



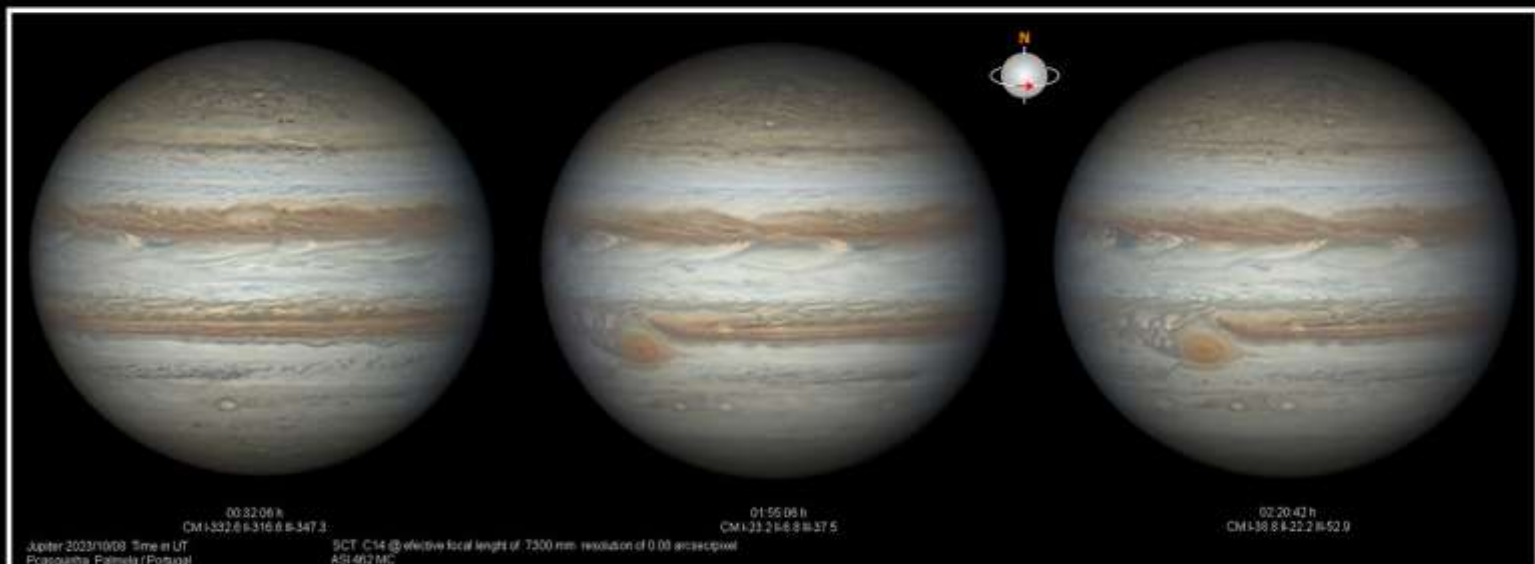
APAA

Associação
Portuguesa
de Astrónomos
Amadores

ASTRONOMIA

de Amadores

N.º 60 2024



**EVENTOS E OBSERVAÇÕES PÚBLICAS EM 2023 COM A PARTICIPAÇÃO DA APAA
RUI LOURENÇO**

**A CYCLE OF CELESTIAL OBJECTS, THE FIRST BOOK WRITTEN EXPRESSLY
FOR THE AMATEUR ASTRONOMER. PEDRO RÉ**

HENRY DRAPER'S (1837-1882) FIRST LUNAR IMAGES. PEDRO RÉ

JOHN CHARLES DUNCAN'S PHOTOGRAPHIC STUDIES OF NEBULAE. PEDRO RÉ

**HENRY CHAMBERLAIN RUSSELL'S PHOTOGRAPHS OF THE MILKY WAY
& NUBECULAE. PEDRO RÉ**

UNITRON/POLAREX/WELTBlick TELESCOPES. PEDRO RÉ

1X TELESCOPE FINDERS. PEDRO RÉ

PROCESSAMENTO DIGITAL DE IMAGENS DE JUPITER. PAULO CASQUINHA

**REDE NACIONAL DE OCULTAÇÕES DE ESTRELAS POR ASTERÓIDES
RUI GONÇALVES**



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ÍNDICE

EVENTOS E OBSERVAÇÕES PÚBLICAS EM 2023 COM A PARTICIPAÇÃO DA APAA. RUI LOURENÇO.....	5
A CYCLE OF CELESTIAL OBJECTS, THE FIRST BOOK WRITTEN EXPRESSLY FOR THE AMATEUR ASTRONOMER. PEDRO RÉ	8
HENRY DRAPER'S (1837-1882) FIRST LUNAR IMAGES. PEDRO RÉ	14
JOHN CHARLES DUNCAN'S PHOTOGRAPHIC STUDIES OF NEBULAE. PEDRO RÉ	20
HENRY CHAMBERLAIN RUSSELL'S PHOTOGRAPHS OF THE MILKY WAY & NUBECULAE. PEDRO RÉ	27
UNITRON/POLAREX/WELTBlick TELESCOPES. PEDRO RÉ	30
1X TELESCOPE FINDERS. PEDRO RÉ	48
PROCESSAMENTO DIGITAL DE IMAGENS DE JUPITER. PAULO CASQUINHA	52
REDE NACIONAL DE OCULTAÇÕES DE ESTRELAS POR ASTERÓIDES RUI GONÇALVES.....	59



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EVENTOS E OBSERVAÇÕES PÚBLICAS EM 2023 COM A PARTICIPAÇÃO DA APAA

RUI LOURENÇO

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Durante o ano de 2023 a APAA- Associação Portuguesa de Astrónomos, encetou todos os esforços para continuar a promover a divulgação da astronomia pela população em geral e incentivou a comunidade de astrónomos amadores a participar em eventos de norte a sul do país, expondo os seus trabalhos e disponibilizando os seus conhecimentos e recursos a todos.

Essencialmente direcionada para a astronomia amadora, a APAA voltou a lembrar a sociedade portuguesa que está viva e ativa para ajudar a desenvolver as iniciativas locais, conjuntamente com as diversas instituições camarárias e escolares.

Das diversas iniciativas em que participámos merecem destaque a colaboração que realizámos com o Centro de Ciência Viva de Constância em que mais uma vez sentimos o orgulho de uma vida dedicada à divulgação da astronomia e da realização de um sonho, pelo Máximo Ferreira Os recursos disponíveis no magnífico Parque de astronomia do Centro são exemplares.

Tivemos ainda a grande satisfação em colaborar no desenvolvimento do projeto de solidariedade social para que a pequena Matilde conseguisse ter a sua vida um pouco mais facilitada dada a doença rara de que padece.

Passamos a descrever de seguida as diversas iniciativas em que a APAA colaborou durante o ano de 2023:

Local : Mourão, Aldeia da Luz

Tema: Maratona Messier

<https://www.apaa.co.pt/maratona-messier-20230415-museu-da-luz-mourao/>

Data: Abril 2023

Participantes: População em geral

Número: 50 participantes

Telescópio: #1 Celestron SCT 8" da APAA e vários telescópios particulares foram instaladas

Entidades Envolvidas: Albireo, APAA, IA

Alvos: Objetos Messier

Local : Ericeira, Mafra

Tema: Observação pública

Data: 30 Junho 2023

Participantes: Hóspedes de um hotel

Número: 25 participantes

Telescópio: SkyWatcher Newton 8" da O.Colares, #1 Celestron SCT 8" da APAA

Entidades Envolvidas: O.Colares, APAA

Alvos: Passeio pelo céu e explicação das constelações e observação da Lua

Local: Constância

Tema: Astrofesta 2023 <https://www.apaa.co.pt/category/apaa/actividades-associativas/>

Data: 25, 26 e 27 de Agosto 2023

Participantes: População em geral

Telescópio: Observatório do Parque de Astronomia e a APAA disponibilizou o seu Celestron SCT 8"

Entidades: C.C. Viva de Constância, IA, a APAA patrocinou e colaborou nas palestras e na disponibilização de recursos para a observação pública

Local: Sesimbra, Castelo

Tema: Dia Nacional dos Castelos

Data: 14 outubro de 2023

Participantes: População em geral

Número: 40

Telescópio: #1 Celestron SCT 8" da APAA, SkyWatcher Newton 8" da O.Colares

Entidades: APAA, O.Colares e C. Municipal de Sesimbra

Local: Colares, Sintra

Tema: Dia Internacional de Observação da Lua, promovido pela NASA (adicionalmente colaborámos em projetos de solidariedade social)

Data: 21 outubro de 2023

Participantes: População em geral

Número: 60

Telescópio: Devido à meteorologia desfavorável não houve a possibilidade de fazermos a observação da Lua. Recorremos a software de planetários para simularmos a observação

Entidades: O.Colares e APAA



Dia Internacional de Observação da Lua (21 de Outubro de 2023)



Dia Internacional de Observação da Lua (21 de Outubro de 2023)



Castelo de Sesimbra, Dia Nacional dos Castelos, 14 outubro de 2023

A CYCLE OF CELESTIAL OBJECTS, THE FIRST BOOK

WRITTEN EXPRESSLY FOR THE AMATEUR ASTRONOMER

Pedro Ré

<http://pedroastrophotography.com/>

The *Cycle of Celestial Objects* published in 1844 is considered the first book to be written with the amateur astronomer in mind. It's author, Captain William Henry Smyth was born on January 21, 1788.

Smyth spent an entire career in the Royal Navy, enlisting as a seaman, serving in the Napoleonic Wars, distinguishing himself by his accurate coast surveys of the Mediterranean, and rising all the way up to Admiral. In 1813, while mapping the port of Palermo in Sicily, he chanced to meet Giuseppe Piazzi, the Italian astronomer who had discovered the first asteroid, Ceres, in 1801, and who at the time of Smyth's visit was publishing his great Palermo star catalogue. This encounter convinced Smyth that he should turn from seafaring to astronomy, and eventually he acquired a well-made 5.9" refracting telescope, returned to his home in Bedford, built an observatory, and began to observe the heavens.

In 1844 Smyth published a two-volume observing guide for amateurs' astronomers: *A Cycle of Celestial Objects*, also referred to as the *Bedford Catalogue*.

