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PIETRO COSSALI AND THE ECLIPSES OF 1791 AND OF 1803

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ABSTRACT

The figure of the astronomer Pietro Cossali (1734-1815) is little known in Verona and around city, however he is a character whose work was various, worthy of note, known by the scientific contemporary community. His production of observative researches and publications specifically astronomical is concentrated principally between 1787 and 1805, period in which he was in service by Ferdinand of Borbone with the office of astronomy, meteorology and hydraulic professor at the royal University of Parma.

The precise framing of valence of this character in the historical astronomical contest requests the valuation of his wide interests and must pass through a careful verification of his works to give value to a judgement about quality of his observations and his unpublished writings. In this article we take into consideration his solar eclipse observations in 1791 and the previsions made for eclipse in 1804.

The eclipses

The mechanism of eclipses has known from thousands of years, in fact already the Chinese and the Chaldeans succeeded in foreseeing with exactly lunar and solar ones, and prognostics were considered very important, but for reasons different from ours: in fact the concealment of two celestial bodies had a magical and political meaning. In the sixth century BC, for example, a battle between Medi and Chaldeans was interrupted by a solar eclipse and the two armies took to their heels untidily, sure to have aroused the anger of divinity with their violence. The Chinese, on the other hand, believed that an eclipse regularly foreseen could not have harmful consequences, but that it was an advice of very serious misfortunes the one escaped to the attention of scholars: this fact explains why the astronomers Hi and Ho(1), at the court of Tshung-Kang, were sentenced to death just to have mistaken the calculus, it seems because of their usual drunkness.

The prevision of the location of an eclipse is not simple because of the complexity of lunar motion so the witness of one is always interesting because it has often given the opportunity to develop new mathematical algorithms. Besides we have a conspicuous comparison historical material(2) because is however a question of one of the most observed phenomena in any century(3) and from the ancient time in any civilisation.

Since today we are able to know the exact Earth-Moon distance, through laser reflectors(4), the reached precision has by now an uncertainty of few cm and this fact has consented also a net improvement of the solar system physics, then a superior quality for analyzing eclipses and for dating of historical events linked to them, at least until 1400 B.C.

The eclipse of 1791 and the prevision for that one of 1804

Among the published works of Cossali I have selected the documentation of two eclipses to be able to evaluate the quality of observation that he could obtain, the type of calculus used to reconstruct the lunar motion and at least to understand the causes of the imprecisions in the dataset or in the used methods(5). In this way it will be possible to deepen the actual research about scientific height of personality of this astronomer. This work confirms us that the study of eclipses in the past represented an important source of observations and an opportunity to develop new calculus systems to improve the results of prediction. The astronomy of '700 was concerned practically only about dynamical problems with a theoretical work which looked over orbital motions in the solar system.

APPARENZE
DEL
SOLARE ECCLISSI
DEL GIORNO 3 APRILE 1791
IN PARMA,
CON SPIEGAZIONI
ATTE A METTERE ALL'INTELLIGENZA
DELLE PERSONE UN PO' COLTE
ALCUNI ARTICOLI GENERALI
DI ASTRONOMIA
ANCHE ELEVATA;
DI PIETRO COSSALI C. R.
PROFESS. D'ASTRON., METEOR., E IDRAULICA
NELLA R. UNIVERSITA'.

PARMA
DALLA STAMPERIA REALE.

Fig. 1 Title-page of publication in which Cossali explained solar eclipse of 1791.

The two publications examined are, the first of 1791 in which it is described the observation and calculus of relative positions of Moon and Sun, eclipse duration, and the parameters that allowed the reconstruction of the run along the orbit; the second one of 1804(6) deals with the prevision of the development of different moments of a solar eclipse. The used mathematical calculus was the Lalande(7) method for the most refined corrections, that Cossali believed of "extraordinary accuracy". This method results more exact than that one explained by la Caille(8) and besides it had the advantage to need a smaller number of elements.

In the published texts we notice the evident intent of the author to be comprehensible for a wider audience than that one of insiders only that is "l'essere quinci più facile a ravvicinarvelo, ed il tenere ai sensi un più immediato rapporto". Altogheter we are in presence of a declared educational aim so that everyone could acquire a specific language of astronomy and above all the information that this science could supply. So this Theatine outran times, purposing an aim popular too which today is in fashion in much modern scientific literature(9).

