of sea ice, taken from Captain Scott's narrative of his South Pole expedition, which recalls the subject to mind. This picture seems to afford a very decided support for the above theory.

I conceive that the conditions under which eskers were formed were similar to those illustrated by this view of a pressure ridge, although in this case the ridge is understood to have been formed in ice resting on water. It is possible that at the time of the formation of the esker ridges the movement of the ice was facilitated by water underlying the sheet over considerable areas, so that the ice was partially afloat at least for portions of each year.

Very pronounced ridges of boulders and other material are formed under weather conditions now existing around the shores of small interior lakes in cold climates by the "push" of the ice that covers the lakes each winter.

I believe that the seasonal variations in temperature that must have occurred even during the low average temperature of the glacial period, with resulting changes in the internal structure and movements of the ice, constituted an influence of more importance in connection with general glacial phenomena than has heretofore been recognized.

The "trough" or depression along one or both sides of the ridge which sometimes occurs as a marked feature in connection with an esker was probably due primarily to the greater scooping and shoving effects of the ice on the underlying earth material immediately adjacent to the ridge, on account of the broken condition of the ice and the increased weight resulting from increased thickness and the superimposed broken blocks and fragments. The esker ridge itself and such side depressions would sometimes determine or materially modify the immediate post-glacial drainage of the locality, when the depressions would become still further emphasized by stream erosion during and after the melting of the ice. Furthermore, the "delta formation" sometimes found near the end of the esker is thus explained.

A theory similar to the above is applicable to certain irregular detached groups of knolls or hummocks and short ridges with intervening troughs and hollows, called *kame* areas. Some examples of these may mark a sort of focus for the lateral shove from various directions of the surrounding ice sheet. In at least one locality that has been studied in considerable detail the assumption of the formation of an interglacial ridge by a process similar to that described above, but with a direction transverse to that of the general movement of the ice sheet, seems to afford a clue to an explanation of several surface features of the vicinity, and possibly this may also apply to some special cases where there has been difficulty in fitting the terminal moraine theory with entire satisfaction.

The probability of an extensive ice sheet of moderate thickness in comparison with that of earlier ice "invasions" of the same area, and as the final stage of the glacial period for the region in question, suggests other interesting deductions in connection with the causes of present surface forms. JOHN MILLIS

November 25, 1913

MATTER AND MEMORY

ON reading with interest the article of Professor R. D. Carmichael, SCIENCE, December 19, I find on page 869 a statement which can not pass as entirely general: " . . . mind . . . has chosen to assume that matter is without memory."

While in abstract reasoning we prefer to assume that matter has no memory, nevertheless we well know that in all too many cases this assumption is made for simplicity, not for exactness. The existence of zero drift, permanent set, elastic, magnetic and dielectric hysteresis, etc., so complicates the actual conditions, by making them dependent on the previous experiences of the material under consideration, that we can not set up ideally exact general equations. The complications are by no means as overwhelming as those, for example, which present themselves in dealing with warm-blooded animals, but they are real. What the instrument-maker desires is matter which does forget, whether he be interested in galvanometer suspensions or transformer cores. To speak figuratively, the suspension "remembers" 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.

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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.

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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.

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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.