All observations were made with a 5.9-inch refractor made by Charles Tully¹. Designed by Reverend R. Sheepshanks and made by Dollond of London, this was the first equatorially mounted telescope in England to be driven by clockwork. The refracting telescope with a 5.9-inch (150mm) lens was initially installed at Captain William Smyth's observatory in Bedford in 1827. Smyth used it to survey the sky for his book, 'A Cycle of Celestial Objects' (1844). Smyth sold the telescope to his good friend Dr Lee, who had an observatory at Hartwell near Aylesbury, Buckinghamshire. It was subsequently purchased by the British government who sent it on the 1874 transit of Venus expedition to Egypt. It was donated to the Science Museum, London in 1929 (Figure 1, 2 and 3).

Smyth used this instrument to observe a variety of deep sky objects over the course of the 1830s, including double stars, star clusters and nebulae. These observations were published in 1844 which earned him the Gold Medal of the Royal Astronomical Society in 1845 and the presidency of the society. The first volume of this work was on general astronomy, but the second volume became known as the Bedford Catalogue and contained Smyth's observations of 1,604 double stars and nebulae. It served as a standard reference work for many years afterward; no astronomer had previously made as extensive a catalogue of dim objects such as this. It was reprinted in 1986, and in the Foreword to that edition George Lovi writes, "*What makes it so special is that it is the first true celestial Baedeker and not just another cold catalogue of mere numbers and data*". Like the original Baedeker travel guidebooks of the last century, this work is full of colourful commentary on the highlights of the heavenly scene and heavily influenced several subsequent works of its type, even to the present day. It is in the descriptive material that Smyth is a delight. He not only describes what the

¹ Charles Tully was a London optician of the first half of the 19th century that played a small but effective part in the development of the achromatic telescope. Tully's 5.9-inch objective 8 ½ feet focus was mounted on a brass polar axis, provided with a 3-foot brass declination and hour circles taken from Sisson's equatorial sector at Greenwich. Smyth bought this telescope for £200 and remounted it by George Dollond on a large polar axis driven by a Sheepshanks clock-drive (Figures 1 to 3).

user of a small telescope will see, but also includes much fascinating astronomical, mythological, and historical lore. A good example is the description of Messier 31 (see below).



Figure 1 - Smyth equatorial refracting telescope, 1829 (Science Museum London).

XXIV 31 M. ANDROMEDA (pages 14/17 – Bedford Catalogue)

An overpowering nebula, with a companion about $25'$ in the south vertical. It is of an oval shape, light, brightening towards the sf edge of the general mass, and of a milky irresolvable nebulosity; but though described "*in cingulo Andromedae*," is between the robes and left arm of the Lady, and certainly below the girdle. There are numerous telescopic stars around; and three minute ones are involved in the glow, but which can have no connection with it, and are doubtless between our system and the nebulosity. The axis of direction trends *sp* and *nf*; and it may be caught by a good eye, on a very fine night, by running a fancied line from Alamak to Mirak, and from thence carrying a rectangular glance to a distance of about $6\frac{1}{2}^\circ$. It can also be struck upon by a ray from γ in the mouth of Cetus, over Sheratan in the head of Aries and through Mirak, or β Andromedae, to $6\frac{1}{2}^\circ$ beyond.

This is the oldest known nebula ; for though it attracted but little notice till the seventeen century, it was seen, at least, as far back as 905 A.D. Simon Marius re-discovered it, if such a term can be applied to an object seen with the naked eye: in his rare work- *De Mundo Joviali* - that astronomer acquaints us, that he first examined it with a telescope on the 15th Dec. 1612; he was astonished at the singularity

of the phenomenon, but expressly says that he leaves to others to judge whether it was a new discovery or not. It was therefore by an oversight that Halley ascribes the discovery, in 1661, to Bulialdus (Ismael Bulialdus); who himself mentions its being known as *Nebulosa in cingulo Andromedae*, and that it had been noticed 150 years before by an expert though anonymous astronomer. The tenuity of its boundary offering no definition for exact comparison, has made the several attempts to figure it so conflicting as to mislead. Marius describes it as resembling the diluted light of the flame of a candle seen through horn. Halley mentions that it emits a radiant beam. Cassini calls it - *à peu-près triangulaire*. Le Gentil considered it round for some years, then oval, but always of a uniform light in all its parts, while Messier represents it as resembling two cones, or pyramids of light, opposed by their bases.

From such statements, Boulliaud and Kircher thought this wonderful object appeared and disappeared, like Mira; and Le Gentil had no doubt of its undergoing changes in form. But probably this discordance is a consequence of the means employed. Le Gentil, by his paper of 1749, seems to have used telescopes of various sizes, in order to see it very clearly "*non seulement pour servir a la reconnaître, mais encore pour voir si dans la suite elle ne seroit point sujette à quelque variation, soit dans la figure, soit dans la position;*" yet 15 years afterwards Messier differs from him, by assigning a greater brilliancy to the centre than to the edges, which latter accords better with my views of it, than do our apparent mean places. It is, however, remarkable that Messier examined this giant nebula with a 4½ Newtonian, and then turned the instrument upon γ Andromedae "*qui en étoit fort près*" to compare its light with that of the star, on a beautiful night of August 1764; but he makes no mention of the duplicity, or contrasted colours, of that lovely star.

Sir William Herschel gave this a rigid scrutiny and concluded it to be the nearest of all the great nebulae. "The brightest part of it," he says, "approaches to the resolvable nebosity, and begins to show a faint red colour; which, from many observations on the magnitude and colour of nebulae, I believe to be an indication that its distance in the coloured part does not exceed 2000 times the distance of Sirius." Does not exceed that distance! That is so far from us, that light, which is endowed with the swiftest degree of motion yet known, flying along at the rate of 186,660 miles in a second of time, or about it millions of miles in a minute, would require upwards of 6000 years to traverse the awful interval : as to that type of terrestrial velocity, so often cited, the cannon- ball, with its 500-miles-an-hour pace, it would have no chance of passing the same space under nine or ten thousand millions of years. What an overwhelming idea does such an astonishing conclusion give of the All-wise and Omnipotent Intelligence.

The companion was discovered in November 1749, by Le Gentil, and was described by him as being about an eighth of the size of the principal one; he adds, "*elle m'a paru exactement de la meme densité que l'ancienne*" The light is certainly feebler than here assigned. Messier whose No. 32 it is observed it closely in 1764 and remarked that no change had taken place since the time of its being first recorded. In form it is nearly circular.

The powerful telescope of Lord Rosse has been applied to this, after finding that no actual resolution in the large nebulae could be seen, though its edge had stellar symptoms; and it proved to be clearly resolvable into stars – the which directly interferes with Le Gentil's remark.

REFERENCES

King, H.C. (1955). *The History of the Telescope*. Dover Publications Inc., New York
Smyth, W.H. (1844). *A Cycle of Celestial Objects*. The Bedford Catalogue (Vol II)

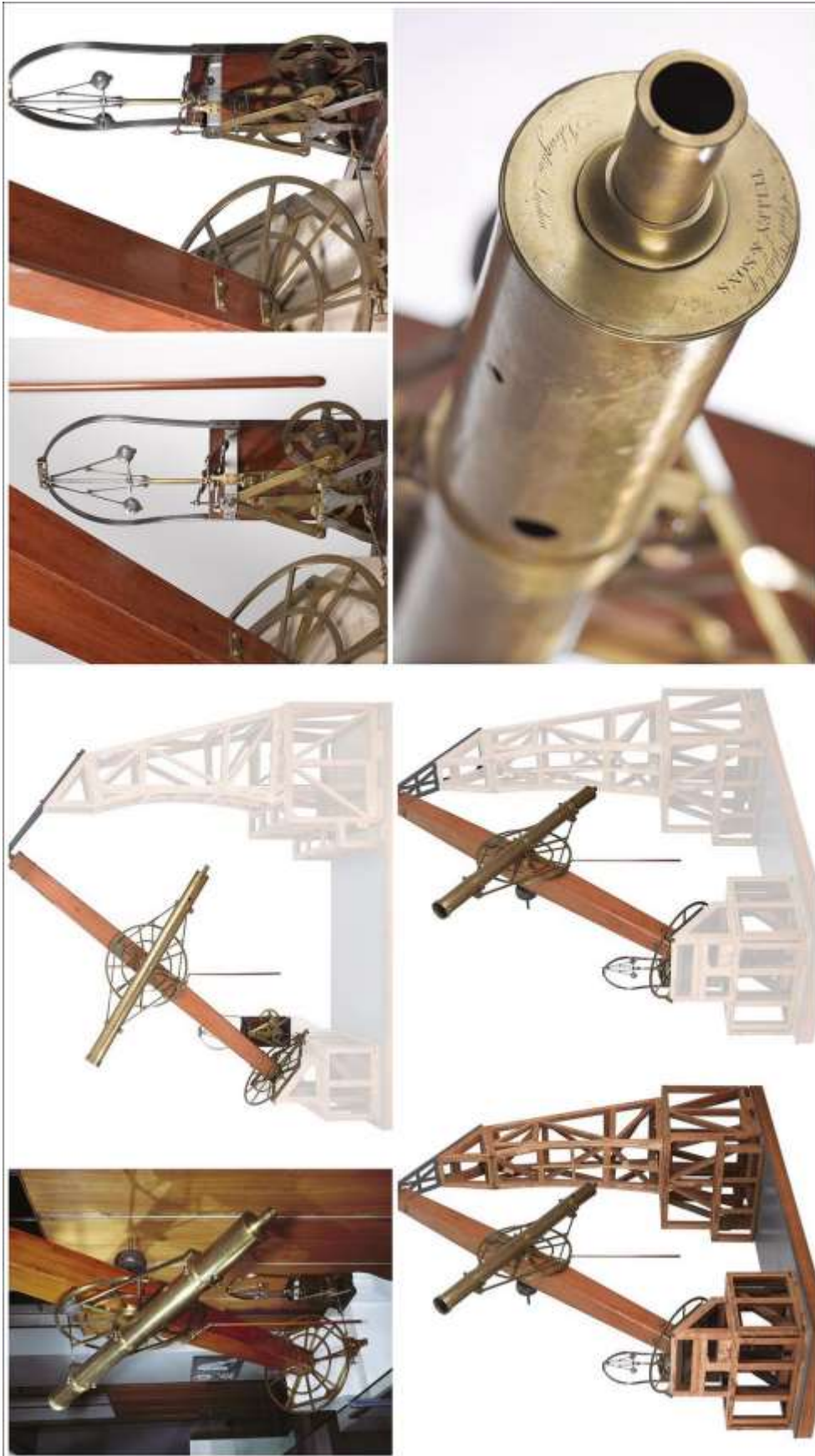


Figure 2 - Smyth equatorial refracting telescope, 1829 (Science Museum London).

