A Revised Collection of Sunspot Group Numbers

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Abstract: This paper describes a revised collection of the number of sunspot groups from 1610 to the present. This new collection is based on the work of Hoyt and Schatten (1998). The main changes are the elimination of a considerable number of observations during the Maunder Minimum **(hereafter, MM)** and the inclusion of several long series of observations. Numerous minor changes are also described. **Moreover, we have calculated the active day percentage during the MM from this new collection as a reliable index of the solar activity. Thus, the level of solar activity obtained in this work is greater than the level obtained using the original Hoyt and Schatten data, although it remains compatible with a grand minimum of solar activity.** The new collection is available in digital format.

Keyword: sunspot observations, solar activity, sunspot group counts.

1. Introduction

Telescopic observations of sunspots made since 1610 allow us to have an essential element to reconstruct the solar activity in the last four centuries (Vaquero and Vázquez, 2009; Clette et al., 2014). Not surprisingly, the counting of sunspots is the longest active experiment of the History of Science (Owens, 2013). We need two essential elements for the reconstruction of solar activity: (i) a collection as complete as possible of telescopic observations of sunspots and (ii) a methodology to obtain a single time series from all records contained in the collection. Therefore, a good collection of the number of sunspot groups is vital for a correct reconstruction of solar activity in the past. Rudolf Wolf clearly understood it in the sense that he made a monumental effort to obtain (and publish) the greatest possible number of historical records. Subsequently, Hoyt and Schatten (1998) (hereafter HS98) conducted a new systematic survey in order to further increase the number of records, beyond what Wolf had already collected. However, the resulting extended data archive only included sunspot group counts, as HS98 aimed at building a Group sunspot Number that did not include a count of individual sunspots.

The aim of this paper is to describe a new corrected version of the collection of sunspot group counts based on the previous efforts by R. Wolf and HS98. In the last 15 years, several works have been published containing analyses of historical sources of sunspot observations (see references in Clette et al. (2014) for details). Therefore, this article compiles the available information published in recent years and adds some other records, including a revision of several counts available from HS98.

We should keep in mind that the compilation presented here only forms a first fundamental base. Indeed, historical records can provide other elements about sunspots such as hemispheric asymmetry (Zolotova et al., 2010), positions (Arlt et al., 2013), areas (Vaquero, Sánchez-Bajo and Gallego, 2002; Balmaceda et al., 2009) or photospheric rotation rate (Casas, Vaquero and Vázquez, 2006; Arlt and Fröhlich, 2012). An extensive use of historical sources related to sunspots should provide catalogs of sunspots (Arlt, 2009; Arlt et al., 2013). The scientific exploitation of these catalogs could be complex, because of a lack of common standards for the different sources (Lefèvre and Clette, 2014). Still, the new database described here contains the primary information for establishing the long-term common scale for the Group sunspot Number. As the latter can only result from full reconstructions starting from raw observations, a fully correct and validated archive of those observations thus forms a first essential foundation.

In this article, we provide information about the format and availability of our collection (Section 2), as well as a detailed description of changes and revisions for different time periods: early period (Section 3) and 19th-20th centuries (Section 4). Additionally, we offer some conclusions and perspective for future work in Section 5.

2. A revised collection

The revised collection of sunspot group counts is contained in a machine-readable text file that is available through several web sites including SILSO (http://sidc.be/silso/) and HASO (http://haso.unex.es). **This file is divided into six columns. The first three columns contains the year, month and day of the observation, respectively. The fourth column indicates the name of the station and the fifth column the observer**

of the station (both are equal to zero if they are ignored). Finally, the sixth column shows the number of sunspot groups (missing days are represented by the value -1). An example of the format is given in Table 1.

Table 1. Some example lines with the format of the data file.

YEAR	MONTH	DAY	STATION	OBSERVER	GROUPS
2004	12	17	614	1	4
1802	8	15	0	0	-1
1637	9	24	723	1	2

Additionally, there is another file containing the list of sunspot observers. In each row, it appears: the number of the station, the initial and final year of observation, the total number of observations in this period, and the name of the observer. Lastly, we have added a file describing the differences between this revised collection and the data provided by Hoyt and Schatten (1998).

This revised collection of sunspot group counts contains more than one million of different observations by 738 different observers covering the period 1610-2010. Over these 4 centuries, time coverage is, of course, irregular. Figure 1 shows the number of days with records per decade in the revised collection presented in this article (dark grey columns). Also show is the corresponding temporal coverage for the HS98 database (light grey columns). The number of days of observation by decade is slightly lower in the revised collection than in the HS98 database because we have discarded observations that we considered erroneous for various reasons, especially in the historical part of the collection (1610-1848).

