GRANDMASTER DE ROHAN'S ASTRONOMICAL OBSERVATORY (1783-1789)

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The presence of the Order of St. John of Jerusalem in Malta helped to keep the Maltese Islands in the mainstream of developments in various areas of knowledge. The Order's achievements in medicine, military architecture and fine arts have been well attested by numerous studies. But the knights' interests in the natural sciences and mathematics are not well known. Exception however, must be made of the contributions of Deodat de Dolomieu, a French knight commander of the Langue of Navarre, whose exploits in the fields of geology and mineralogy earned him the reputation as one of the leading scientists in those fields in the late eighteenth century.[1] In 1782, Dolomieu turned his attention to astronomy and persuaded Grand Master Emmanuel de Rohan-Polduc to build an astronomical observatory and to engage a full-time astronomer as its director.

Dolomieu's arguments for the establishment of an observatory in Malta are set out in his *Memoire sur le climat de Malthe*[2] and in a letter dated June 9, 1782 to Joseph-Jerome de Lalande,[3] an eminent French astronomer who was appointed a member of the French *Institut National* at its foundation. Dolomieu first noted that Malta's skies were clearer and the stars shone with greater brilliance than in other countries. Clouds were almost totally absent for at least six consecutive months, while for the rest of the year observations of the stars were possible once or twice every night during clear intervals. He also mentioned that for a number of years the need was felt for a new map of the stars of the northern hemisphere. According to Dolomieu, the work involved in drawing up an accurate star chart would certainly

[1] The *Académie des Sciences* of Paris published his biography in two volumes by A. Lacroix, *Déodat Dolomieu (1750-1801), Sa vie aventureuse, sa captivité, ses oeuvres, sa correspondance*, Paris, 1921. See also K.L. Taylor 'Dieudonné Guy Sylvain Tancrede de Gratet de Dolomieu' in *Dictionary of Scientific Biography* ed. C.C. Gillispie, New York, 1970, which contains a detailed review of Dolomieu's scientific work. Dolomieu is the eponym of dolomite, a calcareous mineral of magnesium and of the Alpine region largely composed of it.

[2] D. de Dolomieu, *Voyage aux iles de Lipari*, Paris, 1783, p.206.

[3] Lacroix, pp.91-96.

lead to new discoveries.[4] He concluded that such an undertaking by an observatory in Malta would surely bring honour to the Grand Master and render a good service to science. Apparently, De Rohan was immediately persuaded by Dolomieu whom he entrusted with the task of equipping the observatory with the best instruments.[5]

SETTING UP THE OBSERVATORY

Regarding the observatory's instruments, Dolomieu sought the advice of Lalande whom he visited in Paris during the winter of 1782-1783.[3] Presumably as a result of this visit, Lalande supervised the acquisition of a three-foot quadrant which was shipped to Malta on August 6, 1784.[6] The instrument was constructed by Pierre Mégnié, also known as Mégnié the Elder. In 1779, this instrument maker had received an award of 2600 livres in addition to 1200 livres which was half the prize for a competition instituted in 1774 by the renowned *Académie royal des Sciences* for the best quadrant of a radius of three feet.[7] The quadrant sent to the observatory in Malta must have been similar to the prize-winning one, but in addition it had a scale which allowed the reading of positional angles to an accuracy of two or three seconds of arc. Such a device had not yet been installed in the best astronomical instruments of those days.[8]

Plans were also reported for the purchase of an eight-foot mural quadrant similar to the one owned by Bergeret and successfully used by Lepaute d'Agelet, both French astronomers.[9] This quadrant was constructed by John Bird, an Englishman

[4] The need for a definitive star map can be illustrated by the following episodes. When William Herschel discovered the relatively bright planet Uranus in March 1781, it was soon realized that several astronomers had observed it on many previous occasions but failed to identify it as a new object because they did not have adequate star maps of the area where it was found. Another relevant case involving a number of astronomers mentioned in this paper concerns the discovery of the much fainter planet Neptune. The planet was discovered on September 23, 1846, the same night the search was started for it by J.G. Galle assisted by H.L. d'Arrest as a 'star' near the position predicted by Leverrier that was 'not on the map'. It had narrowly escaped detection by Lalande years before. On May 8 and 10, 1795, Lalande noted a faint star within two arc minutes of where Neptune was located. Since the two positions disagreed, Lalande deleted the first observation and marked the second as doubtful. The difference in the two positions corresponded exactly to the motion of Neptune in two days. R. Baum, 'Neptune' *Journal of the British Astronomical Association*, 94(4), (1984), pp.171-3.

