Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 279.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Inertia and Energy

A LUCID account has been provided by Lord Rutherford in his James Watt lecture (NATURE, Jan. 25) of the recent extraordinary development in the world of atomic projectiles and rays, which would be incredible on the usual electric basis were it not that, from the nature of the subject, as soon as a result is announced it is capable of immediate test, with marvellous precision, by the experts in other laboratories. A basic principle in the speculative side of this subject is the identity of mass and energy, including extinction of structural atoms, which the chemical world, with its great tradition and achievement, appears to accept with equanimity; it has, however, as now appears, been coming into question, but can of course be adjusted by the supposition that there are types of energy hitherto unrecognised. For, as Lord Rutherford insists, universal energy is an abstraction, unheard of a century ago, and repudiated even much later by great astronomers; and energy as well as mass is relative, depending on the frame of reference.

The discrepancy now encountered may permit reference to another aspect of the case, not loosely supported. So far as I am aware, this dogma of identity pertains strictly only to the abstract four-fold continuum (now changing into translatory *quanta* ?) of space-time, in which energy is merely the last of the ten components of a fundamental tensor into which it is found that mass (except inertia of atomic spin ?) has to be fitted. But this abstract translatory mass in the universe of space-time has, as one may note, nothing to do directly with the inertia that is measured by an observer with his instruments which are located in his own environment in his personal space and time, with which alone even astronomers can deal. Incidentally, one is here tempted to quote a pronouncement of Torricelli ages ago which fascinated Clerk Maxwell (at the end of the "Treatise", § 866), that energy "is a quintessence of so subtle a nature that it cannot be contained in any vessel except the inmost substance of material things".

The present subject takes on a different, though doubtless more intricate, aspect when developed directly, as it was originally, in terms of the associated (Lorentz) group of frames of reference of the various possible related observers travelling throughout the unique universe, of which the space-time merely affords a hypergeometric condensation convenient for certain purposes of analysis. But the subject, surely fundamental in metaphysics as well as in cosmical physics, scarcely admits of brief exposition. A discussion, from the side of this experimental foundation in spaces and times of observers, relating specially to the inertia of radiation and its interchange with the inertia of the radiators, involving loss of kinetic mass from the latter, may be referred to in a lecture by the writer to the International Association of Mathematicians at Cambridge (1912), reprinted with cognate papers and notes in "Mathematical and Physical Papers" (1928), cf. vol. 2, p. 444; the verification there is restricted, as coming from a Lorentz transformation, to *translatory energy* in relation to *translatory inertia*.

JOSEPH LARMOR.

Holywood,
Co. Down.
Feb. 2.

'Extra' Rings in Graphite Electron Diffraction Patterns

RECENTLY we have obtained transmission patterns from graphite powders in which prominent 'extra' rings appear; owing to insufficient resolution these have hitherto escaped notice. Two of these rings lie in a band comprising also the 100 and 101 diffractions (see Fig. 1), and others lie out beyond this region. These 'extra' rings have been obtained from both natural and artificial graphite powders of high carbon content, and are therefore not due to impurities; nor can they be ascribed to a Lennard-Jones surface lattice deviation effect, because the sharpness of the 110 ring negatives any such explanation. The dimensions of the 'extra' rings and the manner in which they break up into arcs on inclining an orientated specimen in the beam shows that these rings are due to planes, the spacings of which have no counterpart in the structure assigned to graphite by X-rays.

FIG. 1. Electron diffraction pattern (much enlarged) from graphite powder.

A relatively thick graphite crystal gives a Kikuchi line pattern which, however, completely confirms the X-ray structure, whilst a sufficiently thin flake cleaved from the same crystal gives a cross-grating type of pattern containing the 'extra' diffractions. Hence we are faced with the apparent paradox that although the thick and thin crystals must both have the same lattice structure, the thin crystals contain certain Bragg plane spacings not exhibited by the thicker graphite. It seems to us that the solution lies in the fact that in the case of a thin graphite flake the periodicity of certain lattice rows is not fully developed; hence parallel planes are not necessarily equally densely populated. Thus, let