In this sense we find other writings with these features above all in the introductions at the articles about ephemerides(10)(11) or in the works where it was calculated the period in which fell Easter in a particular year(12).

In the article of 1791, for example, Cossali explained the reasons of the obliquity of ecliptic and the oscillatory movements that it accomplishes in one century around a central value, that is the phenomenon of nutation of terrestrial axes and precession of equinoxes; he doesn't forget the practical aspects or a theoretical model and he suggests also the construction of a pastboard little model of which he provided a detailed description.

> *Tagliatevi un cerchio di cartone, e da questo tagliatene via un concentrico, con che avrete un anello di cartone pieno: infilzate questo in una verghetta, e fermatelo ad essa perpendicolare al di lei punto di mezzo. alzate diritto su d'una tavola l'anello di cartone nella linea da Oriente in Occidente, e ponetevi voi ad oriente; indi tragitatte per il centro del vano dell'anello di cartone la verghetta sino ad insinuare attraverso di esso vano il cerchio di cartone pieno, in modo che la metà di questo vadi al di là, la metà resti di qua del piano dell'anello, e lo tagli in due punti, uno basso verso la tavola, l'altro in alto, formando un angolo di gradi circa 23 e 1/2. Vi rappresenti l'anello di cartone il piano dell'Eclittica, il pieno cerchio quello dell'Equator terrestre, e la verghetta l'asse della terra. Stringendo tra il pollice e l'indice della sinistra mano la verghetta presso il di lei punto di mezzo, dove sta infilzato il pieno cerchio, prendete col pollici e l'indice della destra la metà della verghetta, che verso di essa si stende, allontanatela da voi girandola in alto, e voi girandola per basso riconducetela. Vedrete la metà opposta girare contrariamente per basso e in alto, e venir così dalle due metà descritte in contrario verso due superficie coniche, colle punte l'una all'altra opposta; e vedrete per tal giro delle due metà della verghetta il punto alto d'intersezione tra il cerchio di cartone pieno, e l'anello andare in là da voi verso Occidente, e ciò fare, che il punto d'intersezione basso diametralmente opposto salga verso di voi ad Oriente cola medesima direzione di rivolgimento, sebben con effetto rapportato a Voi contrario. Vedrete altresì andar cangiando l'angolo tra l'anello e il cerchio di carton pieno; e il simile accade nell'angolo tra il piano del terrestre Equatore e il piano dell'Eclittica.*

In the text of prevision for the eclipse of 1804 he submitted the problem to determine the residual luminosity during the maximum of occultation, when the Moon would have covered for more of 11/12 the solar disk. From his calculus the luminosity approximated at 1/12 of the total solar light, however he expressed also his doubts about this type of prevision. By comparison he had found an eclipse in 1715, visible from

Paris, that came out to cover the Sun in the same proportion of that one in 1804. The author of the note, Gian Domenico Cassini, affirms that:

> *la chiarezza del giorno diminuì notabilmente; si sentì un po' di freddo; e l'oscurità fu tale, che si vider o uscire de' pipistrelli, ed all'incontro degli uccelli cercare ritiro, come al principiar della notte.*

From the comparison of the two eclipses Cossali derived that the residual light would be lightly inferior than the eclipse of 1715, as much as the ratio 105/110, but however he admitted that the astronomers had never attended to this specific problem.

The quantitative elements of the publication of 1791 begin in defining the position of Parma observatory, which in that period was waiting for an adequate supply of observational instruments, after its reopening for the interest of a minister, Count Cesare Ventura. Since we want to verify the quality of observations we have to consider that Cossali worked with instruments which he didn't believe optimal, in fact later he succeeded in endowing the observatory with better optics.

Earth and celestial coordinates

A first problem rises from the coordinates of Parmese observatory. The geographical longitude and latitude of Parma were calculated roughly 30 years in advance, when the observatory was inaugurated: λ_P = 27° 35', φ_P = 44° 44' 50''. These data are fundamental because they are basic for the ephemerides and of every astronomical calculus, so it is very important to give also the coordinates measured nowadays: they are more precise and they will be useful for some considerations about precision of measures published by Cossali.