[5] Dolomieu, 206 and elaborated upon by C.E. Engel, *L'Ordre de Malte en Mediterranée* (1530-1798), Monaco, 1957, p.298.

[6] M. Daumas, *Scientific instruments of the 17th & 18th centuries and their makers*, trans. and ed. by M. Holbrook, London, 1972, p.335 n.114.

[7] *Ibid.*, p.275.

[8] *Journal des Sçavans*, (Février 1785), p.112.

[9] *Ibid.*, p.113.

who was arguably the best maker of large quadrants in those days.[10] Its use would have permitted the compilation of a very accurate catalogue of stars, nebulae and star-like objects.[11] However, it is not known whether the eight-foot quadrant was actually acquired for the Malta observatory.

Observations of star positions with the purpose of constructing a star map require the use of an accurate chronometer, but no mention of any time pieces acquired by the observatory has been found as yet. However, it is recorded that other instruments, of an unknown type, were ordered from Florence and England.[12] Besides astronomical instruments, the observatory housed some meteorological instruments including a barometer.[13]

On a suggestion by Dolomieu, the directorship of the observatory was offered to Jean-Auguste Dangos, an astronomer and a physicist. Born in Tarbes, at the foot of the Pyrenees, on May 13, 1744,[14] Dangos joined the French army in the infantry regiment of Navarre at an early age. The highest point of his military career was the promotion to the rank of captain of the grenadiers.[15] Over the years he developed a keen interest in astronomy and a high degree of mathematical ability. The quality of his work was such that on August 23, 1780, the *Académie des Sciences* appointed him as correspondent, a form of membership of the prestigious *Académie*.[16]

The connection between Dolomieu and Dangos is not clear but, according to Claire-Elaine Engel, the two must have become friends during one of Dolomieu's visits to the Pyrenees. Finding that besides having an agreeable disposition, Dangos was an astronomer with a talent for mathematics, it is understandable that he was Dolomieu's first choice as director of the observatory. Soon after his appointment to the post, Dangos was referred to as M. le chevalier D'Angos, but it was not

[10] H.C. King, *The History of the Telescope*, London, 1955, pp.115-8.

[11] By 1760, large quadrants of 7 or 8 feet radius gave readings with an accuracy of the order of half a second of arc. Daumas, p.193. Subsequently, the quadrant owned by Bergeret was acquired by Lalande in 1785 who used it to determine the positions of about 50,000 stars, the content of his *Histoire céleste Française* published in 1801. King, p.116-7.

[12] Letter from Dolomieu to Ph. Picot de Lapeyrouse dated April 28, 1785. Lacroix, p.138.

[13] A(rchives) of the A(cadémie) des S(ciences), Paris, *Dangos dossier biographique*. Letter from Dangos to Citoyen Cordier dated le 25 pluviose an 12 (February 13, 1804).

[14] AAS, *Index biographique Académie des Sciences (1666-1978)*, Paris, 1978.

[15] Anon., 'D'Angos (Jean-Auguste)', *Souvenir de la Bigorre* Recueil mensuel, Tarbes, 1882, 127-9. See also Lacroix, p.59 n.1.

[16] AAS *Index biographique*. The appointment was as correspondent to Charles Messier, the famous French comet observer and discoverer.

possible to confirm from records his status as a member of the Order.[17] However, a caption to his portrait showing him as an old man, reads: *J.A. D'Angos, Ancien Capitaine, Chevalier de Malte et de l'Ordre Royal et Militaire, de St. Louis, Membre correspondant de l'Institut, de l'Académie des Sciences et belles lettres de Rouen et de plusieurs autres Sociétés savantes.*[18]

OBSERVATIONS

The observatory was situated in the Grand Master's palace and all preparations were almost completed by the end of September 1783. Daily observations were to start soon after.[19] Unfortunately, next to nothing is known about the routine astronomical observations of star positions since these were lost. The little that is known is mainly due to two special episodes which attracted the attention of the scientific world to the observatory and its director.