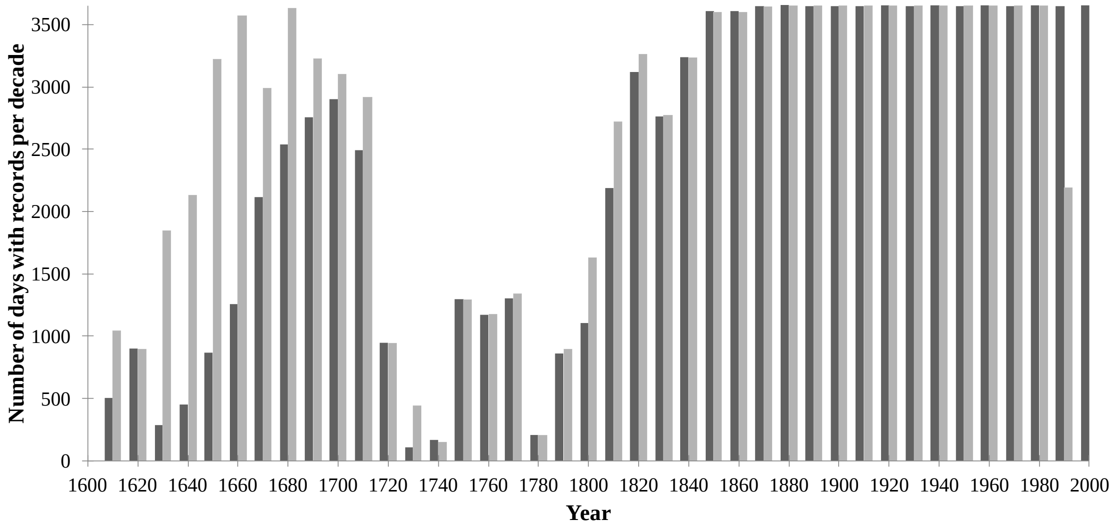


Figure 1. Number of days with records per decade in HS98 (light grey columns) and the revised collection presented in this article (dark grey columns).

3. Revisions of early data

Our knowledge of solar activity in the historical era is derived from reconstructions from very sparse data. Therefore, it is important not only to obtain the largest number of observations, but also high-quality data. Recent articles have shown that HS98 included in their database a large number of counts derived from general mentions of the absence of sunspots on the solar disc and astrometric measurements of the Sun such as solar meridian observations (Clette et al., 2014; Vaquero and Gallego, 2014). These kinds of data should be removed of the collection of the sunspot group counts. Recent studies of explicit sunspot observations by Hevelius (Carrasco, Villalba Álvarez and Vaquero,

2015) and Flamsteed (Carrasco and Vaquero, 2015) have indicated that the general level of solar activity computed from explicit observations is significantly higher than the one computed from general comments and astrometric records. Therefore, we have removed large parts of the HS98 database.

We also made an effort to re-count sunspot group**s** from original sunspot drawings. Thus, the sunspot drawings by Galileo, Gassendi, Staudach, Schwabe, Wolf (small telescope), and Koyama were analyzed in order to obtain the number of sunspot group**s** using modern criteria based on the morphological classification of sunspot groups.

Moreover, we have incorporated in this revised collection some original observations that were not used by HS98. The case of **Pehr** Wargentin in 1747 is interesting mostly because of the scarcity of records around that year. However, the main changes concern three different periods: (a) the first years of observations, (b) the**MM**, and (c) the years around the "lost solar cycle". The very recent data presented in Usoskin et al. (2015) and Neuhäuser et al. (2015) have been also incorporated.

3.1. The first years

The first years of our collection of observations, from 1610 to the beginning of the **MM** in 1645, are characterized by a great variability in the number of counts available. Generally, the number of observations per year is scarce.

We have added sunspot group counts (not used until now) made by four early scientists: Argoli (Vaquero, 2003), Marcgraf (Vaquero et al., 2011), Strazyc (Vaquero and Trigo, 2014), and Horrox (Vaquero et al., 2011). Moreover, we have removed the **observations** attributed to Marius, Riccioli and Zahn for the periods 1617-1618, 1618 and 1632 respectively, because they are an almost continuous list of zero-spot reports.

Finally, we have made two modifications in the counts by Horrox and Rheita according to the recent contributions by Vaquero et al. (2011) and Gómez and Vaquero (2015).

3.2. The Maunder Minimum

In recent months, several studies fed a controversy about the true nature of MM from the phenomenological point of view (Zolotova and Ponyavin, 2015; Vaquero and Trigo, 2015; Vaquero et al., 2015; Usoskin et al., 2015). **An important** conclusion is that there is no doubt that **at least some** instruments used for solar observations during the MM were good enough to make an accurate count of sunspot groups. As an example, we can see in Figure 2 the equipment used by Hevelius. Therefore, a correct collection of the number of sunspot groups observed during the MM is crucial for further studies. In this section we briefly describe the actions taken to obtain the revised collection. Basically, these actions can be split into three categories: (a) the elimination of incorrect records, (b) the addition of newly found observations, and (c) the correction of counting errors.