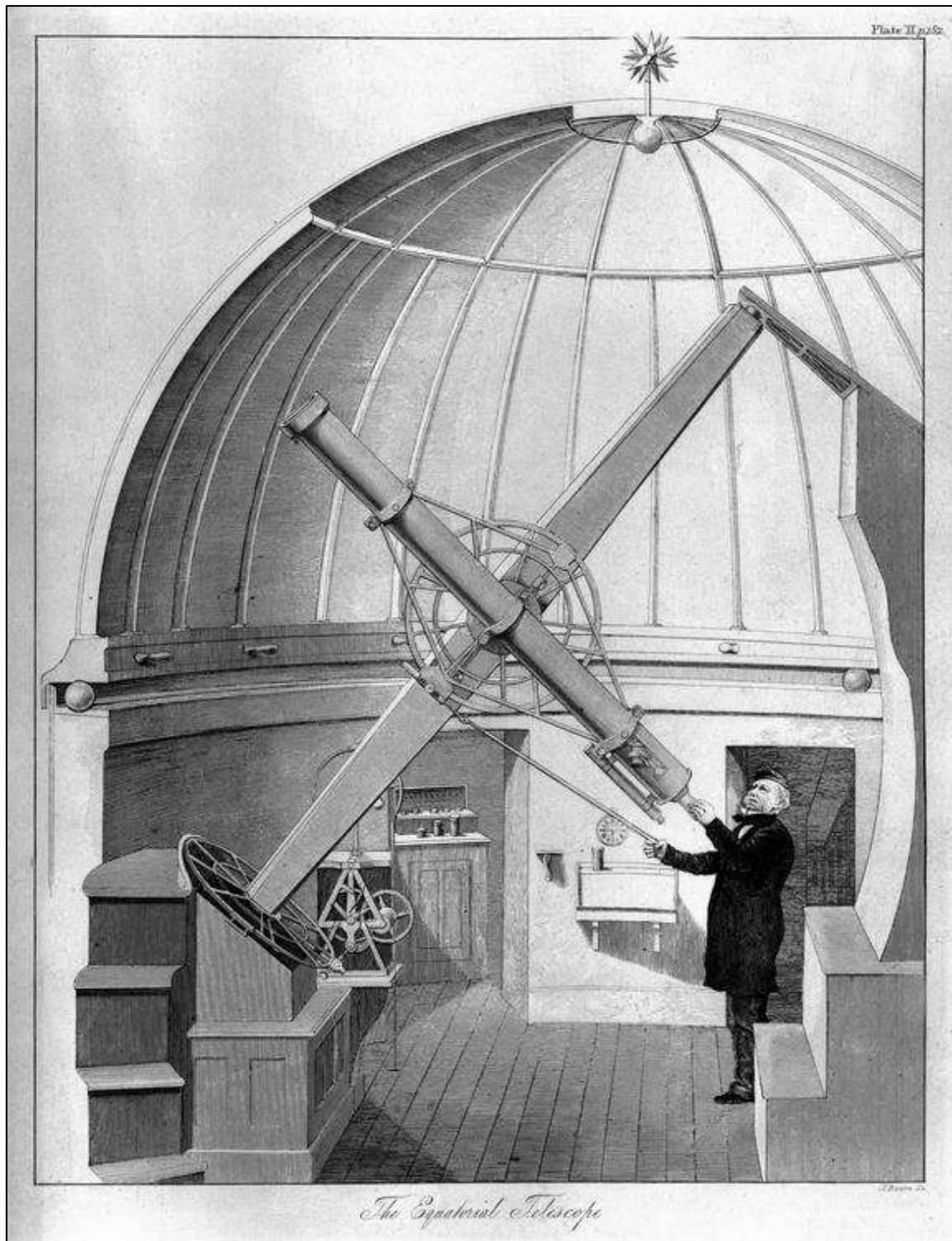


Figure 3- The Smith equatorial telescope (*Cycle of Celestial Objects*).

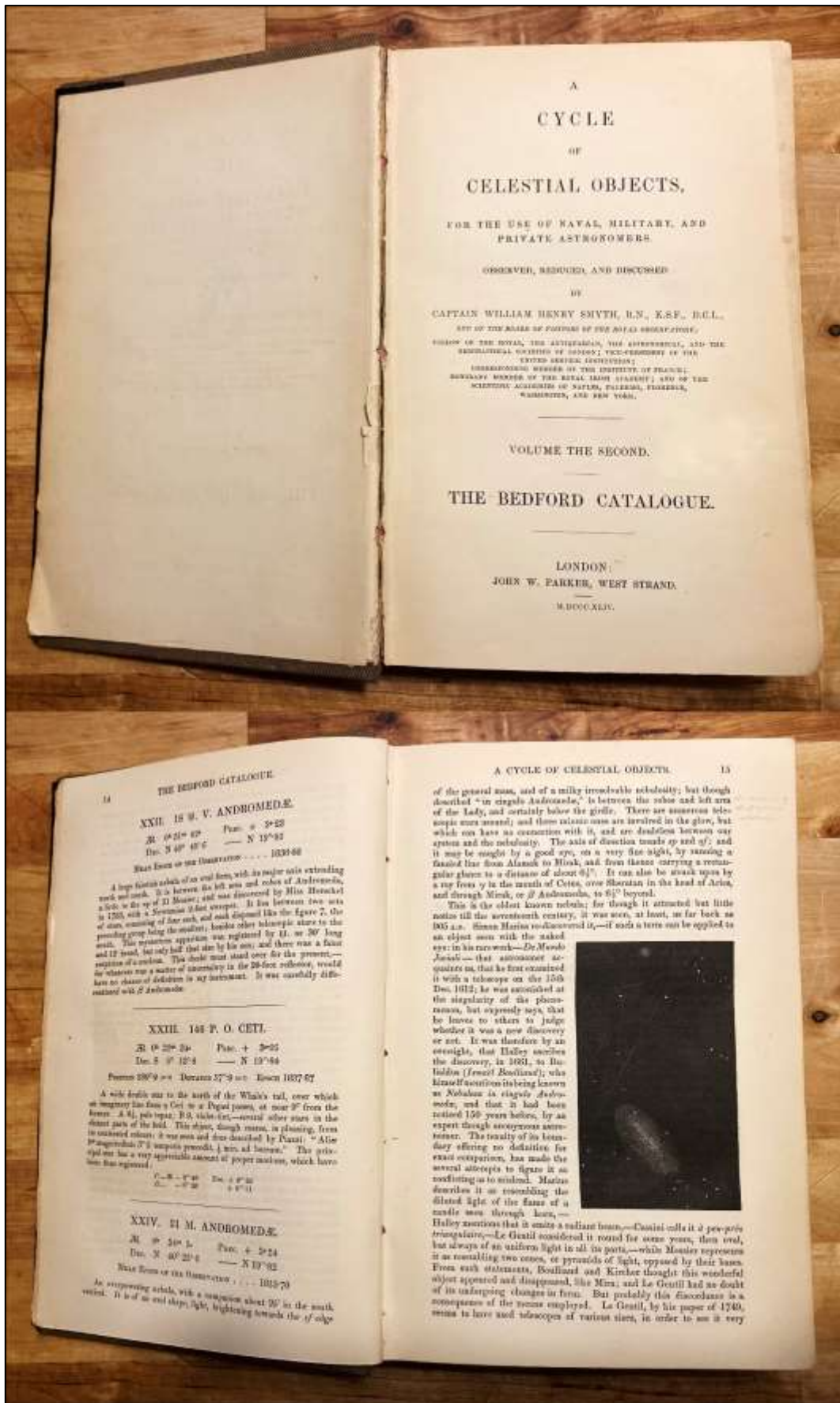


Figure 4- A Cycle of Celestial Objects. The Bedford Catalogue (Vol II). Author's copy.

HENRY DRAPER'S (1837-1882) FIRST LUNAR IMAGES

PEDRO RÉ

<http://pedroastrophotography.com/>

Henry Draper was a medical doctor and a pioneer astrophotographer. His father John William Draper (1811-1882) was the first to obtain a daguerreotype image of the moon in 1840².

Henry Draper is well known for obtaining the first photograph of the Orion nebula (M 42) on September 30, 1880 (Figure 1). Draper used a 28 cm (11-inch) Alvan Clark refractor supported by an equatorial mount also built by Clark (51 min exposure). Draper also obtains two other photographs of M 42 on 1881/1882 with longer exposure times (104 min and 137 min). In 1872 H. Draper records for the first time a star spectrum (Vega) using a 72 cm reflector and a quartz prism. Three years later (1875) Draper was able to photograph the spectra of almost all the bright stars using the 11-inch refractor and a quartz prism located close to the photographic plate.

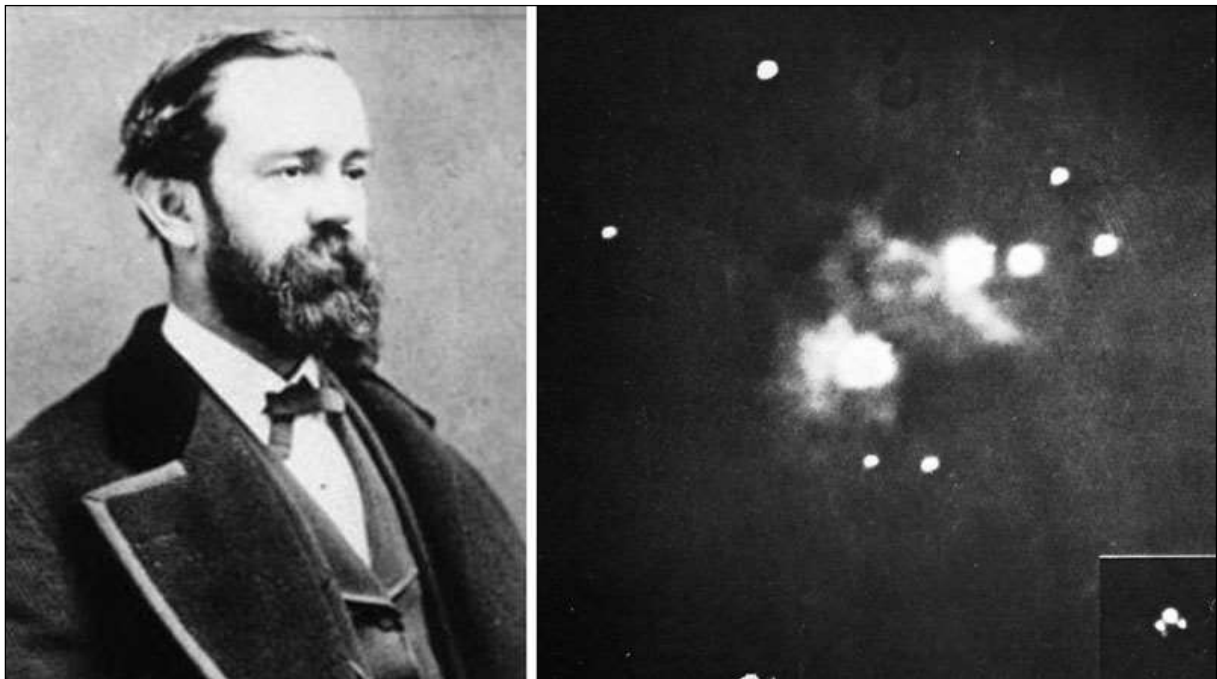


Figure 1- First photographic image of the Orion nebula (M 42) obtained by Henry Draper in 1880.