On January 22, 1784, Dangos reported the discovery of a comet in the constellation Cetus.[20] The comet's highly inclined retrograde orbit and its southerly declination made it possible for Dangos to observe it before the well-known French observers Jean-Dominique Cassini, the director of the Paris Observatory, and Pierre Méchain who first observed it on January 24. The comet was bright enough to be seen with the naked eye and presented quite a spectacle. Its coma (head) was only 33 arc seconds across but its tail was between two and three degrees long. Dangos followed its motion and reported a number of accurate positions, which along with other observations permitted an exact calculation of its orbit.

At first it was thought that Dangos was the first astronomer to see the comet but later it was reported that it had been observed as early as December 15, 1783 from the southern hemisphere. Numerous observations were made during February and March 1784 especially by Messier and Méchain. The latter determined its orbital elements and predicted its position after perihelion passage. Following a period when it could not be seen because of the glare of the sun, the comet was recovered by Méchain himself on May 9. By then it had become very faint but it was followed

[17] His name does not appear in the *Ruolo Generale*. The same outcome is reported in J. Castex, *Ramond, ses compagnons et ses concurrents*, Tarbes, 1987, p.14.

[18] His portrait is a lithograph by de Frey (29cm x 19cm) numbered 247e and listed as no.504 in the catalogue of 1881 of the Municipal Library of Tarbes. The portrait is also reproduced in Castex, 9; another portrait is found in AAS, *Dossier biographique*.

[19] Letter from Dolomieu to Picot de Lapeyrouse dated September 30, 1783. Lacroix, pp.112-5.

[20] *Journal des Sçavans*, (Mai 1784), p.319.

until May 26, 1784.[21] Although the discovery was not attributed to Dangos, his independent observations raised hopes that the Malta observatory would become very useful for astronomy.

These aspirations received a further boost a few months later when on April 11, 1784, Dangos announced the discovery of a second comet in the constellation Vulpecula.[22] His letter of April 15 to Charles Messier described the comet as being very small, without a tail and having only the slightest trace of nebulosity. In fact, at first Dangos mistook it for a small nebula but on subsequent days he assured himself that it was a comet by its movement against the background stars. The letter also explained that because of fog and clouds, he could only measure its exact positions in the early hours of April 11 and April 15 but not on the other days in between when he could just see it occasionally.[23] For some unknown reason, Messier received the letter a month later, on May 13, 1784. His search for the comet was unsuccessful because it was supposed that by then either its distance from Earth had increased so much that it became too faint to observe or that it had turned to a southerly declination and became too low to observe from Paris. The two positions given by Dangos were not enough to work out the comet's orbit and to attempt to recover it after its reappearance from behind the Sun. Indeed, at least three accurate positions are needed to determine a comet's orbital elements and to calculate its orbit.

Meanwhile, Dangos had continued to observe the comet and managed to make fourteen positional observations in all until May 1. From these he calculated its orbital elements which he published in February 1785 making it the eighty-first comet whose elements were known with sufficient accuracy so that it could be identified on a possible second approach to Earth.[24] The matter stood there for twenty years when queries were made about the comet's orbit. Eventually these developed into a controversy involving some of the best astronomers and mathematicians of that age, and it was not settled until about a hundred years later as will be discussed below.

Besides astronomical observations, Dangos also recorded meteorological data which included readings of barometric pressure at sea level. He also made observations

[21] A.G. Pingré, *Cométographie, ou Traité historique et theorique des comètes*, Tome II, (Paris, 1784), 512-3. I am indebted to Dr Brian G. Marsden of the Smithsonian Institution Astrophysical Observatory for providing me with a copy of this reference and references 40, 41, 46 and 49.

[22] *Journal des Sçavans*, (Septembre 1784), pp.623-4.

[23] Pingré, pp.513-4.

