

歴史上、初めて望遠鏡を用いて行われた星食観測

1623 July 5 at 21h 23m 57s (UT), Moon occulted Spica, observed by Bulliandus

2023.7.5 宮下和久 (JCLO)

本稿を書いている 2023 年 7 月 5 日は、史上初の望遠鏡による星食観測が行われてから 400 年の記念すべき日に当たります。JCLO では、7 月からの数か月間を「星食 400 周年」のキャンペーン期間として星食観測の紹介やお薦めをしていきます。

そこで、その第一歩として、Dave Herald 氏からご紹介いただいた資料について、文字起こしと邦文訳を試みました。（ラテン語部分の訳はできないので、そのままにしています）

まず、Herald 氏による紹介文から始めます。

It is a 400 year anniversary. On 1623 July 5 at 21h 23m 57s UT, the French astronomer I Bullialdus (apparently his name was actually Boulliau) reported the first recorded lunar occultation of a star observed through a telescope. He was located in Paris near Isle de Cite - at or near the current Institute de France building, at the southern end of the Pont des Arts.

The text from Simon Newcombe's 'Researches on the Motion of the Moon' (the authoritative reference to old lunar occultations) has the following description:

400 周年の記念日がやってきます。1623 年 7 月 5 日 21 時 23 分 57 秒 (UT)、フランスの天文学者 I Bullialdus（本当の名前は Boulliau）は、初めての望遠鏡を使った月による星食を報告しました。彼はパリのシテ島近く、ポン・デ・ザール（橋）の南にある現在のフランス研究所の建物の中、またはその近くに住んでいました。

サイモン・ニューコム『月の運動に関する研究』（昔の「月による星食」に関する権威ある参考文献）には、次のような記述があります。

OBSERVATIONS OF BULLIALDUS AND GASSENDUS.

The authorities for these observations are the printed works of the authors, namely:—

BULLIALDUS, *Astronomia Philolaica*. Paris, 1645.

GASSENDUS, *Opera*, Tome IV, *Commentarii de Rebus Coelestibus*.

I believe we must accord to BULLIALDUS the honor of being the first to actually observe the time of an occultation with a telescope. We begin with his observations. The times have been deduced from the observed altitudes, using the mean places of the stars given on the next two pages. The geographical positions of the places of observation of the two observers have been adopted as follows:—

Latin Name.	Modern Name.	Latitude.	Long. from Greenwich.	$\log p \sin \phi'$.	$\log p \cos \phi'$.
.	Paris.	48 52	9 21 E.	9.8747	9.8192
Juliodunum } Lodunum }	Loudon	47 1	0 20 E.	9.8622	9.8344
Dinia . . .	Digne	44 5	24 57 E.	9.8403	9.8570
Aquæ Sextiæ	Aix	43 32	21 47 E.	9.8358	9.8610

It will be remembered that in making these observations the observers used no clock, but determined their time by observing the altitude of some well-determined object at the moment of the phenomenon. The star-positions used in reducing the observed altitudes of all the observers whose work is discussed in the following sections are shown in the following table. No refinement has been aimed at in their derivation, nor have the places been corrected for nutation and aberration. All the corrections which should be applied are completely masked by the probable errors of the observed altitudes.

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Bullialdus と Gassendus の観測

これらの観測の出典は、下記のような著者の印刷物による。

BULLIALDUS, *Astronomia Philolaica*. Paris, 1645.

GASSENDUS, *Opera*, Tome IV, *Commentarii de Rebus Coelestibus*.

私は、我々が Bullialdus に「実際に望遠鏡を使って星食の時刻を観測した最初の人物である」という栄誉を与えるべきであると信じる。彼の観測から始めていこう。

時刻は、観測された高度から次の 2 ページで与える星の平均位置を使って推測される。

二人の観測者のそれぞれの地上の位置は次の値を採用した。

(表 略)

「当時の観測者はこれらの観測をするために時計を用いていないが、それらの時刻は、現象時刻において、いくつかの位置がよく決定された天体の高度を測定することにより決定された」ということが思い出されることだろう。以下の章で議論する作業をした全ての観測者の観測の整約に用いられた星の位置について、以下の表に示す。

彼らの発表内容について改良することを目的とはしないし、章動と光行差についての補正もされていない。ここで適用されるべき全ての補正は、観測された高度の推定誤差によって覆い隠されてしまうからである。

The place of the moon is that computed from HANSEN's Tables for $9^h 33^m 37^s$ Paris time, and corrected for parallax.

The local times thence deduced are :—

From alt. of Spica, $17^\circ 7'$, Sid. T. = $16^h 27^m 15^s$; M. T. = $9^h 33^m 18^s$.

Moon, $17^\circ 20'$ $16^h 26^m 58^s$; $9^h 33^m 1^s$.

