

Description of sunspots at the Royal Observatory of the Spanish Navy (1833–1840)

Vaquero and Gallego (2014) presented the marginal notes about sunspots that are included in the manuscripts of the meridian solar observations made at the Royal Observatory of the Spanish Navy during the period 1833–1840. In its historical archive, “Astronomía” section, “Observaciones encuadernadas” series, we have consulted the original manuscripts corresponding to the observations in the years 1833 (box 286), 1834 (box 275), 1835 (box 276), 1836 (box 276), 1837 (box 277), 1838 (box 277), 1839 (box 278), and 1840 (box 278). A complete list of the annotations about sunspots is reproduced below containing the date of the report, the name of the observer (all the observers belonged to the staff of ROA) and the original description of sunspots. In total, there are 40 references to sunspots for the years 1835 (4 references), 1836 (14), and 1837 (22).

Original reference

J.M. Vaquero and M.C. Gallego (2014) "Reconstructing Past Solar Activity using Meridian Solar Observations: the Case of the Royal Observatory of the Spanish Navy (1833-1840)" *Advances in Space Research* 53, 1162-1168 (doi: 10.1016/j.asr.2014.01.015).

Abstract

Solar meridian observations have been used to evaluate the solar activity of the past. Some important examples are the solar meridian observations made at the Basilica of San Petronio in Bologna by several astronomers and the observations made by Hevelius published in his book *Machina Coelestis*. However, we do not know whether these observations, which were not aimed to estimate the solar activity, are reliable for evaluating solar activity. In this paper, we present the marginal notes about sunspots that are included in the manuscripts of the meridian solar observations made at the Royal Observatory of the Spanish Navy during the period 1833–1840. We compare these observations with other solar activity indices such as sunspot area and number. Our conclusion is that solar meridian observations should be used with extreme caution to evaluate past solar activity.

Appendix I: Original texts from manuscript sources in Old Spanish.

| Date | Observer | Original text [Modern English translation] |
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| 25 Apr 1835 | Montejo | Muy cerca del 2º limbo del Sol había dos grupos de manchas notables [Two groups of notable spots were very close to the 2nd limb of the Sun.] |
| 30 May 1835 | Montejo | Corría el hilo merid.º una mancha notable cuyo centro antecedía al 2º l [One notable spot, whose centre precedes the 2nd limb, crossed the meridian wire.] |
| 31 May 1835 | Montejo | Antecedía la mancha [al segundo limbo] y estaba al sur del [hilo] ecuatorial [The spot preceded [the second limb] and was south of the equatorial [wire].] |
| 2 Aug 1835 | Montejo | Dos grupos notables de manchas tiene el Sol; el uno muy inmediato al primer margen por encima del hilo ecuat. ¹ : el otro como á un tercio del $\frac{1}{2}$ diametro solar del segundo [margen] y bastante debajo del mismo hilo. Es considerable la parte de superficie que cogen sobre el disco del Sol [Two notable groups of spots are on the Sun. The first is close to the first limb above the equatorial wire. The other group is approximately one-third of the solar semi-diameter from the second limb and a good way under the same wire. The portion of spotted area on the Sun's disc is considerable.] |
| 21 Apr 1836 | Montejo | Continúan viéndose grupos notables de manchas en el Sol [Notable sunspot groups continue to be seen.] |
| 21 May 1836 | Montejo | Dos grupos notables de manchas, uno hacia el primer limbo, muy próximo al hilo ecuatorial, y por debajo de él en general; el otro hacia el 2º y mucho más bajas aparentemente respecto del mismo hilo [Two notable groups of spots. One towards the first limb, close to the equatorial wire, and below it in general; the other towards the 2nd limb and apparently much lower relative to that same wire.] |
| 5 Jun 1836 | Montejo | No se ven manchas [No spots are seen.] |
| 10 Jun 1836 | Montejo | Numerosas manchas por debajo del hilo ecuatorial en casi todo el disco: una muy notable por su tamaño (grupo más bien) muy cerca del 2º Limbo por encima del hilo ecuatorial [There are numerous spots below the equatorial wire on nearly all the disc. One very notable for its size (it is a group, rather) is very close to the 2nd limb above the equatorial wire.] |
| 19 Jun 1836 | Montejo | Bastantes manchas por todo el disco [Many spots over the entire disc.] |
| 16 Jul 1836 | Montejo | Bastantes manchas hacia el 2º l. y por todo el disco [Many spots towards the 2nd limb and over the entire disc.] |
| 17 Jul 1836 | Montejo | Bastantes manchas por todo el disco [Many spots over the entire disc.] |
| 4 Sep 1836 | Montejo | Un grupo notable por su extensión en estos días pasados de manchas regulares que corría en la dirección NE-SO se ha reunido en una mancha |

