The death of electric current

In his September 1981 letter, R. T. Lamb seems to think that if he establishes that we are merely discussing a *model* rather than a theory or a fact, he has also established that a bad model is no worse than a better model. When he writes, ". . . any model that shows that electric current is not needed in that model," I would reply that the successful removal of primitives such as ρ and $\mathcal{J}$ from a model is a major advance. It is important that unnecessary accretions be cleared away from a model (cf. Occam's Razor). This is particularly true if these accretions create insurmountable difficulties – see my first two paragraphs, August 1981 issue, page 40. Why hold on grimly to redundant primitives, ρ and $\mathcal{J}$, if they create the insoluble problem there discussed? If Lamb thinks (unlike me) that a mere model is in dispute, why the tenacity?

In the first paragraph of his letter in the March issue, Lamb accepts the reciprocating model for a charged capacitor as true. This model, when used in the discharge of a capacitor through a resistor, does not result in an exponential, as Lamb suggested on page 46 of the September issue. Using time domain reflectometry, my colleague Malcolm Davidson has experimentally established that when a resistor is switched across a charged capacitor the result is a series of steps (similar to the appendix to our article "Displacement Current" in the December 1978 issue) and not an exponential.

Ivor Catt
St Albans
Herts

Mr Ivor Catt's assertion (August Letters) that conventional electromagnetic theory cannot cope with transients for which it was specifically developed is, to say the least, a trifle rich.

Tilting at the giants of our great heritage of scientific understanding is a useful pastime, even if it only serves to stimulate the thinking of others. I think that Mr Catt has some fundamental misunderstandings of conventional theory which is giving rise to some difficulty in having his own accepted.

A conductor cannot have an electric field in it; the wires of a transmission line cannot have an electric field along their length but Mr Catt's August letter shows a deficiency of charge to the right of his wavefront, a situation which would result in a field along the axis of the wire, the axis of propagation of the wave. But the wave is transverse (TEM) and has no such component.

Electromagnetic wave theory does not consider a wave to be a column of electrons advancing down a wire like peas down a tube. A conductor is a region with a large number of free carriers in charge equilibrium with fixed carriers; a metal wire has a large number of free electrons in charge equilibrium with the positively charged nuclei. These electrons interact with electric potentials external to the wire in a manner described by the equations of Maxwell. This can be verified experimentally.

Mr Catt's crude model is thus fundamentally wrong. The model of a wire full of free carriers is also quite crude but at least it is fundamentally correct. In this model it is reasonable to describe the wavefront as the dividing line between that region where carriers have started to move and that where they are not yet disturbed by the approaching wave. It is, of course, fairly common knowledge that the approaching wave is external to the conductor (it cannot be inside, see above) and it influences the surface charges first (skin effect).

Mr Catt's contributions on e.m. theory are shot through with misunderstandings of the same sort. In March 1979 he quotes conventional theory (using displacement current) as requiring two components for charging a transmission line, $i + dD/dt$ (p. 68) where i is the line charging current and dD/dt is

the Maxwellian displacement current. But the line charging current is the displacement current according to Maxwell's laws; it is nonsense double them up.

In July 1979 ("The Heaviside Signal") he defines:

$$\sqrt{\frac{\mu}{\epsilon}}=\frac{E}{H}$$

and then goes on to derive:

$$\frac{E}{H}=\sqrt{\frac{\mu}{\epsilon}},\quad \frac{E\mu}{B}=\sqrt{\frac{\mu}{\epsilon}} \text{ and } E=BC$$

all nonsense. Why? Because E, H and B are all vectors andμ and ϵ are scalars. Surely he knows that they cannot be equated?

Maxwell's laws are concerned with electric and magnetic fields. In Mr Catt's, charge appears to give rise to neither. Will he be announcing the death of electric charge next?

Dermod J. O'Reilly
Antwerp
Belgium

JANUARY 1982

Concepts in physics

I have mixed feeling about J. L. Linsley Hood's letter in the November 1981 issue discussing the prevalent censorship of any ideas which have tended to cast doubt on the validity of orthodox theories.

The self-appointed guardians of the faith, who have arrogated to themselves the right to stop me from publishing in any learned journal in Britain and the USA by means of the refereeing system, are today an extremely ignorant, arrogant bunch in the fields of relativity and electromagnetic theory. On the other hand, the fact that one is a dissident does not necessarily mean that one is competent, and unfortunately one at least of the suppressed dissidents has failed completely to understand his subject. I only wish the lines were more clearly drawn beteeen the goodies and the baddies.

