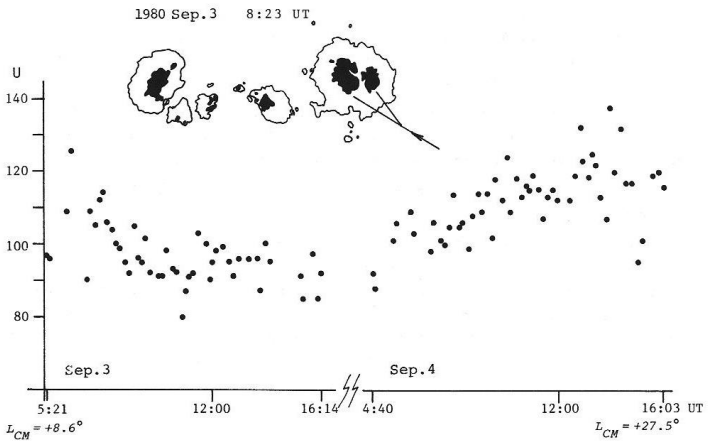


Fig.8 An example of a series of area measurements of a large double-umbra (U) over two days.

(The arrow in the drawing marks the measured double-umbra. Cf. additional pictures of the spot in L.Gesztelyi and L.Kondás, *Publ.Debrecen Obs. 5*, pp.133-143, 1983 and L.Gesztelyi, *Adv.Space Res. 4*, No.7, pp.19-22, 1984 = *Heliophys.Obs.Debrecen Preprint No.1.*)

PUBLICATIONS OF DEBRECEN HELIOPHYSICAL OBSERVATORY
Heliographic Series No.1
Appendix 3

L. Dezső

An account of the Greenwich Photoheliographic Results of 1874-1976 and of Debrecen's first Catalogue of 1977

1. INTRODUCTION

A certain periodicity in the occurrence of sunspots, found by H.Schwabe from his persistent systematic observations during the years of 1826-1843, became known worldwide through A.Humboldt's *Cosmos* (Volume 3) in 1851. Shortly after this, in 1852, E Sabine (London), R.Wolf (of Zürich) and A.Gautier (Genève) discovered independently a connection between Schwabe's period and the Earth's magnetic field, which was principally supported by John Lamont's (München) earlier announcement (1851) on a periodicity of about 10.3 years in the annual average daily ranges of magnetic declination. Herewith, from that time on the initial steps have been taken in investigations of relationships on solar-terrestrial physics.

However, in the middle of the 19th century, there was a lack of adequate solar data. As this became widely realized, new initiatives in recording sunspots were undertaken in several places. R.C.Carrington was the first who started and successfully carried out a long series of detailed observations and determined "the Elements of Position of the Pole and Period of Rotation" of the Sun numerical data of which are still used up to now. His results were published in *Observations of the Spots on the Sun from November 9, 1853, to March 24, 1861* {London, 1863}.

He remarks in the "Concluding Section" that "... in future observations of the Sun, ... the methods of photographic registration ... are obviously those to be followed, rather than the method of sketching and time observations which I have employed, while those improved processes were not yet worked out" (p.248).

The photographic registration were already recommended in 1854 by John Herschel and this "led to the preparation of the Kew photoheliograph"

(loc.cit.p.2). The prototype was designed by Warren de la Rue "with which he obtained in 1857 successful photographs of the Sun. This ... was transferred ... to the Kew Observatory ... in 1858, ... the Kew daily record ... continued unbroken until 1872." {H.W.Newton, *The Face of the Sun*, p.60, Penguin Books, 1958.}

In the "first instalment of the measurements" of positions and areas of sunspots observed with the Kew photoheliograph, the Authors, in dealing with the reduction of the positions, "followed the elegant and convenient method given by Mr. Carrington in his volume". {W. de la Rue, B.Stewart and B.Loewy, Researches on Solar Physics, *Phil.Trans. (Royal Soc.) 159*, pp.1-110, 1869.}

In 1873 the Kew photoheliograph, and the responsibility for regular observations of sunspots in respect to determination of their areas and heliographic positions were transferred to Greenwich.

