ON THE SECULAR VARIATION OF THE MAGNETIC DECLINATION IN EKATERINBURG AND SIBERIA.

By ROBERT ABELS, *Physicist at the Ekaterinburg Observatory.*

Using as a basis the magnetic observations made by Dr. A. Smirnow in 1900, 1901, and 1909, and those in 1916, by the author of the present paper, as well as the observations at the Ekaterinburg Observatory, it is found that the magnetic needle reached recently in Siberia its maximum eastern declination and that it has begun its reverse movement towards the west.

At Ekaterinburg, the north end of the needle, since 1761, when the first determinations were made, until the year 1916, has moved constantly towards the east with a mean annual change of about four minutes. In 1761 the value of the declination was $0^{\circ}50'E$; in 1916, $11^{\circ}03.8'E$. For the year 1917, however, the annual mean value as obtained from the hourly observations at the Observatory, amounted to $11^{\circ}03.7'E$ and for 1918, $11^{\circ}03.4'E$. Accordingly, the needle remained stationary during 1916-1917, and in the following year moved 0.3 towards the west. It may be expected, therefore, that it will now continue to move toward the west.¹

The reverse movement of the magnetic needle began earlier in Siberia than at Ekaterinburg, as may be seen from the following data. Among the points at which the author made observations in 1916, there were four at which Smirnow had observed in 1901. These values, together with those obtained at Ekaterinburg, afford the following comparison:

TABLE 1

Station	Easterly Declination		Annual Change
	1901.5	1916.5	
Ekaterinburg.....	10 08. 6	11 03. 8	3. 7 E.
Petropavlovsk.....	12 26. 0	13 00. 1	2. 3 E.
Tatarskaja.....	12 06. 7	12 25. 8	1. 3 E.
Narym ²	14 31. 7	14 47. 0	1. 0 E.
Mariinsk.....	11 16. 0	11 02. 7	0. 9 W.

The magnetic needle, accordingly, during the period 1901-1916, or for the epoch 1909, moved, in general, towards the east, though with varying speed. In the west the movement was more rapid than in the east. At Mariinsk, however, where the movement of the magnetic needle was likewise previously easterly, the westerly movement began about 1909. There must, consequently, have been a point between Tatarskaja and Mariinsk, where the needle

¹ The mean annual value of the declination at the Observatory for 1919 was $11^{\circ}02.8'$; for 1920 $11^{\circ}01.9'$, and for 1921, $11^{\circ}01.5'$.

² Smirnow observed at Narym in 1900, and found the declination to be $14^{\circ}30.7'E$; one minute has been added to his value to refer it to the year 1901.

stood still in the epoch referred to. By interpolation, the geographic coordinates of this place are found to be $\phi = 55^{\circ}.8$ N; $\lambda = 82^{\circ}.9$ E of Gr. There must also have been such a point on the line joining Mariinsk and Narym, probably about $57^{\circ}.5$ N and $84^{\circ}.8$ E.

That the declination was easterly at Mariinsk before 1909 is clear from D. A. Smirnow's paper, entitled "Die magnetischen Elemente auf der Linie von Warschau bis Vladivostok nach den Beobachtungen von 1901, 1904, und 1909." (Bulletin de l'Académie Impériale des Sciences de St.-Petersbourg, 1910). On the last page of this work Smirnow compares the observations which he made at the same stations in 1901.5 and 1909.5. From these data are obtained the following annual changes which may be considered as applying to the epoch 1905.5:

TABLE 2
Annual change of declination 1905.5
(1901.5-1909.5)

Station	
Ekaterinburg.....	4. 5 E.
Petropavlovsk.....	3. 5 E.
Tomsk.....	2. 6 E.
Krasnojarsk.....	0. 9 E.
Irkutsk.....	1. 5 W.

This table gives a representation of the secular change in declination, similar to that shown in the foregoing table. Here also the change in declination is greater in the west than in the east. There is a difference, however, in that the place at which the needle stood still in the year 1905 was between Krasnojarsk and Irkutsk, that is, farther towards the east, than in 1909. By interpolation, we obtain for this place the coordinates, $\phi = 54^{\circ}.6$ N.; $\lambda = 97^{\circ}.2$ E.

We have found, then, that the magnetic needle ceased its easterly movement in 1905.5 at $\phi = 54^{\circ}.6$ N and $\lambda = 97^{\circ}.2$ E; in 1909.0 at $\phi = 55^{\circ}.8$ N and $\lambda = 82^{\circ}.9$ E and at $\phi = 57^{\circ}.5$ N and $\lambda = 84^{\circ}.8$ E, and in 1917.0 at $\phi = 56^{\circ}.8$ N and $\lambda = 60^{\circ}.6$ E.

The positions, at which the magnetic needle came to a stop, have accordingly moved gradually from east to west. The rate of this movement as obtained from the data for 1905.5 and 1917.0 is 3.2 degrees of longitude per year.

From the data for the year 1909, in combination with those for 1905, the annual motion is $4^{\circ}.2$ and $3^{\circ}.7$, while in combination with those for 1917, $2^{\circ}.8$ and $3^{\circ}.0$, respectively. In round numbers, then, the annual retrograde movement of the magnetic needle has amounted to 3 degrees of longitude.

In the application of this value it must be noted that it is perhaps dependent on geographical latitude, a fact which seems to be indicated by the two values for 1909. At any rate, there can be no doubt but that the magnetic needle will soon assume also in Europe, a westerly motion, just as is at present the case from Irkutsk to Ekaterinburg.