Ivor Catt
St Albans
Herts

The death of electric current

Dermond J. O'Reilly, whose letter was published in the December 1981 issue under the title "The death of electric current", must have missed my article under that title in the December 1980 issue. I wrote, "Electric charge does not exist according to Theory C," and yet a year later Mr O'Reilly writes, "Will [Catt] be announcing the death of electric charge next?"

In his third paragraph Mr O'Reilly attacks what I believe to be my accurate statement of the conventional theory. Surely he should be defending, not attacking, "our great heritage of scientific understanding"?

In paras. 4 and 5, O'Reilly makes the same mistake as Dawe made in the November 1981 issue, page 55. I wrote about the additional *charge* on a wire after the passage of the step, and did not mention the *current*. (See *WW* August 1981, page 40, para. 3) ". . . extra electrons must appear [in/on the wire]", *not* (extra) current must flow.

As to para. 6, if i and dD/dt are one and the same thing, then does it flow in direction BB' (i) or in direction BC (dD/dt)? One current cannot flow in two directions at the same time.

Para. 7, I wonder whether

$$\frac{E}{H}=\sqrt{\frac{\mu}{\epsilon}},\ H=\frac{B}{\mu}$$

were nonsense in Professor Bell's article, *Wireless World* August 1979, page 44? Or are the defenders of classical electrodynamics allowed to write such stuff, but it becomes nonsense when written by a dissident?

Ivor Catt
St Albans
Herts

THE DEATH OF ELECTRIC CURRENT

Ivor Catt's latest letter suggests that some progress has been achieved in an uphill struggle, for he seems to acknowledge that we are discussing models of reality and not reality itself. However, there is some way still to go, for he seems to regard models as "true" or otherwise. Models can be bad or good or better in relation to their accord with observation, but never true or false. So it is fatuous to assert that a model shows that electric current does not exist.

Certainly, there is much to be said for keeping models simple, but I think that other correspondents have shown that the "insurmountable difficulties" introduced by ρ and J exist only in Mr Catt's mind. Further, simple models are not always best: albedo measurements had shown the shortcomings of the green-cheese model of the moon, long before Armstrong arrived to test the flavour!

I was interested by Mr Davidson's achievements with discharging capacitors, but I suspect that those of us not fortunate enough to have a capability for time-domain reflectometry will continue to use the exponential model. This model does have a shortcoming in that it suggests that the discharge current continues for an infinite time, whereas observation shows that it does not. Of course, if we use an electric current model we can account for this by supposing that the discharge current becomes submerged in the noise, currents generated by random motion of the electrons within the conductors. Presumably there is a means of describing the effect using an e.m. wave model?

R. T. Lamb
College of Engineering Studies
British Telecom

THE DEATH OF ELECTRIC CURRENT

Ivor Catt's letter in the February issue only serves to illustrate the deficiences in his knowledge of mathematics and conventional EM theory and the confusion of his own theory.

Can he not see that $E/H=\sqrt{\mu/\epsilon}$ is wrong and $H=B/\mu$ is right for mathematical reasons? There is indeed a small chance that the latter does not describe correctly the true physics of magnetism but at least it is dimensionally sound.

His difficulty with step waveforms on transmission lines becomes clearer. Of course the conduction and displacement currents are both present in the line together, but only as the wave advances. The displacement current dD/dT is associated with the wave front only (D is constant elsewhere). If the wave reaches a (correct) resistive termination dD/dT ceases, the step is terminated and the resistor begins to absorb the energy in the wave. It is precisely because the displacement current flows across the transmission line that the wave is called a transverse EM wave and the displacement current is distinct from the conduction current. The energy associated with the displacement current is stored and can be recovered later (cf. radar pulse generators). It can be seen from Mr Catt's own illustration (Fig. 3, p.68 March, 1979) that the E vector (dB/dT) and the displacement current vector (dD/dT) are at right angles, therefore $E\times H$ is purely reactive. This is analogous with reactive power (VA_r), where current and voltage are 90° out of phase. The H vector associated with the conduction current is also at 90° to the E field and again no energy is dissipated; the power flow is in the direction of the conduction current. In a third case, the transmission line is resistive and there is a component of the E field along the line in a direction opposite to the current flow. Here some of the power is dissipated.

C.A.M.

Mr Catt is further confused with regard to electric charge. The existence of electric charge is not a theory; it is a fact like the sun and coal in South Wales. Since one of the manifestations of electric charge is electric potential, any theory of electric waves that dispenses with electric charge must be rubbish. It is the objective of EM theory to explain the various manifestations of electric charge.

Mr Catt's mathematics is wrong; he does not understand the application of vectors to TEM waves and he does not distinguish fact from theory.

I'm sorry if he believes his version of Maxwell is correct; it isn't. If he was right in his belief some changes would indeed be needed and radios would not work.

Dermod O'Reilly,
Antwerp,
Belgium.