[24] *Journal des Sçavans, (Février 1785)*, pp.112-3.

of the zodiacal light whose nature was still a point of debate in those days. Dangos reported that, weather permitting, the phenomenon could be observed regularly throughout the year from Malta, so he had made numerous observations of its height, width and direction from which he thought that there was an oscillation of the light about a fixed position.[25] Dangos also made a number of miscellaneous observations among which was an observation from Malta of a faint glow at the top of mount Etna. This instigated Dolomieu to ask his friend Gioeni of Catania to confirm that the volcano was preparing for an eruption in which case he would cross over to Sicily immediately to make observations at close range.[26] Some conjoint work was also carried out with Dolomieu. This can be deduced from a letter by Dangos to Delambre, one of the permanent secretaries of the *Académie des Sciences*[27] and from another of Dolomieu's letters which refers to a planned visit to mount Etna to make some experiments and astronomical observations.[28]

DISASTER AND DEMISE

Unfortunately, the good work came to an abrupt end on March 13, 1789 when a fire broke out and destroyed the observatory and practically all its records. These included the logbooks containing the raw observations, finished calculations, astronomical tables, and the manuscript of a new edition in two volumes of Lacaille's work on astronomy which Dangos had finished in 1786 and which he intended to publish in Italy along with the observations from Malta. Only a few notes on loose sheets and the logbooks containing the meteorological observations survived the fire because they were not in the observatory.[29] The fire was apparently caused by lightning[30] but a conflicting report suggests that it was accidentally caused by Dangos himself when he was experimenting with phosphorous.[31] It was not possible to confirm the cause of the fire but the latter report appears to have been made to denigrate Dangos. Whatever the real cause, the observatory was not reactivated and Dangos returned to his native town where he stayed for the rest of his life.

[25] AAS *Dossier biographique*, letter from Dangos to Delambre dated le 15 ventôse an 13 (March 5, 1805).

[26] Letter from Dolomieu to Gioeni dated August 28, 1785. Lacroix, pp.144-5.

[27] AAS, *Dossier biographique*, letter dated May 21, 1806.

[28] Lacroix, pp.137-9.

[29] AAS *Dossier biographique*, letter dated le 15 ventose an 13 (March 5, 1805).

[30] Lacroix, p.xix; L. de Boisgelin, *Ancient and Modern Malta*, Vol. II, Bk. III, London, 1805, 5; M. Miege, *Histoire de Malte*, Tome troisième, Bruxelles, 1805, 25; C.E. Engel, 298.

[31] K. Glyn Jones, *Messier's nebulae and star clusters*, pp.348-9. This claim is also repeated by J. Ashbrook, 'The comets of the Chevalier D'Angos', *Sky and Telescope*, Vol. 14 (1955), p.501.

The loss of the observations and the instruments must have been a hard blow to Dangos, but he recuperated and continued to make astronomical observations with instruments loaned by the *Académie*. Further recognition for his work came February 28, 1796 when he was elected *associé non résidant pour la section d'astronomie de la première Classe de l'Institut national*[32]. This honour increased his reputation in his home town where he was already highly regarded. In fact, one of his colleagues, L.F.E. Ramond, a botanist and also a member of the *Institut* described Dangos as "one of the best astronomers in Europe".[23] Both Ramond and Dangos were the leading figures of the *École Centrale* established in Tarbes where Dangos was appointed professor of mathematics and Ramond was professor of natural history. Together they made many simultaneous observations of barometric pressure at the foot of the Pyrenees and at the summit from which they established the height of the peaks.[34] Dangos also made daily observations of atmospheric pressure and temperature and built a reputation for weather forecasting.

During this period, Dangos reported the curious observation of a dark speck which crossed the Sun's disk on January 18, 1798.[35] He also sent reports on refraction and on a comet which were read at the meetings of the *Académie* on June 23, 1802 and October 21, 1811 respectively.[36] In 1807, the *Institut* granted him a pension.[37]

Later Dangos became the librarian of the town of Tarbes, a post which he held until his death on September 22, 1833. From a published extract of his testament, we learn that he bequeathed all his books, star charts and other things that were in his library to the town of Tarbes with the hope that the youths who study them would

[32] AAS *Index biographique* 1666-1978.

