

What we read below will be a section of the article which was rejected for publication and no reasons for rejection being given.

Arnold. You may find this 23oct97 version good enough for the final version. Ivor

Final part of

A Paradox in Electromagnetics

by Lynch and Catt. 23oct97 bis.

Alternatively, the field may be the fundamental reality, and it manipulates the electrons. This is discussed by **Oliver Heaviside** in his article in *The Electrician* on 10 January, 1885, reprinted in his *Electrical Papers, Vol. 1*, 1892, pages 434-8. Its title is; "On the transmission of energy through wires by the electric current";

[p434].....

By the way, is there such a thing as an electric current? Not that it is intended to cast any doubt upon the existence of a phenomenon so called; but is it a current - that is, something moving through a wire? Now, although nothing but very careful inculcation at a tender age, continuing unremittingly up to maturity, of the doctrine of the materiality of electricity, and its motion from place to place, would have made me believe it, still, there is so much in electric phenomena to support the idea of electricity being a distinct entity, and the force of habit is so great, that it is not easy to get rid of the idea when once it has been formed.

....

[p435] As Maxwell remarked, we know nothing about the velocity of electricity

....

[p436] But is there not the fact that we can send a current into a long circuit, and that it plainly travels along the wire, taking some time to arrive at the other end? Does that not show that electricity travels through the wire? To this I should have answered formerly, when filled with [ideas of] 'Heat as a Mode of Motion,' that there was no evidence in the closed circuit of any motion of electricity through the wire, but only transfer of **energy** through the wire. [He means *between the wires**.]

....

[p438] Now, in Maxwell's theory there is the [electric field] produced in the dielectric parts by the electric force, and there is the magnetic energyin all parts of the field, including the conducting parts. They are supposed to be set up by the current in the wire. **We reverse this;** the current in the wire is set up by the energy transmitted through the medium around it.

.... First define the [Poynting Vector =] **energy-current** at a point [in the dielectric] to be the amount of energy transferred in unit time across unit area

.... The **energy** [current] is poured out of the battery *sideways* into the dielectric....

.... *If there is an instrument in circuit at Edinburgh, it is worked by **energy** that has travelled wholly through the dielectric, then finding its way into the instrument,

When Heaviside wrote; **"We reverse this"**, he announced the advance from Theory N, that current (and charge) causes field, to his Theory H, that field (which he called **energy-current**) causes current (and charge). At that time, charge had no mass. Later, in 1897, J J Thomson invented, or discovered, the concept of charge having mass (unlike heat, in the kinetic theory of heat). By then, Heaviside was engrossed in other matters. First, he was trying to get Preece, Head of Post office Research, to understand his TEM wave, and try loading coils, so as to make long distance telephony was possible. Sir Oliver Lodge told Heaviside he would have a better chance of persuading Preece if he stopped calling him a 'scienticulist'. Also, Heaviside was jousting with his landlady-cousin Miss Way (and finally ousting her). These pressures made him fail to realise that J J's electron had created problems for the TEM wave that Heaviside had propounded decades before. Even earlier, with his **"We reverse this"**, he had failed to notice that if field causes current, and field transports the energy, then current (and charge) become redundant, as is asserted in the third theory, Theory C. This theory resolves the paradox outlined in this article by saying that in a coaxial line, charge and current are merely mathematical manipulations of the E and H fields at the edge of a TEM wave. Maxwell's Equations become merely a device for calculating charge and current, by integrating electric field and magnetic field. As mathematical constructs, they have no mass, and the paradox is resolved. Although electric charge may be necessary to explain other physical effects, the TEM wave down a coaxial line is much better off without it. Although Heaviside's earlier, massless charge could travel at the speed of light, J J Thomson's later, massy electric charge cannot travel fast enough. In the TEM wave, electric charge must lack physical reality. Similarly, in mechanics, a physically non-existent 'acceleration' dv/dt only exists as a mathematical derivation of physically real factors; force, distance, energy, time. (If you persist in believing that any mathematical construct is physically real, then think about whether *rate of change of acceleration* da/dt is physically real!) Although a house cannot exist if it does not have sides, the *sides* of a house do not exist. They have no width, volume or materiality. However, the sides of a house can be manipulated graphically and mathematically. The same is true of so-called 'electric current' in a coaxial cable. According to Theory C, it is merely a mathematical derivation from **energy-current**.