WIRELESS WORLD JULY 1982

THE RIGHT FORMULA

I have been reading with considerable fascination the various controversies about basic theory in your letters pages. 'Death of Electric Current', 'Einstein was Wrong' and 'Electromagnetic Units', to name but three.

No one seems to acknowledge the fact that all such 'theories' are purely human artifacts, designed to make predictions of the way things work! Such equations, when it comes down to it, have to obey one rule – do they give sensible answers, given the measuring techniques open to the one wishing to design a piece of apparatus.

We use ohms, volts, amps and unit of charge, not because such units would mean anything to a scientist from, say, Betelgeuse, but so that we can tell what will happen if changes are made. But any working (hands-on) engineer will tell you that even the simplest of devices can display some very odd behaviour! The trick is to use the 'right' formula! Ask any engineer if he can name a single text-book which will invariably give the correct answers to whatever he needs to know! I can't, and I doubt if any can – no matter how 'simple' his needs!

Does Mr Catt find his theories enable him to do better design work? I very much doubt it! In my experience of designers, all have 'private' data notebooks without which their jobs would collapse. So whilst arguments about units are interesting, no final formulae can or ever will exist. So far as Einstein is concerned the whole thing hinges upon whether any object with mass can move at a relative speed (to that of the universe) greater than the velocity of photons. The answer is less clearcut than physicists would have us believe. Indeed, at this very moment I am informed that certain objects have been observed by astronomers that may be moving faster than lightwaves. Information is scanty and I have no references I can quote.

Incidentally, if atomic particles moving near the speed C do get heavier, how come wires don't weigh heavier when current flows? (Yes – I know the 'peas in a drainpipe' analogy, but a moment's thought will disclose that whilst the electrons may not move very far, they have to have peak speeds approaching C when they 'bounce', for the impulse cannot move faster than the peak speed of the 'peas' – ask Steve Davis!)

Ronald G. Young
Peacehaven
East Sussex

WIRELESS WORLD AUGUST 1982

THE DEATH OF ELECTRIC CURRENT

After Dermond O'Reilly's second blistering attack, May 1982, perhaps Ivor Catt should slink away with his tail between his legs.

When discussing a TEM wave, it is common practice to use the formula O'Reilly objects to, $E/H = \sqrt{\mu/\epsilon}$. See for instance Bell, *Wireless World*, August 1979, page 44, and also A. F. Kip, "Electricity and Magnetism", page 332, equation 12.34. Kip uses the popular convention, where vectors are written in bold type and the amplitudes of vectors are written in faint type. In *Wireless World*, July 1979, page 73, the diagram immediately above my equation (a) that O'Reilly objects to makes it clear that amplitudes are being discussed.

Para. 3. Where is it said by anyone but O'Reilly that a wave is called transverse EM because displacement current flows across it? On the contrary, a wave is described as TEM because E (not dD/dt) and M are transverse. dD/dt has nothing to do with it, and will not even exist in the case of a steady TEM signal. O'Reilly makes this very point earlier in the same paragraph, that the bulk of a steady TEM wave contains no displacement current.

Following your publication in the December 1980 issue of my article 'Death of electric current', you published a letter by R. T. Lamb and my reply to his letter, both in the March 1981 issue. The following quotations from my reply show that I found Lamb's letter muddled;

> "I think Mr Lamb has reversed physicists and engineers."
> "Lamb seems to call Theory N 'the current model' and Theory H 'e-m theory'."

Lamb himself wrote, among other things;

> "This is a broad generalization and, like all such, has exceptions, so please don't rush to quote them at me!"

You then published R. T. Lamb's reply to my reply in September 1981. Here the plot really thickens. For instance, I have no idea what "principal assertion" he refers to in his first sentence:

> "I was pleased to note that Ivor Catt, in his reply to my letter (March issue), gave yet another example of the truth of its principal assertion."

Presumably he is promoting a particular philosophical position in the matter of theory, fact, hypothesis, truth and so on. If he is, then he should give us references to the originator of his philosophical view, or if it originates with himself, he should state it clearly.

Which model of Kepler's is he discussing in his second paragraph, September 1981, when he says:

> "Kepler's problem was that the central construct of his model . . ."?

There should have been more information, or reference to the literature where the particular activity of Kepler is discussed. Lamb may be talking about the ellipse, or the Harmony of the Spheres, or something else. Again, we see Lamb's ability to pitchfork confusion into a discussion.

In the December 1981 issue, you published my reply to Lamb's September letter. Then in April 1982 you published his reply. Again, Lamb confuses the issue. Even though in my latest reply, December 1981, I wrote, "If Lamb thinks (unlike me) that a mere model is in dispute, why the tenacity?", Lamb comes back with the reply, April 1982; " . . . [Ivor Catt] seems to acknowledge that we are discussing models of reality and not reality itself."