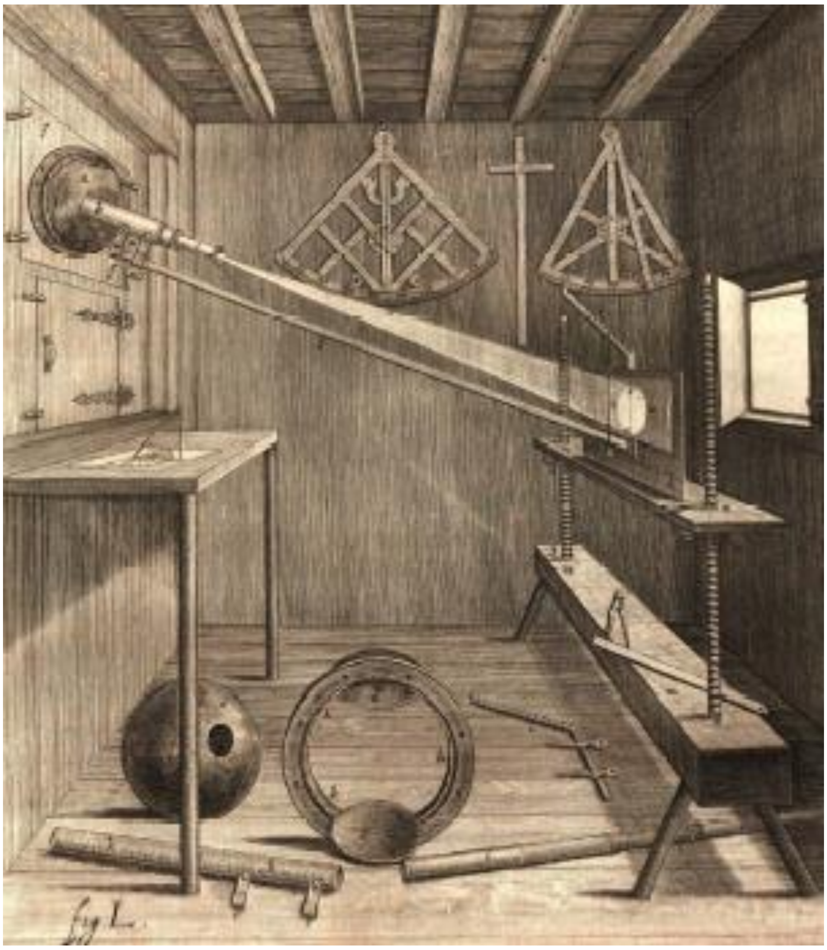


Figure 2. Astronomical instruments for solar observations used by Hevelius from his book *Machina Coelestis* (1679) (Courtesy of Library of the Astronomical Observatory of the Spanish Navy).

We have discarded a large number of observations that were in the HS98 database during the MM, as stated above. Vaquero and Gallego (2014) indicated that records of sunspots made from astrometric observations should not be used for studies of solar activity in the past and may have a significant impact on the reconstructions of solar activity based **from** them. The most illustrative example is formed by observations with the giant camera *obscura* of the Basilica of San Petronio in Bologna. Therefore, we have discarded the observations made with this instrument, which were included in the HS98 database. They are listed in Table 3 of Vaquero (2007). Moreover, observers listed in the HS98 database with ~365 days of observations per year have been removed from the revised collection because these values (usually zero values) are based on general indirect comments and not on well-documented observations (see section 3.2 of Clette et al., 2014). Finally, consulting the original documents, Usoskin et al. (2015) concluded that the sunspot observation assigned to Kircher in 1667 is erroneous and needs to be removed from the HS98 database. Therefore, we have discarded this record.

Very few records of the MM have been added since the publication of the HS98 database. In our revised collection, we have now included the sunspot records by Peter Becker from Rostock (Neuhaeuser et al., 2015) and Nicholas Bion from Paris (Casas, Vaquero and Vázquez, 2006).

In recent years, only one important change has been made in the counting during the MM. Vaquero, Trigo and Gallego (2012) used a simple method to detect inconsistent values of the annual sunspot number in several years, including 1652. Later, Vaquero and Trigo (2014) detected that the origin of this problem is a misinterpretation of a comment by Hevelius describing his sunspot observation of 1652. Therefore, we have changed these observations in the revised collection.

The main modifications with respect to HS98 data are localized in this period. In terms of the solar activity level, we have also found noticeable differences between this work and HS98 during the MM. Figure 3 shows the statistics of the active day percentage extracted from both articles. The level of solar activity calculated from this revised collection is greater than the level obtained by HS98. Using the period 1640–1712, the percentage of active days from HS98 (22915 observations) is 5.9 % while that the same percentage is 9.9 % from our revised collection (13651 observations). Namely, the percentage of active days is almost double in this work compared to HS98.