The geographical coordinates now tabulated(13) for Parma are φ_{Pa} = 44° 48' 8'' and λ_{Pa} = 10° 20' 0''. The latitude has a difference of only 3' then we can consider it accurate, if we remember the instruments and the cartographic difficulties still present in '700, while the longitude has a difference beyond 17°, evident sign that it was measured with modalities and landmark different from those used today. In fact the meridian of landmark used didn't cross Greenwich but it crossed the Island of Iron in the Canarian Islands in the Atlantic(14). One reason of this choice for the reference was of political nature. Till the end of Sixteenth century Spain(15) excelled on the European political scene, it was a dominant power and then had been able to impose in the past a cartography that was referred at its territories, signal of its political strength. When Great Britain became so powerful to defeat on sea also Spain it could make itself political heard and then it could affect about the choice of the new reference meridian, that crossed Greenwich observatory and has remained till today. A second reason was on the contrary of mathematical type: since negative numbers were note used the meridians were counted from 0° to 180° in a positive way and the simplest reference was the latest land in reference Euroafrican continent, that is the Canarian islands. However the measure precision wasn't very good in fact this island stays 18° West so 28° 20' from Parma, with a difference nearly half degree respect the published one. Of course this first error will affect the precision of lunar orbital calculus.

The second furnished quantity is the obliquity of ecliptic in April, that is i = 23° 27' 53,016'', angle about what there were contrasting opinions. In this calculus we have to add the nutation phenomenon that makes the inclination vary during the year even less the nodes precession; from Cossali we learn that the decrease of obliquity of ecliptic was object of contest by the best astronomers of that time (Lacaille, Bradley, Lagrange, Liuville, Lalande, Ximenes) who were in disagreement. The decrease, that for Cossali was better arranged with the theoretical calculus and the observations, was 45'' respect

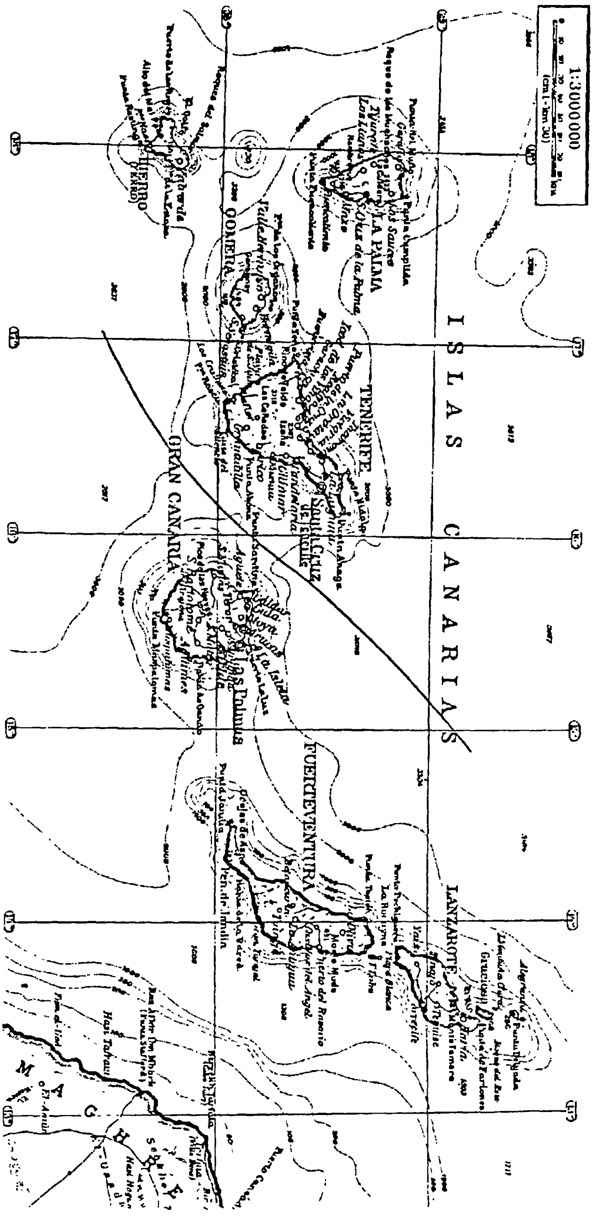

Fig. 2 Geographical location of the Canarian islands.

the time in which the ecliptic and terrestrial equator had maximum angular di
Besides Abbè Reggio performed a set of observations in 1789 and he obtained
27' 53,8'', while for Lalande had to be i = 23° 27' 45,6''. Cossali adopted the
decrease of 45'' with the issue of observation of Abbè Reggio. And this second
of uncertainty affects the precision of calculus position subsequently, though th
independent by measure made by Cossali.