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| | | sola de extraordinarias dimensiones y una penumbra considerable. Otro grupo de manchas diseminadas en la misma dirección, no tan grande; hay más al SO (el 1.º no está lejos del 1 ^{er} l.) y una mancha bastante regular cerca del 2º [A notable group of large, regular spots running NE-SW observed in the past few days has now formed a single spot of extraordinary dimensions and considerable penumbra. Another group of spots scattered along the same direction, not so large. There are more to the SW (the 1st is not far from the 1st limb) and a fairly regular spot near the 2nd limb.] |
| 21 Sep 1836 | Montejo | Un grupo de manchas muy considerable cerca del 2º margen, debe ser el que desapareció hace días por el margen opuesto [A group of very large spots near the 2nd limb. It must be the one that disappeared days ago over the opposite limb.] |
| 18 Oct 1836 | Montejo | Grupos de manchas, algunos de extraordinario tamaño [Groups of spots, some of extraordinary size.] |
| 23 Oct 1836 | Montejo | Muchas manchas por todo el disco [Many spots over the entire disc.] |
| 30 Oct 1836 | Montejo | Se ha formado del 27 acá una mancha considerable próxima hoy al 2º l. [From the 27th until now, a considerable spot has formed which is today close to the 2nd limb.] |
| 9 Nov 1836 | Montejo | Cuatro grupos notables de manchas tiene el Sol, dos hacia el primer limbo y dos hacia el 2º [The Sun has four notable groups of spots, two towards the 1st limb and two towards the 2nd.] |
| 19 Nov 1836 | Montejo | Muchas manchas y de tamaño considerable [Many spots and of considerable size.] |
| 10 Jan 1837 | Montejo | Muchas manchas de consideración casi paralelas al hilo horizontal [Many large spots nearly parallel to the horizontal wire.] |
| 2 Feb 1837 | Martínez | Había ayer sobre el hilo ecuatorial y como unos 4" de tiempo distante del limbo oriental una mancha bastante considerable; hoy se halla como unos 8"5 de tiempo. Su figura es elíptica [Yesterday, a large spot was on the equatorial wire about 4" of time distant from the east limb. Today its position is about 8.5" of time. It is elliptical in shape.] |
| 21 Feb 1837 | Martínez | Varios grupos de manchas por debajo del hilo ecuatorial. Había una algo mayor que las demás a 2"2 de tiempo del 2º limbo [Several groups of spots below the equatorial wire. One was slightly larger than the others, at 2.2" of time from the 2nd limb.] |
| 22 Feb 1837 | Martínez | Varias manchas. La que ayer distaba 2"2 del 2º limbo dista hoy 7"95 de tiempo determinada esta distancia por dos apulsos. Cerca del 1 ^{er} limbo también por debajo del hilo ecuatorial había otras dos manchas grandes; el paso por el meridiano de la más cercana al limbo fue a 22 ^h 22 ^m 35 ^s 10 [Several spots. The spot that yesterday was at 2.2" from the 2nd limb is now at 7.95", this distance of time being determined by two appulses. Close to the 1st limb, also below the equatorial wire, there were two other large spots. The meridian transit of that closest to the limb was at |

