# Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 554.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

## Physical Units and their Dimensions

HAVING an interest in astrophysics, and chemistry, and telegraphy, for each of which some knowledge of electrical quantities and relations is required, more than I can carry in my head, a problem arises where to find it. It has been solved for my case by use of a single page appendix to a treatise on astronomy, which I keep handy with the page turned down, and which provides all that I need. I would not dream of remembering the complexities of nomenclature of an electrotechnical handbook. I observe that all this is now in the melting pot again, with its 'gilbert, gauss, oersted and maxwell' and so on, under new international auspices of some kind, to judge by letters in NATURE which I do not comprehend even by guesswork. Do the technicians of the great industrial corporations really desire to cut themselves off from the general sciences, or do they merely ignore this activity as a play of professors ?

I am old enough to remember the beginnings of standard technical units, first in Kelvin's laboratory owing to the needs of submarine telegraphy, extended later to marvellously precise measurements mainly in the Cavendish Laboratory under Rayleigh's guidance, with results in values and nomenclature adopted into a universal practice mainly through Kelvin's international diplomatic gift. Once the now familiar c.g.s. unitary frame was adopted, the relevant electric unitary quantities followed, from their mutual relations in terms of one of them, thus forming a linear system, their dimensions as deduced from illustrative examples relative to the frame presuming that their relations are for all such examples of mutually consistent mechanical type.

It appears that the electrotechnicians are now invited to inhabit a world of their own in which c.g.s. are replaced by M.K.S., one moreover in which even the classical electrodynamic equations may be replaced by new ones peculiar to them. The standard units on the original c.g.s. frame were indeed in like manner too small for practical electric purposes, and were changed by the original founders to a secondary system affected by powers of 10, for example, a secondary unit concisely specified as $10^8$ c.g.s. being named out of international compliment a volt, and so on. This correlation by factors that are powers of 10 appeared to be simple and universally acceptable. But these secondary units must also be bound together by a basic system of their own, to replace cm., gr., sec. I find on consulting § 620 of the relevant chapter (not too lucid) of Maxwell's "Treatise", a book now almost as obsolete as the "Principia", that this necessary basic system is $10^9$ cm., $10^{-11}$ gm., sec. Thus the secondary unit of mechanical force would be $10^{-2}$ dyne, and so on: on the M.K.S., namely, $10^2$ cm., $10^3$ gm., sec. frame now apparently proposed, it would be $10^5$ dyne. These extensions into mechanics have, however, hitherto been scarcely thought of: while the concise device of powers of 10 as ratios of the units of the same entity that arise has proved precise and adequate without divorce of electrotechnic theory from the scheme of general science. Why cannot it be let alone ? But, by the way, on the other side of this account, may not the use by theorists, now introduced into Britain, of the hybrid electric unitary system favoured by Helmholtz, be a cause of dimensional inconsistencies as possibly felt by practicians ?

A deeper analysis in this regard, indicating a wider significance, is suggested. To secure unambiguous dimensions, the units must be a linear scheme with freedom of transformation backwards and forwards. This can be so, because there is presumed to be a unique ultimate theory which has to be on a mechanical basis as resting on length, mass, time, a presumption which might be called the Kelvin postulate. But regions of this final connected map of phenomena are concealed, and the partial effective theories, for example, the familiar electrostatic and the electromagnetic developments, are built up by working round these blank regions in different ways, establishing contacts where feasible while *ex hypothesi* they cannot show mutual contradictions. Thus, the test that every term in a summation formula must have the same dimensions is an indirect probe that the formula conforms to this unique ultimate foundation scheme. The assignment of dimensions to $K$ or $\mu$, after Rucker, promotes this unification of all systems of units virtually by adding a fourth variable to the c.g.s. three. The deeper significance for dimensions thus indicated has its origin historically with Gauss and Weber, rather than with Newton or Fourier; for they explored and compared the two widely removed paths of experimental entry into what proved to be the same range of phenomena of electrics, and identified them as far as might be; as is illustrated by Weber's recognition that the two resulting modes of measure of charge must be connected in terms of a velocity, while his experiments indicated, almost before its time, in advance of theory, that the velocity of light is here involved.

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Sept. 11.

## Magnetic Storms and Upper-Atmospheric Ionisation

Now that measurements of upper-atmospheric ionisation can be made, using methods of radio exploration, it is of interest to see whether abnormal values of ionisation density are associated with periods of magnetic activity. We have conducted such an inquiry using the measurements of ionisation density in Region $F_2$ of the ionosphere made at the Radio Research Station, Slough, together with the daily magnetic character figures from the Abinger Observatory supplied to us by the Astronomer Royal.