The Ephemeris

Focus and books

An Essay in Science Criticism

Although art criticism is a recognized profession, the same is not true of science criticism. This is odd, in view of the convergent tendency of both fields to be ruled by aesthetic criteria. It might be thought that those who define an area of human endeavor in terms of their personal responses to inner voices should expect and even welcome the sound of other voices criticizing. But the science of physics, which took its most wrenching turn beautywards as recently as 1905—soon after the blossoming of Oscar Wilde (*post hoc ergo propter hoc?*)—is too immature to have evolved career patterns, tenure, and retirement plans for such other voices. The latter are as yet recognized only as bespeaking heresy, treason, or lese majesty. So it is with something of the reckless spirit of the pioneer that I venture the following commentary on the current scene: *By using brick and mortar to build a latrine one can make of it a very solid and enduring structure; and by decorating its interior with French wallpaper one can make of it a thing of beauty, admired of generations. But it is still a latrine, as can be verified by invoking the sense of smell.* This observation begs application throughout the more pretentious parts of all modern theoretical science. But here we confine its illustration to Maxwell-Einstein electrodynamics, the rock on which much of the more loftily towering superstructure of contemporary "beauty" is founded. Without any expectation that our love of either truth or beauty will be requited, let us see what stimulus can be lent to the restoration of critical faculties.

The task begins with a disenchanted look at Maxwell's theory. Alas, it had a wee flaw: It was not Galilean invariant. That is, when subjected to a (first-order-approximate) Galilean inertial transformation, it gave *first-order wrong answers*. For example, it predicted fringe shifts not observed—in contradiction of a first-order relativity principle empirically validated in the last century by Mascart and others. The contradiction was evidenced by explicit appearance of the "**v**" parameter of the Galilean inertial transformation in the transformed Maxwell equations. Any relativity principle demands the disappearance of that parameter.

Now in hindsight we can recognize that first-order wrong answers have to be dealt with at first order. First-order physics, *because of its separate observability*, constitutes a separate "physics" that must be got right on its own terms before the first word can be said about higher orders of description. But the young Albert Einstein did not know this. He chose to finesse the first order by going to second order and substituting for the Galilean transformation the Lorentz transformation, interpreted as the correct higher-order form of (physical) "inertial" transformation. Although the anti-relativistic "**v**" parameter did not altogether disappear (it still linked covariantly-scrambled field components), the notation of a covariant formalism allowed it to be hidden from view. The success of this parameter-hiding coup encouraged Einstein to universalize Maxwell's equations, exactly as they stood, *wee flaw and all*—so that now, *as an expression of the relativity principle*, those equations were mandated to hold rigorously in every (so-called) "inertial" system. [A physical aspect of this mandated "inertiality" involved the never-observed rotation (Thomas precession) of reference frames.] While he was at it—and had Minkowski to help him—young Albert turned his handy pocket universalizer upon a particular *non-invariant feature* of Maxwell's noninvariant equations, their spacetime symmetry. That action brought to light universal covariance, the "metric nature of spacetime," the Lorentz contraction, and other theoretical goodies even now invisible to the crass eye of empiricism. Beautiful—a triumph of the plastic surgeon's cosmetic art! *But underneath was festering the sutured-over first order.*

There is another way to look at the first-order failure of Maxwell's equations, and that is to see those equations as wrong at first order. This way lacks the mountain-high intellectual virtuosity of Einstein-Minkowski's approach and thus appeals very little to academia's *raffiniert* aesthetics. But it is the straightforward way, and it is the way that had earlier been adopted by Heinrich Hertz—although he never put it in those terms. If alleged equations of "physics" are wrong at first order, as evidenced by wrong answers, they have to be *changed at first order*, and this is what Hertz (in the last chapter of his book *Electric Waves*) in historical fact accomplished. Without any fanfare, he substituted for Maxwell's partial time derivatives $\partial/\partial t$ total time derivatives $d/dt = \partial/\partial t + \mathbf{v}_d \cdot \nabla$, and adjusted the source terms so that Maxwell's equations of vacuum electromagnetism became formally Galilean invariant. That got the *formalism of electromagnetic physics* for the first time right at first order. Inertial transformations were described with first-order accuracy by the Galilean transformation (GT), and a first-order relativity principle was expressed through formal invariance—which involved *rigorous disappearance* from the transformed Hertz equations of the GT velocity parameter **v**. The false fringe shifts disappeared along with that parameter. The first-order wrong answers were thus eliminated by getting the mathematics right at first order—as they should always be in real physics valid at any order.