We can compare the average obliquity of the ecliptic deriving by the expres

$$i = 23°{,}440852 - 0{,}00000036T \qquad (1)$$

where time T is T = day of the year + fraction of day, or T = 93,5583 from which we obtain i = 23°,440819 = 23° 26' 26,9484'' for April 3rd 1791.

The considered moments for the observative measures of Sun and Moon position are referred to the beginning of eclipse, or the first contact, of half eclipse, or maximum occultation, and the end of eclipse or last contact, and there are altoazimuthal and equatorial coordinates for them, the astronomical longitude and latitude of the two bodies (in first sign, that is respect point g) for Sunday April 3rd 1791. The right ascension and declination aren't supplied but they are derived from the elevation and azimuth published through classical formulas of coordinates transformation. The three times observed by Cossali are $T_1=13^h\,24^m\,37^s$, $T_2=2^h\,39^m\,56^s$, $T_3=3^h\,54^m\,58{,}22^s$. If we remake the calculus backwards from reciprocal position Sun-Moon I found the times $T'_1=13^h\,46^m\,17^s$, $T'_2=14^h\,10^m\,17^s$, $T'_3=16^h\,15^m\,58^s$, which are different, and not even coming from his celestial coordinates; it is possible to obtain coincidence with the reported times; vice versa if we accept the times measured by Cossali we don't obtain even the celestial measured coordinates. This fact emphasizes the complexity and the uninterrupted development that had the measure and position system, the related

Table 1. Position measures of Sun and Moon at time T_1 made by Cossali, positions recalculated at the same time and recalculated and obtained by a new calculus of eclipse T_1. The recalculated time of the first board contact is $T_1 = 13^h\,46^m\,17^s$.

	Longitude	Latitude	Elevation	Azimuth	Right Ascens.	Declination
	Coordinates published by Cossali					
S	13° 24' 7,8''	0° 0' 0''	46° 33' 20,8''	31° 24' 45,92''	$0^h\,49^m\,22{,}38^s$	5° 16' 30,36''
M	13°43'53,27''	0° 44' 46,76''	47° 6' 24,905''	31° 55' 0,62''	$0^h\,50^m\,26{,}04^s$	6° 5' 25,8''
	Coordinates recalculated at time given by Cossali					
S	13° 41' 25''	-0° 0' 40''	48° 14' 45''	24° 00' 46''	$0^h\,50^m\,24^s$	5° 23' 52''
M	13° 7' 50''	0° 18' 24''	48° 07' 44''	24° 57' 43''	$0^h\,47^m\,50^s$	5° 28' 22''
	Coordinates recalculated for the new T_1					
S	13° 42' 18''	-0° 00' 40''	46° 27' 32''	32° 31' 46''	$0^h\,50^m\,27^s$	5° 24' 12''
M	13° 56' 36''	-0° 18' 39''	46° 22' 18''	32° 18' 46''	$0^h\,48^m\,18^s$	5° 31' 37''

Table 2. Position measures of Sun and Moon at the time T_2 made by Cossali, recalculated at the same time and recalculated and obtained by a new calculus with $T_2=14^h\,10^m\,17^s$.

