

THE OVERDUE REVOLUTION

With the arrival of digital science, is our accustomed concept of physical reality outmoded? N. Vivian Pope reports.

Many people nowadays believe that a revolution in scientific thinking about the physical world is long overdue.

Our accustomed concept of physical reality is of an objectively enduring space, sparsely populated with bits of matter interconnected by field-forces such as those of magnetism, electricity and gravitation. The search for scientific understanding is thus seen, typically, as a seeking-out and classifying of the various kinds of matter and field-interconnections. It is a search, in effect, for *mechanisms* according to the traditional Industrial-Revolution precept of mechanical causality.

Despite all effort, time and money spent in this search, it now appears that no true understanding is to be gained by this method. Each successive 'elementary particle' turns out to be composed of other, queerer and queerer candidates, whose interrelations proliferate to such an extent that language can scarcely cope. They are classified and divided like jungle flora and fauna. But none of this brings any hope of understanding to the ordinary intuitive mind.

Many hard-nosed physicists believe this confusion to be inevitable. It is nature 'the way it is', they say, 'take it or leave it'. Others, however, see it as a *reductio ad absurdum* of our traditional mechanistic presuppositions. Smashing atoms to pieces to look for the ultimate constituent of nature and the ultimate forces driving them is as vain, they say, as smashing chessmen to look for the rules of chess.

The space and time in which matter was supposed to subsist have also undergone changes which modify the original conceptions virtually out of existence. No 'continuous vacuum' exists, for instance, at the quantum level, nor any continuous 'field' that might conceivably take its place. Nor are the durations and motions of masses continuous. In some cases (as, for example, with 'photons') the mass and motion-energy are one and the same. And that same energy is required to detect them, so they cannot be seen and be seen travelling at the same time.

Nothing, then, has proved more false than the originally assumed 'permanence and

immutability' of matter. Matter is transformed in the very act of being observed. Its primary, intrinsic properties, such as mass, duration, size, etc. prove to be as relative to the observer as beauty to the eye of the beholder. Indeed, while we continue to look at the world in the traditional way, almost nothing in nature now answers to it. Hanging on doggedly to that way of thinking makes the world look stranger with every new discovery. A child, if his educators would allow, could see that we cannot keep on patching-up that outworn mechanistic model. The time is not just ripe but over-ripe for dumping it in favour of something more suitable.

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What, then, is more suitable? Leaving aside, for the moment, the question of social upheaval which such a conceptual revolution might cause, the logical answer seems to be this: to cease thinking of the ultimate physical constituents as bits of matter and to think of them instead as bits of pure *information*.

Unfortunately, while that revolution is incomplete we tend to think of these information processes as taking place in the same old mechanistic way in the same old space and time. But one might as well try to marry a giraffe with a flying fish as try to merge such antithetical thought-systems.

Finding a successful way of thinking does not entail thinking that way for ever more. It does not guarantee that all further discoveries will automatically fit. At the best of times, readjustments have to be made, to keep a concept-system squared with experience. And the older it gets the more adjustments have to be made. But these cannot be made without limit. So, without divine guidance in choosing our precepts, we are bound to find, from time to time, that further adjustments cannot put off the inevitability of total reappraisal. Unfortunately, like big dinosaurs, estab-

lished idea-systems (like that of the flat-earth or earth-centred solar system) may be dead long before they lie down. So central are they to the common way of thinking that to change them is socially traumatic. Popular opinion militates against such changes. They confound common-sense and outrage authority. But mere expediency cannot stave off, for long, the crisis of understanding which signals when a tradition has reached the end of its logical tether.

As a purely intellectual exercise, then, let us consider what might be the next rational alternative to our present, over-stretched and obsolescent, mechanistic science.

A notoriously abstruse result of interpreting new facts in old ways is the so-called 'constant speed of light *in vacuo*'. In relativity theory this interpretation of *c* ties us to the old way of thinking and makes the theory so difficult to understand.

If we could release this 'fouled anchor' then the new way of thinking would float free of the old dead tradition (as science once did from canonised religion) allowing progress towards understanding.

What is wrong with this 'speed' interpretation of *c*? The answer is that it creates paradoxes. In relativity, for instance (which we are by no means rejecting, see below), it is, incomprehensibly, a universal speed which is constant for all differently moving observers. It is also the upper unreachable limit of all mechanical speeds, because as a body accelerates, its kinetic energy is relativistically converted into mass, which becomes infinite at speed *c*. So no acceleration beyond or even up to *c* is possible. At the same time, a light-particle (photon) has one of the lightest masses of all, yet it travels (*ex hypothesi*) at precisely the 'speed' at which, according to relativity, its mass should be infinite.

Besides, no instrument known to science can detect the passage of a photon '*in vacuo*'. For a photon to reach us from a distant galaxy and to interact, all the way, with the universe at large, it needs more energy than its mass can provide—even if that quantum of energy were distributable in that continuous way, which it is not. So there are no parameters in which a photon's 'existence *in vacuo*' can be defined. We might as well talk about the power-to-weight ratio of an angel in flight as discuss the speed of a photon. Yet we persist in talking about light 'travelling in space' as though it were of no consequence that the hypothesis is unverifiable.

