

# An early drawing of solar granulation?

J.M. Vaquero

Departamento de Física, Centro Universitario de Mérida,  
Universidad de Extremadura, Mérida, Spain.

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The discovery of solar granulation was announced by Nasmyth in 1861. However, an early solar engraving that could contain the first graphic description of solar granulation is showed in this short contribution. This solar drawing was made by the Mexican astronomers José Ignacio Bartolache and José Antonio Alzate to describe the Venus transit of 1769.

**Keywords:** Solar granulation; solar drawing; Venus transit; history of astronomy.

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## 1. Introduction

The grainy appearance of the solar photosphere is called granulation [1-3]. This phenomenon is the visible manifestation of the convection zone that lies below the photosphere. In this process, hot matter rises in the bright granules, cools and then descends in the intergranular lanes. Bartholomew states that the discovery of the solar granulation took place in the second half of 19th century [4-5]. In 1861, James Nasmyth (1808–1890) announced that the entire solar surface was made up of a multitude of filaments, which he called “willow-leaf”. However, Mitchell showed some descriptions of this phenomenon made by Galileo and Scheiner [6]. In fact, solar granulation can be observed using a very modest telescope [7]. Granulation will be visible if the mean size of the solar granules are larger than the limit of spatial resolution due to the daytime seeing. Vaquero and Vázquez [8] (see Fig. 1.20 in Chapter 1) have shown how the contrast of the individual granules strongly decreases when they are observed with smaller telescopes. Therefore, telescopes with minor apertures provide a more degraded image of solar granulation.

Solar granulation was observed by William Herschel who described it clearly in his notebooks [9]. He used a wide terminology for the granulation phenomenon such as “mottles”, “mottles indentations”, “dimples”, and “corrugations”. For large granules, he also used the terms “crankles” and “large dimples”. Furthermore, we can find a drawing (named as “Fig. 1” in his notebooks) that show clearly the granulation around a sunspot observed the day 4 January 1801. That day, Herschell noted down that the granulated appearance was all over the disk, and extended equally to the polar regions and the equatorial ones.

The aim of this note is to point out that there is a solar drawing that could show the solar granulation for the first time. This solar drawing is a part of the printed matter that the Mexican astronomers José Ignacio Bartolache (1739–1790) and José Antonio Alzate (1737–1799) published describing the Venus transit of 1769.

## 2. Venus transit

J.A. Alzate and J.I. Bartolache were two important 18th century Mexican scientists [10-12]. They carried out observations of the 1769 Venus transit in Mexico City, specifically in the building named *Casa del Cabildo*. Alzate included a brief report of the observation in his *Diario Literario*. This report, titled “*Suplemento a la famosa observación del tránsito de*



FIGURE 1. Engraving of the 1769 Venus transit observed by Bartolache and Alzate from *Casa del Cabildo* in Mexico City (Courtesy of Toledo Public Library, Spain).

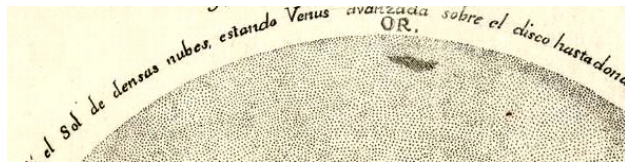


FIGURE 2. An enlarged detail of Fig. 1 (Courtesy of Toledo Public Library, Spain).

*Venus por el disco del Sol, hecha de encargo de la Muy Noble Imperial México por D.J. Ig. Bartolache y D.J. Ant. Alzate el 3 de junio de 1769*", presents a scheme of the event, including an engraving that depicts the place of the observation (Fig. 1). This engraving also included the solar disc where the sunspots and path of Venus are drawn with reasonable precision.

In addition, the engraving of the solar surface is filled with points (see Fig. 2), although we do not know if the observers really wanted to represent solar granulation. I note that there is no text describing the granulation and only the expression "es el Sol un globo de fuego vivo" [The Sun is a living globe on fire] could be ambiguously related with the solar convection. However, it is worth to notice that previous solar disc drawings were not filled using points [8]. Only the idealised solar disc that appeared in *Mundus Subterraneus* by Kircher (page 64) could be related with solar granulation [13].

Another striking fact is that the early professional observations of the granulation around a sunspot in the nineteenth century are represented with structure similar to the engraving by Bartolache and Alzate. As examples, one can cite the image taken by F. Lohse in 1873 in Potsdam [14] and some drawings made by W. Huggins and A. Secchi [15].

### 3. Conclusion

It is plausible that the Mexican engraving could contain the first graphic description of solar granulation. Indeed, granulation is observable even with modest telescopes under favourable atmospheric conditions and this phenomenon was already described by the first telescopic observers of sunspots. The use of points in drawings to fill the solar disc was very unusual in mid-18th century and there was not any scientific terminology to describe solar granulation. Moreover, there are similar representations of solar granulation in some drawings in the 19th century.

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1. A. Bhatnagar and W.C. Livingston, *Fundamentals of Solar Astronomy* (World Scientific, 2005).
2. R.J. Bray, R.E. Loughhead, and C.J. Durrant, *The Solar Granulation (2nd Edn.)* (Cambridge University Press, Cambridge and New York, 1984).
3. R. Muller, in A. Hanslmeier and M. Messerotti, (eds.), *Motions in the Solar Atmosphere* (Springer, 1999) p. 35.
4. J. Nasmyth, *Memoirs of the Literary and Philosophical Society of Manchester* **3** (1862) 407.
5. C.F. Bartholomew, *Q. Jl R. astr. Soc.* **17** (1976) 263.
6. W.M. Mitchell, *Popular Astronomy*, **24** (1916) 22, 82, 149, 206, 290, 341, 428, 488, 562.
7. L. MacDonald, *How to observe the Sun safely* (Springer, Patrick Moore's practical astronomy series, 2003).
8. J.M. Vaquero and M. Vázquez, *The Sun Recorded Through History, Scientific Data Extracted from Historical Documents* (Springer, Astrophysics and Space Science Library, Vol. 361 2009).
9. D.V. Hoyt and K.H. Schatten, *The Astrophysical Journal Supplement Series* **78** (1992) 301.
10. E. Trabulse, *Historia de la Ciencia en México, Tomo III, La ciencia mexicana en el siglo de las Luces* (Conacyt/Fondo de Cultura Económica, México, 1992).
11. J.M. Vaquero and M.A. Moreno-Corral, *Geofísica Internacional* **47** (2008) 189.
12. S. Galindo Uribarri, M.A. Moreno Corral and A. Saladino García, *El Astrónomo José Antonio Alzate* (Innovación Editorial Lagares, México).
13. A. Kircheri, *Mundus Subterraneus, in XII Libros digestus, Tomus I, editio tertia* (Apud Joannem Janssonium à Waesberge & Filios, Amstelodami, 1678).
14. J. Staude, *Die Sterne* **71** (1995) 142.
15. R. A. Proctor, *The Sun: Ruler, Fire, Light, and Life of the Planetary System* (Longmans, Green, and Co., London 1871) (see Figs. 44 and 51).