	Longitude	Latitude	Elevation	Azimuth	Right Ascens.	Declination
	Coordinates published by Cossali					
S	13° 45' 8,7''	0° 0' 0''	37° 47' 3,49''	53° 8' 42,8''	$0^h\,50^m\,57{,}07^s$	5° 24' 45''
M	14° 20' 53,81''	0° 41' 22,92''	38° 39' 23,89''	53° 24' 33,72''	$0^h\,52^m\,30{,}16^s$	6° 15' 27,36''
	Coordinates recalculated at time given by Cossali					
S	13° 44' 24''	0° 0' 40''	40° 36' 26''	47° 27' 18''	$0^h\,50^m\,35^s$	5° 43' 46''
M	13° 34' 39''	-0° 18' 54''	40° 39' 47''	47° 55' 46''	$0^h\,49^m\,28^s$	5° 25' 2''
	Coordinates recalculated for the new T_2					
S	13° 45' 40''	0° 0' 39''	36° 17' 10''	55° 40' 43''	$0^h\,50^m\,40^s$	5° 25' 31''
M	13° 46' 31''	0° 18' 47''	36° 27' 54''	56° 00' 52''	$0^h\,50^m\,10^s$	5° 43' 46''

calculus to derive the coordinates in different measure systems and their evolution in time(18).

The same annotations can be made for the observations at the moment of maximum occultation, even if Cossali repeated them at 2h 38m 9s while he wrote the maximum

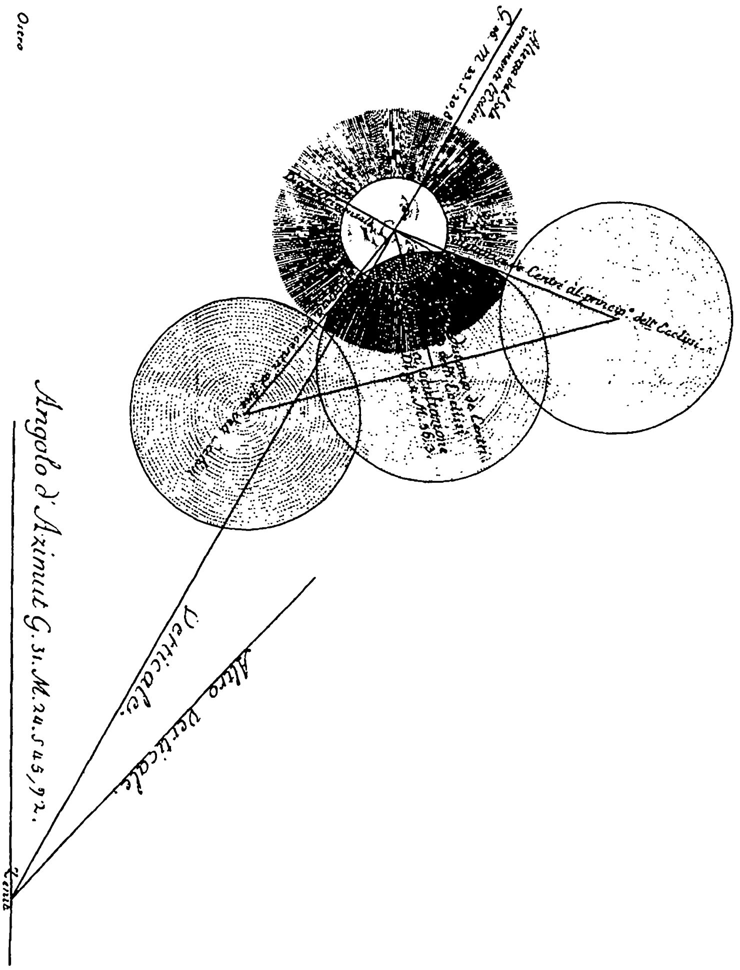

Fig. 3 Drawing by Cossali that represents the different eclipse phases of 1791.

Table 3. Coordinates of Sun and Moon at the end of eclipse, calculated at the time given by Cossali recalculated and obtained by a new calculus of the time T3 with T3=16h 15m 58s. For the time T3 Cossali doesn't report the ephemerides of the phenomenon.

	Longitude	Latitude	Elevation	Azimuth	Right Ascen.	Declination
	Coordinates recalculated at the time given by Cossali					
S	13° 47' 31''	-0° 0' 39''	29° 12' 33''	66° 16' 54''	0h 50m 35s	5° 43' 46''
M	14° 4' 39''	0° 18' 9''	29° 36' 15''	66° 27' 31''	0h 50m 47s	5° 26' 15''
	Coordinates recalculated for the new T3					
S	13° 48' 23''	-0° 0' 39''	25° 44' 50''	70° 41' 53''	0h 50m 50s	5° 26' 35''
M	14° 13' 19''	0° 17' 41''	26° 15' 10''	70° 48' 45''	0h 51m 54s	5° 53' 10''

occultation had happened at $T_2 = 2^h\ 39^m\ 56^s$.