2. ON THE OBSERVATIONS AND PUBLICATIONS

In 1873 E.W.Maunder was appointed at the Royal Observatory, Greenwich, and he developed the photoheliographic programme almost from the beginning. This work was in fact under his direction for nearly a half century.

The regular observations of the Greenwich Photoheliographic Department formally started on April 17, 1874.

Since, due to cloudy weather, it is hardly possible to obtain observations at a single place for each day in a year, it was necessary to fill the gaps in the records by similar photographs taken at other observatories. However, this failed for a long time, as seen in Table 1, especially for the first 4 years.

P h o t o h e l i o g r a p h s

The observations started at Greenwich with the Kew photoheliograph of 3.6-inch aperture. In September 1875 it was replaced by one of the five photoheliographs which were made (in 1873, originally for observing the Venus transits of 1874 and 1882) by the firm Dallmeyer. This was an improved model of the Kew heliograph. It had an objective of 4-inch aperture and 5-foot focal length. The primary image of the Sun's disc was enlarged by a magnifier to a 4-inch diameter on the plate. The heliograph was on a German equatorial mounting and had a driving-clock.

Two of the Dallmeyer heliographs (after its special use) were sent to Northwest India and Mauritius and a third one to the Royal Observatory,

Table 1

The yearly numbers of photographs of different observatories used –

– over more than two decades: Greenwich (G), Cape (C), Dehra Dun (DD), Kodaikanal (K), Mauritius (Ma) and

– occasionally: Melbourne (Me), Harvard (H), Mt.Wilson (MW), Debrecen (D), Naval (N), Yerkes (Y), Zurich (Z), Ebro (E), Freiburg (F), Roma (R), Tokyo (T).

(Both lists given in order of the number of plates supplied.)

Year	NO obs.	G	H / Ma	DD / Me	K	Year	NO obs.	G	C	DD / MW	K	Year	NO obs.	G	C	K / MW
1874	118	139	2			1909	1	172		176	16	1944	N	217	145	3
5	102	150	65		48	1910	–	171	104	89	1	5	–	232	112	6 15
6	95	154	66		51	1	1	225	117	18	4	6	–	233	126	6
7	130	168			67	2	1	235	102	24	4	7	–	164	196	1 4
8	18	147	42	154	4	3	–	252	95	5	13	8	–	184	175	2 5
9	47	127	105	75	11	4	–	236	116	11	2	9	–	226	139	
1880	25	157		168	16	5	–	201	136	17	11	1950	–	228	131	3 3
1	17	168		171	9	6	1	180	166	18	1	1	–	261	98	6
2	22	201		142		7	–	112	243	7	3	2	–	303	61	2
3	25	214		126		8	1	136	217	10	1	3	–	273	90	2
4	51	154		161		9	–	146	208	6	5	4	–	268	91	6
5	6	206	25	128		1920	–	195	153	3	15	5	F	269	91	1 3
6	2	199	36	128		1	–	215	139	5	6	6	–	280	85	1
7	4	185	26	150		2	–	201	151	2	11	7	–	287	74	4
8	7	171	38	170		3	–	199	153	1	12	8	–	275	85	2 3
9	5	178	16	166		4	–	212	147	4	3	9	–	256	105	1 3
1890	4	209	22	130		5	E(2)	216	137	2	8	1960	–	263	94	9
1	2	201	16	146		6	–	192	161		12	1	–	251	108	1 5
2	4	197	24	141		7	–	206	151	1	7	2	–	227	134	4
3	3	212	40	110		8	N	236	123		6	3	–	243	113	1 8
4	1	198	39	127		9	Y(2)	229	123		11	4	–	217	144	5
5	1	219	23	122		1930	Y(3)	221	133		8	5	–	226	132	1 6
6	2	206	19	139		1	–	233	115		17	6	D,Z	229	130	4
7	1	183	25	156		2	–	244	115		7	7	D	250	110	2 2
8	2	165	26	172		3	–	254	99		12	8	D(2)	221	133	2 8
9	1	203	8	153		4	–	243	117		5	9	–	230	129	6
1900	6	145	29	186		5	–	257	98		10	1970	D	246	106	2 10
1	7	149	21	189		6	–	240	111		15	1	–	190	164	3 8
2	17	177	10	162		7	–	241	114	1	9	2	R,Z	179	163	2 20
3	15	226	16	109		8	–	260	91		14	3	D(2)	219	126	4 14
4	3	211	11	139	2	9	–	255	102		8	4	T,Z	237	108	1 17
5	1	183	4	163	17	1940	N	240	119		6	5	D	233	112	9 10
6	1	181	123	8	52	1	–	221	125	7	12	1976	D(2)	258	77	7 22
7	–	183	98	6	78	2	N	241	118		5					
1908	–	171	8	161	26	1943	N(2)	238	119		6					