The results agree well enough, but the fact is that at this time the tables, which cannot be $3'$ in error, show the apparent distance of the centre of the moon and Spica at this time to have been about $28'$, so that the star must have been some $13'$ distant from the moon's dark limb. The moon was then a few hours past her first quarter. Moreover, the moon was about $20'$ north of the star in latitude, so that there could not have been an occultation at all. Indeed, a careful reading of BULLIALDUS's deductions from his observation seems to indicate that he considered the two bodies to have the same longitude at the moment of the observation. Now, we must adopt one horn of this dilemma: either (1) we have to deal with such a blundering observer that he thought a star at the moon's limb when it was $23'$ distant, and in conjunction when the difference of longitude was some $20'$, and that when the dichotomized position of the moon was most favorable to the observation; or (2) he made a mistake in reading his altitude from the quadrant, and a consequent error of some 40^m in his computed time. The latter seems likely to be the correct explanation.

GASSENDUS at Digne was more successful. At the time when the altitude of Spica was $10^\circ 46'$ (local mean time, $10^h 32^m 40^s$), he says Spica was in the same right line with the cusps of the moon, the space being apparently equal to the diameter of Arcturus. This was 45^m in absolute time later than the observation of BULLIALDUS. On the whole, we can do nothing with this observation.

The next occultation is one of α Leonis, 1627, June 17, and is quoted by GASSENDUS as follows :—

The place of the moon is that computed from Hansen's tables for $9^h 33^m 37^s$ Paris time, and corrected for parallax.

The local times thence deduced are:-

From alt. of Spica $17^\circ 7'$, Sid T. $16^h 27^m 15^s$; M. T. = $9^h 33^m 18^s$.

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Hansen の表から パリ時間の 9h33m37s の月の位置を計算し、視差を補正した。そこから推算される地方時は、

From alt. of Spica 17o 7', Sid T. 16h27m15s; M. T.=9h33m18s.

Moon, 17o 20'	16h26m58s	9h33m 1s.
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この結果は充分良好であると言える。しかし、実際のところ、誤差 3'には至らないこの表は、この時刻には月の中心とスピカの間の見かけの距離はこの時刻においておよそ 28'であることを示している。したがって、星は月の暗縁から 13'の距離にあったことになる。月は上弦を数時間過ぎたところである。更に、月は緯度について約 20'星より北にあったことから、それでは星食は全く起こらないことになる。

実際、Bullialdus の彼の観測からの結論を注意深く読むと、彼は観測時に二つの天体が同じ経度を持つと考えていたことを示しているように見える。我々はこのジレンマから、どちらを採択すべきであろうか。

(1) 私たちは、月縁から 23'離れており、そして同時に経度は約 20' 離れている、そして月の二分された位置の星が観測に最も適している と考えている彼を、うっかり者の観測者として扱うべき。

(2) 彼は四分儀から高度を読み誤った。そして結果的に約 40m のエラーが彼の時刻計算結果に生じた。後者が正しい説明として適切であろう。

Digne の Gassendus は、もっと成功した。スピカの高度が 10o46'(地方時 10h32m40s)のとき、彼は、スピカは月のカスプと同一直線上にいたと言った。そのスペースは見た目アークトゥルスの直径と等しい。これは絶対時間において 45 分、Bullialdus の観測より遅い。全体として、私たちはこの観測から何も得ることができない。

次の α Leonis の星食は、1627, June 17, そしてそれは Gassendus により次のように引用されている。

Observations of BULLIALDUS.

From Astronomia Philolaica, p. 159.

Anno 1623 Julij die 5 cum Lunae centrum altum esset g. 17 $\frac{1}{2}$ Parisiis observavi occultationem Spicae Virginis à D.

BULLIALDUS adds that the moon appeared 13' north of the star in latitude; and having thence computed its position, he adds:—"fuit Hora Parisiis ex altitudine Spicae g. 17.7'. post meridiem ix. 30'." There is therefore some doubt whether the actual observation of altitude was made on the moon or on Spica. The correspondence between the difference of altitudes and difference of latitude is somewhat suspicious. The apparent places of the two objects are, as a first approximation:—

Spica, A. R. = 13^h 5^m 27^s; Dec. = — 9° 10'.

Moon, A. R. = 13^h 4^m 40^s; Dec. = — 8° 46'.

Observation of Bullialdus

From Astronomia Philolaica, p. 159

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Spica A. R. = 13h 5m 27s; Dec. = -9° 10'

Moon A. R. = 13h 4m 40s; Dec. = -8° 46'

Bullialdus の観測

Astronomia Philolaica, p. 159 より

Anno 1623 Julij die 5 cum Lunae centrum altum esset g. 17 $\frac{1}{2}$ Parisiis observavi occultationem Spicae Virginis a).

Bullialdus は緯度で星の 13 分北に月が現れたことを付け加えた。そしてそれよりその位置を計算した。彼は付け加えた:—"fuit Hora Parisiis ex altitudine Spicae g. 17,7'. Post meridiem ix. 30'."

実際の高度の観測が月についてなされたのかスピカについてなのかについていくつかの疑いがある。高度の違いと緯度の違いの一致は幾分疑わしい。二つの天体の視位置の最初の概算値は、

Spica A. R. = 13h 5m 27s; Dec. = -9° 10'

Moon A. R. = 13h 4m 40s; Dec. = -8° 46'