aspects; though, as I conceive, the geographical, climatological, and geological elements in the problem are not to be arbitrarily distinguished. Now I am far away from all books of reference, and it is of course essential that I make myself acquainted with what has already been done in these subjects, and I venture to ask for any hints as to the bibliography of them. Can you tell me if anyone has done for geology what Hirsch, of Berlin, has done for geography (in his work on the distribution of disease)? Is there any authority on the chemistry of soils, and what I roughly call their physiology and pathology, their structural and functional changes under influences—climate notably—and their own intrinsic, and the deeper geological interactions?

A. ERNEST ROBERTS.

Meywar Bheel Corps, Kherwara, Central India, September 9.

The Earthquake of Tokio, April 18, 1889.

DR. VON REBEUR-PASCHWITZ'S letter, which appeared in NATURE, vol. xl. p. 294, is of special interest to us in Japan, countenancing as it does the conjecture that the very peculiar earthquake felt and registered here on April 18 was the result of a disturbance of unusual magnitude. It was my good fortune on the day in question to be engaged in conversation with Prof. Sekiya in the Seismological Laboratory at the very instant the earthquake occurred. We at once rushed to the room where the self-recording instruments lay, and there, for the first time in our experience, had the delight of viewing the pointers mark their sinuous curves on the revolving plates and cylinders. At first sight it seemed as if the pointers had gone mad, tracing out sinuosities of amplitudes five or six times greater than the greatest that had ever before been recorded in Tokio. There was not much *sensation* of an earthquake; indeed, after the first slight tremor that attracted our attention, we felt nothing at all, although in the irregular oscillations of the seismograph pointers we had evidence enough that an earthquake was passing. Very few in Tokio were aware that there had been an earthquake till they read the report of it in the next day's papers. Thus the motion, though large, was too slow to cause any of the usual sensations that accompany earthquakes, and suggested a distant origin and a large disturbance, with a consequent wide extension of seismic effect. Excepting the slight tremors recorded at Potsdam and Wilhelmshaven, there has been, so far, no evidence of any such far-reaching action.

My object in writing this note, however, is to correct an error of calculation which Dr. von Rebeur-Paschwitz has unwittingly made. He has assumed that Tokio standard time is mean local time. On the contrary, the standard time for all Japan is the mean solar time for longitude 135° E.,—that is, nine hours in advance of Greenwich mean time. Hence, instead of the Tokio earthquake having preceded the German disturbance by 1h. 4·3m. it preceded it by only 45m. This correction increases the velocity of transmission to 3060 metres per second. We must assume, then, either that large disturbances in the heart of the earth travel with exceptionally high speeds, or that the origin of the disturbance was a considerable distance from Tokio. The latter assumption seems sufficiently satisfactory, if in other respects Dr. von Rebeur-Paschwitz's views meet with approval.

CARGILL G. KNOTT.

Imperial University, Tokio, Japan, September 25.

A Brilliant Meteor.

YESTERDAY evening, November 4, at 7.55 p.m., I was fortunate enough to observe a very brilliant meteor. It became visible almost exactly at the zenith, or a little west of it, and moved, as nearly as I could judge, due east, magnetic; it remained visible for about from one to two seconds, disappearing, finally, rather low down on the eastern horizon. For the first half of its journey it was of a dazzling white brightness, and then it suddenly became a dull red spark. The light emitted from it when brightest reminded me of the light from an arc lamp, and was very much brighter than any of the fixed stars.

As it was so short a time in view, and there were no stars visible, I could only approximately estimate its point of appearance and path. There were a few clouds about, mostly in the west, and the moon was behind them. PAUL A. COBBOLD.

Warwick School, November 5.

ON THE HARDENING AND TEMPERING OF STEEL.[1]

II.

THE following considerations appear to have guided Osmond in beginning his investigations (see *ante*, p. 16). Bearing in mind the fact that molecular change in a body is always accompanied by evolution or absorption of heat, which is, indeed, the surest indication of the occurrence of molecular change, he studied with the aid of a chronograph what takes place during the slow cooling and the slow heating of masses of iron or steel, using, as a thermometer to measure the temperature of the mass, a thermo-electric couple of platinum and of platinum containing 10 per cent. of rhodium, converting the indications of the galvanometer into temperatures by Tait's formulæ.

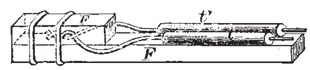

FIG. 5.

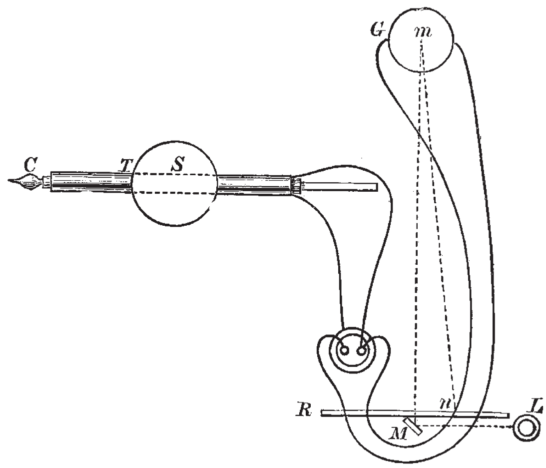

FIG. 6.

FIGS. 5 and 6 show the actual mode of conducting the experiments. F (Fig. 5) is a piece of steel into which a platinum and platinum-rhodium couple, *t*, *t'*, is fixed. It is inclosed in a glazed porcelain tube and heated to bright redness in the furnace, S (Fig. 6). This tube, T, may be filled with any gaseous atmosphere. C is a bulb filled with chloride of calcium. The metal under examination is slowly cooled down. The wires from the thermo-couple pass to the galvanometer, G. The rate of cooling of the mass is indicated by the movement of a spot of light from the galvanometer mirror at *m*, on the screen, R, and is recorded by a chronograph. The source of light is shown at L; M is a reflector.

In the next diagram (Fig. 7) temperatures through which a slowly-cooling mass of iron or steel passes, are arranged along the horizontal line, and the intervals of time during which the mass falls through a definite number (6·6) of degrees of temperature are shown vertically by ordinates. See what happens while a mass of electro-deposited iron (shown by a dotted line), which is as pure as any iron can be, slowly cools down. From 2000° to 870° it falls uniformly at the rate of about 2·2° a second, and the intervals of temperature are plotted as dots at the middle of the successive points of the intervals. When the temperature falls down to 858°, there is a sudden arrest in the fall of temperature, the indicating spot of light, instead of falling at a uniform rate of about 2° a second, suddenly takes 26

[1] A Lecture delivered on September 13, by Prof. W. C. Roberts-Austen, F.R.S., before the members of the British Association. Continued from p. 16.