After 1918 there is no gap in the yearly observations, therefore in the column of "NO obs." it is indicated if an observatory supplied one (or more) additional photograph(s).

Cape of Good Hope for filling gaps in the Greenwich series. The daily photographs of the Sun were commenced at Dehra Dun by order of the Government of India, under the superintendence of Trigonometrical Survey of India. Similar observations started at the Royal Alfred Observatory, Mauritius, too. The Solar Physics Observatory at Kodaikanal, soon after its foundation

at the beginning of the century, also commenced to participate in this work even up to date (cf. p.27). Until 1914 at Kodaikanal a Dallmeyer 4-inch heliograph was used which was replaced by another one having a Cook photovisual objective of 6-inch aperture. The Cape Observatory actually began its regular solar observations only in 1910 but since then remained the principal supplier of Greenwich up to 1976, notwithstanding that in 1972 it became a part of the South African Astronomical Observatory.

The enlarging system in all Dallmeyer photoheliographs has been changed to increase image size of the Sun's disc to nearly 8 inches, first at Dehre Dun in 1883, then at Greenwich in 1884, and finally at Mauritius in 1885. The objective-glass of the Greenwich heliograph was replaced in 1910 by a Grubb photographic objective, while a new enlarging system was supplied by Ross in 1926. Between 1894 and 1936 a 9-inch photoheliograph was also often used for routine observations in general mostly on occasions of good seeing, but it has also been away on various expeditions for longer periods. Its objective was made by Grubb, and it had a Ross enlarging system.

According to the relevant publications, the objective apertures were often stopped down to some extent. E.g. in Greenwich the used free aperture of the Dallmeyer 4-inch photoheliograph was 2.9 inches between 1915 and 1939 and the 9-inch heliograph was stopped down to 3 or 4 inches during the years 1924-1927.

For the first 4 years, 1874-1877, in addition to the Greenwich solar photographs, there were photographs available only from the Observatories of Harvard College and of Melbourne.

Publications

The yearly results of the immediate measures of positions and areas of sunspots, as well as the deduced heliographic coordinates have been published as given in Table 2. Despite the fact that these yearly data sets, covering more than a 100-year, appeared from time to time with different title-pages, they are generally referred to as the *Greenwich Photoheliographic Results* {we abbreviate this as *GPHR*; this, with a date(s) of year, indicates the volume containing the data of that year(s) e.g. as in the first column of Table 2}.

The *GPHR 1886* was the first volume in which the final mode and form of data presentation was applied. For the period 1874-1881, the early Greenwich measurements could only be afterwards supplemented, but even then only partially, by solar photographs from other observatories.

Table 2

Finding list of the daily position and area measurements of sunspots

GPHR	Publ. in	Ref.	GPHR	Publ. in	Ref.	GPHR	Publ. in	Ref.	GPHR	Publ. in	Ref.
1874-85	1907	I	1902	1904	d	1924	1926	e	1946	1955	e
1878-81	1892	II	1903	1905		1925	1927		1947	1955	
1882	1884	a	1904	1906		1926	1928		1948	1956	
1883	1885		1905	1907	d	1927	1929		1949	1956	
1884	1886		1906	1909	e	1928	1930		1950	1957	
1885	1887		1907	1910		1929	1931		1951	1957	
1886	1888		1908	1910		1930	1932		1952	1957	
1887	1888	a	1909	1910		1931	1933		1953	1957	
1888	1889	b	1910	1911		1932	1933		1954	1958	
1889	1890		1911	1912		1933	1934		1955	1958	e
1890	1892		1912	1913		1934	1935		1956	1959	B 14
1891	1893		1913	1914		1935	1936		1957	1961	26
1892	1894		1914	1918		1936	1938		1958	1962	60
1893	1896		1915	1920		1937	1951		1959	1965	103
1894	1897		1916	1921		1938	1949		1960	1967	132
1895	1897		1917	1922		1939	1952		1961	1968	B 144
1896	1898		1918	1922		1940	1952		1962-64	1971	A 6
1897	1898		1919	1923		1941	1953		1965	1973	8
1898	1899		1920	1923		1942	1953		1966	1974	10
1899	1900		1921	1924		1943	1953		1967	1975	11
1900	1902	b	1922	1924		1944	1954		1968-71	1978	12
1901	1902	c	1923	1925	e	1945	1952	e	1972-76	1980	A 13