But now electromagnetism was stuck with an extra velocity-dimensioned parameter (different from the **v** of the GT), *viz.*, the above $\mathbf{v}_d$, needed to secure formal first-order invariance. What could this mean physically? Here Hertz went tragically wrong (and then had the bad judgment to die). He thought that $\mathbf{v}_d$ might describe an ether wind, whereas now we understand that the invariance (**v** disappearance) it secured automatically implies motional relativity and obviates ether wind as a descriptor. If, in seeking an improvement on Hertz's physical interpretation, we recognize that Maxwell's theory from the start has always been missing an essential velocity-dimensioned parameter, needed to parametrize field sink (absorber or detector) motions *in congruity with source motions*, then stubbing his toe upon this extra velocity parameter is, for the physicist, like stumbling over a large lump of gold in the road. For we can kill two birds with one stone by interpreting $\mathbf{v}_d$ as field detector velocity with respect to the observer: (1) We secure true invariance, not covariance, under inertial transformations. (2) We secure source-sink parametrization symmetry (something much more important than space-time symmetry, because there is more physics in it). That makes Hertz's theory an *invariant covering theory* of Maxwell's. For Maxwellian fields become special cases of the invariant Hertz fields, $\mathbf{E}' = \mathbf{E}$, $\mathbf{B}' = \mathbf{B}$, corresponding to the special case of the field detector's being at rest in the observer's inertial system ($\mathbf{v}_d = 0$, $\mathrm{d}/\mathrm{d}t \to \partial/\partial t$, *etc.*). Thus all empirical evidence obtained with detectors stationary in one laboratory, supporting Maxwell, automatically supports Hertz.

Since Hertz discarded spacetime symmetry (his *total time derivatives* being mathematically not symmetrical with respect to *partial space derivatives*) as a condition for getting the physics right at first order, such symmetry cannot be a feature of physics at higher orders of descriptive accuracy. For no symmetry can exist at a higher order of approximation that does not exist at all lower orders. On the Hertzian pathway of description we are thus obliged to forget spacetime symmetry, the metric nature of spacetime, and similar goodies. But there may be one politically-correct goody that should not be too hastily discarded. Now that space and time are dissevered (de-Minkowskiized), we ought to reexamine each on its own merits. Maybe Einstein was largely right about time, while being wrong about space. The CERN muon lifetime evidence gives empirical support for *time dilatation* as an *on-worldline* phenomenon, for *proper time* as a particle-associated attribute, and for physical *inexactness* of the proper-time differential. All observations of high-energy particle motions ("mass increase," etc.) reinforce that evidence. On the other hand, there is no evidence whatever that compels us to discard Euclidean 3-space for describing the *structural* aspects of experience. (On the contrary, the Ehrenfest paradox typifies the structural miseries that unavoidably attend such discarding.) So, following the most obvious course of least resistance, one is led to the trial postulate that the invariants of kinematics are *Euclidean length* and *particle proper time*. The critic must then inquire of the theorist: Have you given a trial to that simplest alternative, before flying farther from the sphere of our sorrow?

Returning to electromagnetism, we note that Hertz's first-order-correct theory used as time parameter the noninvariant Newtonian or "frame" time t of classical physics—whereas at higher orders consistency with the foregoing demands that we substitute for t our postulated kinematic invariant, namely, the proper time τ of an object. What object? Well, we have already settled that. There is in any field theory only one central object of operational significance and this is the *detector* of the "field" (absorber of the field quantum). The field, aside from all the shouting about it, doesn't "exist" without its detector. The detector "creates" the field in the same way a quantum process is created by its own completion—a completion that never *happens* without a localizing *absorber* to make it happen. [Not, dear gods, not even in California, the *mind of the observer*.] So, let us have no misunderstanding about what is the Mont Blanc of electromagnetism: It is the *field detector*—the very thing, the Little Match Girl, the welfare waif, the starveling orphan of the storm, whose state of motion the Maxwellians and relativists unanimously neglected to parametrize!

