

The Natural Philosophy Association (NPA) 2000 talk, University of Connecticut, Storrs, Connecticut, USA. (June 5th – 9th, 2000)

The Angular Momentum 'Ether'

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Abstract

Modern physics is split over the question of whether or not there is faster than light *action-at-a-distance*. Those who think there is are further split over whether this action-at-a-distance is 'pure' action-at-a-distance or is mediated by some sort of 'ether'. But since no-one has the faintest idea of what an 'ether' is, how can it be decided whether there is one or not?

What we do know is that freely moving bodies form holistically balanced systems of *angular momentum* in which the measured motion of every one body is instantly linked with that of each and every other. Is this non-local interconnection to be called 'action-at-a-distance' or 'ether'? Does it matter? Can nature care whether we choose to think of that nexus as 'gravitational', 'inertial', 'electric', 'magnetic', 'electromagnetic' or whatever? What difference can it make so long as the observed linking of movements is properly accounted for?

We demonstrate that angular momentum, which is the observational common factor in all the different orbital motions, is sufficient in itself to explain those motions without the usual theoretical elaborations supplied by the likes of Newton, Faraday, Coulomb, *et al.*

TRANSCRIPT

[Thanks to the organisers, etc.]

There was some talk here, yesterday, about 'paradigms' – whole, logically structured and commonsense-approved systems of thought which may have little in common except for the observational data on which they are based, systems which may appear strange and even hostile from each other's point of view. The non-trivial relevance to physics of these different paradigms is that they produce different experimental and observational predictions. Here is such a system as it has been explored in an ongoing project at Keele University, England.

I once met a highly respected physicist who described a colleague of his as mad for believing in the existence of an ether. When I met that other physicist, he described the first as a lunatic for believing in pure unmediated action-at-a-distance. This set me thinking.

When we look out into space, what do we observe? Gravitational fields? Electromagnetic waves? Light travelling in the vacuum? Of course not. What we actually *observe* are bits of matter behaving in certain ways.

And when we look *into* those bits of matter what do we observe? 'Atoms', 'charges', 'electric fields', 'magnetic fields'? Some of us may *think* so. But remember that the ancient Greeks, seeing men on horseback, thought they observed creatures which were half man and half horse, which they identified as 'centaurs'. And, not knowing, as we do, that the whale is a mammal, people were once convinced that the whale was a *fish*. So, in view of this fundamental weakness in matters of 'observing', which of us here would swear, hand on heart, that he or she can be *absolutely certain* that what appears to us, in our modern observatories and experimental laboratories as 'electrons', 'protons' and the like, will not turn out, in the end, to be every bit as mistaken as the Greek's perceptions of the horse-riding Scythians as 'centaurs', or the biblical identification of Jonah's whale as a 'fish'?

How certain, then, can we be that our present, even most hallowed accounts of scientific observations of things like 'charges', 'force-fields', 'photons' 'quarks', ... and so on, will not seem as quaint to future scientists as, to us, nowadays, do those ancient charts on which winds are depicted as the breaths of angels and areas are inscribed with the words 'Here be dragons'. There is, then, a dimension of scientific enquiry, even in the most hard-line 'experimentalist' areas of physics, which we neglect at our peril. This is the business of *philosophical analysis* – sometimes called *linguistic analysis*. This is to science something like what psychoanalysis is to medicine. As applied to physics, the aim is, when tensions arise between theoretical descriptions of things, to cut all the theoretical 'crap', as the Americans say, and re-focus on plain, direct and more efficient *observational* descriptions of what things are and how they actually *behave*. In other words, the aim, in situations of profound puzzlement, is to strip away the customary conceptual accretion, and re-focus on the actual *phenomena*.

But of course, not everything there is can be observed, in the sense of being pointed to and photographed. Some things can be known only by their effects, like a wind which waves corn or tears up trees. But although the wind does not supply us with optical sensations, it does supply us with tactile ones – as when it fans our cheek or blows us off our feet. But when we see the moon affect the tides, what direct sensations shall we say are in operation there? This throws us upon the necessity of having to invent language in the way the Greeks did in seeking to describe what they conceived as 'centaurs'. In our case, the 'centaur' which we think of as lifting the tides is what we customarily call 'gravitation'.