In his paper published in 1865 (accepted for publication in 1864), *On the Construction of a Silvered Glass Telescope, Fifteen and a Half inches in Aperture, and Its use in Celestial Photography*, Draper describes his investigations into glass-grinding machines (seven different models), glass astronomical mirrors, optical testing, telescope mounts, clock drives and photographic laboratories. This book was intended to be a hand-on guide for building and using glass silvered reflectors. In the first page Drapers mentions:

² On the 23d of March 1840, J.W. Draper presented to the Lyceum of Natural History of New York the first representation of the moon's surface ever taken by photography. The daguerreotype plate was exposed for twenty minutes and the image was about an inch in diameter.

The construction of a reflecting telescope capable of showing every celestial object now known, is not a very difficult task. It demands principally perseverance and careful observation of minutiae. The cost of materials is but trifling compared with the result obtained, and I can see no reason why silvered glass instruments should not come into general use among amateurs. The future hopes of Astronomy lie in the multitude of observers, and in the concentration of the action of many minds.

He also concludes the manual by writing:

My experience in the matter, strengthened by the recent successful attempt of M. Foucault to figure such a surface more than thirty inches in diameter, assures me that not only can the four and six feet telescopes of those astronomers be equalled, but even excelled. It is merely an affair of expense and patience. I hope that the minute details I have given in this paper may lead someone to make the effort.

Draper's telescope and observatory are described in detail in the book (Figure 2):

A short historical sketch of this telescope may not be uninteresting. In the summer of 1857, I visited Lord Rosse's great reflector, at Parsonstown, and, in addition to an inspection of the machinery for grinding and polishing, had an opportunity of seeing several celestial objects -through it. On returning home, in 1858; I determined to construct a similar, though smaller instrument; which, however, should be larger than any in America, and be especially adapted for photography. Accordingly, in September of that year, a 15-inch speculum was cast, and a machine to work it made. In 1860, the observatory was built, by the village carpenter, from my own designs, at my father's country seat, and the telescope with its metal speculum mounted. This latter was, however, soon after abandoned, and silvered glass adopted. During 1861, the difficulties of grinding and polishing that are detailed in this account were met with, and the remedies for many of them ascertained. The experiments were conducted by the aid of three 15 ½-inch disks of glass, together with a variety of smaller pieces. Three mirrors of the same focal length and aperture are almost essential, for it not infrequently happens that two in succession will be so similar, that a third is required for attempting an advance beyond them. One of these was made to acquire a parabolic figure and bore a power of 1,000. The winter was devoted to perfecting the art of silvering, and to the study of special photographic processes. A large portion of 1862 spent with a regiment in a campaign in Virginia, and but few photographs produced till autumn, when sand clocks and clepsydras of several kinds having made, the driving mechanism attained great excellence. During the winter, the art of local corrections was acquired. and two 15 ½-inch mirrors, as well as two 9 inches for the photographic enlarging apparatus, were completed. The greater part of 1863 has been occupied by lunar and planetary photography, and the of the small negatives obtained at the focus of the great reflector. negatives have been produced which have been magnified to 3 feet in diameter. I have also finished two mirrors 15 ½-inch in aperture, suitable for a Herschelian telescope, that is, which can only converge oblique pencils to a focus free from aberration. This work has all been accomplished in the intervals of professional labour. The details of the preceding operations are arranged as follows: § 1. GRINDING AND POLISHING THE MIRRORS; § 2. THE TELESCOPE MOUNTING; § 3. THE CLOCK. movement; § 4. THE OBSERVATORY; § 5. THE PHOTOGRAPHIC LABORATORY; § 6. THE PHOTOGRAPHIO ENLARGER.

THE TELESCOPE MOUNT

The telescope is mounted as an altitude and azimuth instrument, but in a manner that causes it to differ from the usual instrument of that kind. The essential feature is, that the eyepiece or place of the sensitive plate is stationary at all altitudes, the observer always looking straight forward, and never having to stoop or assume inconvenient and constrained positions.

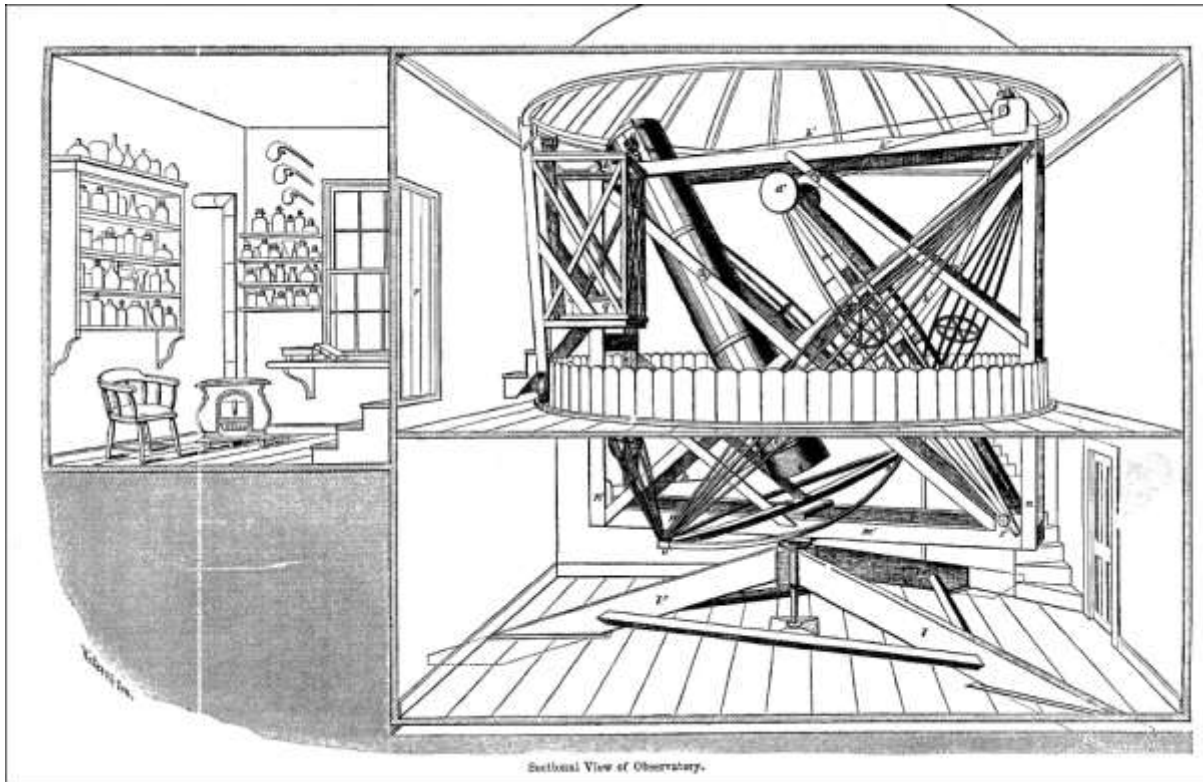


Figure 2- Henry Draper's observatory and Photographic laboratory.

The telescope tube is a sixteen-sided prism of walnut wood, 18 inches in diameter, and 12 feet long. The staves are 3/8 of an inch thick and are hooped together with four bands of brass, capable of being tightened by screws. Inside the tube are placed two rings of iron, half an inch thick, reducing the internal diameter to about 16 inches. At opposite sides of the upper end of the tube are screwed the perforated trunnions upon which it swings. Surrounding the other end is a wire rope, the ends of which go over the pulleys on friction rollers and terminate in disks of lead. These 'counterpoises are fastened on the ends of levers which turn below on a fixed axle.

By this arrangement as the tube assumes a horizontal position and becomes, so to speak, heavier, the counterpoises do the same, while when the tube becomes perpendicular, and most of its weight falls upon the trunnions, the counterpoises are carried mostly by their axle. A continual condition of equilibrium is thus reached, the tube being easily raised or depressed to any altitude desired.

THE CLOCK MOVEMENT

Warren De La Rue, who has done so much for celestial photography, was the first to suggest photographing the moon on a sensitive plate, carried by a frame moving in the apparent direction of her path. He never, however, applied an automatic driving mechanism, but was eventually led to use a clock which caused the whole telescope to revolve upon a polar axis, and thus compensate for the rotation of the earth, and on certain occasions for the motion of the Moon herself. In this way he has produced the best results that have been obtained in Europe. Lord Rosse, too, employed a similar sliding plate-holder, but provided with clockwork to move it at an appropriate rate. I have not been able yet to procure any precise account of either of these instruments.

My first trials were with a frame to contain the sensitive plate, held only at three points. Two of these were at the ends of screws to be turned by the hands, and the third was on a spring so as to maintain firm contact. 'This apparatus worked well in many respects, but it was found that however much care

might be taken the hands always caused some tremor in the instrument. It was evident then that the difficulty from friction which besets the movements of all such delicate machinery, and causes jerking and starts, would have to be avoided in some other way.