References:

I) *Photo-Heliographic Results 1874 to 1885* being Supplementary Results from Photographs of the Sun taken at Greenwich, at Harvard College, U.S.A., at Melbourne, in India, and in Mauritius in the years 1874 to 1885; and measured and reduced at the Royal Observatory, Greenwich

(Appendix to the Greenwich Observations,1907) Edinburgh, 1907 (23+321 pages).

II) *Measures of Positions and Areas of Sun Spots and Faculae* on Photographs taken at Greenwich, Dehra Dun and Melbourne; with the deduced Heliographic Longitudes and Latitudes, 1878-1881.

Solar Physics Committee, Department of Science and Art, London, 1892 (78 pages).

a) *Spectroscopic and Photographic Observations*
(Extracted from the Greenwich Observations, ...)

b) *Results of the Spectroscopic and Photographic Observations*
(Extracted from the Greenwich Observations, ...)

c) *Results of the Photo-Heliographic Observations*
(Extracted from the Greenwich Observations, ...)

d) *Results of Measures ... of Photographs of the Sun*
(Extracted from the Greenwich Observations, ...)
< Greenwich Photo- Heliographic Results >

e) *Results of Measures ... of Photographs of the Sun*
< Greenwich Photo- Heliographic Results >

B) *Photoheliographic Results*
Royal Greenwich Observatory Bulletins, Number ...

A) *Photoheliographic Results*
Royal Observatory Annals, Number ...

Numbers given in column Ref.

(All publications listed above have been printed at H.M.Stationary Office.)

The "Measures of Positions and Areas of Spots ... upon Photographs of the Sun" for the years 1874 to 1877 exhibited in calendar form were originally published as early as the annual volume of the *Greenwich Observations* for the year 1877 (pp.108-148) . Later on a number of solar photographs taken at the Observatories of Harvard College and Melbourne, for days unrepresented in the Greenwich series were also measured and reduced at Greenwich. The combined results from Greenwich, Harvard and Melbourne photographs for the 4 years, 1874-1877, were published in calendar form in the first section of *GPHR 1874-85* (pp.1-45).

The daily Greenwich results of measurements in calendar form for the 4 years, 1878-1881 were first published in the volumes of *Greenwich Observations* for the years 1878 to 1881. These could be partially completed with measurements made at the Solar Physics Observatory, South Kensington, on plates taken at Dehra Dun and Melbourne, and republished as *GPHR 1878-81*. This is the only *GPHR* volume which also includes non-Greenwich measurements. Nevertheless, one of the former measurers of Greenwich was employed as examiner among the measurers at South Kensington.

The publications included in the *Greenwich Observations* concerning the early Greenwich measurements on sunspots for the years 1874-1881 are superseded by *GPHR 1874-85* and *GPHR 1878-81*.

The daily results of observations for the years 1882-1885 were published only in calendar form and only in the 4 volumes of *GPHR 1882 - GPHR 1885*. (In *GPHR 1878-81*, *GPHR 1882*, *GPHR 1883* and *GPHR 1884* /Greenwich/ Mean Solar Time is still used!)

Beginning with the *GPHR 1886*, besides the calendar form, the measures of solar photographs were also given in the form of Ledgers. In these L e d g e r s, the daily results for each s u n s p o t g r o u p are collected together from the measures of the individual spots, i.e. from the daily register, and given in a condensed form. The main part of *GPHR 1874-85* consists of the Ledgers, compiled afterwards for the years 1874-1885. (Here the previously neglected photographs taken at Mauritius are additionally included.)