As it is possible to note there are discordances about all the observative and calculated measures also considering the times of eclipses recalculated independently by Cossali's work. Probably these discrepancies are due to the already cited initial imprecision of the geographical coordinates, then to limits in precision of measure instruments(19) of time and observation instruments, and we must not forget that the problem of temporal reference that today is international and based on a highly careful(20) atomic standard.

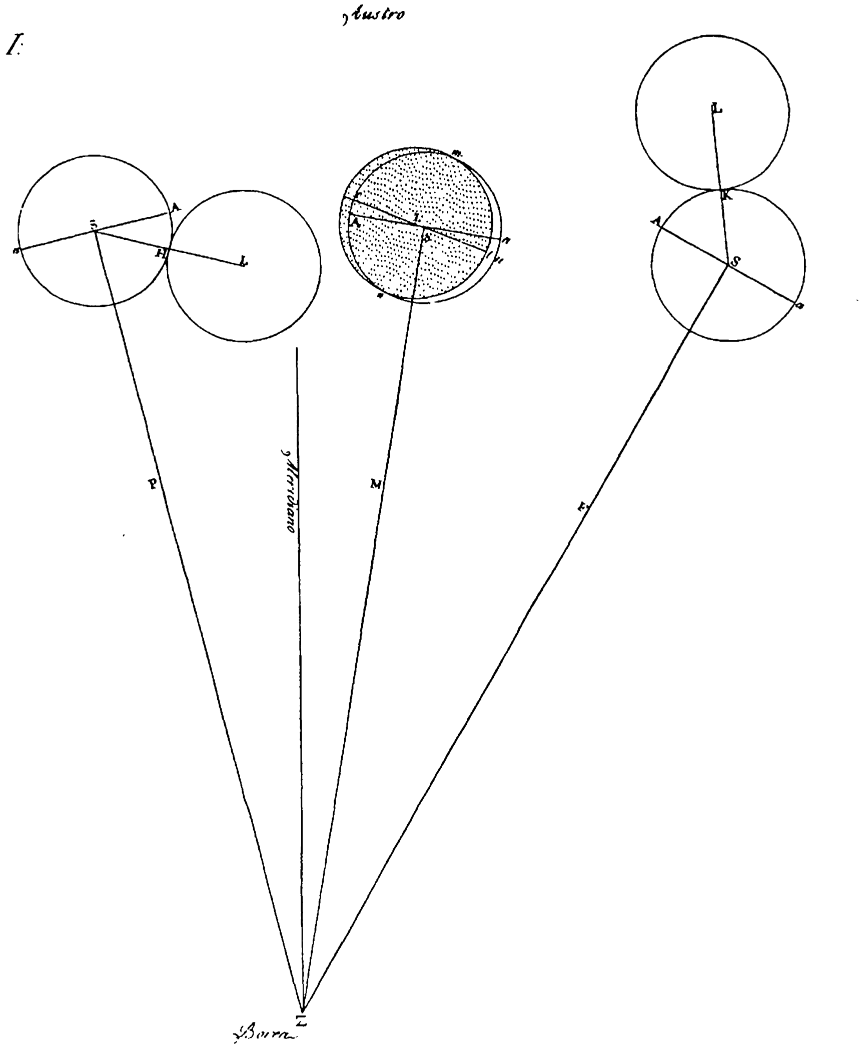

Fig. 4 Drawing by Cossali representing the related positions of the Moon in its orbit during the eclipse foreseen for 1804.

A further factor was then the difficulty in the calculus of lunar positions, in fact he wrote: "Il luogo della Luna nella sua orbita, e quindi rapporto all'Eclittica, è d'un calcolo senza paragone più faticoso che quello del luogo del Sole; essendo il moto Lunare per le complicazioni delle forze attraenti dal Sole e dalla terra su la massa, in confronto piccola, della Luna esercitate soggetto a molte inuguaglianze".

We find other differences with the work of 1791, although less showy, in the measures regarding the apparent diameter of the Moon. In the following table the apparent diameters and the distances Earth-Moon measured by Cossali are compared with those recalculated and obtained from the coordinates of Cossali.