A dialogue, or debate, between two parties is of little value if the debaters ignore what the other man is saying.

Lamb's apparent assertion in paragraph three that it can be experimentally established that RC discharge current does not continue for ever I find astonishing. Also, in the last sentence of that paragraph, what does he mean by "an e.m. wave model"? Is that phrase yet another misnomer for a theory of mine? I don't know. I always name my theories clearly.

In his second paragraph, April 1982, it is unacceptable, because muddling, if he does not clearly specify which "other correspondents" have shown that the " 'insurmountable difficulties' introduced by ρ and J exist only in Mr Catt's mind." No one has retrieved classical electromagnetism from the death-blow dealt to it by the question in my letter of August 1981. It is of crucial importance to establish whether classical electromagnetism collapsed in August 1981, so I am sending a personal request to each of the following experts to submit an answer to *Wireless World*; Professors Mott, Dirac, Salaam, Brown, Lindsay, Bleaney, Gosling and Mr G. G. Scarrott.

The internal contradiction in classical electromagnetism is contained within this set of axioms;

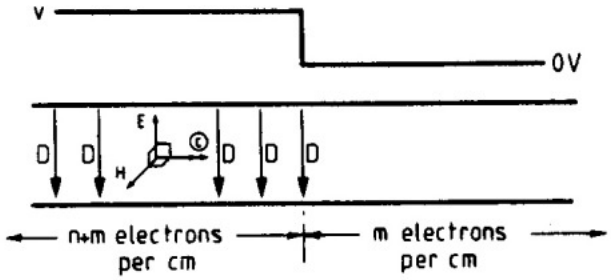
1) A transverse electromagnetic wave (TEM) travels without change at the speed of light in a vacuum, guided by two perfect conductors.
2) Lines of electric flux terminate on electric charge. (This is one of Maxwell's equations.)
3) Electric charge cannot be created or destroyed.

"The internal contradiction .... "(above) starts the first clear statement of "The Catt Question". (Do a Google search for "pepper frs".) This is the first fundamental flaw in classical electromagnetism after the paper "Displacement Current" in December 1978, here at page 34. Then there was a delay of thirty years before further flaws were pointed out. The response to "Displacement Current" and "The Catt Question" has been minimal. – Ivor Catt, August 2011.

4) Electric charge travels slowly in a conductor significantly slower than the velocity of light in a vacuum.

Now consider a TEM voltage step travelling to the right between two perfect conductors.

Behind the step, the D lines from the upper (more positive) conductor terminate in electrons, n per cm length of conductor, in (on) the lower conductor. These electrons are in addition to the electrons, m per cm, which neutralise the holes in the molecules of the lower conductor.



Ahead of the voltage step, m electrons per cm length of lower conductor are present, neutralising the holes. During the next 1/30 nanosecond, the voltage step moves forward by 1 cm (approx.), so that n new electrons appear in this section of the lower conductor, to terminate the newly appearing tubes of D flux between the two conductors. Where do they come from? Not from the upper conductor, because by definition, displacement current is not the flow of electrons. Not from somewhere to the left, behind the voltage step, because such electrons would have to travel at the speed of light in a vacuum.

Ergo, classical electromagnetism, which for this purpose includes both Theory N and Theory H, is dead.

Ivor Catt
C.A.M. Consultants
St. Albans

THE RIGHT FORMULA

Two points of information. First, regarding Mr Young's letter in the July issue "The Right Formula", the super-luminal velocities he mentions in astronomical objects are adequately explained as illusions created by high-energy beam phenomena (see, for example, *Scientific American* June 1982).

Secondly, having consulted several dictionaries of a range of authorship, even one dating back to 1932 (Nuttall's Popular Dictionary of the English Language), I find that every one gives the pronunciation of "patent" as being acceptable with either long or short "a". I object to Mr Fox's tone in his article in the same issue and will continue to pronounce "patent" similar to "latent".

K. Wood,
Ipswich,
Suffolk

Ronald G. Young of Peacehaven asks in his July 1982 Letter to you "How come wires don't weigh heavier when current flows?" In Einstein's Special Theory of Relativity one of the end results is that mass is energy, gravity is acceleration and time is space. Units of mass and units of energy are therefore related and it comes about that 1 gram is 9×10^{20} ergs.

Now, if one passes 1 amp through a wire of resistance 1 ohm with a potential difference of 1 volt the energy required to do so is 1 watt, which is equal to 10^7 ergs per second.

