## LETTERS TO THE EDITOR.

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### The Existence of Absolute Motion.

THE article of Prof. Schuster's in your number of March 15, entitled "A Plea for Absolute Motion," is very interesting, but I think there are several conceptions contained therein which will not bear analysis. Partly in reference to his article, therefore, but also because the question is such an important one, I think it may be well to consider as definitely as may be what direct observational or experimental evidence we have for a zero point of motion belonging to space alone, and to which all motions of material bodies may be referred.

Not to be entangled in the snare which is as old as human discussion, I define my terms for present use. By space I mean vacuum in the ordinary sense, that which exists in interplanetary space, that to which we approach in our laboratories, nothing more or less. We have good reason to believe that in the visible universe no other kind of space exists. This is not, I believe, Prof. Schuster's use of the word, but I shall try to show that it is the only proper scientific use.

By absolute motion I mean motion considered with reference to this space alone.

The first evidence is furnished by the observed orbits of binary stars. If the velocity of light is dependent on the motion of the source, light which left the star when its motion was toward the earth must of necessity reach us sooner than the light emitted when this approach component of the star's velocity was smaller or negative. The observed orbit would therefore be distorted in a perfectly definite manner. The fact that this distortion is not observed proves that the velocity of light is not dependent upon the velocity of the source, and must therefore depend upon some positional property of space alone.

The conclusion is vividly represented as follows:—Imagine a hollow sphere in space with a light source at its centre. In general, a light wave leaving the centre will not reach all parts of the surface in equal times. There exists, however, *one* motion of the sphere for which this condition is fulfilled, and this state, which is absolutely independent of all existing bodies, has a fundamental claim to be called absolute rest, because it depends on space alone.

Further evidence is furnished by the laws of electrodynamics. The magnetic effect of electric convection is generally considered to be now beyond question. From it we know that the electromagnetic attraction between two like point charges moving together is a function of their velocity. Since there is no relative motion of the two and they may be considered alone in space, the motion is with respect to space alone. The state of absolute rest is found when the electromagnetic attraction is zero for all directions of the line joining the two charges.

The evidence furnished by the Kaufmann experiment on the mass of a rapidly moving electron, indicating as it does a limiting velocity in space, also implies the existence of absolute motion.

The evidence is not so good as in the other cases, because the effect is complicated by the existence of an *outside* magnetic field with reference to which the electron moves.

I foresee Prof. Schuster's objection to the above. What I have considered he will call motion relative to the ether, while his argument was based on space in a philosophical sense. I have carefully avoided the term ether. It seems to me the word has nothing to do with the discussion. The universe, out to the furthermost visible star, is of such a nature as to be traversed by light. With space in any other sense we have nothing whatever to do, because it does not exist in the visible universe. Even if such "space" did exist outside the visible universe, it is difficult to understand how our observational data could have any bearing on the matter.

*Finally, if any more argument is necessary to show that* the only space we can consider is that which surrounds us in the universe, it might be derived from the fundamental notion of space perception. Our perception of space is brought about through various sensations, sensations which are caused by events which do not take place in a hypothetical space, non-existent so far as we know, but in the real space which surrounds us. Our very use of the word therefore arises out of experience, and to think of another space is to form only what Mr. Spencer would have called "a symbolic conception." Indeed, I fear if this fundamental standpoint of perception were strictly adhered to, those arguing from the standpoint of another space would have great difficulty in making themselves clear. We cannot be too careful, it seems to me, in considering the origin of our fundamental conceptions.

At any rate, real space, as has been pointed out, possesses a positional, or perhaps better a motional, attribute, and so gives us a basis, founded on experience, for a conception of absolute motion.

DANIEL COMSTOCK.

Zürich, Switzerland, April 3.

### The Magnetic Inertia of a Charged Conductor in a Field of Force.

I THINK there is, in Another Place, possibly some misunderstanding concerning the inertia of a moving charged conductor due to the magnetic energy set up by its motion. It depends upon the distribution of the electrification, and may vary from a minimum up to infinity. No question of distortion due to high speed is involved, so the theory is quite simple. Say a sphere of radius $a$ has any distribution of surface charge. For simplicity, let it be symmetrical round the axis of motion, so that the surface density is representable by the sum of any number of zonal harmonic distributions. The corresponding magnetic fields follow. Their magnetic energies are all independent, so that the actual magnetic energy is the sum of the separate magnetic energies.

The really practical case, which is also very simple, is when the conductor has a charge Q and moves in a uniform electric field F. Then the surface density is

$$\sigma = Q/4\pi a^2 + 3c\text{F} \cos\theta, \qquad (1)$$

where $\theta$ is the polar angle. The magnetic force is

$$\text{H} = \text{H}_1 + \text{H}_2 = (\text{Q}u/4\pi r^2)\sin\theta + 3c\text{F}(a^3u/r^3)\sin\theta\cos\theta. \qquad (2)$$

The magnetic energy is $\Sigma\frac{1}{2}\mu\text{H}^2$, and by integration comes to

$$\text{T} = \tfrac{1}{2}u^2[\mu\text{Q}^2/6\pi a + \tfrac{3}{5}\mu c^2\text{F}^2\pi a^3]. \qquad ($$

The magnetic inertia is therefore $m = m_1(1+h)$, where $m_1$ is the value for the uniform charge, or $m_1 = \mu\text{Q}^2/6\pi a$, and

$$h = n^2/15\pi, \quad \text{if } n = (3\text{F})(4\pi a^2 c/\text{Q}). \qquad (4)$$

This $n$ is the ratio of the induced electric force at the pole to the undisturbed force. If $n=1$, F is just large enough to make the surface density be zero at one pole. Then $h = 1/47$. This is the increased inertia due to the disturbance of the distribution of the charge. The "equation of motion" under F is

$$\text{FQ} = \{m + m_1(1+h)\}\dot{u}, \qquad (5)$$

where $m$ is the mass of the body. The whole is subject to the restriction of small $u/v$ and small acceleration, so that the electric and magnetic fields sensibly travel with the charge. Nor need F be constant in space or in time, provided it does not vary too rapidly in relation to the size of the conductor. In slow motion the magnetic energy is the fraction $u^2/v^2$ of that part of the electric energy that depends upon the transverse electric force.

April 3. OLIVER HEAVISIDE.

### Old Customs and Festivals.

MY mother, now in her eightieth year, was led by a recent article by Sir Norman Lockyer in NATURE to relate some reminiscences of some of the festivals formerly celebrated in Newton-on-Ayr. One of these seems to point to ancient human sacrifices. In *her* mother's school-days, the pupils of Newton-on-Ayr annually elected a king and a *queen on Candlemas Day. On "Pase Friday" (Good*