I N T R O D U C T I O N

The present volume of Debrecen Photoheliographic Data (DPD) contains sunspot data for the years 1993, 1994, and 1995. DPD is a catalogue of positions and areas of sunspots for all days compiled by using white-light full disc observations taken at the Heliophysical Observatory of the Hungarian Academy of Sciences (Debrecen, Hungary) and its Gyula Observing Station as well as at the contributing observatories: Ebro Observatory (Spain), Helwan Solar Station (Egypt), Kanzelhoehe Solar Observatory (Austria), Kiev University Observatory (Ukraine), Kislovodsk Observing Station of Pulkovo Observatory (Russia), Kodaikanal Observatory of the Indian Institute of Astrophysics (India) and Mount Wilson Observatory (USA). In some cases, when there were gaps in our observations but when no spots were reported by the observatories involved in the Solar Geophysical Data (SGD), we refer to the station (Ramey) and time of observation indicated in the SGD as reporting on a spotless disc.

The DPD catalogues are divided into two parts. The numerical part contains the measured position and area data. The second part contains the CCD scans of all the active regions that were found on the photographic plates. Every measured spot is marked with the same number in the picture as in the numerical catalogue. The images along with the measured data allow more complex analysis, morphological studies and comparison with magnetic, H-alpha and other observations.

THE NUMERICAL CATALOGUE

The positions and areas of sunspot groups for every day were published at Greenwich (Greenwich Photoheliographic Results) until 1976. After that date Debrecen Heliophysical Observatory took over this task. The history and description of the Debrecen Observatory as well as its observational material can be found in the volume of Debrecen Photoheliographic Results 1977 (Dezső et al. 1987). Current status of DPD is reported by Győri et al. (2003).

The daily photospheric observations are taken both in Debrecen and its Gyula Observing Station (150 km from Debrecen). The Debrecen-Gyula archive comprises more than 100,000 plates covering almost five decades. The DPD catalogue is compiled on the basis of these archives. For those days in which no observations were obtained in Hungary we use the observations of the cooperating observatories. At our observatory several serii of observations are taken each day, a series usually consisting of three photographic plates exposed within a time interval of 15 minutes. We choose the best triplet (the best pair or single plate if no complete triplet is available) for every day. Kanzelhoehe also takes triplets but from the other observatories we usually receive one plate for a day, and from Kodaikanal only the contact copies of the original plates are sent.

OBSERVATIONS AND DATA

The method of position measurements is based on the software and procedure developed by L. Győri, which is basically similar to that used by Dezső et al. (1987). The time of observations and the positions measured on the used plates are averaged. The mean precision of the positions in DPD is 0.1 heliographic degrees. The mean precision of the positions is usually better than 0.1 heliographic degrees in case of Gyula and it is slightly less accurate in the case of the other observatories. The position of a spot means the position of the centre of the umbra if we could separate the umbra from the penumbra. If we could not identify any umbrae in the penumbra, we measured the position of the centre of the penumbra. We measured every spot which could have been recognized as such, depending on the quality of the observation. The numbering of spots was made arbitrarily on each series of observation, thus, the number of a specific spot usually changes from one day to the next.

Since 1988 the area measurements have been based on the CCD scans of the best of the plates. This new method of area measurements is described in the paper by Győri (1998). In this automatic method of area measurements the "spot" means a local intensity maximum on the negative image of a sunspot group. In some cases the the umbra contains several "spots" which cannot be separated with intensity contour lines without lost area. In these cases the "spots" share a common umbra. The area of this umbrae is indicated at

one of these "spots" and the appropriate columns of the other ones contain only a reference to its No. with negative sign. The situation is similar to the case when several umbrae share a common penumbra.

Concerning the basic data, differences between the new and old procedures do not result in significant inconsistencies between the volumes of the catalogue (Győri et al. 2000, and references therein). The development of the measuring procedure and devices may result in some slight systematic differences (see e.g. Baranyi et al. 2001).

The DPD is published as an ASCII file on the CD-ROM and it contains the area and position of each spot, the total areas and the mean positions of the sunspot groups, and the daily sums of the area of groups. The following data are available for each spot: time of observation, the NOAA number of its group, the measured (projected) and the corrected (for foreshortening) areas of umbrae (U) and the whole spot (U+P), latitude (B), longitude (L), distance in longitude from the central meridian (LCM or CMD), position angle (measured eastward from the north pole of the Sun's axis) and distance from the disc's center expressed in solar radii.

