NOTE ON A SIMPLE MEASURE OF THE EARTH'S DAILY MAGNETIC ACTIVITY.

By Louis A. Bauer.

In a timely paper[1] for the Rome meeting of the International Section of Terrestrial Magnetism and Electricity, Dr. G. van Dijk, of the De Bilt Observatory, makes a very desirable comparison, chiefly for the year 1915, of measures of terrestrial magnetic activity proposed by various investigators. For the various measures, designated below, the following symbols are used here: D, magnetic declination; H, horizontal intensity; Z, vertical intensity; R, absolute diurnal range, or difference between extreme daily values of element considered; and A, diurnal range of hourly values (mean value over 60-minute interval).

Quantity	Proposer and Institution	Designation
$A_h^x + A_d^h = A_d^x$	Bidlingmaier, Wilhelmshaven Observatory	Bi.
$\frac{1}{100}\Sigma(R_D^2 + R_H^2 + R_Z^2) = \Sigma R^2$	Chree, Kew Observatory	Ch.
$\Sigma(A_D + A_H + A_Z) = \Sigma A$	Schmidt, Potsdam Observatory	Sh.
$\Sigma(R_D + R_H + R_Z) = \Sigma R$	van Dijk, De Bilt Observatory	Di.
$\epsilon . H R_H$	Bauer, Department of Terrestrial Magnetism	Ba.
Σ(Mag. Char. Nos.) $= \Sigma C$	Magnetic Commission, International Meteorological Committee	Me.

If at any observatory the diurnal ranges of D and H are not available, then those of the rectangular components X and Y are to be used. In the second, third, and fourth measures the D-range is to be expressed in gammas, namely, $H R_D$.

Every one must feel indebted to Dr. van Dijk for having published the values of the above measures for each day of 1915, for the De Bilt Observatory, thus facilitating a fair comparison. Table 1 gives the mean monthly values as derived from van Dijk's tables, in which any unessential decimals have been omitted and the following additional columns have been added: SN, final sun-spot numbers according to Wolfer; SD, sun-spot departures or D-measures[2] of solar activity based on SN; and SP, mean daily prominence-

[1] Activity of the Earth's magnetism and magnetic characterization of days, *Ned. Met. Inst.*, No. 102, Utrecht, 1922.

[2] Bauer, L. A., *Terr. Mag.* vol. 26, p. 47.

areas observed at Kodaikanal, India, according to manuscript values courteously supplied by Evershed, October 19, 1921.

Fig. 1 shows the 9 curves based upon the data in Table 1. An inspection immediately shows a pronounced crest in June for all magnetic measures (Curves 2–6), excepting for the character numbers (Curve 9). This June crest in the magnetic curves occurs one month earlier than the crest in the sun-spot curve (No. 1); it, however, occurs in the same month (June) as does the crest in the *D*-measure of solar activity (Curve 7).[3] For Curve 3 (Ch-measure) the peak is most pronounced because of the method of computation in which the *squares* of the ranges of the diurnal variation are used. It may thus happen for this measure, that, as in the case of the Bi-measure, a few days of large disturbance, or

TABLE 1. *Monthly mean measures of daily magnetic activity based on the De Bilt magnetic observations for 1915*

Month	S.N.	Bi	Ch	Sh	Di	Ba	S.D.	S.P.	Me
Jan.....	*23.0*	*8.1*	*66*	*73*	*110*	*7.9*	*8.3*	4.4	18.6
Feb.....	42.3	13.6	97	97	142	9.0	23.1	3.9	22.5
Mar.....	38.8	24.6	163	141	190	13.1	18.4	7.1	**23.8**
Apr.....	41.3	26.8	156	143	189	12.1	20.4	6.1	21.4
May.....	33.0	23.1	124	134	171	11.4	26.4	5.6	20.5
Jun.....	68.8	**53.8**	**361**	**173**	**224**	**16.1**	**49.0**	3.8	21.4
Jul.....	**71.6**	31.4	*148*	*158*	*190*	13.0	28.1	3.6	*16.5*
Aug.....	69.6	32.4	158	160	205	13.7	21.8	6.0	21.1
Sep.....	*49.5*	*29.8*	190	149	203	13.1	*16.9*	4.8	20.6
Oct.....	**53.5**	**38.4**	288	**159**	**233**	14.6	**19.8**	6.7	27.0
Nov.....	42.5	32.6	**299**	140	224	**16.1**	11.1	4.4	**28.9**
Dec.....	34.5	14.5	121	83	132	9.4	10.5	5.2	18.9
Mean.....	47.4	27.4	181	134	184	12.5	21.2	5.3	21.8
Curve.....	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

even but one day, may practically control the value of the measure for the entire month. Take, for example, June 17, 1915, when a very severe magnetic disturbance occurred. According to van Dijk's figures, the various measures contribute the following percentages to their respective monthly means: Bi, 44; Ch, 62; Sh, 15; Di, 20; Ba, 21. It is thus seen that "Ch" was affected most by one-day's severe disturbance, and "Sh" least, which is no doubt chiefly due to the fact that in the computation extreme ranges were not used, as in the case of "Di" and "Ba", but *smoothed* ranges, i. e., ranges from the hourly 60-minute means.

The measures "Bi" and "Ch" may also suffer from the fact that they depend on quadratic formulæ; hence, in order to get their mean values for a month, it is necessary to compute the measures for *each* day. For the linear measures, "Sh", "Di", and "Ba", the mean monthly measure may be derived directly from the difference between the monthly mean maximum and minimum values,

[3] See my previous article *Terr. Mag.*, vol. 26, 1921, Fig. V, and explanation, p. 62.