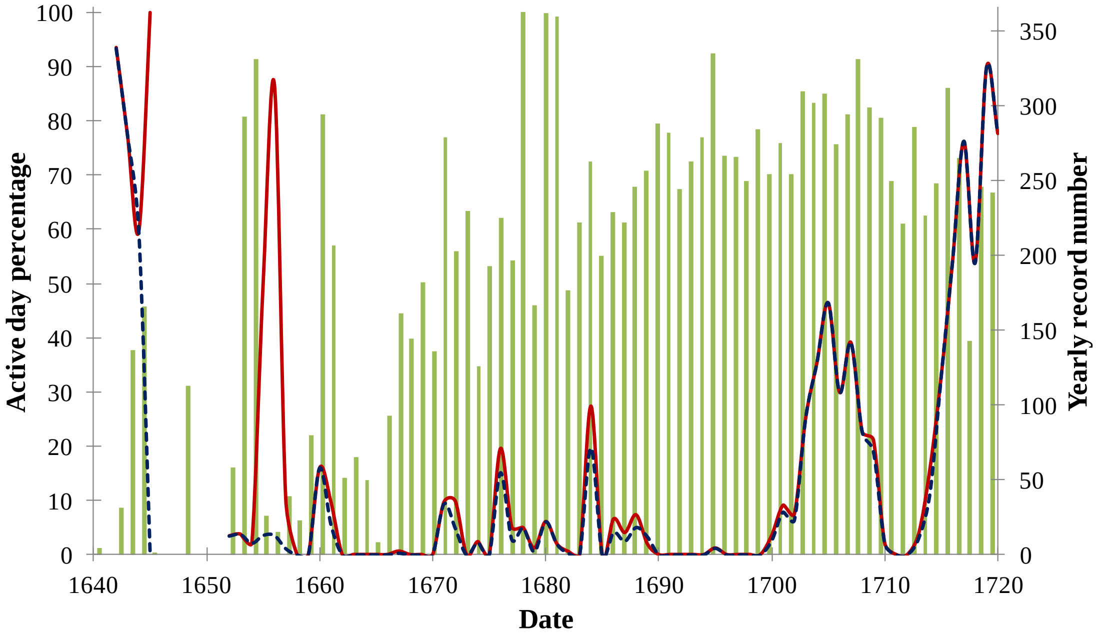


Figure 3. Statistics of the active day percentage during the MM for HS98 (dashed blue line) and this work (red line). The green bars represent the total number of yearly observations in the revised collection.

Despite the level of solar activity calculated from this revised collection is greater than HS98, this new result remains compatible with a grand minimum epoch of solar activity. From a sample of *n* observation with *r* active days, we can know the most probable value of the fraction of active day in a year using the hypergeometric probability distribution (Kovaltsov, Usoskin and Mursula, 2004). Thus, we have estimated the most probable value of the fraction of active days for MM and Dalton Minimum (Table 2). This result shows the expected value for MM is significantly less than for Dalton Minimum which although it is not considered as a grand minimum, it is an epoch of reduced solar activity. Therefore, the level of solar activity estimated from this revised collection denotes MM is a grand minimum.

Table 2. Expected value and upper and lower limits (99% confidence interval) of the fraction of active days (%) estimated for the Maunder Minimum (1640–1712) and Dalton Minimum (1798–1833) from this revised collection.

PERIOD	EXPECTED VALUE	UPPER LIMIT	LOWE LIMIT
MAUNDER MINIMUM	9.94 %	10.33 %	9.55 %
DALTON MINIMUM	61.63 %	62.48 %	60.78 %

3.3. The "lost" solar cycle

A controversy about the presence of a "lost solar cycle" between the classical solar cycle #4 and #5 has divided the community over recent years (Usoskin et al., 2009; Zolotova and Ponyavin, 2011; Owens et al., 2015). Therefore, we have revised some sunspot records related with this controversial period.

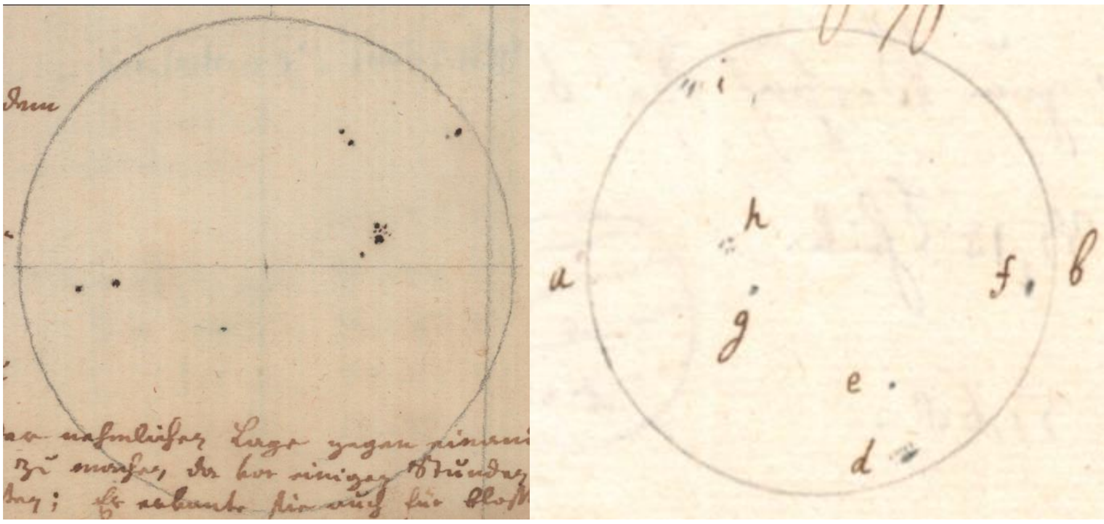
We have analyzed the sunspot observations made by several astronomers (D. Huber, J.E. Bode, H. Flaugergues, F. von Hahn, F.A. von Ende and J. Schröter) who were active during solar cycle 4. The aim of this analysis is to clarify and provide new information on this controversial "lost cycle".

