members" previous torsion, and precision is impaired; the iron "remembers" the preceding cycle, and energy is wasted in concentrating its wandering attention.

Not the least remarkable thing about falling stones, and gravitational action in general, is the lack of hysteresis, or memory.

WILLARD J. FISHER
NEW HAMPSHIRE COLLEGE,
DURHAM, N. H.

LAG AND LEAD WITH A BRAUN TUBE

IN arranging an experiment to show lag and lead with a Braun tube I hit upon a method that was very effective and may possibly be of use to others.

The tube, with its axis horizontal, was excited by an induction coil with a break of variable speed. Two coils were used to produce the magnetic field, one with its axis vertical, and the other with its axis horizontal, and both with axes perpendicular to the axis of the tube. The distance of the one coil from the tube could be varied. If an alternating current was sent through the coil with horizontal axis it would produce a vertical line on the fluorescent screen when the tube was excited. If now the period of the vibrator of the coil was changed until the frequency of the alternating current was nearly equal to a multiple of the frequency of the coil the stroboscopic effect would make the spot of light move slowly up and down on the screen. With the current flowing through the other coil the spot would move back and forth on the screen. When the alternating current from the same source is led into both coils the spot moves up and down diagonally at an angle of 45°.

If now considerable inductance is introduced into one circuit the spot will move around in an ellipse in one direction, but if a condenser takes the place of the inductance the spot moves in an ellipse in the *opposite* direction. Varying the inductance varies the width of the ellipse so that the amount of lag or lead is roughly indicated. If both inductance and capacity are put into the same circuit the width of the ellipse is reduced, showing the neutralizing effect of capacity on inductance.

JOHN FRED. MOHLER
DICKINSON COLLEGE,
November 28, 1913

A SECOND OCCURRENCE OF ICHTHYOSAURIAN REMAINS IN THE BENTON CRETACEOUS

IN 1905[1] Dr. John C. Merrian announced the discovery of Ichthyosaur-like remains in the Benton of Wyoming. That it was not an accidental occurrence now appears to be indicated by the finding of a second specimen in these same beds. Recently I have received for examination a single badly worn vertebral centrum, collected during the summer of 1913 by Mr. C. J. Hares, of the U. S. Geological Survey in the Mowrey shales, some 12 miles west of Casper, Wyoming. This vertebra is of the typical biconcave ichthyosaurian type and in its present condition is indistinguishable from those of *Baptanodon*. The fragmentary nature of the specimen precludes the possibility of determining its true generic affinities, but as recording a second occurrence of ichthyosaur-like remains in the Benton, the specimen is at the least of interest.

CHARLES W. GILMORE
U. S. NATIONAL MUSEUM

A MISNAMED PORTRAIT OF JOHN SHAW BILLINGS

TO THE EDITOR OF SCIENCE: Dr. S. Weir Mitchell's appreciative memoir of the late Dr. Billings in your current issue is not accompanied by a picture and does not refer to one; so the present note may be acceptable. On p. 223 of Vol. VII. of the "Photographic History of the Civil War" the upper right portrait represents Dr. Billings during the war as an assistant surgeon with the rank of first lieutenant; it is misnamed "Brevet Lieut. Col. J. J. Woodward." This legend really belongs to the lower left portrait, which in turn is misnamed "Brevet Major C. B. Greenleaf." To which of the two other portraits this belongs I can not say. In this connection may be noted another error in the work above named. In Vol. X., on p. 263, the portrait named "David R. Jones" is that of Samuel

[1] SCIENCE, N. S., Vol. XXII., No. 568, pp. 640–641.

Jones, identical with that in his book, "The Siege of Charleston." BURT G. WILDER

BROOKLINE, MASS., December 12, 1913

SCIENTIFIC BOOKS

Researches in Magneto-Optics, With Special Reference to the Magnetic Resolution of Spectrum Lines. By P. ZEEMAN. (Macmillan's Science Monographs.) London: Macmillan and Co., Ltd. 1913. Pp. xvi + 219 + viii plates.

Since the discovery by Zeeman in 1896 of the resolution of spectrum lines in the magnetic field, works have appeared at intervals which summarized the development of the subject to the date of publication. Each of these has been needed when it appeared, partly by reason of differences in treatment by the several authors, but chiefly because of the continuous output of new matter, both on the experimental and theoretical sides; so that an author, by the time his book was off the press, would welcome an opportunity to add numerous footnotes or an extensive appendix.

The investigation of the Zeeman effect during these seventeen years impresses one as having been very ably conducted. The immediate development of the elementary theory by Lorentz gave the phenomenon the place in relation to the theories of light and of electricity which it has ever since maintained. Although the demands on instrumental equipment are severe, the rich field and the close connection with theory caused investigations to be taken up in many laboratories and the requirements have greatly stimulated the development of optical methods. In some cases, theory has predicted a result which at once appeared when the experiment was tried. On the other hand, if one compares the original explanation of the normal triplet with the involved mathematical treatments employed to account for the complex resolutions, the pressure exerted on the theorists by the laboratory results is quite apparent. The development of the theory, however, has been one of growth from a beginning still regarded as sound.

In the book under review, Professor Zeeman has given us an account, simple in language, largely historical in arrangement, and occasionally touched with personal reminiscence, which records in a highly attractive manner the main features of the investigations started by his discovery. It is in keeping with the title and with the series of monographs to which this book belongs that the author devotes his closest analysis to those features of the phenomenon which have been studied in his own laboratory. This involves the correlation of his results with those of others on these subjects, but other important lines of investigation, such as the application to spectral series, are not omitted.

The first chapter is devoted to the instrumental means employed in the study of the Zeeman effect, especially as regards the efficiency of different spectroscopes in giving the high resolving power required. Emphasis is laid on the three requirements of great resolving power, high magnetic field-strength, and sharpness of spectrum lines for the best results in this work. At the close of the chapter we are reminded of what has occurred to many investigators, that we are near the limit of field strength to be obtained from an iron-cored magnet, and that the hope of great advance, both as to intensity and uniformity of field, lies in the use of a large solenoid. Although the construction of this would require a larger expenditure than has ever been devoted to a single line of physical research, the certainty of the results would seem to make the adoption of the method only a question of time.

The early investigations on emission spectra and the derivation of e/m from the separation of the normal triplet are treated in the second chapter, and the author passes next to the "inverse effect," or the magnetic resolution of absorption lines. This branch of the study must be regarded as still in a preliminary stage. A decided stimulus has been given to the examination of the inverse effect by the discovery of the magnetic field in sun-spots, and much important work, described in a later chapter, has been done by Zeeman himself. The methods are quite different from