This unavoidable dependence on creative imagination in our descriptions of things is, of course, what we call *science*; and it is, inevitably, in these scientific

descriptions that errors of the peculiarly *theoretical* kind emerge. In the 1920s there were science philosophers, called Logical Positivists, who sought to dispense altogether with what they saw as this unwanted theoretical creativity by reducing all scientific statements to what they thought of as uninterpreted *sense-data* or *instrument-data*. However, this was found to be unworkable and was soon abandoned by its founders. This means that in science we are stuck with the necessity of *theorising* and with all the continuous rethinking and revising of ideas and language that this process unavoidably entails.

All we can do, then, when it is plain that sensations in themselves are insufficient and that there are things in nature which are manifest only in their effects on other things, is to be as sparing as possible with our language in attempting to describe those 'hidden realities'. In other words, the aim of a truly empirical science is, by the use of what has been called Occam's razor, to shave away as many purely creative hypotheses as may prove, on analysis, to be strictly unnecessary. So although the ideal of Logical Positivism can never be fully realised it remains, to a large extent, the standard towards which science must aspire if it is to avoid its language becoming just a register of venerated *theories* about imagined things, or chimeras, a language in which all logicity and true contact with nature are lost.

We must remind ourselves, then, continually, how essential it is for a healthy and efficient science to retain the maximum facility of correcting and revising even its most hallowed and well-established theoretical conceptions. Any hindrance to this must be regarded as a dysfunction of the discipline and therefore a barrier to progress.

In short, then, things don't come labelled with the names and descriptions of what they are. This is left to *us* to decide; and as scientists we must not be dogmatic about those decisions. With that in mind, let us now return to the question of how one piece of matter can influence another at a distance, without something acting in between. Obviously, it can't, because if one thing influences another, some connection is there, by definition. This undoubtedly is what prompted Newton to state, in his much-quoted remark to Richard Bentley:

'That one body may act upon another at a distance through a vacuum, without the mediation of anything else, by and through which this action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man, who has in philosophical matters a competent faculty of thinking, can ever fall into it.'^[1]

¹ Passage quoted by Michael Faraday from letters of Newton to Richard Bentley, 1692-93, as quoted in notes of the Cajori edition of Newton (1687), p.643.

(Note, by the way, Newton's correct use, here, of the word 'philosophical' in connection with physical science.)

Well, alright, so if something *has* to act between bits of matter, then what shall we say that 'something' is? It can't be just more matter, because if all space were filled with matter, then nothing could move. Everything would be jammed solid – a case of Eleatic stasis, or cosmic 'gridlock'. What kind of *non-material* 'something', then, shall we say links things like the moon and the tide or a pair of magnetic poles or electrostatic charges? Some say 'ether'. Others say 'field'. But what are these but just empty words unless we define precisely, in empirical terms, what it is to which these words apply?

There is, though, something which fits the description of a present-all-over, *non-material* 'something' which links the motions of all freely moving bodies. This is *angular momentum*, in which masses are automatically paired and balanced by the law of moments on moment-arms whose lengths are the distances between those masses. Also, unlike Newton's so-called 'gravitation' whose alleged 'effects' alone we may see, angular momentum is all 'up front'. It consists of nothing more nor less than a self-sufficient quantitative description of how bodies move in relation to one another, in terms of the directly observable measures, mass, length and time. As we shall see, this observational account shows that in angular momentum the motions of free masses are automatically closed, or orbital. This removes any need to postulate, in the way Newton did, the existence of mysterious and invisible 'forces' responsible for accelerating bodies away from his imagined Euclidean 'straight and narrow'. But, of course, a 'straight line' is virtually the same as the circumference of a circle of infinite radius. So that straight-line, so-called 'inertial' momentum $m\mathbf{v}$ of Newton's [chalks on board] implies an angular momentum $m\mathbf{v}r$ with an *infinite* radius r , which is an *infinite* angular momentum. Since infinity is impossible, then it follows that for all real (*i.e.*, *finite*) angular momenta the radius r has also to be finite, so that the trajectory is naturally cyclic or orbital. This removes all need of theories postulating a balance of *in vacuo* 'centrifugal' and 'centripetal' forces responsible for orbital motion.