We have revised the observations made by D. Huber. Note that observations made by D. Huber were improperly attributed to his father, Johann Jakob Huber, in the original HS98 database. In the latter, there is one record by Huber counting four sunspot groups on 28 May 1793. This is a very important record because observations around 1793 are very scarce. We have located the original document (Huber, 1808. *Brouillon für astron.*

Beob. 1793-1808, p. 47) at the Library of the University of Basel: it is reproduced in Figure 3a. We have changed the count from four to six sunspot groups. D. Huber noted in German: “My father had asked me to make this check, because a few hours ago Venus was (about to be) in conjunction with the Sun […]. He also recognized that they were clearly sunspots.”

We have also revised the observations by J.E. Bode. We have modified the sunspot count for April 3rd 1791 from five to six sunspot groups. The original sketch made by Bode (*Notebooks*, vol. 6, p. 24-25) is reproduced in Figure 3b. Moreover, we have incorporated one additional record for May 20th 1794, when Bode recorded three sunspot groups (*Notebooks*, vol. 9, p. 23- 24). These manuscripts were located at the Archive of the Academy of Sciences of Berlin-Brandenburg.

H. Flaugergues was an important sunspot observer in this same time interval. His observations corresponding to the years 1794 and 1795 were made in Aubenas (not in Viviers). We have removed the records assigned to “H. Flaugergues (C. de T.)” in the HS98 database because they include continuous null spot counts and show inconsistences with the observations reported by the same observer (H. Flaugergues) from Viviers. We have also corrected a total of 17 records using the original documents (**one** record in 1788, 4 in 1794, 7 in 1795, and 5 in 1796). We have lowered the sunspot counts in 13 observations and have increased it in **four** other cases. Moreover, another 34 sunspot counts have been added to the revised collection (**one** in 1795, 9 in 1796 y 24 in 1797). These sunspot group counts from new observations are ranging from 0 to 2. Two original sources have been consulted: (1) the manuscripts located at Library of the Paris Observatory (Flaugergues, *Astronomie du 12 Novembre 1782 au 21 Septembre 1798*) and (2) the records contained in the journal *Mémoires de l'Institut National des Sciences et Arts*.



(a) (b)

Figure 3. Original sketches of sunspot observations by (a) Huber (28 May 1793) and (b) Bode (3 April 1791) [Sources: (a) Huber, 1808. *Brouillon für astron. Beob. 1793-1808*, Sign. L lb 12, fol. 47, Library of University of Basel, and (b) Bode, 1791, *Notebooks*, vol. 6, p. 24-25, Archive of the Academy of Sciences of Berlin-Brandenburg].

We have also revised the records by F. von Hahn, incorporating a lost record (February 4th 1793) when no sunspot group was observed. This record can be consulted (in German) in *Berliner Astronomisches Jahrbuch* ("Remarks about Venus, Description of some remarkable sunspots, and astronomical news. Submitted from May 13th to June 16th 1793", p. 188-191, Berlin, 1793). Moreover, we did not modify data from F.A. von Ende that ha**s also** been reviewed.

Finally, three observations by J. Schröter in the year 1795 (November 30th, December 3rd and 5th), when he recorded one sunspot group in **each of** the three cases, **these** were added to the collection. These observations (in German) lie in *Neuere Beyträge zur Erweiterung der Sternkunde* (Chapter VI: Observation of a remarkable and astonishing sunspot, together with further remarks about the natural constitution of the Sun (Lilienthal, Feb. 1st 1796), p. 56-77, Göttingen, 1798).

4. New series in the 19th-20th centuries

4.1. D.E. Hadden

D.E. Hadden made sunspot observations in Alta (Iowa, USA) during the period 1890-1931. However, we were only able to recover 13 years from the 42 years of observations with daily information. In total, 2964 daily counts have been recovered. These counts were published in several astronomical journals; some of them were local journals. Moreover, Hadden used different telescopes in each observation period: (i) 1890-1896, refractor telescope (3-inch; ~76 mm) and (ii) 1897-1902, refractor telescope (4-inch; ~100 mm).

In their database, HS98 included records by Hadden only for the last third of 1890 (67 observations in total). However, these values are incorrect since they only report new groups that appeared on the solar disk and not the total number of groups present on the Sun (Carrasco et al., 2013).