As a rule, the daily data published in all volumes of *GPHR* relate to measurements on a single photographs, except for the very few cases, when in the early years two plates were measured and the means of measures were generally given.

For the 103-year period of 1874-1976 all data of the *Greenwich Photoheliographic Results* can be found in the volumes listed in Table 2. Over and

above the daily results given in calendar form and in Ledgers (until 1955 inclusive) the following are published: the daily (projected and corrected) total areas of umbrae and whole spots, as well as their means for each synodic solar rotation and for the year; and four kinds of mean heliographic latitude of sunspot groups for each rotation and for the year. Exactly the same kind of area and latitude data are given in the *Debrecen Catalogue*, too.

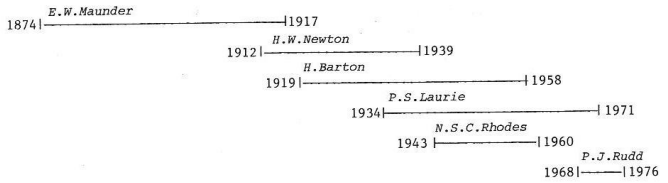
3. MEASUREMENT AND REDUCTION

The measures of the photographs were made with a large position-micrometer. The distance of a spot from the centre of the Sun's disc and its position angle were directly read, while the areas were measured with a glass diaphragm ruled with cross-lines into squares (cf.p. 226). Both the device and the method of measuring had practically no change over the whole Greenwich period of measurements.

As a rule, the plates were measured twice independently by two measurers and the means taken. (The initials of the two persons measuring the photograph are given in the publications until *GPHR 1915*). From *GPHR 1916* to *GPHR 1955* there are some volumes where mention is made that several plates were measured only once, each by an experienced measurer. All in all, nearly 80 persons were engaged in this work but only ten percent of them participated in measuring plates of a single year. While ten persons took part in measurements of a series of plates which covered at least a 10-year period of observation. Table 3 makes plausible that the steady homogeneity of the measurements could be assured.

Table 3

The principal measurers and their period of activity



The probable error in measurements of positions and areas of sunspots, as well we the personality in measurements of areas were already studied in the eighties of the last century and discussed in detail in two papers {*GPHR 1885*, pp.XV-XXXII and *GPHR 1888*, pp.XV-XLII}. It was found, among others, that both the position and area measurements are as accurate for the 4-inch as for the 8-inch solar images. The probable error in area measurements are in rough approximation about the same in Greenwich as in *Debrecen* (pp.219-230).

The zero of position angles for the photoheliographs has been determined by different methods, by means of two overlapping solar photographs, or visually, observing the apparent path of the Sun. A correction for the inclination of the Sun's path to the spider-wire was applied. (In case of 4-inch solar images, a correction was applied for optical distortion of the Dallmeyer photoheliographs, while no correction has been used to the 8-inch images.) When required, a correction was made for the effect of atmospheric refraction according to the formula:

$$\textit{VERTICAL DIAMETER} = \textit{(HORIZONTAL DIAMETER)} \times (1 - \sin 57.5'' \, \mathrm{tg}^2 z)$$

where z is the apparent zenith-distance.

The heliographic coordinates were calculated as given in the paper mentioned at the end of Section 1. Over more than three decades the necessary parameters have been derived from W.de la Rue's *Auxiliary Tables for determining the Angle of Position of the Sun's Axis and the Latitude and Longitude of the Earth referred to the Sun's Equator*, while later on from the *Nautical Almanach and Astronomical Ephemeris for the year 1907* and its following issues.