Table 4. Apparent diameter and distance of the Moon from the observer at times T_1, T_2, T_3 given by Cossali and at recalculated times.

	Apparent diameter	Distance Moon (km)
Cossali (T_1)	30.13'	396.592,9
Calculated (T_1)	30.12'	396.758,7
Cossali (T_2)	30.08'	397.296,4
Calculated (T_2)	30.05'	397.707,1
Cossali (T_3)	29.99'	398.412,6
Calculated (T_3)	29.97'	398.772,2

In the second work Cossali published the previsions of the eclipse beginning for T_1=11^h 7^m 23,45^s, the top for T_2=12^h 30^m 39,71^s and the end for T_3=13^h 50^m 41,57^s.

I recalculated the eclipse and it results on the contrary T_1=11^h 41^m 36^s, T_2=12^h 24^m 46^s, T_3=14^h 26^m 16^s.

Table 5. Coordinates of the eclipse foreseen by Cossali for 1804, always in the three moments of beginning, half and end of eclipse.

	Longitude	Latitude	Elevation	Azimuth	Right Ascens.	Declination
	Coordinates published by Cossali for T_1					
S	39° 33' 14"	00° 00' 40"	27° 46' 24"	14° 30' 22"	21^{h}34^m 04^s	-14° 40' 11"
M	40° 49' 30"	-0° 14' 34"	27° 29' 40"	13° 19' 7"	21^{h}33^m 13^s	-14° 47' 53"
	Coordinates recalculated for the new T_1					
S	39° 34' 40"	0° 0' 40"	29° 44' 55"	15° 41' 29"	21^h 35^m 49^s	-14° 18' 59"
M	39° 3' 43,"	-0° 11' 14"	29° 28' 34"	14° 14' 40"	21^h 34^m 04^s	-14° 40' 11"
	Coordinates published by Cossali for T_2					
S	39° 36' 43"	00° 00' 40"	30° 53' 26"	1° 23' 59"	2 1^{h}35^m 57^s	-14° 18' 19"
M	39° 35' 38"	-0° 05' 59"	30° 43 05"	1° 35' 38"	21^{h}35^m 16^s	-14° 28' 43"
	Coordinates recalculated for the new T_2					
S	39° 36' 28"	0° 0' 40"	30° 51' 47"	3° 44' 22"	21^h 35^m 56^s	-14° 18' 24"
M	39° 21' 32"	-0° 06' 39"	30° 40' 23"	3° 58' 27"	21^h 35^m 08^s	-14° 30' 08"
	Coordinates published by Cossali for T_3					
S	321° 40' 03"	0° 00' 41"	28° 18' 58"	201° 32' 16"	21^h 36^m 10^s	-14° 17' 14"
M	321° 57' 30"	0° 3' 30"	28° 31' 08"	201° 17' 41"	21^h 37^m 15^s	-14° 08' 55"
	Coordinates recalculated for the new T_3					
S	321° 41' 32"	0° 00' 41"	25° 32' 41"	210° 41' 33"	21^h 36^m 16^s	-14° 16' 45"
M	322° 12' 57"	0° 7' 57"	25° 58' 40"	210° 20' 21"	21^h 38^m 09^s	-13° 59' 43"

At last to complete the data I calculated the local sideral time, semidiameter and parallax(22) of the Sun and the Moon even less the distance of the Moon as regard the terrestrial centre with the coordinates and the times given by Cossali and compared with the times and coordinates recalculated, in which there are the differences again.

Table 6. Local time, local sideral time, semidiameter and parallax of the Sun and the Moon for Parma as regard three times given by Cossali and those one recalculated.