4.2. Madrid Observatory

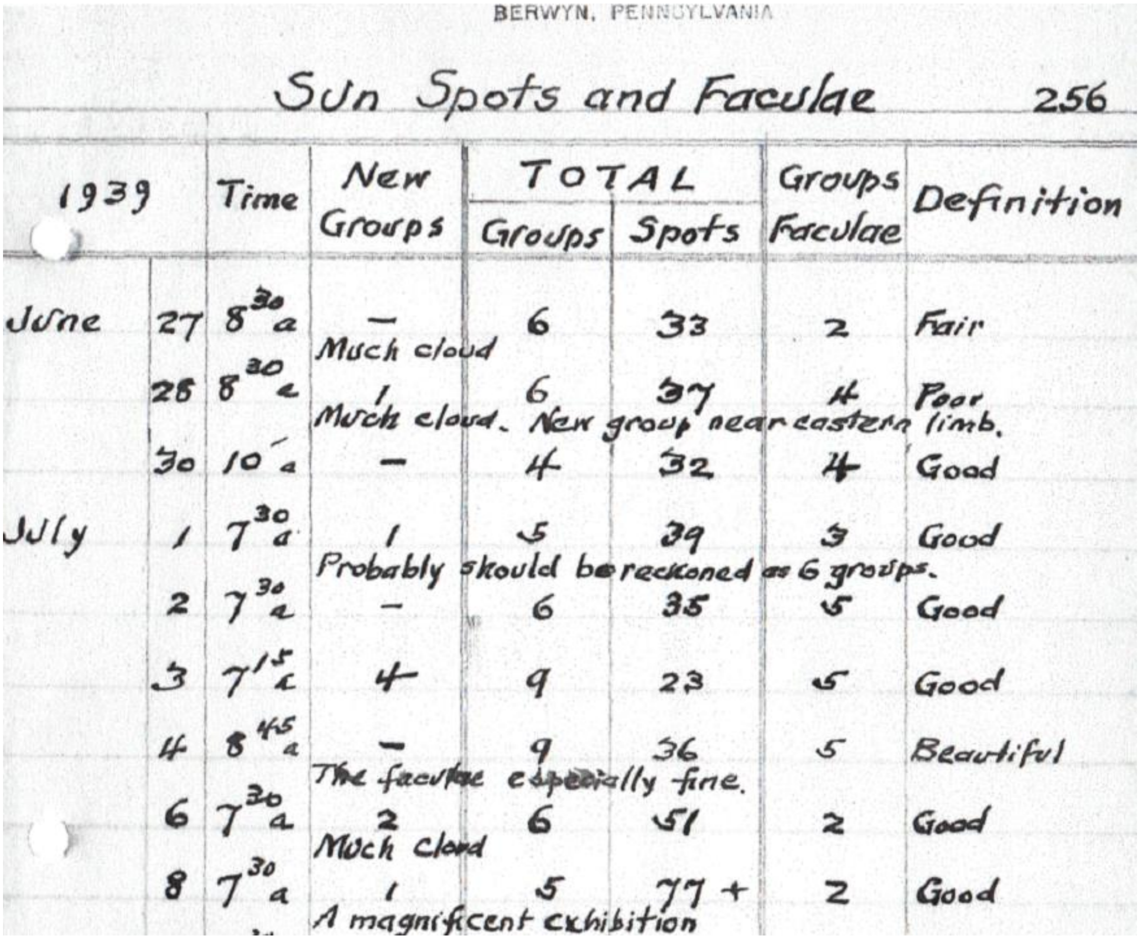
The Astronomical Observatory of Madrid (AOM) was founded in the late 18th century. Systematic observations were made from 1876 to 1986 to determine the sunspot number and areas. The data were published in various Spanish scientific publications. Aparicio et al. (2014) retrieved and digitized these data. From the group and sunspot counts, they computed the Madrid sunspot number (MSN) and the Madrid group sunspot number

(MGSN). The subsequent analysis showed that the MSN and the MGSN can be considered as reliable series given their very high correlation with other reference indices.

In addition, Aparicio et al. (2014) recovered interesting metadata about the instruments, methods, and observers of the AOM solar program. These metadata reveal some mistakes in the construction of the Group Sunspot Number (GSN) by HS98. They considered Aguilar to be the observer for the period 1876-1882 and Merino for 1883-1896. However, the observer for those years was Ventosa. Aguilar and Merino acted only as directors of the observatory in those respective periods. Later, HS98 took observations for the years 1935-1938, 1940-1957, 1959-1972 with "Madrid Observatory" as observer name. However, as can be seen in Aparicio et al. (2014), two important facts must be taken into account. Firstly, the observations for the years 1937-1938 were made in Valencia (due to the Spanish Civil War) by other observers with other instruments. Secondly, in the period 1935-1986, there **were** a large number of observers with an irregular distribution. For those reasons, we must be very careful when working with these data in order to calculate the correction factors. Lastly, Aparicio et al. (2014) added a lot of available sunspot group data that were not used by HS98. **Thus, the daily observations from AOM corresponding to the periods 1876–1896 and 1936–1986 have been included in this revised collection. We highlight that the observations made at AOM from 1973 to 1986 are not included in HS98 database. The total number of these new records is equal to 2936 counts.**

4.3. Harry B. Rumrill

Harry Barlow Rumrill followed closely in the footsteps of his friend, Alden Walker Quimby, in observation of solar sunspots. Rumrill's estate included an archive of his sunspot work. The archive is now in the possession of John Koester, of the Antique Telescope Society (New York, NY). The**se** raw data consists of a large collection of pencil drawings of the solar disk. A few thousand drawings dating from Jan 8, 1928 through Oct 31th, 1950 (with gaps) are present. **Raw** data from the drawings were summarized in smaller notebooks, which were photocopied by Koester and forwarded to one of us [**L. Svalgaard**]. Each page in these notebooks gives data in 6 columns, one of which is subdivided into 2 parts. They are labeled: date; time; new groups; total groups/total spots [these given in one subdivided column under heading "Total"]; groups faculae (sic); definition [in addition to description of observing conditions, this column often has a note as to which telescope was used] (see Figure 4).