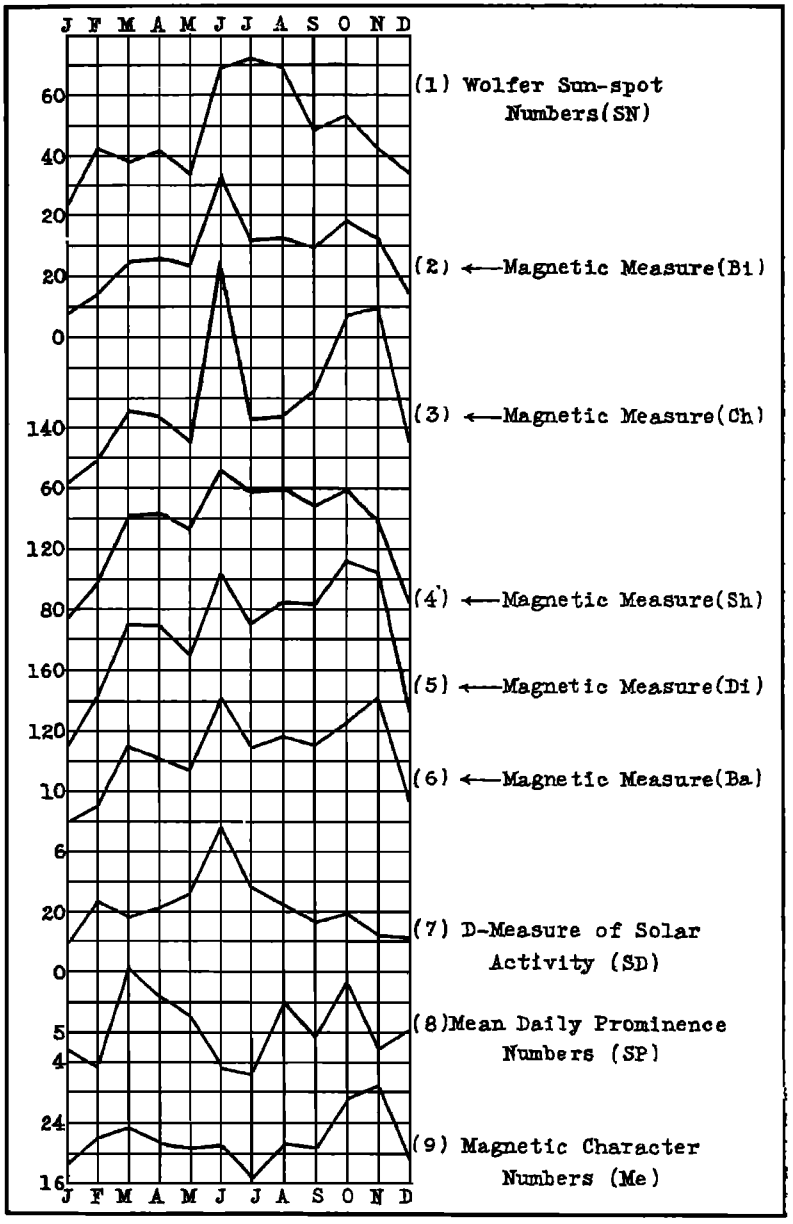

FIG. 1.—Monthly Measures of the Earth's Daily Magnetic Activity for 1915 and the DeBilt Observatory.

and it is, therefore, not necessary to compute the values for each day, unless they are required for some other purpose.

All the magnetic curves (Nos. 2–6) of Fig. 1 show also a pronounced peak, either in October or November, for which no exact counterpart, except to a limited extent, is found in the sun-spot curve (1) and in the *D*-measure (Curve 7). However, the solar-prominence curve (8) shows a peak in October and the magnetic character numbers, Curve 9, a peak in November; otherwise Curve 9 is the most disappointing one of the magnetic measures, as far as relation with solar activity is concerned. It would appear as though this autumn maximum in the magnetic measures is a striking illustration of an over-developed customary disturbance maximum near the equinoctial months (see also Fig. 10 on page 24 of the present issue of this *Journal*). We have here a class of magnetic disturbances, which cannot be related immediately to sun-spot activity as observed on the disc of the Sun turned at the time towards the Earth. This class must apparently be referred to eruptive matter from solar-prominences and to coronal matter through which the Earth passes in its revolution around the Sun; such cases will be treated at greater length in a future paper.

A further discussion of some of the interesting points raised by van Dijk will have to be postponed at present. It must suffice here to remark that some of the computations made for combined measures, as given, for example, by van Dijk in his Table 5, page 17, I have not advocated for reasons in part stated in paragraphs 23 and 26 of my previous paper[4], and to be more fully set forth in the later paper. When the ranges R_X, R_Y, R_Z, or R_H, and R_Z, must be used instead of the *variations*, dX, dY, dZ, I tentatively restricted my activity measure to $\epsilon H R_H$. There are two obvious numerical errors in the last column of van Dijk's Table 5, page 17, namely, the quantities for August and November should evidently be 23.59 and 16.09, respectively. If these corrections are made, it will be found that the figures derived from my simple measure in which only the *H*-range is used and given in the first column of van Dijk's table, follow the same course as those from his extended computations (corrected figures of last column), in which the ranges for the three magnetic components are used.

The limitations of the computing personnel at most of the magnetic observatories require that a measure of magnetic activity be used, preferably of the linear type, which can be readily computed and which will be found to be approximately the same at stations in moderate magnetic latitudes all over the Earth. As already intimated, this matter will be treated at further length in a future communication. Evidently the numbers used at present to characterize the magnetic character of a day require early supplementing in some effective manner.

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[4] *Terr. Mag.*, vol. 26, 1921, pp. 57 and 58.