Terrestrial magnetism. — "*Do the forces causing the diurnal variation of terrestrial magnetism possess a potential?*" By Miss ANNIE VAN VLEUTEN. (Communicated by Dr. J. P. VAN DER STOK).

(Communicated in the meeting of June 30, 1917).

1. In their analysis of the diurnal field of variation, SCHUSTER [1]) and FRITSCHE [2]) assumed that this field possesses a potential, the necessity of this hypothesis not being proved a priori. For a test by means of integration along a closed curve on the surface sufficient data are still lacking, but another method enables us to inquire how far the horizontal forces can be deduced from one and the same function.

According to the Gaussian theory the potential of the terrestrial magnetic field is determined, when we know:

either the Northcomponent over the surface, or the Eastcomponent over the surface and the values of the force, directed North along a curve joining the two poles.

As in this case the forces are those causing the diurnal variation, hence completely periodical, the Eastcomponent on the surface alone is sufficient to determine the potential.

When for a number of points on the surface ΔX and ΔY are given, we can deduce from ΔX a function π_x representing the potential, if there exists such a function; in the same manner we can deduce from ΔY a function π_y and compare these two expressions.

2. From the diurnal variation at *Pavlovsk* (59°41 N. 30°29 E.); *Sitka* (57°3′ N. 135°20′ W.); *Irkoutsk* (52°16′ N. 104°19′ E.); *De Bilt* (52°6′ N. 5°11′ E.); *Cheltenham* (38°44′ N. 76°51′ W.); *Zi-ka Wei* (31°19′ N. 121°2′ E.); *Honolulu* (21°19′ N. 158°4′ W.); *Bombay* (18°54′ N. 72°49′ E.); *Buitenzorg* (6°35′ S. 106°47′ E.) and *Samoa* (13°48′ S. 171°46′ W.), all for the period 1906—1908, for each of the components a function has been deduced in this manner.[3])

1) The Diurnal Variation of Terr. Magn. Phil. Trans. Vol. 180 (1889) A.

2) Die Tagliche Periode der Erdm. Elemente St. Petersburg 1902

3) This research is treated more at length in a thesis for the doctorate.

TABLE I.

	g_1^1	h_1^1	g_2^1	h_2^1	g_3^1	h_3^1	g_4^1	h_4^1	g_2^2	h_2^2
SUMMER										
π_x	– 1.70	2.96	–11.45	1.81	– 8.33	– 1.61	27.71	– 5.76	1 60	–4.36
π_y	– 6.42	– 1.89	– 3.02	18.58	–34.41	–29.77	46.67	29.88	–0.31	–3.36
WINTER										
π_x	6.36	– 0.61	–13.31	1.77	1.78	– 0.87	22.99	– 1.30	0.50	–0.51
π_y	1.34	– 7.19	– 2.17	23.88	–35 26	–37.11	55.97	37.94	–3.00	1.55

	g_3^2	h_3^2	g_4^2	h_4^2	g_3^3	h_3^3	g_4^3	h_4^3	g_4^4	h_4^4
SUMMER										
π_x	9.76	– 1.91	2 62	0.94	0.26	2.31	– 4.01	2 03	0.03	–0.43
π_y	11.63	– 4 02	1.22	– 0.86	0.44	1.59	– 4 44	3.11	–0 29	–0.36
WINTER										
π_x	10.11	– 1.53	– 3.05	1.96	– 0.53	0.73	– 4.27	1.73	0 26	–0.52
π_y	15.80	5.74	– 8.17	3.78	0.43	– 0.88	– 5 23	3.82	0.31	–0.22

g_n^m and h_n^m are the coefficients of the function P_n^m, which GAUSS used in his "Allgemeine Theorie des Erdmagnetismus", where:

$$\frac{V}{R} = \sum_{n=1}^{n=\infty} P_n$$

$$P_n = \sum_{m=1}^{m=n} (g_n^m \cos m\lambda + h_n^m \sin m\lambda)\, P_n^m$$

λ represents the geographical longitude, V the potential, R the radius of the earth, the functions P_n differing from the spherical harmonics only by a numerical factor.

It is worth notice that most of the coefficients in π_x are much smaller than those in π_y, whereas the sign is not always the same.

3. If we want to know what part of these differences may be ascribed to the choice of the sets of observations, we have first to find out how far these coefficients represent the results of observation.

In order to avoid disturbing influences as much as possible, we used the diurnal variation on "*quiet*" days; in consequence of the use of the "international" quiet days the material for all the stations refers to the same days and therefore is as *homogeneous* as possible.

By means of the calculated values of g and h the FOURIER-coefficients for the diurnal variation were obtained for the places used in the calculation, and for the 10 stations an average deviation between calculated and observed amplitude (positive and negative values taken with the same sign) was found, amounting to

34 % in the diurnal, 35 % in the semi-diurnal period for ΔX
20 % " " " 16 % " " " " " ΔY

4. For a determination of the harmonic coefficients at other places a *graphic* interpolation is the most suitable. The calculated points in the diagram are joined by a smooth curve, by means of which the coefficients for each intermediate latitude can be read off. Moreover we can decide how far observations made at stations situated outside the interval 60° N.—14° S. follow the curve of the calculated points.

A test in this manner gave satisfactory results and led to the following conclusions:

a. In the main the curves would show the same character if more stations had been used for the calculation.

b. The difference between π_x and π_y cannot be completely attributed to insufficient observational material, i.o.w: The forces causing the diurnal variation, taken as a whole, do *not* possess a potential, although it remains always possible to deduce part of these forces from a potential.