LETTERS TO THE EDITOR

PROMPT publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the twentieth of the preceding month; for the second issue, the fifth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

To Contributors

It is now five years since the establishment of the Letters to the Editor section in the *Physical Review*. Its growth in that period, both in volume and in interest, has been gratifying, but there are two considerations which cause us some concern.

The more serious of these is the growing tendency among contributors to be satisfied with the hasty, incomplete, and often inadequate record of their investigations which the Letters to the Editor section provides. Few enjoy the labor of preparing a complete, critical and well considered report of their work, particularly when the primary urge to secure priority for it can be satisfied by dashing off a Letter to the Editor.

The less serious, but none the less troubling, consideration is the ever increasing cost of maintaining this section. In the past five years there has been a healthy growth in the number of Letters submitted, from 120 to about 220 per year. There has, however, been at the same time a not so healthy growth in the average length of these Letters from about 500 to 750 words.

These considerations make it necessary to use rather more Editorial supervision of the Letters submitted than in the past and the Editors would, therefore, like to formulate the policies which will govern that supervision.

The primary purpose for which the Letters to the Editor section was established was to provide prompt publication for new results in fields of general current interest or importance, or for the exchange of ideas about them. It was intended neither that it should be a place for the preliminary announcement of *all* work nor that, in the fields covered, it should replace more formal and critical articles. If the present tendency to record much of the important work in several laboratories by a series of Letters to the Editor of gradually increasing length is continued, the standard of scientific exposition in the *Physical Review* will be seriously lowered.

The Editors ask for your cooperation in the following particulars:

1. In cases where there may be doubt each contribution in the form of a Letter to the Editor should be accompanied by a letter stating the reasons this form of publication is desired.

2. Except under unusual circumstances no Letter to the Editor should be longer than 600 words.

THE BOARD OF EDITORS

Hysteresis Losses and the Area of the Hysteresis Loop

Emil Warburg[1] was the first to propose that the area of what later came to be called a hysteresis loop measures the energy losses during a slow traversal of the magnetic states represented by its consecutive points. He was careful to remark in his analysis that the magetic force was assumed to be homogeneous throughout the specimen. In the wires he used, also, the magnetic force H was parallel to the magnetization I. (We translate his terminology into more modern form.) Under these conditions his result may be stated as follows:

$$W_h = \oint H dI.$$

More generally, if **H** and **I** are vectors:

$$W_h = \oint \mathbf{H} \cdot d\mathbf{I}.$$

The assumption of homogeneous **H** in actual ferromagnetic specimens is no longer tenable, for it now appears that **I** is merely a space average over a multitude of small regions (domains) in each of which there is always approximate saturation, $I_i = I_\infty$, in some direction. Changes in **I** in the neighborhood of $I = 0$ are principally due to reversals of magnetization in such domains. This involves extreme inhomogeneity in magnetic force, even if we consider only its average value in single domains, $\mathbf{H}_1, \mathbf{H}_2, \cdots, \mathbf{H}_i$. If as in actual specimens with residual strains, large numbers of domains reverse together, **H** may be still more variable. Now it is not generally true that the average scalar product of two vector point functions is equal to the scalar product of their averages. We conclude that the equations given above can only be approximately correct and may, for very small loops, be very far from adequate. It is also, we think, obvious that inhomogeneous $\mathbf{H}_i$ generally involve additional positive terms in W_h. As an extreme case we may suppose that a reversal occurs in a domain magnetized at right angles to the average magnetic field. This would contribute nothing to $\oint \mathbf{H} \cdot d\mathbf{I}$ but would still involve dissipation of energy. Even as regards the components of the $\mathbf{H}_i$ parallel to **H** it is reasonable to suppose that contributions to the space average $d\mathbf{I}$ are more probable where $\mathbf{H}_i$ has a larger component parallel to $d\mathbf{I}$ than has the space average **H**. The values of $\mathbf{H}_i$ at places where changes occur will, on this view, be in advance of the value **H** in a cyclic process.

This argument offers a new approach to the problem of anomalous losses in alternating magnetization of small amplitude when total losses are of the order of 10^{-5} erg/cm^3/cycle. The alternating-current bridge, which measures all energy losses, would be expected to include the effects of inhomogeneity which are missed by ballistic and magnetometric methods. It will then be unnecessary to suppose[2] that the quasi-static $I-H$ loop differs from the loop traversed at frequencies of a few cycles per second. The correction to Warburg's law will depend upon the distribution function for $\mathbf{H}_i$ and this may be expected to vary widely in different materials. Such variability is characteristic of the anomalous losses.

It may be well to consider how the extra energy gets into a specimen from a primary circuit, especially in the case of alternating magnetization. The energy represented by the ordinary hysteresis loop may be regarded as due to a net inward energy flux through the bounding surface depending on the mean vector product of the electric vector **E** and the magnetic vector **H** at all its points. The internal inhomogeneities must result in local variations of **E** and **H** from point to point on this boundary corresponding to an additional inward flux of energy. The importance of the dimensions of comagnetized regions is perhaps more readily appreciated from this point of view, which may be more natural to many. We are indebted to T. C. Fry for bringing this way of presenting the matter to our attention.

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[1] E. Warburg, Ann. d. Physik [3] 13, 141–164 (1881).
[2] As, for example, has recently been done by E. A. Neumann, Zeits. f. Physik **89**, 309–318 (1934).

Electron Microscopy of Biological Objects

In a previous communication[1] we discussed the possibilities of electron-microscopy of biological objects and presented 4 methods to preserve the objects from destruction: (1) Intense cooling of the object (for example, by contact with an extremely thin metal foil); (2) Impregnating the object with a substance which makes the object less destructible; (3) Impregnating the object in such a way that a framework of the object is preserved although the object itself is destroyed; (4a) Combining methods (1) and (2) or (4b) Combining methods (1) and (3).

In the same communications we presented our first microphotographs obtained by the third method. This method presents the disadvantage that only coherent "frameworks" can be photographed. In the case of vegetal or animal tissues, for instance, they are only the cell-walls which are visible and the inner parts of the cells (protoplasm, nucleus) are failing in absence of any object-holder (Fig. 1).

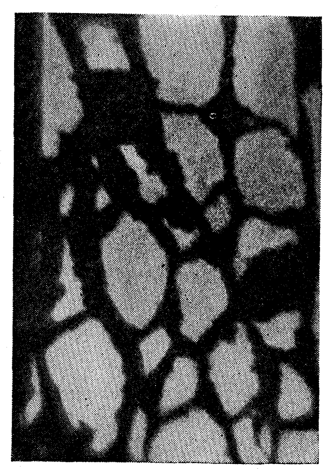

Fig. 1. Seaweed. ×1000.