I next constructed a metal slide to run between two parallel strips and ground it into position with the greatest care. This, when set in the direction of the moon's apparent path, and moved by one screw, worked better than the preceding. But it was soon perceived that although the strips fitted the frame as tightly as practicable, an adhesion of the slide took place first to one strip and then to the other, and a sort of undulatory or vermicular progression resulted. The amount of deviation from a rectilinear motion, though small, was enough to injure the photographs.

My brother, Daniel Draper, to whose mechanical ingenuity I have on several occasions been indebted for assistance in the manifold difficulties that have arisen while constructing this telescope, continued these experiments at intervals. He presented me with a slide and sand-clock, with which some excellent photographs have been taken. He had found that unless the slide above mentioned was made ungovernably long, the same trouble continued (Figure 3).

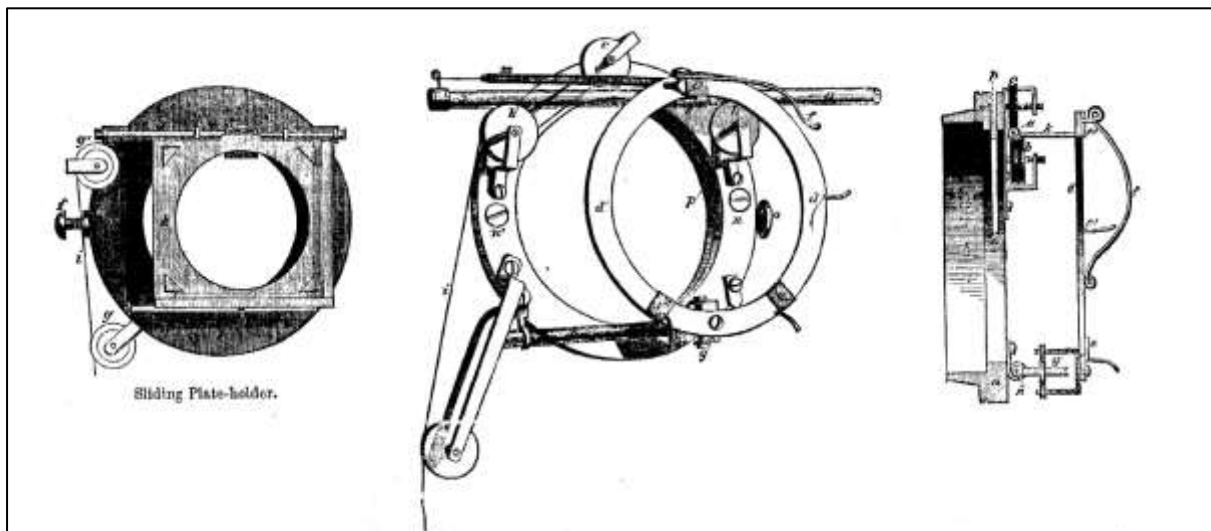


Figure 3- Sliding plate holder

The length of time that such a slide can be made to run is indefinite, depending in my case on the size of the diagonal flat mirror, and aperture of the eyepiece holder. I can follow the moon for nearly four minutes but have never required to do so for more than fifty seconds. At the mouth of the instrument, where no secondary mirror is necessary, the time of running could be increased.

My prime mover was a weight supported by a column of sand, which, when the sand was allowed to run out through a variable orifice below, could be made to descend with any desired velocity and yet with uniformity. In addition, by these means an unlimited power could be brought to bear, depending on the size of the weight. Previously it was proposed to use water and compensate for the decrease in flow, as the column shortened, by a conical vessel but it was soon perceived that as each drop of water escaped from the funnel-shaped vessel, only a corresponding weight would be brought into play. This is not the case with sand, for in this instance every grain that passes out causes the whole weight that is supported by the column to come into action. In the former instance a movement consisting of a series of periods of rest and periods of motion occurs, because power has to accumulate by floating weight lagging behind the descending water, and then suddenly overtaking it. In the latter case, on the contrary, there is a regular descent, all minor resistances in the slide being overcome by the steady application of the whole mass of the weight. When these advantages in the

flow of sand were ascertained, all the other prime movers were abandoned. Mercury-clocks, on the principle of the hydrostatic paradox, air-clocks, in great variety, had been constructed.

I determined to try a clepsydra as a prime mover. The reason which led to this change was that it was observed on a certain occasion when the atmosphere was steady, that the photographs did not correspond in sharpness, being in fact no better than on other nights when there was a considerable flickering motion in the air. A further investigation showed that in these columns of sand there is apt to be a minute vibrating movement. At the plateholder above this is converted into a series of arrests and advances. On some occasions, however, these slight deviations from continuous motion are entirely absent, and generally, indeed, they cannot be seen, if the parts of the image seem to vibrate on account of currents in the air. By the aid of the microscopic exaggeration described on a former page which was subsequently put in practice they may be observed easily if present.

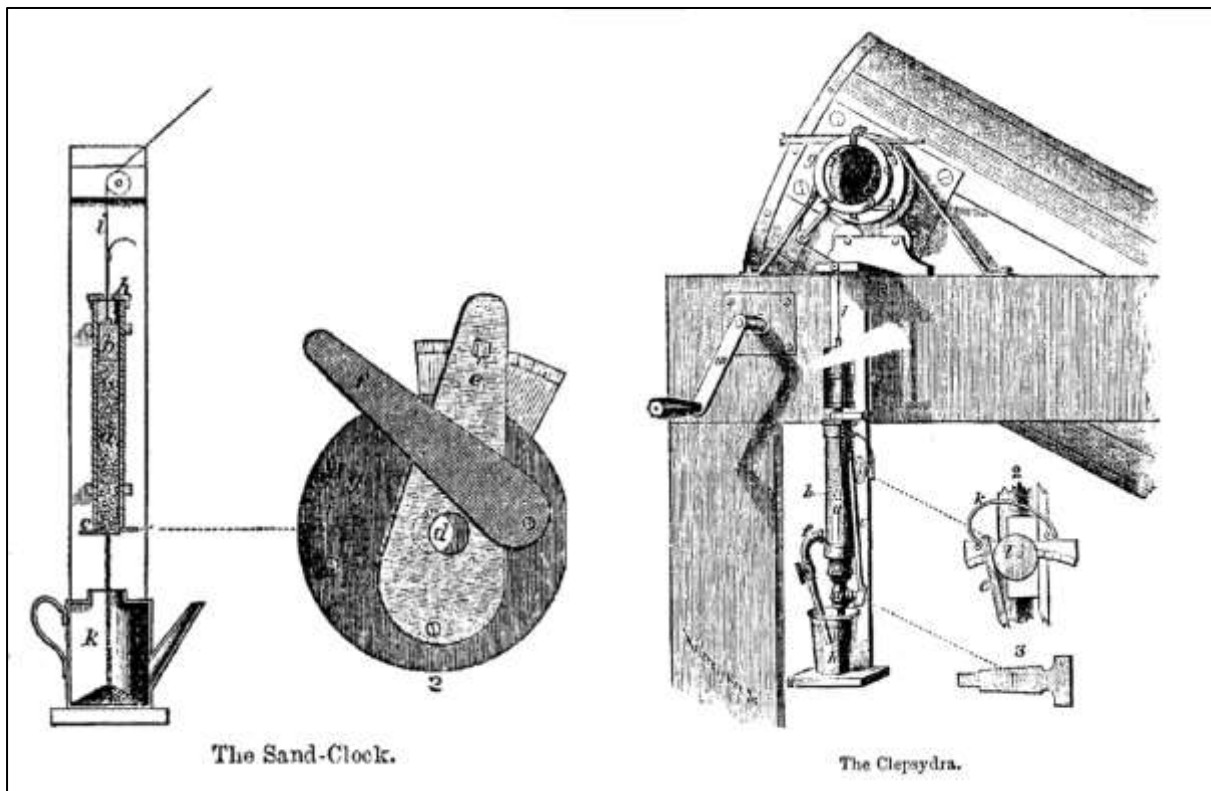


Figure 4 – Sand-Clock and Clepsydra.

It is obvious that in a water-clock, where the mobility of the fluid is so much greater than that of solid grains, this difficulty would not arise. The following contrivance in which the fault of the ordinary clepsydra, in varying rate of time as the column shortens, is avoided, was next made. With it the best results are attainable, and it seems to be practically perfect.

Draper brought the telescope to a complete rest before exposing, then moved the plate holder to track the movement of the Moon. During the exposures, lasting several seconds, the photographic plate was driven automatically by a Clepsydra connected to the plate holder by a chord (Figure 4).

By 1863 Draper obtained more than 1500 collodion wet plates of the Moon. These were regarded as some of the best lunar photographs ever taken, maybe only surpassed by Lewis Morris Rutherford image of the first quarter moon obtained in March 6, 1865 in almost perfect seeing conditions.