Many people have great difficulty trying to picture what angular momentum is, especially in relation to freely moving bodies. They may understand what it means when those bodies are connected by something solid, like the spokes of a wheel or the strings of a bolas. However, a wheel is one thing; a system of freely moving bodies in a state of pure, unfettered angular momentum is something else. Here [OHP 1, below] is such a system:-



OHP.1

A Prime Example of an Angular Momentum System

The Great Spiral Galaxy M31 in Andromeda, 1.5 million light-years distant and 150,000 light-years in diameter, consisting of thousands of millions of stars similar to those in our own Milky Way galaxy.

Now this object plainly exists as a whole, with all its constituents balanced with one another. That is to say, its angular momentum is holistic and is conserved throughout, with all the different motions of its individual stars, planets, gas molecules and so on evidently interconnected – else how would those objects hang together in that way? The same goes for galaxies with respect to one another, including, of course, our own galaxy. These, again, form mutually balancing and orbiting groups. But if it were true that

nothing can travel faster than light, then the balance between stars at opposite ends of those galaxies should take thousands of years to pass between them; and between galaxies it would take millions of years. Stars might be born and die before they could balance one another, which makes the concept of finite-speed interconnection completely absurd.

In an angular momentum system, then, any change in the angular momentum at one place must be *instantly* accompanied by a compensatory change in angular momentum somewhere else. It has to be instantly, regardless of distance, otherwise the angular momentum would be disconserved, which the law of angular momentum forbids. So there cannot be any time-delay in this overall connection. This makes *angular momentum*, by definition, the essential *non-local* presence that is variously called 'field' or 'ether' by which all things are connected.

Angular momentum, however, is not the sort of stuff which can set up a resistance to motion, or an 'ether drift'. Michelson and Morley's failure to detect its presence relative to the moving earth is therefore scarcely surprising. To imagine such a drift on the part of an angular momentum ether would be what philosophers call a 'category mistake', like trying to measure what courage weighs or what is the frequency of a wave of panic. Angular momentum, as such, can neither offer resistance to motion nor propagate knock-on type displacements like wave-disturbances in air or water. The angular momentum ether, if such it may be called, is neither material nor quasi-material as ordinarily signified by these terms. It is pure, non-local, present-all-over, *action-at-a-distance*.

Okay, so now let's get down to business. What about the so-called 'speed of light' *in vacuo*, the alleged finite speed-limit of all physical interaction? Could this be just another conceptual 'centaur' like 'gravitation'? Well, the fact that all speeds are distances divided by times quite obviously does not entail that all distances divided by times are speeds, any more than the fact that all ants are insects means that all insects are ants. The fact, then, that all distances in space turn out to be times in the constant ratio of units c does not *necessarily* signify a speed of motion. This leaves us logical latitude for thinking of c in a different way. For instance, we may take c as a constant relating conventional lengths-in-metres to times in seconds in the way that 39.37 inches to the metre is a constant relating imperial and metric length-units for all measurers – like c , needless to say, in all states of relative motion or rest.

In this non-motion interpretation of c as a *pure constant* relating units of length and time, the components of true motion (that is, of real bodies, as opposed to the

hypothetical *in vacuo* 'waves' and/or 'photons') are s/c and t , both measured in the same units of seconds [see **OHP.2**, below]:

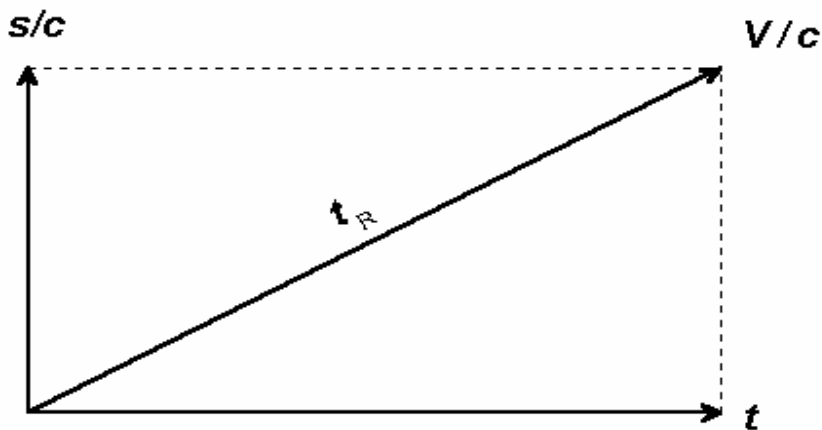


Figure 1

OHP 2

Being *dependent* measures, these dimensions are now related *geometrically*. So V is the so-called 'Galilean' velocity, which is the classical, or instantaneously extended distance s travelled by a body in the classical time t registered by that body's own clock ^[2].