	TL	TSL	Solar D/2	Solar parallax	Lunar D/2	Lunar parallax
Cossali (T_1)	$13^h\ 24^m\ 37^s$	$2^h\ 30^m\ 49^s$	15.977’	8.785’’	14.879’	54.607’
calculated	$13^h\ 46^m\ 17^s$	$2^h\ 52^m\ 26^s$	15.977’	8.785’’	14.878’	54.602’
Cossali (T_2)	$14^h\ 38^m\ 9^s$	$3^h\ 44^m\ 26^s$	15.977’	8.785’’	14.875’	54.591’
calculated	$14^h\ 07^m\ 27^s$	$4^h\ 13^m\ 49^s$	15.977’	8.785’’	14.873’	54.585’
Cossali (T_3)	$15^h\ 54^m\ 58{,}22^s$	$5^h\ 1^m\ 28^s$	15.977’	8.785’’	14.870’	54.575’
calculated	$16^h\ 15^m\ 58^s$	$5^h\ 22^m\ 31^s$	15.976’	8.784 “	14.869’	54.571’

Calculus of the eclipse parameters

The method more used to determine the temporal and geometrical characteristics of a solar eclipse in a specific place is that one that employs the Bessel’s elements. Essentially it consists in the analytic (and geometrical) description of relative motion on the celestial sphere of the Moon disk in relation of the Sun disk. It is based on geócentrical coordinates of specific place and it uses the formulas about influence of day-time parallax on right ascension and on declination.

The spherical distance Sun-Moon centre doesn’t get over 33’ during solar eclipse. The motion of lunar centre in comparison with solar one can be described with the reference to the Cartesian system with its origin in the solar centre while the plane [x, y] coincides with the tangent one to the celestial sphere and with axis x in direction of declination parallel passing by this point and the axis y as a maximum circle passing through the same point and the terrestrial poles.

The coordinates [x, y] are calculated in comparison with the equatorial topocentric coordinates. When it is defined the time range during which the eclipse happens it is possible to calculate the coordinates of the lunar centre in comparison with solar one in different moments. The topocentric coordinates are derived from the geocentrical ones with a transformation of parallax from geocentrical α and δ to topocentric α' and δ', if it is known the equatorial horizontal parallax P_0 of the body, the apparent local sideral time, the ratio $f = r'/r$ where r is the geocentrical distance and r’ the topocentric distance of the body, distance and geocentrical latitude of the observational place ρ and φ' that are derived from the geocentrical latitude φ and from the altitude H over sea of the observational place. And all these parameters were published by Cossali.

The beginning of the eclipse is obtained from the parametric equations at the time t (minutes), x(t) and y(t), remembering that the sum of Sun and Moon rays is 31’ 6,22’’ at time T_1, from which $[x(t)]^2 + [y(t)]^2 = (31' \ 6{,}22'')^2$. The time t satisfying this equation gives the time T_1. On the contrary the instant T_2 in which happens the maximum phase of the eclipse is obtained from the minimum value of $[x(t)]^2 + [y(t)]^2$.

Light deflection

The last interesting annotation regards the inflection of the light rays which are tangent the lunar board with $i_r = 4{,}5''$, of which I report the original text.

Il Signor de Sejours accintosi a discutere le osservazioni dell’Eclissi

> *Solare del 1764, e trovandole fra loro discordi, nè con alcuna industria di calcolo riuscendogli di conciliarle, tentò se poteva riuscirvi supponendo dietro le idee del de la Hire, e dell'Eulero intorno alla Luna un'atmosfera rifrangente, ed inflettente i raggi, che radendo i lembi della Luna in essa cadono, e ne ebbe ottimo successo: la discordanza sparì; tutte le osservazioni convennero fra di loro posta un'inflessione di secondi 4,5. L'effetto di questa si è di far apparire più grande che non è la distanza degli orli della Luna e del Sole ...*
> *So che l'atmosfera Lunare, e l'inflessione de' raggi soffrono tuttavia delle opposizioni da rispettabilissimi Astronomi; ciò non ostante non ho voluto ometterne la considerazione.*

Discarded the hypotesis of lunar atmosphere we could consider a deviation of light produced by the lunar gravitational attraction; this deflection is function(21) of $2g/Rc^2$ with g the lunar acceleration of gravity, c the light velocity in emptiness and R the lunar ray: introducing the physical data of the Moon(23) the light is deviated of a quantity $\theta=1{,}326\mathrm{x}10^{-3}$ s, angle not sufficient to justify the deviation cited by Cossali. Unfortunately in this work there is no other information to deepen this text, awaiting to find any notes about this matter in the unpublished writings that I am now studying.

As a conclusion of this short analysis I think the Cossali's works deserve attention and can contribute to the historical reconstruction of the Veronese astronomical environment that had for many centuries characters with high qualities and skills in the astronomical research.

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