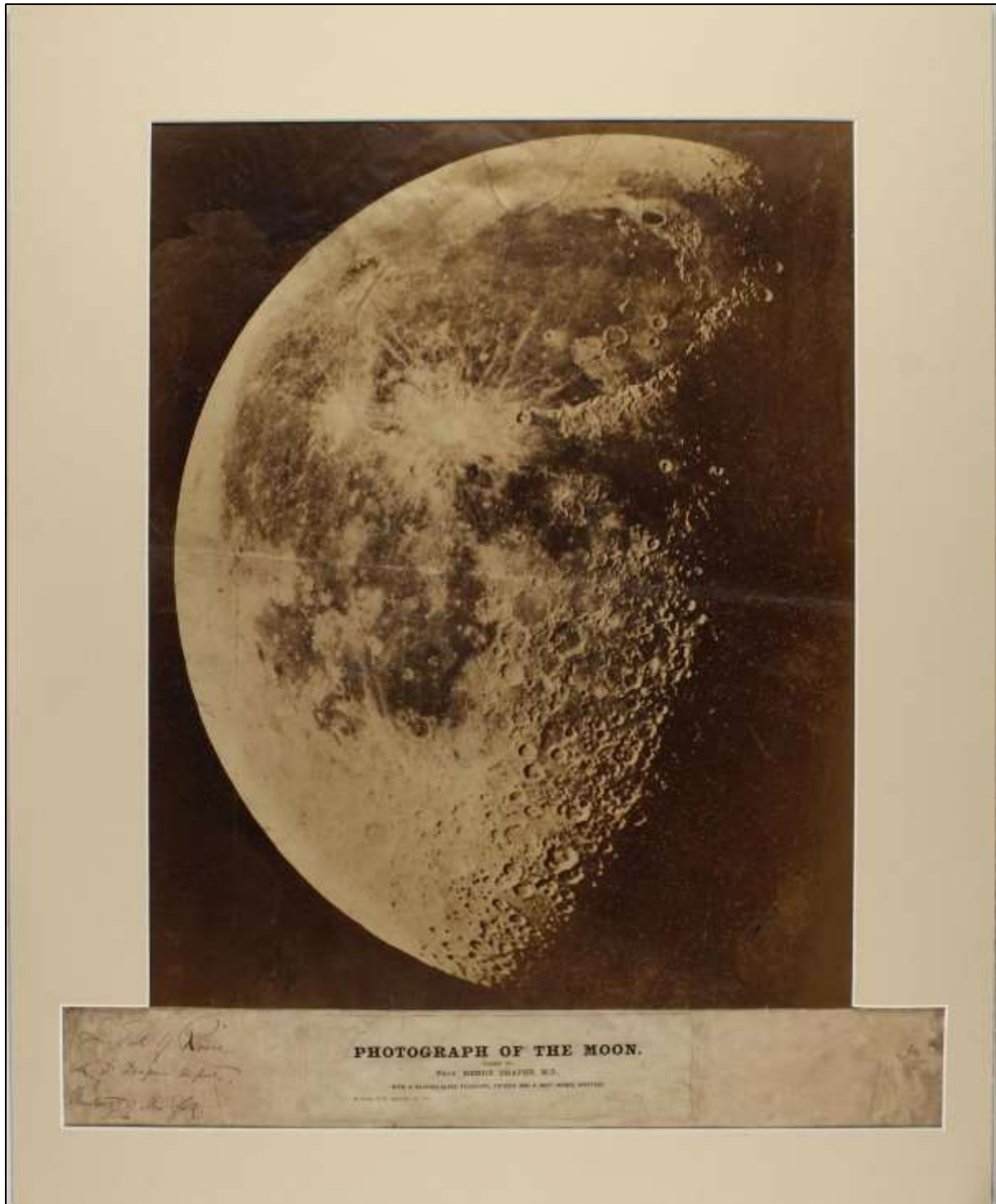


Figure 6- Henry Draper albumen silver print photograph of the Moon (1863).

Sources:

Draper, H. (1865). *On the Construction of a Silvered Glass Telescope, Fifteen and a Half inches in Aperture, and Its use in Celestial Photography*. Smithsonian Contributions to Knowledge XIV: 55 pages.

Hirshfeld, A. (2014). *Starlight Detectives*. Bellevue Literary Press, New York.

Hughes. S. (2013). *Catchers of the Light*. ArtDeCiel Publishing: 1612 pages.

JOHN CHARLES DUNCAN'S PHOTOGRAPHIC STUDIES OF NEBULAE

PEDRO RÉ

<http://pedroreastrophotography.com/>

John Charles Duncan (1882-1967) is mainly known for his photographic demonstration of expansion in the Crab nebula (M1)³. He is also the author of *Astronomy*, a standard college textbook for more than 30 years, which is illustrated with many astronomical photographs obtained by Duncan at Mount Wilson Observatory.

Duncan received his BA in 1905 and his Master in 1906, both at the Indiana University. He was a fellow of Lowell Observatory obtaining a PhD in 1909 at the University of California. His dissertation was on Cepheid variables and his supervisor was William Wallace Campbell (1862-1938).

From 1909 until 1916 Duncan was an instructor in astronomy at Harvard University and later became Professor of astronomy and director of Whitin Observatory.

Duncan compared a photograph obtained in 1909 by George Willis Ritchey (1864-1945) with one he took in 1921 with the same instrument (60" reflector Mount Wilson Observatory). He was able to demonstrate that the filaments of the planetary nebula M1 were expanding⁴. Confirmation of these expansion came in 1938 when Duncan obtained another photograph of the Crab Nebula (Figure 1).

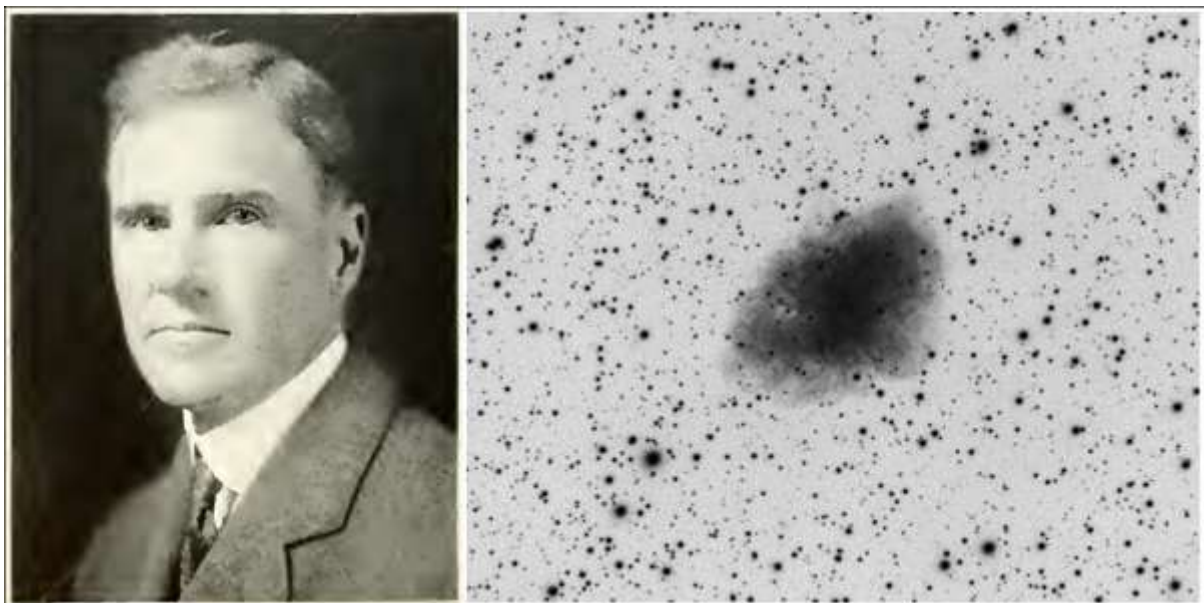


Figure 1 – John Charles Duncan, Crab Nebula (Pedro RÉ, TMB175 F/8, STL11000).

³ The Crab nebula, located in the constellation of Taurus, is associated with the pulsar NP 0532. It is the remnant of a supernova observed in Japan and China in A.D. 1054.

⁴ J.C. Duncan compared photographic plates taken 11.5 years apart and found that the Crab Nebula was expanding at an average of about 0.2" per year; backtracking of this motion showed that this expansion must have begun about 900 years ago. Duncan, J.C. (1921). Changes Observed in the Crab Nebula in Taurus. Mt. Wilson Communications, No. 76. *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 7 (6): 179-180.

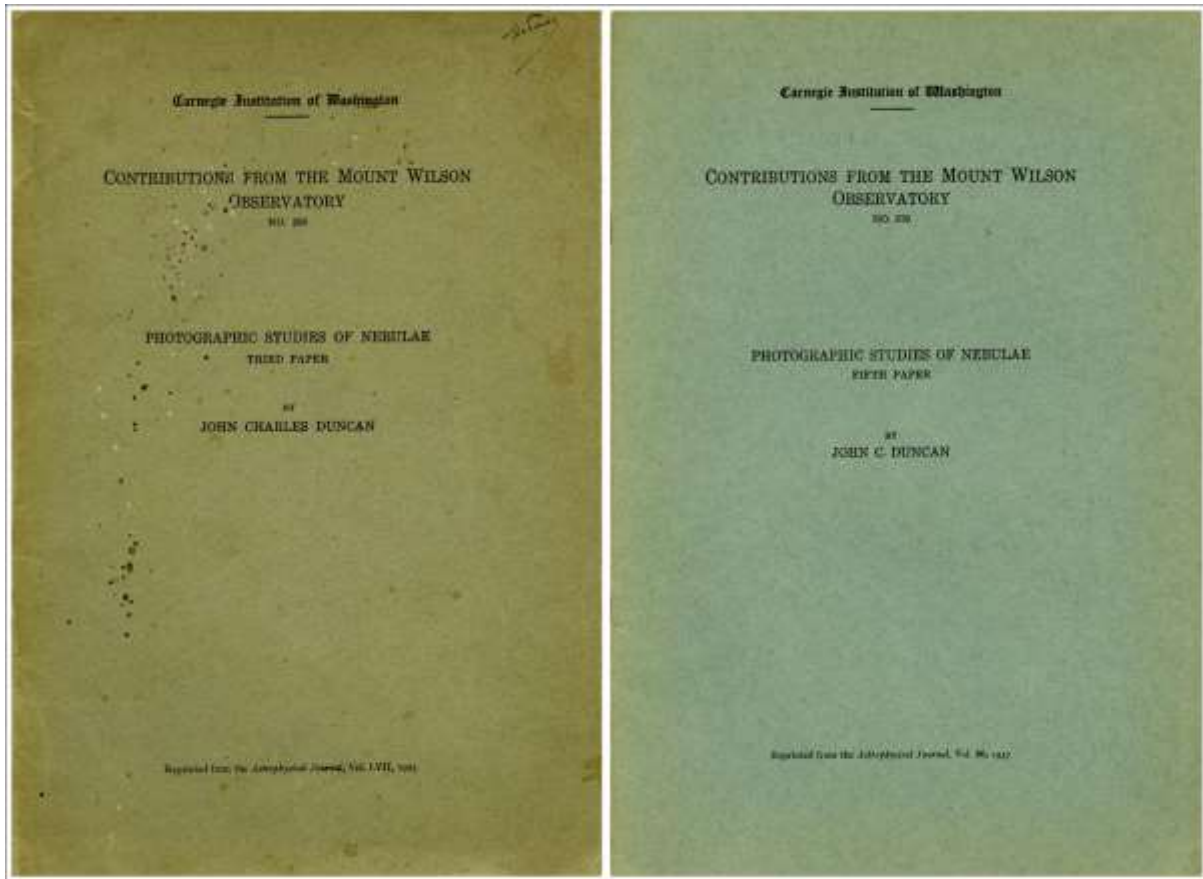


Figure 2- Photographic Studies of Nebulae (third and fifth papers), 1927 and 1937.