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| | | 22 ^h 22 ^m 35.10 ^s] |
| 23 Feb 1837 | Martínez | La mancha cuyo paso meridiano fue ayer 22 ^h 22 ^m 35 ^s 10, pasó hoy a 22 ^h 26 ^m 20 ^s 10 [The spot whose meridian transit yesterday was at 22 ^h 22 ^m 35.10 ^s , today transited at 22 ^h 26 ^m 20.10 ^s .] |
| 25 Feb 1837 | Martínez | Dos grandes manchas cerca del 1 ^{er} limbo y por debajo del hilo ecuatorial. Su paso por el meridiano fué á 22 ^h 33 ^m 59 ^s 00 la más próxima al limbo. 22 ^h 34 ^m 3 ^s 20 la más lejana. [Two large spots near the 1st limb and below the equatorial wire. Their meridian transits were at: 22 ^h 33 ^m 59.00 ^s the spot closer to the limb; 22 ^h 34 ^m 3.20 ^s the farther spot.] |
| 26 Feb 1837 | Martínez | De las dos manchas observadas ayer desapareció la primera. La 2 ^a pasó hoy á 22 ^h 36 ^m 45 ^s 98 observ. ^{ta} amp. ^{ta} [The first of the two spots observed yesterday has disappeared. The 2nd transited today at 22 ^h 36 ^m 45.98 ^s .] |
| 27 Feb 1837 | Márquez | Una mancha cerca del 2 ^o l. y corriendo el hilo ec. ^l pasó á 42 ^m 32 ^s 6 h. ^o m. ^o [A spot near the 2nd limb and running along the equatorial wire transited at 42 ^m 32.6 ^s .] |
| 25 Apr 1837 | Martínez | Un gran grupo de machas por debajo del h. ^o ecuat. ^l y cerca del 1 ^{er} limbo [A large group of spots below the equatorial wire and near the 1st limb.] |
| 30 Apr 1837 | Martínez | 2 ^h 29 ^m 40 ^s 90 Centro de una gran mancha inmediata al 1 ^{er} limbo y por debajo del hilo ecuatorial [2 ^h 29 ^m 40.90 ^s centre of a large spot next to the 1st limb and below the equatorial wire.] |
| 1 May 1837 | Martínez | El paso del centro de la mancha observada ayer ha sido hoy á 33' 22"55 por tres apulsos [Today the transit of the centre of the spot observed yesterday was at 33' 22.55", by three appulses.] |
| 17 Jul 1837 | Balzolá | Una mancha de consideración dista 3 ^s 5 del 2 ^o limbo [A large spot at 3.5 ^s from the 2nd limb.] |
| 18 Jul 1837 | Balzolá | La mancha dista hoy del 2 ^o limbo [The spot today is at 10.6 ^s from the 2nd limb.] |
| 27 Jul 1837 | Balzolá | 8 ^s 27 ^s 57 ^s 76 Centro de dos manchas de una misma ascensión recta y de alguna conside. ⁿ por su tamaño [8 ^s 27 ^s 57.76 ^s centre of two spots of the same right ascension and fairly large in size.] |
| 28 Jul 1837 | Balzolá | Las manchas distan hoy 11 ^s 28 por cuatro [apulsos] de 1 ^{er} . [The spots today are at 11.28 ^s from the 1st limb, by four appulses.] |
| 30 Jul 1837 | Balzolá | Las manchas distan 26 ^s 53 del 2. ^{do} l. ^o , por tres determinaciones [The spots are at 26.53 ^s from the 2nd limb, by three measurements.] |
| 8 Aug 1837 | Balzolá | 9 ^s 12 ^s 36 ^s 74 Mancha de consideración que se acerca más al 2. ^{do} l. [9 ^h 12 ^m 36.74 ^s Large spot that is closer to the 2nd limb.] |
| 9 Aug 1837 | Balzolá | La mancha observada ayer dista hoy del 1 ^{er} l. 11 ^s 10. Otra mancha pequeña dista del 2. ^{do} 4 ^s 07 [The spot observed yesterday is today at 11.10 ^s from the 1st limb. Another small spot is at 4.07 ^s from the 2nd |

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| | | limb.] |
| 10 Aug 1837 | Balzolá | 9 ^s 19 ^s 56 ^s 52 1 ^a mancha próxima al 1 ^{er} l. observada los días anteriores. La otra mancha pequeña y cuya distancia al 2. ^{do} l. fue determinada ayer por tres apulsos, dá hoy por igual número 10 ^s 47 de dis. ^a [9 ^h 19 ^m 56.52 ^s the 1st spot observed close to the 1st limb on the previous days. The other small spot, whose distance to the 2nd limb was determined yesterday by three appulses, is today at 10.47 ^s .] |
| 11 Aug 1837 | Balzolá | La primera mancha desapareció. La distancia de la segunda al l. 2. ^{do} no he logrado determinarla por la difícil posición en que para ello está la tal mancha [The first spot has disappeared. I was unable to determine the distance between the second spot and the 2nd limb due to the difficult position of this spot for this purpose.] |
| 20 Aug 1837 | Balzolá | 9 ^s 59 ^s 22 ^s 20 Gran mancha que va delante del 2. ^{do} l. [9 ^s 59 ^s 22.20 ^s Large spot that precedes the 2nd limb.] |
| 23 Aug 1837 | Balzolá | La gran mancha dista hoy del 2. ^{do} l. 38 ^s 27. [The large spot is today at 38.27 ^s from the 2nd limb.] |