Understanding Nonsense

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I could never understand nonsense
-- Laurence Tisch

Common sense recommends the proposition that the earth is flat. The earth is flat because it looks flat For most of human history the flatness of the earth was universally accepted. It is said that some of Columbus' sailors – in the fifteenth century – were fearful that they would fall over the earth's edge. Aristotle taught the flatness of the earth and his authority, co-opted by the authority of the Church, prevailed for many centuries after Eratosthenes, a Greek astronomer\mathematician in Alexandria, Egypt, showed convincingly in the second century A.D. that the zenith in different latitudes is different. But the roundness of the earth was nonsense. Today, with photographs of the earth from space satellites, the nearly spherical shape of the earth is beyond question and those who maintain otherwise are "flat earthers", a term of derision and disparagement. The nonsensical round earth is understood.

The daily rising and setting of the sun, moon and stars was thought originally to be a real motion of the heavens because it appeared to be. The idea that the earth rotated at the center of the celestial sphere was "nonsense" because no centrifugal acceleration at the earth's surface can be felt and no east-to-west wind was experienced. But when the existence of the equatorial bulge of the earth was established, the "nonsensical" rotation of the ponderous earth had to be accepted.

The annual revolution of the earth about the sun , even more nonsensical than the earth's daily rotation, lacked observational proof until the discovery of the aberration of starlight in 1728 and the detection of stellar parallaxes in 1835 and thereafter. The seeming immobility of the earth gave way to the nonsensical annual revolution of the earth about the sun. Galileo was offered absolution by the Inquisition if he could demonstrate stellar parallaxes, but this was well beyond the capabilities of the feeble telescopes of his day. The annual revolution of the earth about the sun , by default, was nonsense for more than another century, and the Church's apology to Galileo came nearly four centuries too late.

Astronomers of the nineteenth and twentieth centuries concentrated almost exclusively on the study of individual stars, many of which turned out to be binary systems – pairs of stars revolving about their mutual center of gravity. For many such pairs, the details of their revolution could be known by analysis of their orbital velocities; as one of the stars approached the earth, the other receded. From a relatively extensive body of such observations, it could be shown that in empty space the velocity of light from these stars was entirely independent of the motions of the stars themselves and of the orbital velocity of the earth about the sun. This result seemed quite contrary to what one would reasonably expect from terrestrial experience with sound waves and inspired a number of sensitive and crucial tests in the twentieth century. In all cases, the outcome required the "nonsensical" conclusion that the velocity of light in empty space is the same no matter what the velocity of the source or of the observer! Incorporation of this "nonsensical" conclusion into the equations of dynamics and electromagnetism was the genesis of the theory of special relativity. An almost incidental result was the derivation of the fateful mass-energy equation $E = m c^2$.

The special theory of relativity had numerous successes, but a theory of gravitation was not one of them. It was assumed, therefore, that a more general theory must be required. As a result, Einstein promulgated his general theory of relativity some ten years after putting forward the special theory. It had almost immediate success: a correct accounting for the theretofore unexplained advance of the perihelion of Mercury and a correct prediction of the bending of light at the limb of the sun. The dramatic verification of the latter by a British eclipse expedition in 1918 earned Einstein almost instant worldwide acclaim and established the general theory of relativity as the ultimate expression of a theory of gravity, displacing the venerable law of Isaac Newton.

So commanding were the theories of special and general relativity as the ultimate formulations of the laws of electromagnetism and gravitation, respectively, that Einstein and some of his illustrious contemporaries sought to prove via atomic theory that Lorentz contraction was literally a shortening of material bodies receding rapidly from the observer. That it was only an apparent kinematic effect was considered to be nonsensical. That a mathematical transformation could undo the effect was at first overlooked. What was needed was not a new law of gravitation but a correct expression for the mass of a gravitating body, one including the implications of the mass-energy relation.

The successful prediction of the otherwise anomalous advance of Mercury's perihelion by general relativity was attributed to a mysterious cause – the curvature of spacetime by the presence of the sun. This was, in fact, the only inferential evidence for spacetime curvature. The equation for this effect showed that it was proportional to the arithmetic mean of the perihelion and aphelion gravitational potential energies divided by c^2. That is to say that these energies increased Mercury's mass by precisely the amount required by the mass-energy relation. This being so, spacetime curvature is not needed to explain gravitational effects; the mass-energy relation is a more palpable, more concrete cause.

By extension, it must therefore be included in the calculation of the mass of any system of masses – a system such as a globular cluster or a galaxy. The mass is now not that of a small planet such as Mercury or of a single star such as the sun, but of a very large numbers of suns – many billions, for example. Even though these stars may be separated by great distances, up to hundreds of thousands of astronomical units, their combined effect can be very great. The effect of billions of stars on one another may increase their effective mass by a factor of approximately six. This is evidenced by the high velocities of stars on the outskirts of galaxies, where their observed orbital velocities would far exceed the velocities of escape appropriate to the mass of the visible matter in the galaxy or cluster. The inferred extra mass is, of course, quite invisible, hence termed "dark". The observed higher kinetic energy, not justified by the observable matter, is termed "dark energy".

The vast amounts of "dark" matter and the attendant vast "dark" energy have not been treated as "nonsensical", however; their source simply has not been correctly identified. It is time it was explicitly acknowledged and the mystery dispelled. Let "nonsense" be supplanted by understanding.