Duncan was also interested in comets, spectroscopic binary stars, and novae. His photographic studies of Nebulae were obtained during several visits he made to Mount Wilson Observatory as a guest astronomer in 1920 and during subsequent summers spent as a voluntary research assistant⁵ (Figure 2).

John Charles Duncan used the 60", 100" Hooker and later the 200" Hale telescopes to obtain some of the finest astrophotographs ever taken. His image of B33 taken in 1920 is now known as the Horsehead Nebula⁶. Duncan used the 60" and 100" telescopes, in 1939, to obtain colour photographs of star clusters and Nebulae using Kodachrome sheets. In the same year during the Sixty-Second meeting of the American Astronomical Society Duncan reported on his experiments with colour Photography of Nebulae:

With the 60-inch and 100-inch Mount Wilson Telescopes, the author has photographed a few nebulae and star-groups on sheets of Kodachrome Aim, "daylight" type, size 4x5 inches, Vivid pictures of certain star clusters were obtained, notably of Chi Persei with an exposure of two minutes and of M11 Scutti with as exposure of thirty minutes. These show star images of a wide range in magnitude and colour ranging from a pronounced blue to a deep orange red. The colours of bright as well as faint stars are well shown while the centre of the image of a bright coloured star might be overexposed, there is near its edge a zone correctly exposed (...). Certain coloured planetary nebulae also are well pictured. The colours of certain diffuse gaseous nebulae, on the other hand, appear strange, for example the grrat

⁵ Duncan published six papers on "Photographic Studies of Nebulae" in the years 1920-1949.

⁶ Duncan obtained on November 13, 1920, a three-hour photograph of the Horsehead nebula with the 100-inch Hooker telescope. It is this image which gave the name of, the up until then, anonymous dark nebulae.

nebulae M42 and M8 which over most of their areas are green to the eye and photographed without a filter are bright purple and with a W2A filter, which stops the ultra-violet light but very little visible light, are red. On the Orion nebulae, exposures were made with the 100-inch up to 45 min and with the 60-inch up to two hours. They show especially well the multitude of faint red and the portions of the nebulae which appear reddish to the eye (...).

PLATE VI
North



Negative Δ 187

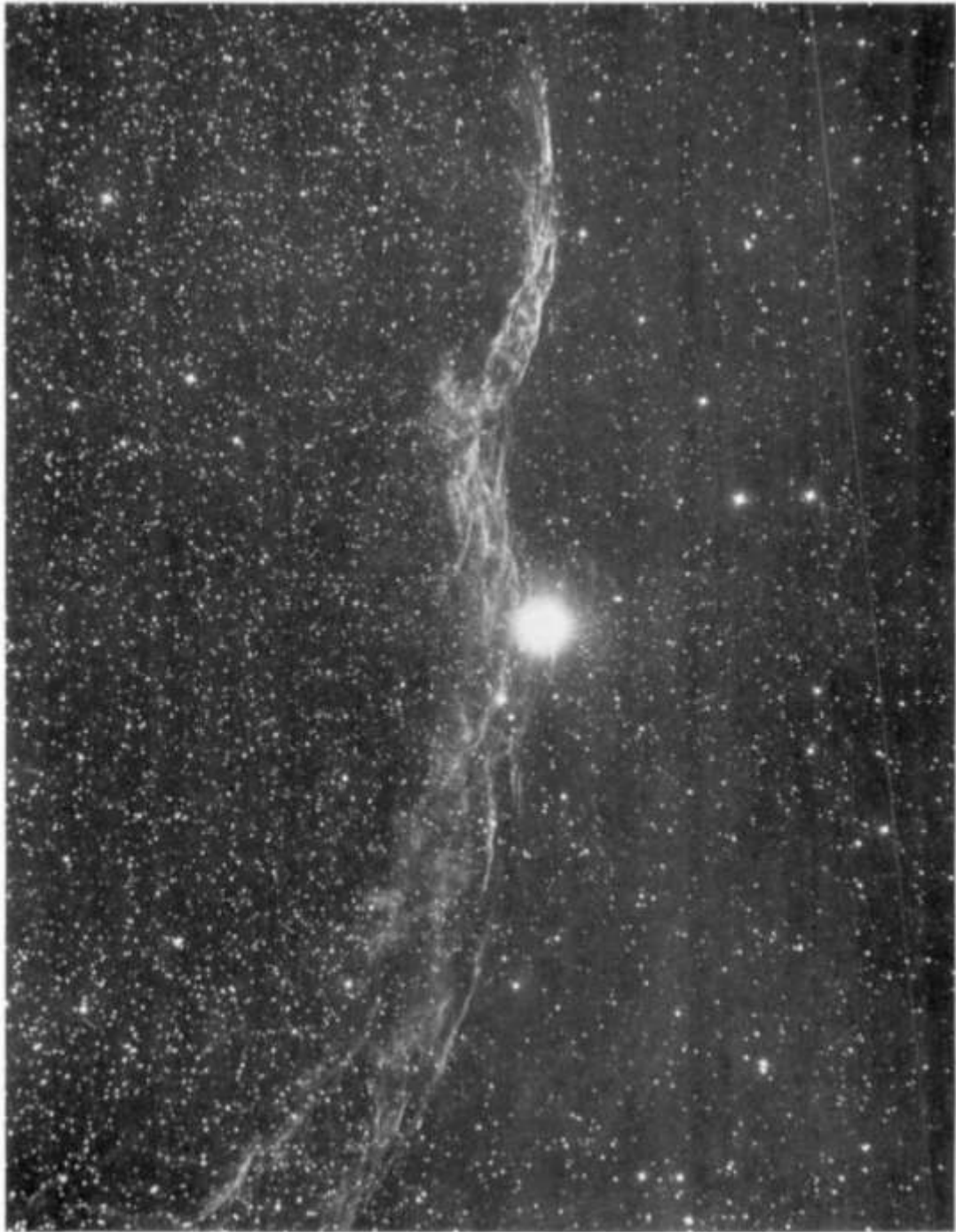
THE NEBULA N.G.C. 1977, SURROUNDING ϵ ORIONIS

Photographed with the 100-inch Hooker telescope, 1921, January 7. Exposure, 5^h40^m

Scale: 1 mm = 18'2 (0.87 that of original negative)

PLATE XIII

North



Negative Δ 203

THE NEBULA N.G.C. 6960 CYGNI, WITH METEOR TRAIL

Photographed with the 100-inch Hooker telescope, 1921, August 3. Exposure, 7 hours
Scale: 1 mm = 21'9 (0.72 that of original negative). The line on the right is the meteor trail

PLATE IX

North



Negative Δ 184

THE TRIFID NEBULA, N.G.C. 6514 = M20 SAGITTARII

Photographed with the 100-inch Hooker telescope, 1921, June 30. Exposure, 2^h30^m

Scale: 1 mm = 11".5 (1.37 times that of original negative)

PLATE VIII

North



Negative A 289

THE DARK NEBULA BARNARD 74 OPHIUCHI

Photographed with the 100-inch Hooker telescope, 1921, July 4. Exposure, 2^h43^m
Scale: 1 mm = 157 $\frac{1}{2}$ (0.87 that of original negative)

PLATE XIV

North

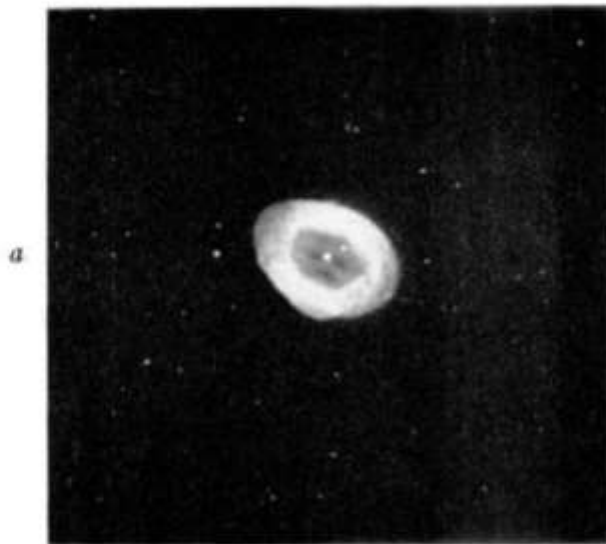


THE PLEIADS

Negative 2548. Photographed with the 100-inch telescope (aperture reduced to 84 in.) and Ross zero-power correcting lens, August 20, 1933. Imperial Eclipse plate. Exposure, 2 hours and 10 minutes. Scale: 1 mm = 237.

PLATE XV

North



THE RING NEBULA IN LYRA

Photographed with the 100-inch Hooker telescope (aluminum-coated mirrors) and Imperial Eclipse plates. (*a*) Negative $\Delta 554$, aperture 84 inches, August 6, 1935; exposure, 15 minutes. (*b*) Negative $\Delta 591$, full aperture, August 13, 1936; exposure, 2 hours. Scale of both cuts: 1 mm = $5''.3$.

HENRY CHAMBERLAIN RUSSELL'S *PHOTOGRAPHS OF THE MILKY WAY & NUBECULAE*

PEDRO RÉ

<http://pedroastrophotography.com/>

Henry Chamberlain Russell (1836-1907) published in 1891 "*Photographs of the Milky Way & Nubeculae*" a collection of 16 prints⁷ (Ilford gelatine photographic plates)⁸.

Russell joined the Sydney Observatory in 1859 as a *computer* and later (1870) became the Observatory Director, a post he would occupy until his retirement in 1905. Russell was interested in astronomy and meteorology (Figure 1).

