

Paignton Devon

June 13. 93.

Dear Prof. Fitzgerald. I certainly do believe
that the idea of inertia should be associated
with μ (inductivity) and the idea of momentum
with B (the induction). I do not mean that
the one is density and the other velocity \times density,
but that we sh^d understand it in a generalised
sense, as, for example, in the well-known case
of a rotating body with one degree of freedom,
(moment of inertia etc etc). It has always been
a puzzle to me how Maxwell could have
made A the electrokinetic momentum. I
could not see it at first, and all later knowledge
has led me further & further away from A to
 B for the "momentum". The example you
mention is, however, very peculiar. It is, I
think made plainer by taking a real case,
(very approximately) of subsidence of dis-
placement (initially static) and with it, of
the associated electrification, in a finite
conducting dielectric. The distribⁿ remains
static, and subsides all over alike at the
same rate, according to the time-constant
 $\epsilon - Kt/c$ in rational units, (K conductivity

ϵ permittivity or spec. ind. cap^y), without
magnetic induction, or electric current, (force) or
flux of energy. The electric energy is degraded
to heat on the spot. I see no good reason to
doubt the theory, as it perfectly harmonises with
the behaviour of conducting condensers; but
as regards the theory I have remarked in my
E.L. mag. Th^y § 195 "It sh^d be remembered that
we are dealing always with matter in the gross,
& not with molecules at all; or equivalently,
we assume a homogeneous constitution of the
elements of volume. Thus, when displacement
subsides in an electric conductor without gen-
erating magnetic force, the possibility and
necessity of which are clearly indicated by the
two circuital laws, it may be that if we go
in between the molecules there is magnetic force.
It is, indeed, difficult to conceive how displ^t
in a heterogeneous medium of mol^r constitution
c^d be done away with without the generatⁿ of
mag. force, considering that the energy of the
displ^t is converted into heat energy. This matter
however does not belong to the skeleton theory
of electromagnetism, but is rather to be considered
as a side-matter involving physical hypotheses
to account for the influence of matter upon
the electromagnetic laws". In another form,
in a skeleton theory we can take no cognisance
of irregular magnetic force, but only of that

which prevails over the internal irregularity; and in the case of subsidence without apparent mag. force, there is still the irregular sort between the molecules, with no resultant momentum.

The question is of course a different one from that of the Kinetic notion of the electric energy. If we enlarge Maxwell's electromagnetic scheme by admitting magnetic conductivity as well as electric, we introduce a number of phenomena which have no real existence, and at the same time make the scheme perfectly symmetrical on the electric & magnetic order, so that we could not get the slightest information as to whether the electric or the magnetic energy was to be ^{probably} considered the potential energy (in the usual sense). But as there is no plain sign of the extra phenomena due to magnetic conductivity the case is different, and it seems to me that the usual course is right, that mag. energy is Kinetic, and el. energy potential. I do not by that mean that ~~the~~ ^{the latter} may not be itself ultimately ~~potential~~ Kinetic as well; perhaps it is so necessarily, but that it is potential in the same sense as the energy of a strained spring ^{at rest} is said to be potential, although it may be ultimately Kinetic. There is a

practical distinction.

As regards inertia of the electric current itself I don't see why it sh^d have any inertia, or what evidence there is that it has any. It seems to me that those who believe it has sh^d give plain form and substance to the idea, so that it could be worked out to see what results; but first perhaps have good grounds for believing in its existence.

You sh^d make allowance for my dogmatic style of writing. I am open to new views or evidence for all that. Of course Maxwell's theory cannot remain always in its present indefinite or abstract form, but must be developed physically. This involves, as you very well know, the nature of the ether, of matter, & of their connexion, & if we learn out gravitation, then we know beforehand that we have not got to the bottom of it.

Yours very sincerely

Oliver Heaviside

14/3