According to physicists, 1 gram is equivalent to 9×10^{20} ergs. Now 10^7 ergs are expanded by 6.2×10^{18} electrons per second and this corresponds to a mass of 1.1×10^{14} grams per second. The confusion between mass, amps and ergs lies in their "Relativity" and different frames of reference perhaps. One may measure the distance of a star from earth in feet, miles, seconds or light years or even angles. Mass is a measure of resistance to a change of velocity.

O. B. Balean,
Chatham,
Kent

In July, R. G. Young wrote, ". . . . all such 'theories' [e.g. Theory C, *WW* Dec. 1980] are purely human artifacts, designed to make predictions of the way things work!"

Young is describing the reigning philosophy in science today, called "instrumentalism" by Karl Popper, see "Conjectures and Refutations", RKP, 1963, p100. As Popper says on page 101, instrumentalism is used in a defensive mood – to rescue the existing theory. The instrumentalist view is that the winning theory is the theory which has produced practical results, and that since there is no such thing as absolute truth (which last remark is held to be absolutely true!), we should not modify our theories if they are serving well enough.

The flaw in the instrumentalist argument is that the decision on whether the old theory serves well enough is a value judgement based on experience, and if (as is the case) the guardians of the faith – professors, lecturers, Nobel prize winners and text book writers – have no experience of high speed logic (and have never used a sampling oscilloscope), they will reject (and in my case suppress) theories which help in that field. Instrumentalism is the philosophical rationale for a general clamp-down on progress in science into new fields by those whose experience, careers and prestige are based on the old (analogue) experience.

Young writes, "Does Mr Catt find his theories enable him to do better design work?"

The pre-Catt pot-pourri which served as electromagnetic theory (see for instance D. B. Jarvis, "The effects of interconnections on high-speed logic circuits," *IEEE Trans. Electronic Computers*, vol. EC-12, pp476-487, Oct. 1963), could not help me to successfully design high speed systems (see Fall Joint Computer Conference, 1966). The new Catt theories were developed in order to make possible the reliable interconnection of high speed (1 ns) logic gates.

The refusal to publish my theories by instrumentalists in the IEE, the Institute of Physics and elsewhere led to a collapse in the use of fast (1 ns) logic gates already available in 1964 and a decline back to slower t.t.l., and then to the very slow microprocessors of today. The computer industry has paid a heavy price for the suppression of theoretical advances by means of instrumentalist arguments. Still today, hardly anyone can successfully assemble 1 ns logic as I did in 1964.

Similarly, in the field of computer architecture, the suppression of the content addressable memory by instrumentalists who only know (and who live off) von Neumann has blocked advance towards more practical machines for a third of a century.

References.

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2. M. H. and B. R. MacRoberts, "The Scientific Referee System", *Speculations in Science and Technology*, Vol. 3, No. 5 (1980) – p573-578
3. I. Catt, "The scientific reception system as a servomechanism", *Journal of Information Science 2* (1980) pp 307-308

Ivor Catt
St Albans
Herts.

WIRELESS WORLD OCTOBER 1982

THE DEATH OF ELECTRIC CURRENT

Oh dear! Ivor Catt's latest letter (August) identifies him as a prime candidate for compulsory reading of Dr Scott Murray's series of articles. Then, at least, he might not confuse theories.

Classical electromagnetism, as developed by Maxwell in the 1860's, makes no appeal to the existence of the electron. For the case of a wave guided by a pair of wires, the wires determine the boundary conditions to the solution of the equations. Electrostatic theory requires that electric flux lines terminate on charges, but this is not always so for the electromagnetic wave. In any case, the classical theory of electric conduction imposes no limit on the speed of charges in the conductors – that comes from relativity theory.

So, Mr Catt is muddling models, which brings me back to the original point. Electric current and electromagnetic waves are only mechanistic models of processes which are beyond our comprehension – what Dr Scott Murray calls miracles. Hence, to say that a model does not exist is meaningless. If Mr Catt chooses not to like the electric current model that is his privilege, but it does not seriously devalue the usefulness of the model, which is judged by criteria other than credibility or personal preference.

Incidentally, M. G. Wellard may wish to note that the speed of light in water (refractive index ~ 1.33) is considerably less than that in vacuum. Cerenkov radiation is the electromagnetic equivalent of Concorde's sonic boom. Its existence (which is a fact) does not conflict with relativity. Perhaps Mr Wellard will apologize to Cerenkov.

R. T. Lamb
British Telecom
Milton Keynes

If Mr Catt's difficulties with electromagnetism are summarised by the example he gives at the end of his letter of August 82 then perhaps he can be helped.