The total area is the sum of the areas of each spot in a group. The mean positions of the group were calculated by multiplying the positions of all separately measured components of the group by their corrected U+P areas, and by dividing the sums of these products by the sum of the areas. When there were more than one umbrae in a penumbra, the position of the centre of gravity of this component was computed by weighting the positions of the umbrae with the corrected U areas before calculating the mean position of the whole group. If a group was intermittent then zero areas are indicated and no position is given.

The Julian Date is also included in the table in order to facilitate the usage of the long time-series. We appended the values of P (position angle of the northern extremity of the axis of rotation, measured eastwards from the north point of the disk) and B_0 (heliographic latitude of the central point of the disk) at the time of observation to the row of the daily data. The value of L_0 (heliographic longitude of the central point of the disk) can be easily calculated as L-LCM.

For numbering the groups we used the NOAA/USAF sunspot group numbers published in the tables of SGD. If there was no data in the SGD for a group found by us, we created a new number by attaching the letters m,n,... to a NOAA number existing at about the same time.

As we do not investigate the magnetic polarities of spots, it may sometimes happen that the separation of nearby groups does not exactly correspond to the polarity conditions. However, we try to avoid that case in which a spot of a group "leaves" its group and "joins" another one. This means that we try to find the separating line between the same spots of two nearby groups on each day. This intention sometimes causes deviation from the NOAA numbering. For example two nearby groups rotated onto the disc on April 6, 1987: NOAA 4787 and 4790. Because of the evolution of NOAA 4787, the large single spot of NOAA 4790 got into the common penumbra of several umbrae of NOAA 4787 by April 11, and they cannot be separated since that time. Thus, we decided to indicate the whole complex as NOAA 4787 since April 6. However, there was another case when we had to follow another strategy. On December 21, 1993 the complex of NOAA 7640+7641+7644 rotated onto the disc in which mainly the separation of the following part of 7640 and the preceding part of 7644 was hardly determinable. During the first few days it seemed to be better not to separate them, but after that the complex became too large, and the separation was unavoidable. Thus, we had to separate them at the most probable separtion line from December 21. However, the preceding part of 7644 got into a common penumbra with the following part of 7640 on December 30, and the separation can not be made in the necessary form. We had no choice, we had to regroup this part of the complex, and all the spots in this penumbra were grouped to the NOAA 7640 causing a sudden jump in its whole area.

The following examples show further types of problematic numberings. For instance the same group was indicated as NOAA 5227 by some stations, and as NOAA 5236 by the others on 7 and 8 November, 1988. A new group appeared close to this group on 11. Some stations separated these groups, and the new one was observed as NOAA 5236 between 11 and 14. The others indicated the whole complex as NOAA 5227 at the same time. After that time every station numbered this complex as 5227 till 17. We indicated it as NOAA 5227 from 7 to 17. The group 5080 was observed between 18-20 July, 1988. On 26 July a group was seen

again at about the same location. Five stations indicated this group as 5091, but two stations found that the group 5080 reappared after its intermittent state. We indicated the new group as 5091.

When the groups were relatively close to each other, and most stations did not separate them, we usually indicated them as one group, and chose the number used by most of the stations (e.g. 5025 and 5025A). When the groups were at relatively large distance, we usually decided to separate them independently from the number of separating stations (e.g. 4990 and 4990A).

These examples show that some kinds of comparative studies (comparison of areas of sunspot groups of different observatories, and study of motion and evolution of groups) need the investigations of the specific cases, and may demand the special investigation of positions, areas, magnetograms and CCD scans of groups.

It is important to note that the sporadic spots of a region of weak magnetic field usually are indicated as spots of the same group. This means that different spots of the group may be seen on consecutive days, which can cause apparent jumps of several degrees in the positions (e.g. 5124a). In special cases the position of a larger group can also show such apparent jumps. For example the group 4720 was seen between 24-27 March, 1986. On 28 March this group was intermittent, but another group appeared near it on this day, and this new group was still seen next day. On 30 March the new group died out but the old one appeared again. The SGD indicated them as 4720 during the whole time, thus, we insisted on this number. These types of cases should be selected out in the case of studying of motion of spots.