BERWYN, PENNSYLVANIA

Sun Spots and Faculae 256

1939		Time	New Groups	TOTAL Groups	TOTAL Spots	Groups Faculae	Definition
June	27	8^{30} a	—	6	33	2	Fair
			Much cloud				
	28	8^{30} a	1	6	37	4	Poor
			Much cloud. New group near eastern limb.				
	30	10 a	—	4	32	4	Good
July	1	7^{30} a	1	5	39	3	Good
			Probably should be reckoned as 6 groups.				
	2	7^{30} a	—	6	35	5	Good
	3	7^{15} a	4	9	23	5	Good
	4	8^{45} a	—	9	36	5	Beautiful
			The faculae especially fine.				
	6	7^{30} a	2	6	51	2	Good
			Much cloud				
	8	7^{30} a	1	5	77 +	2	Good
			A magnificent exhibition				

Figure 4. A page example of the Rumrill's notebooks (courtesy of John Koester).

4.4. Herbert Luft

Herbert Luft has one of the longest series of sunspot observations of this revised collection. His observations begin in 1923 and end in 1987. The series is thus 65-year long, although there are some gaps concentrated in the 1930s and 1960s. Luft made his observations in several parts of the world, **first in** Germany**, then Brazil then** the US. He was detained at the Buchenwald concentration camp for five weeks in 1938 and, therefore, decided to **immigrate** to Brazil in 1939. His refractor telescope of 52 mm diameter was one of the few personal effects that accompanied him on this trip. He belonged to several astronomical associations and was mentored by the German astronomer Wolfgang Gleissberg, who recommended Luft focus on the observation of sunspots (Mattei and Mattei, 1989).

The original database of HS98 contains no records by H. Luft. Of the nearly 12,000 pages of sunspot observations in the notebooks of Luft, one of us [**L. Svalgaard**] has recovered those with good image quality. Thus, **10628** new **daily records made by Luft** are **now** incorporated into the revised collection.

4.5. Thomas A. Cragg

Thomas A. Cragg joined the AAVSO in 1945 at age 17, when he was working as an assistant at the Mt. Wilson Observatory in California (Figure 5, left). He made an impressive total of over 157,000 variable star observations (AAVSO Observer Initials CR), but he was equally dedicated to his daily solar observing (AAVSO Solar Initials CR), which spanned the years 1947 through 2010. Each sunspot count recorded in his observing journal included a drawing of the group and spot configurations (Figure 5, right).

Cragg lived in Los Angeles until he was about 48 (thus, around 1976). Then he moved to Australia and worked at the Siding-Spring Observatory, as well as continuing his observing. After his death in 2011, his wife Mary sent all of his solar (and variable star) records to AAVSO Headquarters for the AAVSO archives. Mike Saladyga and Sara Beck have entered these **solar** data into the SunEntry solar database at AAVSO Headquarters.

In 1947, the AAVSO began collecting sunspot data from 23 observers, including Cragg, all of whom contributed to the American Relative Sunspot Number Index (R_a)

generated using the data submitted to the AAVSO. This was the start of the AAVSO's Solar Division (now Solar Section). At that time (and until recently), the paper report forms containing observers' raw data were not saved once the R_a number had been generated. Without the paper forms, and with no way to save the**se** data electronically**,** for many years the AAVSO historical solar raw data were lost.

Recovery of original sunspot data is possible, however, when observers' solar observing **notebooks** are made available for digitization. Recently, longtime solar observer Herbert Luft's nearly 70 years' of sunspot data were recovered from his **notebooks** at the AAVSO (see section 4.4). Now, we have the Thomas Cragg drawings digitized in the SunEntry database as a continuous record of group, sunspot counts, and Wolf numbers.