As a pulse travels along the line the charge that terminates the electric field lines is provided by a current I. This consists of mobile electrons of charge e and if there are n such electrons per unit length of the line their velocity is $v=I/ne$. Suppose that I=1A and the conductors are copper wires of 1 mm^2 cross section then, ignoring the skin effect V is about 10^{21} per cm. Thus with $e=1.6.10^{-19}C$ we have $V=6.10^{-3}$ cm s^{-1} or 2.10^{-13} the velocity of light. The skin effect, for a pulse of 1 ns risetime might raise V to 2 cm s^{-1} and, if the conductor is perfect and the electronic motion is solely limited by inertia V might even be as high as 100 cm s^{-1}, so that the electrons actually have to acquire a kinetic energy of $2.5.10^{-12}$ eV from the field.

F. N. H. Robinson
Clarendon Laboratory
Oxford

I write in response to Mr Ivor Catt's request in his letter on "The Death of Electric Current" (*W.W.* Aug. 1982).

The contradiction claimed by Mr Catt stems from his assumption that the apparent velocity with which charge moves along a conductor is the same as the velocity of individual electrons. It is well known from the free electron model of metals (see for example Solid State Physics: Second Edition: C. Kittel, Wiley 1956) that this is not the case. The current density, J (A/m), is given by NeV_D, where N is the number of electrons per cu. metre, e the electronic charge and V_D the drift velocity of the electrons. The drift velocity is the directed velocity component resulting from an electric field and superimposed on the thermal velocities of the electrons. The drift velocity is much less than the thermal velocity except in electric fields of very high values. The current density may be interpreted as qv, where q is the charge per unit length of conductor to sustain the electric flux of the TEM wave and v is the velocity with which the wave moves. Hence,

$$vq = NeV_D$$

and $V_D/v = q/Ne$ will be a small ratio in typical conductors. The statement that "such electrons would have to travel at the speed of light in a vacuum" is thus wrong.

Dr J. Brown, C.B.E.
Technical Director
Marconi Electronic Devices Ltd

WIRELESS WORLD NOVEMBER 1982

THE RIGHT FORMULA

Mr K. Wood cites an example in Letters, September 1982, which was not the one I had in mind. The one that intrigued me was a throwaway remark by Patrick Moore that an American observatory (I failed to catch the name) had observed the products of a supernova expanding at *ten* times the speed of light. I do not believe any valid explanation has as yet been put forward for the phenomena.

Mr O. B. Balean has figures closely paralling my own. What is not clear to me is why it is a mathematical 'figment'! It seems an awful lot of mass to 'lose', yet plainly it does not exist. Perhaps it is 'relativistic mass' which is the figment.

Mr Ivor Catt seemed rather tetchy! I suppose it must be rather frustrating when adjudicators demand 'proof' and he simply doesn't have any! Why is he so bitter about 'instrumentalists'? Is there any way of working with electronics without using instruments? He implies he uses a sampling oscilloscope and certainly uses a computer. His remark that 'today, hardly anyone can successfully assemble 1ns logic' is highly suspect, since pulse circuitry is peculiarly adaptable to analysis by computers and checking by multiple-beam oscilloscopes. Is it really true that Mr Catt's theory came *before* he had found out how to do the job?

What *is* a 'theory', anyway? I read his letter and find he uses the word to mean (a) an equation, (b) an aid to understanding, (c) an extension of electromagnetic concepts and (d) a new way to view the phenomena. All in one letter! Surely the engineering comes *first*. Later on, the academics follow along, as always a few years behind! After all, isn't the whole fun of electronics the fact that we don't know how anything really works, we just know that if we do so'n'so, such'n'such happens and on such slender bases huge industries grow.

I would merely ask Mr Catt two questions. What is the use of a theory if it doesn't predict what a circuit will do?

The second question is an equation:

$$\frac{E}{R}=?$$

Ronald G. Young
Peacehaven
Sussex

DEATH OF ELECTRIC CURRENT

In August 1982, page 60, I discussed a serious anomaly in classical electromagnetism which, if unresolved, must force us to reject the conventional view of the subject as invalid. I asked eight leading experts to comment. Three did, but one of these asked that his comments remain unpublished. The second reply, by Professor Abdus Salem, was as follows:

> "Dear Dr Catt, I am sorry I cannot write to the Journal as you suggest, since you seem to be having a private discussion in which it would be fruitless to enter for an outsider. With kindest regards, Yours sincerely, Abdus Salam."

I am very grateful to Professor J. Brown, CBE for the third reply, Letters, October.

Brown does not seem to grasp the problem, which is that 1/30 nanosecond after the state shown in the diagram, electric charge must have reached a distance 1 cm further to the right, ahead of the wavefront's position shown in the diagram. To get there, the charge must travel at the speed of light in a vacuum so as to be in place to sustain the newly appearing electric flux. It is not good enough for ten times as much charge to travel at a tenth of the speed; the correct charge would have to travel at the full speed.