THE IMAGES

The images are given in FITS as well as in JPG format. Each file name is created from the NOAA number (omitting the first digit) and the date. For example 379-0101 means that the file in the 1993fits or 1993jpg directory contains the image of the group 7379 on 1st of January 1993. If the group number has a letter extension, then it is inserted in place of the "-" mark, as in the case of 7393a on January 6 1993 (393a0106).

The header contains the size of the image, the date (day/month/year) and the time of the observation (hour:min:sec), the NOAA number of the group, the name of the observing station, the resolution in the sky in arcsec/pixel in the directions of the rows and columns. These data have also been depicted in the image with the exception of the resolution. To orientate the images the heliographic North and West directions belonging to the disc's centre are indicated. The lengths of the bars mean 1 heliographic degree in the directions of rows and columns of the image belonging to the centre of the image centre. The date is written as usual: month/day/year.

To create the FITS images we used those scans which were measured with the automatic method. The original CCD scans usually have 16-bit gray level resolution but they are transformed to 8-bit FITS images. In some cases we had to use a camera of 8-bit gray level. On account of the limit of 256 gray levels the dynamics of the original images cannot be maintained. Thus, the quality of the FITS image may be lower than that of the original observation.

The scans are filtered and the limb darkening is extracted from them in the most cases, which usually improves the quality and helps to find the spots. However sometimes these procedures give an unusual appearance to the images containing the limb or other special feature (drawing or defect). The larger umbrae may be overexposed in order to make the smaller spots more prominent. Sometimes there are some features in the pictures which do not belong to the Sun. These are the cross-wires or their filtered paths, the segment of the second exposure (which helps to measure the geocentric North direction) and inhomogeneities or plate defects. These should be ignored.

The images in JPG format are conversions of FITS images. They make the quick browsing possible between the sunspot groups. While creating these jpg images, we tried to find optimal settings of brightness, contrast, and gamma providing good overall appearance on the monitor but in lots of cases we could not avoid the saturation of umbrae if we wanted the small spots to remain noticeable.

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1993

Gyula	178	(Z. Lengyelné, I. Lengyel, L. Győri, A. Ludányi)
Debrecen	128	(A. Ludmány, Á. Kovács, G. Csepura, J. Kiss, G. Makó, T. Baranyi, O. Gerlei, I.Nagy)
Kislovodsk	49	(V.V. Makarova, V.V. Valentinovna, E.I. Davydova, and many others)
Kanzelhoehe	7	(H. Freislich, W. Otruba, T. Pettauer, A. Schroll)
Helwan	2	(E. Bebars, M. Khaleel)
Kiev	1	(O. Lushnikova)

1994

Gyula	258	(A. Ludányi, I. Lengyel, L. Győri)
Debrecen	42	(A. Ludmány, G. Csepura, Á. Kovács, G. Makó, J. Kiss, T. Baranyi)
Kislovodsk	31	(V.V. Makarova, V.V. Valentinovna, E.I. Davydova, and many others)
Kanzelhoehe	29	(H. Freislich, W. Otruba, T. Pettauer, A. Schroll)
Ramey	4	
Kiev	1	

1995

Gyula	197	(A. Ludányi, I. Lengyel, L. Győri)
Debrecen	78	(Á. Kovács, A. Ludmány, J. Kiss, O. Gerlei, G. Csepura, G. Makó, T. Baranyi)
Kanzelhoehe	55	(H. Freislich, W. Otruba, T. Pettauer, A. Schroll)
Kislovodsk	26	(V.V. Makarova, V.V. Valentinovna, E.I. Davydova, and many others)
Ramey	4	
Helwan	2	(S. El gezerry)
Ebro	1	(J. Cid)
Kodaikanal	1	
Mount Wilson	1	(N. Johnson)

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DATA POLICY

Data and images published in this catalogue are freely available for research and educational purposes. We underline that the DPD project has no permanent support. We can only get temporary supports if we can prove its usefulness. Thus, we ask the users to refer to the DPD in the appropriate way when the data or images were used in a scientific publication. If the data of several years were used, it is enough to refer to the latest volume of the catalogue. We would be especially grateful if the authors sent a copy or a short message with the bibliographic details of their paper when the DPD was referred to. Requests, comments or questions can be sent by e-mail to baranyi@tigris.unideb.hu or by ordinary mail to Heliophysical Observatory, H-4010 Debrecen, P.O. Box 30., Hungary

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EXPLANATIONS TO THE TABLES

The tables contain three kinds of rows, they are explained separately.