[33] C. Girdlestone, *Louis-François Ramond (1755-1827)*, Paris, 1968, p.254.

[34] F. Massie, 'Documents, Explorations Pyrénéennes', *Bulletin de la Société Ramond*, Bagnères-de-Bigorre, 1935, pp.136-141; Girdlestone, 285, 306-7, 334; Castex, p.19.

[35] AAS, *Procès Verbaux Tome I, 1795-1799*, 342. This observation was later interpreted by Dangos as a comet passing in front of the disk of the Sun.

[36] AAS, *Procès Verbaux Tome II, 1800-1804*, 517; *Tome IV 1808-1811*, 545.

[37] M. Mangin, 'Note sur le chevalier d'Angos', *Bulletin de la Société Académique des Hautes-Pyrénées (Années 1952-1953)*, Tarbes, 1953, pp.41-2. This reference contains the gist of eight letters to Dangos from the *Institut* and from other astronomers, but none of these refer to his work in Malta.

become interested in the exact sciences. He also wished that they would find in them the same consolation that he had found during the failings and misfortunes of life.[38]

CONTROVERSY

Despite the reported loss of all the records of the observatory, interest in the observations of the second comet did not die. In 1805, J.K. Burckhardt, a French astronomer wanted to calculate its orbit for which he needed more than the two published observations. He contacted Dangos through Delambre for any further observations or, in case these were not available, the date when Dangos could search for the comet again after the initial observations. The answer was that all the records had been lost in the fire except for the meteorological logbooks which showed that for the rest of the month of April 1784, that is after April 15 when the comet was last observed and for the month of May, the sky was constantly covered with thick fog. However, on April 22, 1784, he had observed the zodiacal light and he would certainly have searched for the comet had the weather permitted.[39] Rather than giving up, Burckhardt used the two observations and calculated several sets of orbital elements, making various assumptions regarding the comet's distance from the Earth. All these were far off from those published by Dangos.[40] Thus it became clear that there was something wrong with the observations of the comet or with the calculations.

These suspicions were fuelled twelve years later with the discovery that an obscure German periodical of 1786 contained a note by Dangos giving fourteen observations of his comet extending to May 1, 1784.[41] This contradicted what Burckhardt had been told and furthermore, the newly discovered observations did

[38] The death certificate and an extract from his testament are reproduced in a contribution to *Souvenir de la Bigorre, Tome II, (1862)*, pp.127-9. From an enquiry to the librarian of the Municipal Library at Tarbes about Dangos' papers it transpired that there was no catalogue entry under Dangos. Subsequently, the Municipal Library and the *Archives Departementales* of Tarbes, and the library of the Musée Pyrénéen at Lourdes were visited by Marianne Ventura and Agnes Camilleri in July 1988. Besides a number of secondary sources used in this paper, the search unearthed a manuscript of unpaginated lecture notes on mathematics by Dangos (Ms. 72 AG 53) and a copy of his portrait by de Frey, both kept in the Municipal Library. The letters mentioned by Mangin and, in particular, his meteorological logbooks were not found.

[39] AAS, *Dossier biographique*, letter dated March 5, 1805.

[40] Ashbrook, p.501.

[41] H.L. d'Arrest, 'Einige bemerkungen zur geschichte des zwieten cometen von 1784', *Astronomische Nachrichten*, **65** (1555), (1865), pp.289-296. d'Arrest gives details of the fourteen observations from the obscure 'Magazin' and discusses them in detail. I am indebted to Vincent Riolo for the translation of this and the other German references.

not fit the elements calculated by Dangos. Matters came to a head in 1820 when J.F. Encke[42] found that with Dangos' orbital elements he could reproduce the fourteen positions provided that in the calculation he used exactly ten times too large a value for the Earth's distance from the Sun.[43] His judgement was severe: "Dangos had the audacity to forge observations that he never made, of a comet that he had never seen, based on an orbit he gratuitously invented, all to give himself the glory of having discovered a comet".[44] This conclusion was accepted by many astronomers and although a subsequent list of comets published by Olbers in 1823 still mentioned the comet, it added that this was a "shameful invention".