I can now demonstrate to you how the Einsteinian representation follows very simply from this 'Galilean' version of motion, in a way which Galileo or Newton might easily have noticed if the circumstances of history had been different. For instance, the fact that both s/c and t are now measured in the same units of seconds gives to the Galilean velocity (gradient) V/c a *geometro-temporal* significance expressed by the following Pythagorean relation (formulae on OHP.3):-

$$t_R = \sqrt{[(s/c)^2 + t^2]} . \tag{1}$$

In this formula, t_R is the observational or relativistic resultant of the two Galilean motion components, s , (or, rather, s/c) and t . And there you have it: Special Relativity, from Galileo by plain Pythagoras. You don't believe me? Well, let me prove it to you.

Now s , in observational terms, is v (small v) times t_R , where small v is the *relative* or observational velocity s/t_R . Substituting accordingly gives us [seen OHP 3, below]:-

^[2] In angular momentum relations the trajectories of bodies are, of course, non-rectilinear. The trajectory V , which in the diagram is drawn straight, for simplicity, may be regarded as some small section of the straightest part of a very long and very thin ellipse, in which s , in metres, is the instantaneous distance between the positions of the object and observer, respectively.

OHP 3

$$t_R = \sqrt{[(vt_R/c)^2 + t^2]} \quad (2)$$

Square everything to get rid of the square root:-

$$t_R^2 = \sqrt{(vt_R/c)^2 + t^2}$$

Subtract $(vt_R/c)^2$ from both sides:-

$$t_R^2 - (vt_R/c)^2 = t^2$$

Simplify:

$$t_R = [1 - (v/c)^2] = t^2$$

Dividing by the bracketed expression and taking square root then produces:-

$$t_R = t(1 - v^2/c^2)^{-1/2} \quad (3)$$

which is, of course, the familiar *time-dilation* formula of Lorentz and Einstein.

(End of OHP 3)

It is not the case, then, that Einstein 'superseded' Galileo and Newton or that there is some kind of 'conflict' between classical and relativistic physics. It is simply that velocities expressed in the *classical* way, in terms of distances travelled in the time registered by *the travelling body* tend, in the old way, to the natural limit of infinity (*i.e.*, instantaneity), whereas velocities expressing those same distances s travelled by those same bodies in the *observer's* time tend towards the finite limit c , as in Special Relativity. So, as I say, there is no conflict between 'classical' and 'relativistic'. *The two are completely complementary and optional*, like heads and tails of the same coin.

Instantaneous and delayed, then, can be conceived without contradiction as no more than different aspects of the action we customarily call light. For instance, in (1), when the proper time t of the interaction is zero (*i.e.*, *instantaneous*), then t_R is the *time-delayed* measure s/c . Plainly, then, any idea that instantaneous and time-delayed are contradictory, hence that Relativity and Quantum theory are irreconcilable, is false.

Now let's consider the relevance of this Occam's-razored rendering of special relativity to the previous discussion about angular momentum. These measures s are *classical* distances between bodies in an *instantaneous* angular momentum connection.

This disposes of the 'centaur' which Newton saw as an invisible 'force of gravity' accelerating bodies towards one another in a Euclidean space'. In its place we have a unified conception in which light-connections and so-called 'gravitational' connections complement each other in a very simple and natural way, as I shall now demonstrate.

Let it be stressed, then, that in talking about distances between bodies we are now talking about those angular momentum relations to which the names 'field' or 'ether' may equally apply. So there is no need to ascribe different fields or ethers for 'gravitation', 'electrostatics', 'magnetics' ... and so on. *A single angular momentum formula* serves to describe the motions of all pairs of freely moving bodies. This is [see OHP.4]

OHP 4
$$mvr = 2(K_O + K_X)r/v = \mathcal{G} mM/v \quad (4)$$

Here, L is the orbital angular momentum, K_O is the orbital kinetic energy and K_X is any extra kinetic energy in joules, such as, for example, spin. \mathcal{G} ('Curly gee') is a variable which, when K_X is zero, is equivalent to the usual 'gravitational constant' G .