The most paradoxical aspect of 'light in space', however, is that it makes the *information*, out of which relativistic and quantised space and time are projected, seem to be *conveyed* in that very same space and time—which is as though a painting were to portray the actual process of its being painted.

All sorts of 'theory-saving' devices can be mobilised to explain away these absurdities. But that would defeat the object of the exercise. So, instead, let us examine a clear ahistorical alternative to the 'light-in-space' interpretation of *c*.

There are two ways of interpreting a time-interval between events in space: one is as a simple sequence, without anything travelling between and the other is as successive appearances of a something travelling. In the case of light *in vacuo*, since nothing moving between the two events can be detected, we are thrown on the necessity of adopting the former interpretation: that light is a purely sequential phenomenon (psychologists call it a 'phi-phenomenon'), with the constant ratio, *c*, of distance units to time-units.

This alternative interpretation does not affect physical formulae involving *c*. Perhaps the first to demonstrate this was Hermann Bondi (1), whose formulation of relativity makes the 'light-velocity' interpretation of *c* redundant. This redundancy has been confirmed in a wider, more philosophical context by the author and his colleagues. (2) In both these independently-arrived-at conclusions, *c* is no more than a dimensional conversion factor for converting distance-units (metres) into time-units (seconds) in the same way that *c*² converts energy in joules into mass in kilograms. As Bondi argues, if, instead of choosing metres for our length-unit, we had happened to choose a unit equal to 3×10^8 metres, then *c* would be unity and need not have appeared in physical formulae.

But if light is a purely sequential phenomenon, then what about the *causal* effect of a light-signal (or radio-signal) on the receiver of that signal? What, for instance, causes the sequence of illuminations of dust-particles in a sunbeam if it is not light travelling between them? The answer is that these sequences occur, basically, not 'in space' but in the eye of the observer; and it is from such information that the observer projects the phenomenon of space with sunbeams shining in it. The whole thing is a 'video-projection', as it were, out of pure sequences of observational information. The primary dimension, therefore, is *time*, of which the so-called 'spatial' forms of extension are no

more than sub-dimensions (space-time). Our world is thus like a 'star-wars' game projected from a computer disc.

The information-sequences out of which our vastly more complex and beautiful world is spun, in both direct and instrumental perception, are those of quantum physics. At the quantum level, ordinary space and time disappear. So do matter, motion and mechanical causality. It is no use trying to picture quantum-informational processes in ordinary observational terms. They are not determinate and mechanical but are what the information-theorist calls stochastic. These are describable only in statistical and entropic/negentropic terms. In other words, the old reductionistic explanations of phenomena in terms of 'hidden mechanisms' fail at this fundamental level, where there is nothing determinate on which such explanations can be based. The only explanations are macrophenomenal ones. That is, it is principles like goal-direction and intention (in the case of organisms) or sheer probability (with inorganic physical bodies) which specify the kinds of statistics involved, not vice versa. (Inorganic phenomena are characterised by randomness and Gaussian predictability, organic, goal-directed processes by laws of a more ordered, non-Gaussian, kind—represented by skew, as opposed to bell-shaped, curves, etc.)

These information-quanta are the true elements of reality, being neutral as between 'physical' and 'mental' (an outworn dichotomy according to the present thesis). They are the true un-smashable 'atoms' which science has sought all along. Their interrelations are not describable in terms of 'field-forces' or any other kind of causal interaction. They are neither 'particles' nor spatial events. They are purely formal and sequential. Their dimensions are those of action (the

product of energy and time) and they are the natural 'software', of which all phenomenological programs consist.

All understanding requires a 'model' of some kind. It seems fitting, then, that whereas our traditional models for physics were the machines of the Industrial Revolution, the model for our next phase of scientific understanding (in biology as well as physics) should be the modern computer. In the transition from mechanical to digital science, as embodied in the modern computer, we have, it seems, the basis of conceptual revolution. In this new model, Man is essentially an information-processor with multi-choice inputs and outputs (observers) and many programs and scenarios which can run concurrently, in co-ordinated or conflicting ways.*

Some people, of course, regard computers as an abomination, to be rejected 'on principle' as a suggested model for science. But since the traditional alternative is the 'engine', then in rejecting the computer as a model, these people may be likened to the lady who rejected air-travel, preferring to 'travel in trains, as God intended'.

* Some finer points and practical consequences of this thesis are discussed in some conference papers by the author, eg. *The New World Synthesis* (PHI, 3rd ed. Sept. 1986); *A Question of Paradigms in Physics* (PHI, 2nd ed, June 1975 and in various bits of correspondence. These are available from the author on receipt of £1.00 (or £1.50 if abroad), to cover postage, package and printing. Write to N. Vivian Pope, 209 Newton Road, Burton-on-Trent, Staffs DE15 0TU.

References

- (1) Bondi, H.: *Relativity and Commonsense*. Heinemann, 1965.
- (2) Pope, N. V. & Osborne, R. D.: 'A New Approach to Special Relativity', *International Journal of Education in Science and Technology*, Vol. 18, No. 2, 1987.