The letter from Dr J. Brown, CBE, was published in *Wireless World*, October 1982, along with a letter from F. N. H. Robinson, who makes the same elementary error, which is that if I have promised to deliver one dozen eggs to Oxford, one hour from now, Oxford being 100 miles away, there is no point in despatching ten dozen eggs in a vehicle which travels at only 10 mile/h. I must find a way to transport eggs at 100 mile/h.

Today, 80% of electronics is digital, and the primitive in digital electronics is a logic step travelling from one gate to the next. The reigning theory *must* cope reasonably with this, Theory C (*Wireless World*, Dec. 1980) does so perfectly, and no other theory does.

* * *

In answer to R. T. Lamb's letter, WW Oct 1982, I never attributed the existence of the electron to Maxwell. The four axioms that I stated in my August 1982 letter do not mention the electron. Later on in my letter I adopt conventional parlance, which embraces the electron. However, the content of what I said remains equally disastrous for the conventional view if for "n electrons" you read "n coulombs of charge".

"Classical electromagnetism" is not Maxwell taken out of deep freeze. Rather, it is the Maxwell view embellished by later luminaries.

Lamb goes on to write, "Electrostatic theory requires that electric flux lines terminate on charges, but this is not always so for the electromagnetic wave." By this statement, he sets himself apart from the whole tradition in electromagnetic theory. Can he supply any reference or expert to support this extraordinary statement, that a line of electric flux does not have to terminate on electric charge?

Ivor Catt
St Albans
Herts

Although Ivor Catt has again been rather dropped on (Letters, October), he should regard that as a small price to pay for the privilege of being instrumental in exposing the shortcomings of our current physical theories.

Almost everyone's picture of the behaviour of a radio dipole is of electrons rushing from one end of it to the other, and back again, once in every r.f. cycle; it is easy to see that in order to travel anything like two half-wavelengths in one r.f. cycle the average velocity of the electrons would have to be something like c, the velocity of light. But if one does the sums the result turns out to be not like that at all. A *heavy* electric current – one that makes a copper wire too hot to touch – corresponds to an electron flow of only about one millimetre per second, irrespective of the gauge of the wire.

So it would seem that the rapidly-moving "lines of force" of Heinrich Hertz's radiation field cannot be connected to the real electric charges that are carried by real, slow-moving electrons. They must terminate instead on imaginary charges which oscillate at the speed of light, or at least at velocity v where, as Dr Brown says, "v is the velocity with which the wave moves", which is as near to c as makes no matter. Nobody at my school told me that the "charges" of electromagnetic theory, which give rise to the electromagnetic radiation field, were *imaginary* charges . . .

The feature that I find amazing is that your correspondents do not seem at all disturbed by the difference – only a factor of 10^{12} or so! – which they agree exists between the values of the charge velocity according to the two theories. It isn't a matter of mixing models or of likes and dislikes; one at least of the theories must be wrong. So why not be honest and admit it?

Scott Murray
Cloughton
Yorks

I have followed Mr Catt's correspondence about his new theory of current flow with great interest, even if without a full understanding. As indeed I have the sentiments of those who think it possible that Einstein was not quite right in some of his conceptions. And moreover have often wondered myself.

It is extraordinary how mankind has made so much of his progress starting from ideas that later were contended to be quite wrong. For instance, how the 'flat earthists' of long, long, ago, went on their voyages of discovery and all came out right in the end. But, all based on notions that experience subsequently showed were not quite right. So with this in mind I am working hard to get into such mental state as will allow me to follow Mr Catt's new thinking.

Brought up as I was in the days of the gold-leaf electroscope, I can imagine how a source of potential can be applied to a conducting surface and spread out over it. As one can drop oil onto water and watch it spread out. I expect the new theory explains this, but that I have failed to grasp it.

Where I have failed miserably, in Mr Catt's terms, is to be able to visualize (because for such as myself, visualization is the only tool) how charges originate and subsequently dispose themselves, where both the surfaces concerned are non conductors. In other words. I go back as far as rubbing the ebonite rod with the cat's fur.

What is it that comes from where, and, what is sitting on what?

How I wish simplicity still ruled.

Ouida Dogg
Hurstpierpoint
West Sussex

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THE RIGHT FORMULA

In reply to Ronald G. Young's letter, November issue, the answers to the questions he posed for me are

1) a theory which does not predict practical results has no practical use

2) $R = E/I$ by definition.

As to his third paragraph, I would assure him that by the word 'instrumentalist', (see his book "Conjectures and Refutations", RKP, 1963, p100,) Karl Popper does not mean people who use instruments like oscilloscopes and computers. The brilliant Wireless World editorial of July 1981 mentions instrumentalism, and puts Young's position into historical perspective.