Later however, several authorities considered Encke's remarks as exaggerated. Thus, for example, while accepting that Encke had shown that there was an error in the computation, the illustrious mathematician and astronomer K.F. Gauss held that this was only an indication and not a proof of fraud. This he explained in a letter to Schumacher[45] and in a paper published posthumously in 1866.[46] Similarly, H.L. d'Arrest[47] accepted that part of Encke's conclusion that Dangos' observations cannot apply to a comet's heliocentric movement. He proposed that the comet could have come well within the sphere of gravitational attraction of the Earth and for a period of time it could be considered as if it were a satellite of the Earth. He then went on to present a calculation which took a different size of the sphere of attraction of the Earth from that accepted at that time but which otherwise corroborated the geocentric thesis. However, he added that he could not claim certainty for this thesis and noted that a decisive study would require very complex computations.[48] This explanation was not widely accepted as many astronomers found the solution rather contrived.

[42] Johann Franz Encke (1791-1865) is principally famous for his discovery that a comet first seen by Méchain in 1786 was actually a periodic comet and that it had reappeared in 1795 and 1805. His prediction of its return was verified in 1822 and the comet, which reappears every 3.3 years, is still known as Comet Encke. He was appointed director of the Berlin observatory in 1825 and professor of astronomy at the University of Berlin in 1844.

[43] J.F. Encke, *Correspondance astronomique*, **IV** (1820), p. 456, quoted by d'Arrest and by Ashbrook.

[44] Translation in Ashbrook.

[45] Quoted over the initial P. in *Astronomische Nachrichten*, **65**(1555), (1865), p.296.

[46] C. Behrmann published Gauss' manuscript entitled 'Ueber den Dangos'schen cometen', *Astronomische Nachrichten*, **66**(1574), (1866), pp.219-222.

[47] Heinrich Louis d'Arrest (1822-1875), German astronomer and comet discoverer chiefly known for his role in the discovery of Neptune and for the periodic comet that bears his name. In 1858 he was appointed professor in the University of Copenhagen and director of its new observatory.

[48] d'Arrest, p.296.

Summing up the various studies related to the comet, J.G. Galle found it impossible to account for the mistake discovered by Encke by which it was possible to represent all fourteen alleged observations with rare precision, unless these observations were not fabricated precisely on the basis of this error. Galle also considered it unthinkable that Dangos made a genuine mistake when calculating the orbital elements of the comet from real observations and then, seeing that the observations did not fit exactly, made another mistake by replacing the actual observations with others that fit.[49]

In spite of the protracted debate about the existence of the second comet of 1784, many astronomers had lost any vestige of credibility in Dangos long before when he reported the discovery of a new periodic comet. This happened when it was shown that his claim of a return of a comet first seen in 1672 and which he had observed in 1784[50] and again in January 1798 was an invention based on a calculation using a wrong value of the node of the comet.[51] The latter case is today still referred to as "an outright fraud".[52] Thus in his overeagerness to emulate the discoveries of the French astronomers of the latter half of the eighteenth century, Dangos achieved an unexpected notoriety and an unenviable place in the history of astronomy.

In the final analysis, Dolomieu's expectations were not fulfilled. Neither did the observatory bring honour to the Grand Master nor did it render good service to science. The only positive aspect of the Dangos affair was the reaction of his colleagues which illustrated quite clearly how peer review functions in a scientific field when the replication of observations is not possible. However, the potential of an astronomical observatory in Malta was not forgotten. Only nine years after the destruction of De Rohan's observatory, Napoleon decreed that among the seven professors of the *École Centrale* which he wanted to establish in Malta, there should be a professor of geometry and astronomy, and that an observatory should also be established.[53] For well-known reasons, these decisions were never implemented.

