others in the American Museum in Lane Co., Kansas.

It measured fourteen feet in length and was eight inches in diameter at its proximal end where it was broken from the upper jaw. Dr. Matthews assures me that it is the largest specimen so far recorded, I regret to say that it was not saved owing to its friable nature.

CHARLES H. STERNBERG

CONCERNING STENO

TO THE EDITOR OF SCIENCE: It happens to all of us to fancy that what is new to us must be new to the world; and if we fail to look in the right places we do not become disenchanted.

The recent reference in SCIENCE (May 10) to Steno's noted work on crystallography and a newly-discovered English translation of it, led me to wonder if all the great bibliographers had overlooked the latter. The four authorities that came to hand first were Brunet, the British Museum Catalogue, Watts's 'Bibliotheca Britannica' and Poggendorff's 'Biog.-lit.-Worterbuch'; all of these include H. O.'s translation of Steno, except Brunet, who has few scientific titles and does not include this in any language. The translation is also cited in the 'Catalogue' appended to Young's 'Natural Philosophy,' about 1805.

The guess and conclusion that H. O. was Henry Oldenburg is confirmed by the article about him in the 'Dictionary of National Biography.'

This incident will strengthen the views of those who think that a prerequisite to any advanced degree should be a short course in bibliography; for, whatever Pope meant by his lines, they are increasingly true to-day:

* * * Index-learning turns no student pale,
Yet holds the eel of science by the tail.

C. K. W.

WASHINGTON, D. C.,
June 4, 1907

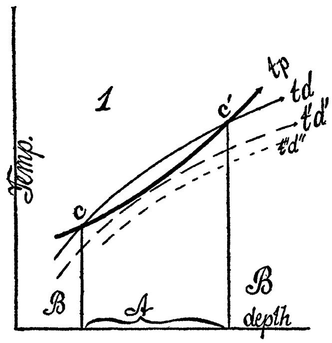
SPECIAL ARTICLES

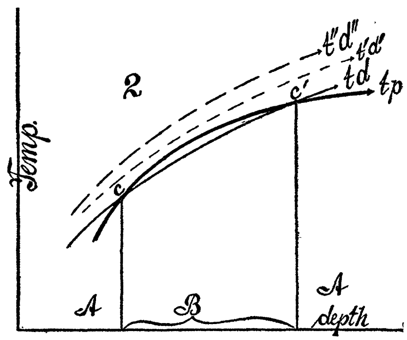
ON SUN SPOTS

APROPOS of certain recent discussions on solar activity to which I listened with pleasure in Philadelphia, I have wondered whether a possible analogy between geyser-like action and periodic solar disturbance has been suggested. For instance, let the line td in the diagram represent the distribution of temperature and depth below the solar surface, or, from some points of view, the distribution of temperature relative to pressure. Let the line tp represent the condition of transition, referred to temperature and depth, from an atomic form A to an atomic form B. Below the tp line the element B is stable, above it A is stable. At depths corresponding to c or c', therefore, neither form is persistently stable, but as the spherical shells are thin there need be no marked consequences. To make the engine work, two points of intersection, c, should occur.

I shall assume that the transition of A into B takes place along a doubly inflected intrinsic isotherm for the system AB, after the manner explained by James Thomson and Van der Waals. It therefore requires a certain amount of 'supersaturation,' or an excess of heating, to affect the transfer from A to B, in the absence of special external interferences. I shall also assume that the transfer A to B is accompanied by an evolution of heat, B to A by an absorption of heat, and that the A matter is eliminated from the whole active region by gravitational convection. Finally different atomic forms are arranged between concentric spherical shells, according to their density.

Suppose, therefore, as a first alternative, that after a sun-spot period, the td line has been depressed by the sudden cooling of all active strata to the position $t'd'$ in Fig. 1. The points c have been displaced towards each other and have quite vanished from the curve. B matter only is present. In the lapse of time, however, the line $t'd'$ again rises to reach td, due to heat arriving from below, within the depths bracketed in the now unstable state A. It is agreed that the td position will have to be very closely approached, or a considerable 'supersaturation' will be required, before another eruption occurs, which drops the td line to $t'd'$ in turn. Whereas the depression of this line is relatively sudden, its gradual rise together with the prop-





erties of the AB system determines the frequency of the sun-spot period: the element A escapes (let us say) in gaseous form. As the curves are drawn there is not sufficient 'supersaturation' to transmute A to B. This would occur at $t''d''$ for instance.

The relation of the curves td and tp will vary with the solar latitude, for td is a mere graph of temperature and depth while tp is inherently a graph of temperature and pressure. On passing from pole to equator tp moves bodily from left to right in diagram. At the poles the region A may thus be permanently absent, while at the equator $t'd'$ may never fall below tp. Hence, an intermediate sun-spot zone may be inferred.

Finally it is clear that the cycle of changes may be reversed as in Fig. 2. Let the transition of A into B be a source of heat, and let the ensuing eleven years of the sun-spot period be an interval of cooling. Immediately after eruption, the temperature depth line will have some high position, $t'd'$, and A matter only is in occurrence. As the sun cools superficially, $t'd'$ tends toward td, and between the depths c and c', B matter is potentially present. When, after sufficient 'supersaturation,' the transition A to B ultimately does occur, tp is again raised to $t'p'$; and so on in turn. The engine works at the expense of atomic energy, supposing that B matter[1] is continually eliminated from the active region by gravitation, as the $t''d''$ condition is not reached.

CARL BARUS

[1] If corpuscles leave A to transfer it into B, an absence of these may prohibit the reversed transfer BA.

DOES THE MAMMALIAN HEART OBEY THE LAW FOR CHEMICAL REACTION VELOCITIES AS INFLUENCED BY TEMPERATURE?

IN a recent paper[1] it was shown that the temperature coefficient for the velocity of the heart-beat in mammals is the same as that for a purely chemical reaction. From the results of previous workers who experimented upon the influence of temperature upon the mammalian heart this fact was shown in a clear and decisive manner. At that time the writer had not yet seen Herlitzka's paper.[2] This author takes data out of only three of the fifteen to eighteen tables in Langendorff's paper, and determines a few constants. In one case, table XIV., in a range of temperature from 23° to 39° C., he exhibits only five constants. Between 29° and 35.2° there are no constants shown, but for these degrees he finds the constants 3.45 and 10.8, and then complains that these constants do not represent the curve of the formula for a chemical reaction velocity for temperature, but rather a straight line. In tables VII. and VIII. he says that the values observed correspond well enough with the values of K calculated from the formula, but that one, for 35° (3.74), is too high!

Herlitzka has looked at a few individual cases of Langendorff's results. On the other hand, the present writer put all of Langendorff's results (from fifteen cat hearts) together into one table; put the figures in round numbers and determined the constants from

[1] Snyder, Charles D., *Amer. Jour. of Physiology*, December 1, 1906.

[2] Herlitzka, 'Richerche sull' azione della temperatura sul cuore isolato di Mammifero,' *Zeitschrift f. Allgemeine Physiologie*, V., 264, 1905.