4. WHAT WAS DIRECTLY MEASURED

In all solar photographs taken prior to 1916 the individual spots in a sunspot group (specified with a No) have in most cases been measured separately and also given in the publications one by one. However, in many cases two or more little spots close together were combined into a cluster and the position of the centre of gravity and the aggregate area of the cluster are given. (A spot when identified from one day to the next got a letter or a number beside the group No.) The mean position of a group was calculated from the positions of the separately measured components of the group taking their weighted means by using the areas as weights. In this respect a difference was made in the practice from 1916 on. From that time on, the position of the centre of a sunspot group was estimated and only in the case of large or complex groups of spots were the positions of the chief components measured individually, and also for groups near the east

or west limbs of the Sun's disc, where the effects of foreshortening are appreciable. It was found that the latter method saved much numerical work without any diminution of accuracy {*GPHR 1916*, p.VIII}.

In *Debrecen* we returned in principle to the old Greenwich method (of E.W.Maunder) but of course the spots have been combined with respect to their magnetic polarity.

5. VARIOUS MAIN TABLES OF DATA

From 1874 to 1915 *Ledgers* of groups of sunspots are given together for all groups. They contain for each day both the projected and corrected areas, the heliographic coordinates and the distance from central meridian; furthermore, for the period of observation the (simple) means of the corrected areas and coordinates are given.

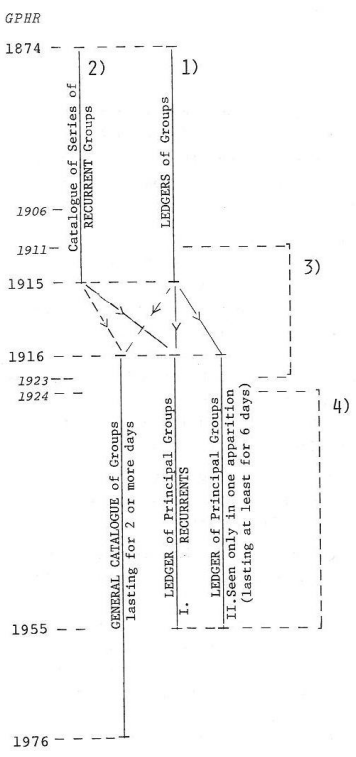
From 1916 Ledgers are only compiled for the principal groups, i.e. lasting for six or more days, however individual components are also given after their respective groups, where they are large and distinctive. Such Ledgers are published last in *GPHR 1955*. Later, the data of the principal and most stable components of groups are separately given only in the daily results. The Ledger I supersedes the *Catalogue of Recurrent Groups* (cf.Table 4). The recurrent groups of spots are those which were observed in two or more consecutive apparitions. Important components of these groups have been given in all cases where it appeared probable that an individual component lasted to the second or third rotation after its first appearance.

In the *Debrecen Catalogue* a group is given as recurrent only if at least one of its component passing over the west solar limb could be identified to all probability on the east limb after a full fortnight.

By way of the Ledgers it is easy to survey the life history of all groups till the end of 1915. For the second period of the Greenwich observations it is the *General Catalogue of Groups of Sunspots* where the most important data of each group are summarized. Here, beside the mean corrected areas and mean heliographic coordinates, as given in the Ledgers, the date and longitude from central meridian for the first and last appearances of the group, as well as its duration in days are tabulated, and from 1927 the time of central meridian passages are also included. Reference is also given to the recurrent series number of the spot groups and its order in the series. (For the period 1945-1955 the corresponding Mt.Wilson group numbers can be found, too.)

Table 4

Schematic finding list of the main data of Groups of Sunspots



Explanations:

1) The first sunspot group included in the Ledgers (i.e. in *GPHR 1874-85*) is the No.82 (photographed on April 17,1874) and the last one in *GPHR 1915* is No.7590. Till 1915 inclusive the Ledgers contain all groups, i.e. even the groups seen on one day only, usually composed of one or two very little spots. Beginning with 1916 in the General Catalogue the group numbers are in continuation of those given in 1915, i.e. it starts with No.7591; the one-day groups appear only in the daily results and with a distinctive numeration. (However from 1933 they also can be found in a separate list at the end of the General Catalogue; in the *Debrecen Catalogue* the one-day groups are not given at all.)

2) For the years 1874 to 1906 it was compiled by Annie S.D.Maunder and published in *Appendix to Greenwich Observations, 1907*. The Series No.1 of the Recurrent Groups was first seen on June 1,1874, the last one in 1906 was the No.624. The continuation (Nos.625-754) were published in the relevant annual volumes, the last in *GPHR 1915*. In Ledger I the last Series of recurrent groups was the No.1678 in *GPHR 1955*. The recurrent groups from 1916 to the end of 1976 (Nos.754-2213) are indicated in the References of the General Catalogue.