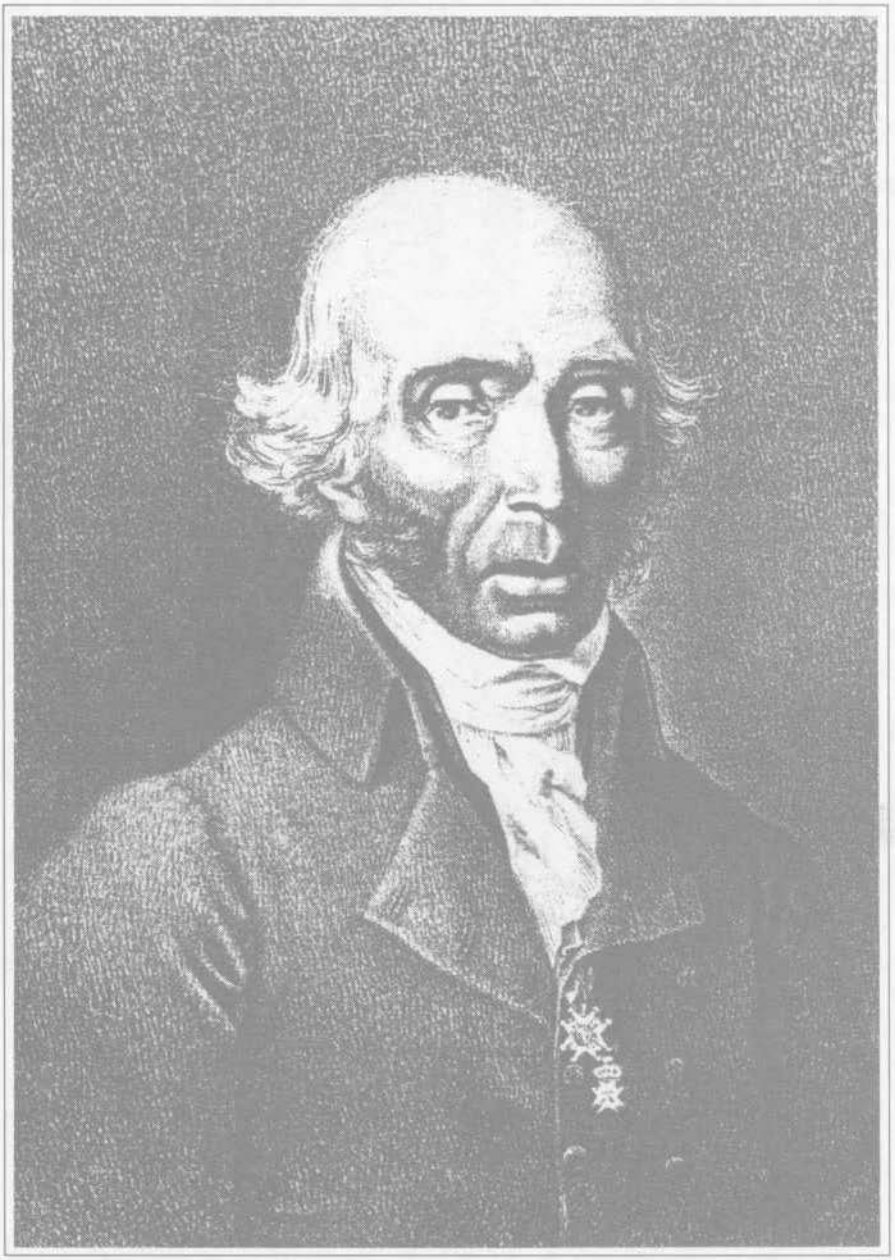
[49] J.G. Galle, *Cometenbahnen*, (1894), p.179.

[50] In his letter to Delambre of March 5, 1805, Dangos recalled the observation of a comet projected against the zodical light which he saw from Malta "probably on the 1st October 1784". This must be the same comet referred to here.

[51] Ashbrook remarks that the calculation went wrong because Dangos used a value of the node of the comet of 1672 which was 60 degrees in error because of a misprint in Lalande's *Astronomie*.

[52] D.K. Yeomans, 'Comets and the perversity of Nature', *Sky and Telescope*, 78(3), (1989), pp.253-4.

[53] Order VIII of June 18, 1798 given in C. Testa, *Maż-żewġ naħat tas-swar*, L-ewwel ktieb, Malta, 1979, pp.123-4.



Portrait of Jean-Auguste D'Angos (1744-1833), the director of De Rohan's astronomical observatory in Malta. Lithograph by de Frey. *With the courtesy of the Municipal Library at Tarbes, France*