

FORUM

Standard Time

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THE controversy over the introduction of corrections to standard time, so as to force agreement between Atomic Time and Mean Solar Time seems to have its roots in an erroneous concept of the meaning or concept of the entity we call Time. For example, the preamble to H. M. Smith's paper on 'Time Data and Navigation'¹ suggests that '... Greenwich Time and longitude are inseparable ...' and in D. H. Sadler's paper on U.T.C.² there is an odd confusion in noting that Time is a measure of the rotation of the Earth on its axis and at the same time that the rotation is not uniform.

These honourable and learned gentlemen are most certainly well aware that, as a point of natural philosophy, Time is an entity separate and apart from the rotation of the Earth, the vibrations of pendulums or caesium atoms, or of any other mechanism by which the passage of time is marked. The most satisfactory definition of the entity we call Time appears to be that it is the independent variable of certain physical relations, viz.: Newton's laws of motion, Maxwell's equations of electromagnetism, Einstein's theories of relativity, and so on.

One delightful article called 'Dimensions Anyone' appearing as a factual article in *Astounding Science Fiction* some years back proposed that the universal unit of time be defined in terms of Planck's constant of action (h), electron mass (m) and wave velocity (c) as: $t_0 = h/mc^2$, yielding a unit t_0 that would be a constant of the Universe.

As a quite intangible entity, Time can be humanly observed or its passage marked only in terms of the evolutions of some quantity that varies with time. That quantity may evolve so as to mark the passage of time but it is not Time itself.

In earlier days the one more or less linear function of time to be universally observable was earth rotation, and we are lucky in more ways than one that it is as uniform as it is. It is so uniform in fact that traditionally astronomers, astro-navigators and surveyors have come to consider the rotation of the Earth and Time to be one and the same thing and hence interchangeable. Lately, however, with the advent of caesium and rubidium atomic resonators, and the hydrogen maser, there have appeared physical entities whose evolutions marking the passage of time are demonstrably more uniform functions of time than is Earth rotation, even with all the corrections and predictions that the finest astronomic observations and most elaborate data reduction methods have been able to achieve.

So now a point of bifurcation has been reached. What the astronomer, the astro-navigator and the surveyor has traditionally labelled Time, is actually Greenwich Hour Angle of Aries, a quantity evolving more or less uniformly with time that is not Time itself. Those gentlemen are not really interested in

Time as a philosophical entity, in the sense the physicists are in analysing wave action or the calibration of laboratory instruments. What they must know is Greenwich Hour Angle and, for their convenience, they wish to keep the standard definition of the Unit of time to be Earth rotation.

It is, however, philosophically repugnant to adopt as a standard of the entity Time, something that is not time, nor is it a particularly smooth linear function of Time. A more philosophically satisfactory approach would be to provide the astronomer, the astro-navigator and the surveyor with a G.H.A. Indicator, i.e. a mechanical entity evolving linearly with time but regulated to indicate directly Greenwich Hour Angle of Aries and not call the indications Time at all, whilst the scientific world would maintain the most uniform continuous linear time scale that the state of the art can produce, so that when it is desired to relate some event occurring at a specified instant of time in one location with something else that occurs at some other specified instant at some other location, one is not at a loss to determine how many odd seconds must be added or subtracted to obtain the actual difference.

REFERENCES

- ¹ Smith, H. M. Time data and navigation. *This Journal*, 25, 13.
- ² Sadler, D. H. The new system of coordinated universal time. *This Journal*, 25, 32.