Now some of you will be familiar, in the journals and on various websites, with the details of all this, which it is impossible to recount in this short talk. Suffice it to say that they reveal that there is, for the taking, a simple unified account of what tradition has quite unnecessarily split into the three theoretical categories, 'gravitation', 'magnetism' and 'electrostatics'. These three are replaced by a single 'wheels-within-wheels' account of angular momentum, in which 'electronic charges' in coulombs and other traditional measures, such as webers, henrys, farads and so on, are all cashed-out in terms of mechanical units such as, ultimately, joules.

Let me just remind you, then, of what has been proposed here. It is *not* just another theory. It is a suggestion for *getting rid* of theories by the judicious use of Occam's razor. This reveals, beneath all the historical fuzz, a wholesome, clean-shaven, natural relativity with precisely the same consequences for time and space as were discovered by Lorentz and Einstein. There is a difference, however. It is that whereas in the Einsteinian version, the 'special' and 'general' aspects are separate and, as many have argued, contradictory (that is to say, the special theory denies the existence of an ether and the general theory affirms it), in the angular momentum account these two classically divided aspects of physical interaction, light in Special Relativity and 'Gravitation' in General Relativity, are logically integrated. In other words, *angular momentum* replaces

the 'absolute space-time continuum' of General Relativity and, in its spatial interconnections between bodies at a distance, fits the description of a 'luminiferous ether'. Angular momentum also provides the preferred frame of reference, or universal frame, with respect to which gyroscopes orientate themselves, in the manner noted by Mach and by others, such as Franco Selleri, here, Peter and Neal Graneau, Tom Phipps and Andre Assis.

However, time flies – relativistically or otherwise. For whoever wants to know more about these ideas, here are my website addresses. The historical account of what followed from a short correspondence with Einstein, in 1954, may surprise you.

[OHP 5]: WEBSITES:-

www.poams.org
www.vivpope.co.uk
www.vivpope.org
www.nrig.org

As a prelude to discussion, let me say this: For merely suggesting that in order to deal with some persistent confusions, certain venerated conventions may need to be revised. I have been publicly yelled at, sworn at, cursed and castigated, without being offered a shred of true logical or mathematical refutation. 'It is not *physics* as we know it', said one eminent professor. 'It is immoral,' said another. In St. Petersburg, Russia, I was almost physically attacked; and in Cambridge, England, a member of the audience accused me of 'corrupting the populace' – the very words used in the trial of Socrates, as I said to my accuser. That evening, as I was passing a colleague's room, he invited me in for a drink. 'What'll you have, Viv,' he asked, jocularly, 'wine, gin or hemlock?'

All this hostility makes it plain – to me at any rate – that in one way or another the traditional language of physics, with its obligatory talk of 'electrodynamics', 'charges', 'wave-dynamics', 'force-fields', 'photons', 'superluminal virtual particles', 'EPR' ... and so on, must not be 'messed with'. Not even for the sake of scientific truth must one seek to spoil the academic game. This reminds me of the scene in a British movie of many years ago, called 'The VIP'. In that film, a distinguished scientific genius (played by James Robertson Justice) accidentally becomes a prisoner of war. On arrival at the prison camp, on a table he sees a copy of 'The Times' and, in about a minute, completes the notoriously difficult crossword. When a longer-term inmate (Stanley Baxter) discovers this he yells, 'You dirty swine! That crossword was supposed to last us a whole month!'

To conclude, then, in the time I have left for discussion, I would like you people to tell me something. Let me put it to you this way: How much longer do you think we should continue doing our theoretical washing without changing the now almost totally congealed tub-water of conceptual tradition? Over to you.

Conclusion

The ensuing discussion was both interesting and vigorous, revealing much disillusionment among the members with what was called 'Establishment Physics'. But, of course, that was scarcely surprising, in view of the fact that this Natural Philosophy Association is, statedly, a 'dissident' organisation. Some concern, however, was expressed, that my paper had not 'refuted Einstein' in the way that its title seemed to promise. Indeed, it seemed that my paper had done more to confirm Relativity than to refute it. To that accusation, I would unreservedly have to plead 'Guilty as charged!'