As to my bitterness about instrumentalists, I give good reason in my September 1982 letter.

Those college professors, institution officials and Nobel prize winners who (unlike me) get salaries, expense accounts and fringe benefits from electromagnetic theory – I understand that the dinners for potentates in the IEE are very lavish – are seen in the recent *Wireless World* debate entitled "Dispacement Current" and "Death of Electric Current" to be abysmally ignorant of their subject, and yet those same people as referees of learned journals, have for ten years exercised their power by preventing me from publishing my results in any learned journal in Britain or the USA, including journals of the IEE, IEEE, Inst. Phys.

Some *Wireless World* readers will be surprised to learn that during 25 years of work, I have never succeeded in publishing any of my work in any British learned journal. The defences against new information are particularly strong in Britain. The Inst. Phys. broke their contract with us to publish the paper. "The History of Displacement Current" (later published in *Wireless World* March 1979) when they discovered that it contained new information. If one did not become bitter over such a scenario, when would one?

The arrogance of the ignorant power brokers in our society seems limitless when it comes to suppressing scientific advances by Catt, Heaviside, Galileo etc. The ability to manoeuver one's way to the top of the IEE or Inst. Phys. is no justification for suppressing advances in the disciplines which generate the financial base of those institutions. If these people resent their good faith being questioned, then I look forward to being invited to publish in their journals and lecture in their halls.

Further reading

1. T. Jaynes, Foundations of Probability Theory and Statistical Mechanics, from Delaware Seminar in the Foundation of Physics, ed. Mario Bunge, Springer-Verlag Berlin 1967. (Library of Congress no. 67-16650). First chapter "What makes theories grow?" pp. 77-83.

2. O. Heaviside, Electrical Papers Vol. 1. Macmillan London 1892, pp. vii-x. Heaviside discusses the way in which his publications were blocked. It includes "Perhaps it was thought that official views were so much more likely to be right that it was safe to decline the discussion of novel views in such striking opposition thereto. There seemed also to be an idea that official views, in virtue of their official nature, should not be controverted or criticised . . . "

Ivor Catt
C.A.M. Consultants

DEATH OF ELECTRIC CURRENT

December 1982, when Dogg questions Catt I think the editor should smell a Ratt, and check the telephone directory.

For the new (Theory C) model for the charged capacitor, go to the penultimate diagram, page 80, *Wireless World* Dec. 1980. Now assume that a small section in the middle of the top plate is lossy, e.g. there is a 50 ohm resistor. Now replace that 50 ohm resistor by a piece of 50 ohm coax going straight upward, out of the paper, from the centre of the top conductor. Conventional theory for reflection at discontinuities in a transmission line (and we now have three paths leaving this point; to the right, to the left, and upward) leads us to conclude that no energy will travel up the new branch. That is, a "steady" charged capacitor ignores deviations from perfect conduction in a plate of the capacitor. This means that one plate could have been made of ebonite and the other could be a cat's fur. Now move the two 'plates' away from each other. The standing wave of energy current remains, reciprocating to and fro in the space between the now distant plates.

Theory C has nothing to say about the effect of rubbing the ebonite rod with the cat's fur. Rome was not built in a day.

Ivor Catt

Hooray for Ouida Dogg's letter in your December issue! A person after my own heart who wants a simple explanation which can be visualised.

Having myself done a fair amount or rubbing various insulators with cat fur (synthetic) and silk (also synthetic), I was led to believe that some substances have a greater "affinity" (sic) for electrons than others. In the course of the friction electrons were grabbed either by the cloth or the insulator – usually a rod. The one which lost electrons became more positive, and the other more negative. Because the rod was an insulator it was stuck with a charge until the electrons slowly re-distributed themselves, partly through the air and into or out of the rest of the world. The cloth, being grasped by a moist hand, usually did this quickly; but it could be held in insulating tongs.

This simple theory was easily visualised and easily supported by experiments with a gold-leaf electroscope (also synthetic).

Along came semiconductors, and we had to think of positive holes moving around. Soon afterwards Nuffield Science came into schools; and electroscopes, magnetometers, quadrant electrometers and other "boring" gadgets became old hat.

With due respect to those who *can* keep up with developments and even explain them fairly lucidly (thank you Mr Catt), let us praise such famous names as Scroggie (Foundations of Wireless), Camm (innumerable publications for beginners), Cocking (Wireless Servicing Manual), Sylvanus P. Thompson FRS (Calculus Made Easy, 1910 ff), and Cathode Ray of *Wireless World* in the 1950s. These were people who knew the score and could help us along.

John P. Marchant
Putnoe
Bedford