3) In the Ledgers of 1911-1923 and in the General Catalogue of 1916-1923 the longitude of the group is given as computed upon two different systems. In *System I* the daily sideral motion due to the Sun's rotation being assumed to be constant for all spots, whatever their latitude, corresponding to Carrington's assumed mean rotation period. In *System II* the daily sideral motion was assumed to vary with the latitude (B) in accordance with the formula: $14.11^\circ - 2.13^\circ \sin^2 B$. In *System II* the longitude of the centre of the Sun's disc was adopted as the longitude given in *System I* for the commencement of the year in question.

4) In the Ledgers of 1924-1955 the proper motion in longitude is given as derived from the difference of longitude thus computed from the measured positions on any given day and the first day on which the group of spots or single spot was visible, after the correction for the motion appropriate to the latitude has been applied according to the formula:
$14.37^\circ - 2.60^\circ \sin^2 B$.

This General Catalogue of Groups is quite similarly continued in *Debrecen*, the only difference being that the mean position data are weighted arithmetic averages using the areas as weights. When a sunspot group during the disc passage of its solar region is not seen upon the Sun's disc on one or more days but later on the region is again not spot-free, then this new spot emergence is generally not regarded as a different spot group. Both in Greenwich and *Debrecen* such a kind of group is referred to as intermittent.

Groups which are approximately in the same heliographic position in consecutive disc passages (partially or complete) but with definite breaks in their history between each rotation are not classed as recurrent. Such groups may be termed as revivel; they differ from "intermittent" groups in their being of long period intermittency. The revival groups have been tabulated in series and separately given only from *GPHR 1917* to *GPHR 1955*. (For the years 1916-1925 they are also marked in the General Catalogue of Groups.)

In *Debrecen* no special effort was made to pick out the revival series of groups as it is hardly possible to complete this task unambiguously on the basis of spot observations alone. Namely, on the far side of the Sun, the intrinsic proper motions of spots remain unknown and, consequently, there is always an element of uncertainty. For this reason, in the *Debrecen* list of recurrent series of groups, only the unquestionable cases are included.

For the years 1956-1976 a brief annual summary of sunspot activity was added in the Greenwich publications, which will also be continued in the future.

6. SUPPLEMENTARY NOTES

On the preceding pages a brief review was given on the entire long series of *Greenwich Photoheliographic Results*, meanwhile mention was made about some differences between the Greenwich catalogue and our new undertaking. To be more correct, often the original wording of the published volumes has been used. After all it could be seen that in the *Debrecen Photoheliographic Results* almost every kind of data on sunspots can be found that were formerly published in the corresponding Greenwich volumes.

It should be emphasizes that instead of a brief description of the group according to the Greenwich fashion, in our daily results additional data and various signs are given to be able to form a detailed picture about the spot group.

The Debrecen method of measurements is quite different from that of the Greenwich but still the results should agree as shown by some experiences of Ágnes Kovács and O.Gerlei (cf. papers in this issue, pp.211-230).

The essential difference between the Greenwich and Debrecen proceeding is in the way of looking at the sunspot groups, as we also take into account the magnetic polarity of the spots. Hence, the position of the group is derived by us from the means of the separately calculated mean positions of the *p*- and *f*- polarity spots. That does not inevitably agree exactly with the means of the positions of all spots of the group.

Beside the standard Greenwich data, by means of the magnetic spot polarities there is a possibility to present data on features of sunspot activity in more detail. However, in those parts of the *Summaries of results* which also include separately the *p*- and *f*- parts of groups, all data are only given within approximately 60° longitude from central meridian; furthermore, here the groups of the old and the new solar cycles are also separately tabulated. The limitation of 60° or so is an expedient restriction as near the solar limb the spot observations are falsified by an up to now unknown effect.

In conclusion, taking it all in all, the *Debrecen Catalogue* of sunspots seems to be a fairly homogeneous continuation of the *Greenwich Photoheliographic Results*.