemingly too high for physicists to pay voluntarily; They would have to give up their commitment to universal causal retardation (the beloved field contact action—matter not acting where it is not) and accept that there are in nature actions that are truly instantaneous at a distance. (Those who, unlike Newton, must have hypotheses might wish to contemplate a model for instant actions based on flights of virtual particles—which, being governed by time-reversible wave equations, can be directed backward in time as readily as forward, in such manner as to synchronize action–reactions at the ends of the universe.)

In the last chapter the authors show that in the quantum area physicists have already tacitly paid the "price" mentioned above... yet are so far from getting their act together that they have thus far declined to recognize any connection between quantum nonlocality and Newtonian instant action-at-a-distance. If professions are defined by their conspiracies of silence, this is surely the one that most rigorously defines the "profession" of modern physics. The silence is doubly curious because quantum mechanics is manifestly of that breed of mechanics known as "Hamiltonian." That is, it stems formally from an *energy* formulation of mechanics and is in fact a sort of q-number image of the c-number classical canonical theory. The latter in turn is simply a mathematical reworking of Newton's c-number action-at-a-distance physics... so, were it not for the silence, it could surprise nobody that nonlocality is a hallmark of the q-number legacy theory.

In addition to its Machian, third law, and Ampère-law messages—which offer significant options for the progress and intellectual revitalization of the profession of physics—and its leavening of little-known empirical fact, this book provides an entertaining source of historical anecdote and seminal quotations from the literature. For instance, who said, "... Newton's... clear and wide ideas will forever retain their significance as the foundation on which our modern conceptions of physics have to be built."? Answer: Einstein. And did you know that in the time of Galileo "Italy had thirteen universities while Britain had only three." About this the authors sagely remark, "This opened the field of opportunity for an Italian, but it also meant there were so many more Aristotelian scholars in Italy with whom Galileo had to join battle." I could go on, but prefer to let potential readers make their own discoveries. Highly recommended.

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