Having substituted $\mathrm{d}/\mathrm{d}t$ for $\partial/\partial t$ in Maxwell's equations to get Hertz's first-order invariant electromagnetism, and having recognized the associated velocity as that of the paramount object of field theory, the detector, we obviously must further substitute $\mathrm{d}/\mathrm{d}\tau_d$ for $\mathrm{d}/\mathrm{d}t$, where τ_d is proper time of the field detector, in order to obtain a higher-order invariant candidate version of electromagnetism that might as well be called "neo-Hertzian." In that way our equations of electromagnetism will be formulated explicitly, rigorously, and exclusively in terms of postulated higher-order kinematic *invariants*. Is not that the way all laws of physics should be expressed by theorists and aesthetes even mildly sensitive to beauty lying deeper than cosmetics?

The same applies and can readily be contrived for the equations of particle mechanics. For instance, the higher-order invariant form of the one-body *second law* is $\mathbf{F}_{inv} = \left(\mathrm{d}^2/\mathrm{d}\tau^2\right) m_0 \mathbf{r}$, where $\mathbf{F}_{inv} = \gamma \mathbf{F}_{obs}$, $\mathbf{F}_{obs}$ is the force observed in the laboratory, τ is the invariant proper time of the particle under description, and γ is the usual time-keeping rate-conversion factor between inertial frame time t and particle proper time τ. All quantities appearing in this form of the second law are kinematic invariants. The same being true of the neo-Hertzian electromagnetic equations in vacuum—that they contain only kinematic invariants—it is clear that we stand on the threshold of a consummation devoutly to be desired: That all equations of physics become expressible in terms of quantities that are genuinely invariant, not covariant. And that first-order physics is no longer stitched-over or hushed-up but is also formulated explicitly in terms of (first-order) invariant quantities. Separate invariances are thus to be invoked at each order of physical approximation—each order being, in observational or instrumental terms, its own physics.

Now, in the higher-order approximations, what coordinate transformation represents physical inertial transformations? This is one of the crucial points as yet unresolved and remaining for future study. (Here endeth the didactic portion of my essay.) I still think there is merit in the transformations discussed in my 1987 book (*Heretical Verities*), but admit that I am queasy about the velocity composition law proposed there and possibly some other aspects. A better solution of the neo-Hertzian wave equation (more general) than that given in the book was included in a paper of mine that appeared about a year ago in *Galilean Electrodynamics* (Vol. 5, p. 46) entitled "Neo-Hertzian Wave Equation and Aberration." Since there were innumerable misprints in the published version, I suggest that anyone interested ask me for a corrected copy. The wave equation is set up there and solved in terms of the "proper" quantities, proper time τ_d and proper velocity $\mathbf{v}_d$ of the field detector. The solution in terms of these quantities is readily translated into the equivalent solution in terms of the "frame" or laboratory time t and velocity $\mathbf{v}_d$, which may be of greater practical utility.

Concerning the wave equation I need say only that $\nabla^2 \mathbf{E} = \partial^2 \mathbf{E}/c^2 \partial t^2$ is the wrong starting point for *higher-order* electromagnetic studies. It is wrong because it supports spacetime symmetry, which for the most general descriptive purposes is invalid even at first order. The right first-order starting point uses Hertz's $d^2\mathbf{E}/c^2 dt^2$. Still better is to get everything right at all orders from the start by recognizing that the $\mathbf{v}_d$ parameter introduced automatically by d/d*t* ought rightly to refer to field-detector (sink) velocity relative to the observer (or his field point), and that the higher-order invariant kinematic parameter associated therewith is the proper time t_d of the detector. So, really, the only logical starting point for higher-order description is $\nabla^2\mathbf{E} = d^2\mathbf{E}/c^2 dt_d^{\,2}$, where $d/dt_d = \partial/\partial t_d + \mathbf{V}_d \cdot \nabla = \gamma_d(\partial/\partial t + \mathbf{v}_d \cdot \nabla) = \gamma_d\, d/dt$. This is what is yielded by the neo-Hertzian equations here proposed. Best, then, to admit a two-fold formal error in Maxwell's formulation: use of a partial time derivative where a "convective" one is called for, and use of noninvariant frame time where invariant proper time of the convecting object is called for. One proof of the neo-Hertzian pudding is the description of stellar aberration mentioned in the preceding paragraph. The merely Hertzian (first-order) pudding fails this test.