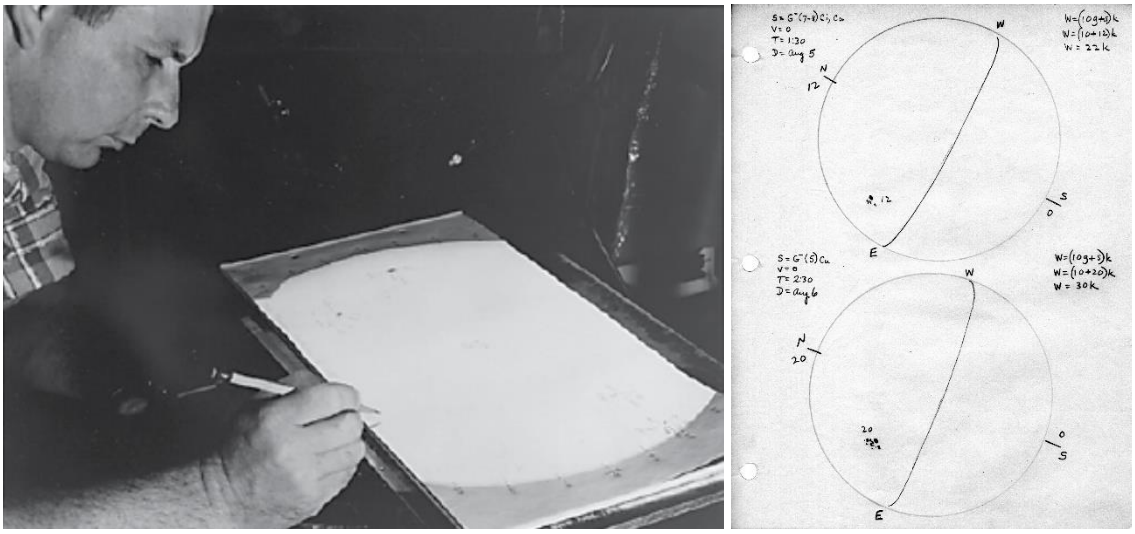


Figure 5. AAVSO member and observer Tom Cragg at work in the Mt. Wilson Solar Observatory (September 1962) (left) and an example page of his notebooks (right).

4.6. Astronomical Observatory of the University of Valencia

The Astronomical Observatory of the University of Valencia (Spain) was founded in 1909 by Ignacio Tarazona y Blanch. This observatory developed a solar monitoring program where the responsible astronomer for the observations was Tomas Almer Arnau. Sunspot counts were based on photographic plates. The Observatory published a catalog of sunspots for the period 1920-1928, except for 1921-1922 (Carrasco et al., 2014). Furthermore, it had good equipment, in particular a refractor telescope by Grubb of 152 mm in diameter. These observations made at the Observatory of Valencia were not compiled by HS98 in their database. Therefore, we have incorporated a total 1893 days with new observations in the revised collection, representing approximately 74% of all days over the studied period.

4.7. Data from the World Data Center SILSO

For the most recent part of the database after 1980, we imported the group counts from the extensive sunspot number database of the World Data Center SILSO (Clette et al. 2007, Clette et al. 2014). This database includes all observations collected on a monthly basis from the worldwide network coordinated by the WDC-SILSO, for a current total of more than 530,000 individual daily observations. In total, 282 stations contributed since 1980, with on average 85 active stations at any given time and between 20 and 45 observations available on any given day. Among all stations, 80 long-duration stations provided data over more than 11 years, some for more than 35 years. Two-thirds of the observers are individual amateur astronomers and one third of the stations are professional observatories, then often with different observers serving at different times. Given the abundance of observations, this part of the database allows extensive statistical diagnostics for the determination of the Group sunspot Number.

When importing group data from the SILSO database, we used the standard two-letter station identifier, as defined for all SILSO stations since 1980 and still currently in operational use.

5. Conclusion and future work

In this article, we have presented a revised collection of sunspot group numbers. Our collection has a smaller number of observations **than** the HS98 database for the historical period. However, the quality of observations has been largely improved, many typos have been fixed, and an update has been made. A large number of observations that we have discarded are reports of a spotless Sun during the **MM**. These records were associated to astrometric observations of the Sun. In fact, some of these observations were made using pinhole cameras (not telescopic devices). **Furthermore, we have calculated the statistics of active days during the MM. We emphasize that although the level of solar activity extracted from this new collection is greater than the level obtained from HS98, the result here supports that the MM is a grand minimum of solar activity. Thus, this contradicts the work of Zolotova and Ponyavin (2015).**

The experience acquired during the process of compiling this collection has shown that records of sunspot groups can still be improved. The recent addition of supposedly lost observations, like the observations by Marcgraf (Vaquero et al., 2011), Wargentin, or Peter Becker (Neuhäuser et al., 2015), illustrates how a meticulous inquiry in historical archives and libraries could still offer surprising data for our international community. Moreover, the language used in the historical reports is mainly Latin. Thus, the translation from Latin to a modern language such as English is a priority task and some efforts have been made recently (Carrasco, Villalba Álvarez and Vaquero, 2015a;

Carrasco, Villalba Álvarez and Vaquero, 2015b; Gómez and Vaquero, 2015). **Therefore, we hope to update the revised collection of sunspot groups presented in this article every two or three years, publishing the updated files in several web sites including SILSO (http://sidc.be/silso/) and HASO (http://haso.unex.es).**

But this remains an ongoing work. The possibilities offered by historical observations are vast and so far, we only derived the number of sunspot groups from them. An immediate first step should be to complement this collection with the total number of spots in each observation. The second step should be the compilation of hemispheric values. Both tasks would give us useful data to undertake further studies of the evolution of solar activity during the last four centuries.

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