Rows beginning with character "d" (day):

Column	*Fmt*	*Description*
2- 5	I4	Year
6- 7	I2	Month
8- 9	I2	Day of month
10-13	F4.3	Time in thousandths of a day (by convention .500 represents 1200 UT)
14	A1	Blank
15-18	A4	Origin of the observation: DEBR: Debrecen EBRO: Ebro GYUL: Gyula HELW: Helwan KANZ: Kanzelhoehe KIEV: Kiev KISL: Kislovodsk KODA: Kodaikanal MWIL: Mount Wilson RAME: Ramey
19-23	A5	Blank
24-28	I5	Daily sum of projected U (umbra) area in millionths of the solar disc
29-33	I5	Daily sum of projected U+P (umbra+penumbra) area in millionths of the solar disc
34-38	I5	Daily sum of corrected U in millionths of the solar hemisphere
39-43	I5	Daily sum of corrected U+P in millionths of the solar hemisphere
44-49	A6	Blank
50-60	F11.3	Julian Date (by convention .500 represents 0000 UT)
62-67	F.6.2	P (position angle of the northern extremity of the axis of rotation, measured eastwards from the north point of the disk) at the time of observation
70-74	F.5.2	B_0 (heliographic latitude of the central point of the disk) at the time of observation

Rows beginning with character "g" (group)

Column	*Fmt*	*Description*
2- 5	I4	Year
6- 7	I2	Month
8- 9	I2	Day of month
10-13	F4.3	Time in thousandths of a day

14-20 A7 NOAA sunspot group number; if no NOAA number was assigned then a number close to another NOAA number was given with an additional letter (e.g."m" or "n")
21-23 A3 Blank
24-28 I5 Total projected U (umbra) area of the group in millionths of the solar disc
29-33 I5 Total projected U+P (umbra+penumbra) area of the group in millionths of the solar disc.
34-38 I5 Total corrected U of the group in millionths of the solar hemisphere
39-43 I5 Total corrected U+P of the group in millionths of the solar hemisphere
If all the total areas are equal to zero it means an intermittent phase of the group.
44 A1 Blank

The following entries refer to the position of the given sunspot group, which is the mean position of its spots weighted by the U+P areas of the single spots. In the case of several umbras within the same penumbra the mean weighted umbra position was calculated within their common penumbra prior to the calculation of group mean position.

45-50 F6.2 Heliographic latitude B; positive: North, negative: South
51 A1 Blank
52-57 F6.2 Heliographic longitude L
58 A1 Blank
59-64 F6.2 Longitudinal distance from the Sun's central meridian (LCM)
65 A1 Blank
66-71 F6.2 Position angle
72 A1 Blank
73-78 F6.4 Distance from the centre of Sun's disc measured in units of the solar radius

Rows beginning with character "s" (spot) (available only on the CD_ROM)

Column	*Fmt*	*Description*
2- 5	I4	Year
6- 7	I2	Month
8- 9	I2	Day of month
10-13	F4.3	Time in thousandths of a day
14-20	A7	NOAA sunspot group number
21-23	I3	No. of spot within the group
24-28	I5	Projected U (umbra) area in millionths of the solar disc, negative values indicate that the umbra consists of fragmented regions which cannot be separated without losing umbral area. In this way several spots (intensity minima in the umbra) have a common umbra, e.g. -2 means that the given spot shares an umbra with spot No.2, and the common U value is indicated at spot No.2.
29-33	I5	Projected U+P (umbra+penumbra) area in millionths of the solar disc, negative values indicate that several umbras have a common penumbra, e.g. -7 means that the given umbra shares a penumbra with umbra No.7, and the U+P value is indicated at No.7.
34-38	I5	Corrected U in millionths of the solar hemisphere, for negative values see Column 24-28.
39-43	I5	Corrected U+P in millionths of the solar hemisphere, for negative values see Col. 29-33.
44	A1	Blank
45-50	F6.2	Heliographic latitude B; positive: North, negative: South
51	A1	Blank
52-57	F6.2	Heliographic longitude L
58	A1	Blank
59-64	F6.2	Longitudinal distance from the Sun's central meridian (LCM)
65	A1	Blank
66-71	F6.2	Position angle
72	A1	Blank
73-78	F6.4	Distance from the centre of Sun's disc measured in units of the solar radius