There is one other qualitative feature that needs to be brought up, and this is *velocity nonreciprocity*, which seems to be unavoidably entailed in the approach herein suggested. We noted that inexactness of the proper time differential was implied by the CERN observations, so it is an essential part of the big picture—a part never clearly elucidated by Einstein. If one in thought straightens out the CERN muon track ($\gamma = 29$) in the laboratory, one sees that the space traveler goes 29 times as far as he could possibly explicate by thinking of his own velocity as subluminal. Einstein says there is no trouble about this because the traveler "sees" the landscape Lorentz-contracted by a factor of 29, so everything *in his view* is subluminal, as per Einstein's second postulate. But what about *our* view? It's our laboratory, isn't it? That fellow sure went a long way in very little of his own *invariant* time. If my alternative proposal is right, that Euclidean length is the correct spacelike invariant of kinematics, there is no escape for the traveler with the slow-running pocket watch from "measuring" a superluminal velocity of the landscape relative to himself—although the traveler is measured by us *noninvariantly* to have subluminal velocity in the laboratory. [I have claimed that in many cases we and our earth play the role of space travelers (similar to the muons), who *measure* with comoving clocks (recording *invariant* Earth proper time) superluminal velocities of astronomical phenomena. Such measurements have been repeatedly reported, of course, and as often explained-away by the thought police.]

Now, if length transforms invariantly and if the reality of time dilatation is "clinched" by physical inexactness of the proper-time differential, then *frame-time velocity*—the quotient of invariant distance and noninvariant (dilatable) time—must be noninvariant. That is, it must depend on viewpoint. (Thus, it is not distant simultaneity that is "relative" but ordinary measured *velocity*—the one thing Einsteinians exonerate from relativism.) Therefore velocity reciprocity among inertial systems fails: A relative velocity between two observers that one of them measures as subluminal may be measured as superluminal by his "traveling" partner. Otherwise, when the traveler returns, how are they or we to account for the observed "real" aging difference, betokening an objective rate difference of their clocks? Without the Lorentz contraction to dodge behind, I can see no answer to this question ... and in fact when I analyzed the kinematics in my book I did indeed find velocity nonreciprocity, with the possibility of superluminal relative velocity being measured by one partner (but not the other) of a nominally inertial pair.

Naturally, there has to be some physical asymmetry, perhaps connected with history of acceleration, between these "inertial systems." *How did they get up to speed?* But the basic asymmetry lies in the difference between a frame and an object. That's the setup we meet in the real world. It is we who impose a spurious "symmetry" by imagining a gratuitous other inertial frame comoving with the object. We never attempt to imagine how we got these systems into a state of relative motion. We pay for both our imaginings and nonimaginings by creating first a theory such as Einstein's with *too much symmetry* in it, and then having to retreat from that back to the basic physical (*e.g.*, aging) asymmetry we are compelled to recognize in the long run and should never have overlooked in the first place. I suggest that the physical asymmetry, to mirror inexactness of the proper-time differential, may be expressible mathematically in a dual form of symmetry, $\gamma \leftrightarrow \gamma^{-1}$, $v \leftrightarrow -v$, such as was illustrated in a paper of mine on "Absolute Simultaneity ... ," forthcoming in *Galilean ED*. [Simultaneity needs to be rehabilitated because once invariance of length is admitted it becomes natural to define the "meter" in every inertial system as the distance between *simultaneous events, e.g.*, at the two ends of the Paris meter stick. It can be shown that in effect one is accepting the legitimacy (for clock setting) of extrapolation to *infinite signal speed*—from which the finite speeds characterizing the motions of inertial systems are all equally remote; so that clock-setting is a *symmetry operation* among all physical inertial systems with respect to particular notional signals. This revitalizes action-at-a-distance.]

In the twin problem it is velocities that must be asymmetrical because it is velocities that produce persistent or remanent effects in time. Asymmetries of acceleration cannot tell the main story because they can be very brief and in themselves produce no remanent effects other than velocity changes. But differential aging effects are precisely as remanent as velocity differences. Hence it is to velocity nonreciprocities that one must look to explain (or to quantify) "real" aging nonreciprocities. Suppose, then, that the traveling twin does indeed come back younger than his brother. Relativists pay lip service to this idea ... and I, for one, fully accept it as a fact of life. But I assert that Einstein's theory has too much symmetry ever to cope with a real world in which such objectively asymmetrical things can happen. (Never mind that this theory "predicted" it. Theories don't predict anything without coaching.) His two postulates plainly lack the straw to make such bricks. That's the beastly side, to mitigate which, all the beauty in the world cannot supply an extra straw. And, if you augment his two up-front beauties with a third postulate, that the differential of proper time is inexact, you still have just as much symmetry in the theory as before—namely, too much. This troubled Herbert Dingle and got him ostracized from the Drones club. It broke his stout heart of British oak. But are *we* down-hearted? You bet.

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