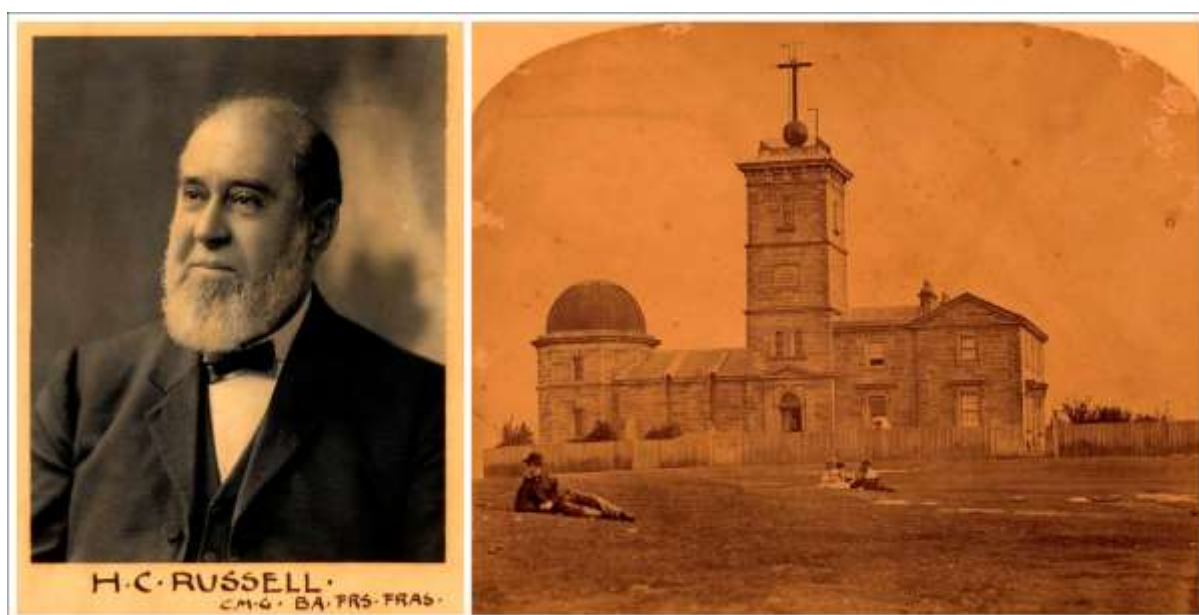


Figure 1 - Henry Chamberlain Russell and the Sydney Observatory (c1860).

Russell was responsible for the instrumentation of the Sydney Observatory. The Observatory housed several instruments: 18.4 cm Merz refractor; 29.2 cm Schroeder refractor; 15.2 cm Troughton & Sims transit telescope and a 33 cm astrograph with a 26 cm guide telescope. H.C. Russell was a firm supporter of the International Astrographic (*Carte du Ciel*) Project, attending the 1887 *kick of meeting*.

Unlike other participating observatories, Russell bought the Grubb optics for the astrographic telescope and supervised the construction of the instrument in Sydney. This project took much of Russell's research time in the last ten years of his career.

Russell was also responsible for the observation of 1874 and 19882 Transits of Venus from Sydney. In 1874 the event was observed at four different stations. In 1882 cloudy weather prevented successful

⁷ 14 prints taken from glass negatives on Ilford gelatine photographic plates of the Southern Milky-Way and two additional plates of the Orion constellation for comparison purposes.

⁸ Russell was assisted by James Walter Short (18656-1943)

observations of the transit. Sydney Observatory played an important role in the calculation of the solar parallax. Double stars were also studied by Russell⁹.

Russell was a pioneer of astronomical photography. During the second half of the 1880s, Russell obtained a series of excellent photographs of the Magellanic Clouds and several regions of the Southern Milky Way as well. Some of the Photographs were published in *Monthly Notices of the Royal Astronomical Society*.

These astrophotographs were the first obtained of the Southern Skies. *Photographs of the Milky-Way & Nubeculae* was published in 1890 (Sydney Observatory) and includes 16 mounted original photographs. Each photograph is accompanied by a leaf of explanatory text (Figure 2).

These astrophotographs were taken from 23 July to 19 October 1890 with exposures from 2h 30min to 8h (Figures 3, and 4). In 1890 the equatorial mount was complete, but the objective lens had not arrived from Ireland. Russell photographs were obtained with a 6-inch Dallmeyer Portrait Lens of 32-inch focal length, which gave sharp definition over a field of about 4.5-inches on the 6.5 x 8.5-inch plates.

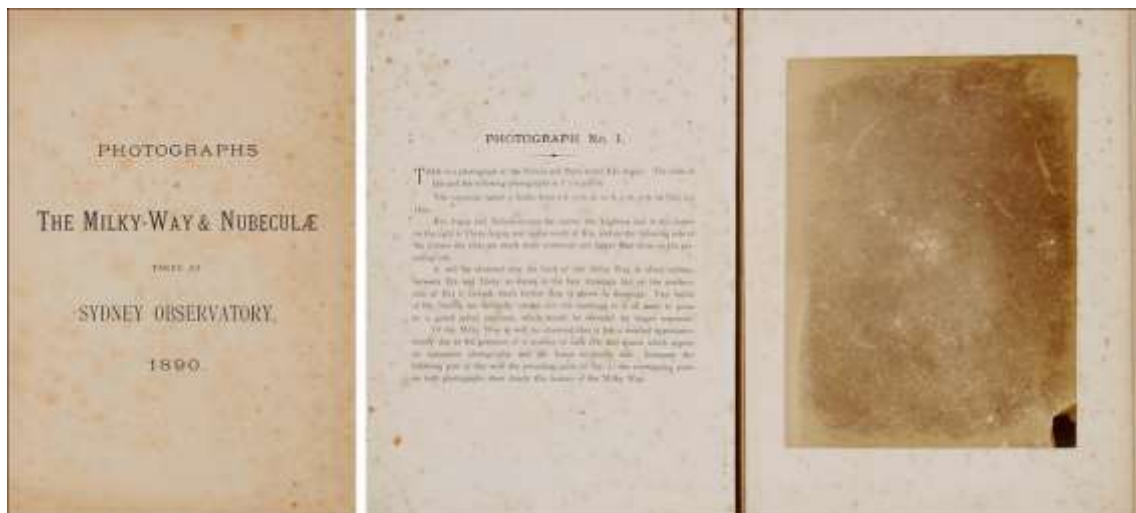


Figure 2- *Photographs of the Milky-Way & Nubeculae*.

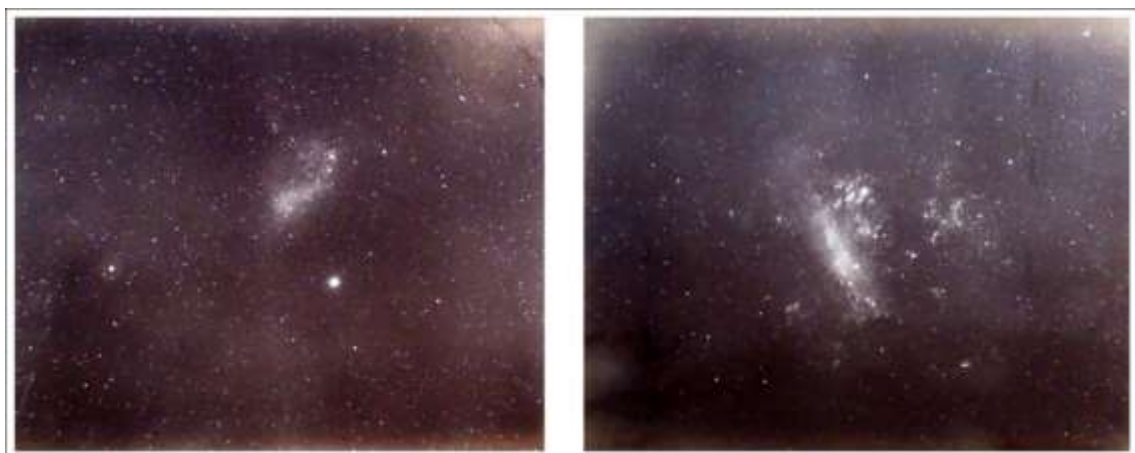


Figure 3- Photograph of the Small Magellanic Cloud, 8 h exposure – 14 October 1890 (left). Photograph of the Large Magellanic Cloud, 7h and 3 min – 17 October 1890.

⁹ In 1870 Russell discovered more than 500 new double stars.

Astrophotographs descriptions by H.C. Russell (Large and Small Magellanic Clouds):

Large Magellanic Cloud: The photograph shows the nubecula major after 7 hours 30 minutes exposure – from 8.57 p.m. October 17, 1890, to 4 p.m. on 18th. The night was fine and clear throughout, and the photograph was very successful, marred only by a stain on the plate, which fortunately in not serious... On the preceding side may be seen three spiral groupings of stars, on the north side another, and on the following side, a little below the middle line, is a circular patch of nebulous light, very faint here, but visible in three negatives, and may therefore be assumed to be a fact, while about the main mass are numbers of clustering stars arranged in a way that is very suggestive of spiral structure... Altogether so much is revealed by this photograph and so much suggested that I regret exceedingly the want to more powerful camera, by means of which additional detail could be brought out of the most complex object which photography has yet revealed to us.

Small Magellanic Cloud: Photograph No. 11 shows the Nubecula Minor after eight hours of exposure, and it is obviously under exposed, but no longer period of darkness or more powerful lens could be obtained. Enough is, however, recorded to show its general form and character, and it is remarkably similar in this respect to Nubecula major, and there is not wanting near its indication that the more powerful camera would reveal spiral groupings of stars like those about the larger cloud. We have on the preceding size of it one of the finest globular clusters in the heavens, and north of it a second globular cluster of the same character but smaller, and closely falling it a group in which the a strong likeness to spiral structure is evident; and on the north following side of the cloud it is great curve we have the most striking nebula it contains, situated in the same relative position with regard to general outline that is occupied by 30 Doradus in Nubecula major. One cannot compare the photographs of the two clouds without being struck by the strong family likeness between them. This photograph was taken on October 14, 1890, from 7h 40m p.m. to 3h 40m a.m. of the 15th, or 8 hours.



Figure 4- Photograph of the Orion Nebula, 3 h exposure, 17 December 1890.

Sources:

Andropoulos, J.I. (2014). *Astronomical publications of Melbourne Observatory*. PhD Thesis, James Cook University

Hughes, S. (2016). *The ages of Astrophotography 1839-2015. Celebrating Edwin P. Hubble (1889-1953)*. eBook

Orchiston, W. (2014). Russell, Henry Chamberlain. T. Hockey (ed). *Biographical Encyclopaedia of Astronomers*.

UNITRON/POLAREX/WELTBlick TELESCOPES

PEDRO RÉ

<http://pedroastrophotography.com/>

Unitron History¹⁰

The Company Nihon Seiko Kenkyusho, Ltd. based in Tokyo was established in the mid 1930's, marketing achromatic refracting telescopes with a Zeiss type E air-spaced doublet achromatic lens design. Telescopes up to 125 mm aperture were marked under the POLAREX or SEIKO SCOPE trade names.

Nihon Seiko manufactured Unitron refractor tube assemblies for distribution in the US, of three inches aperture and other sizes as well; four-inch Unitron objectives were produced by many sources. The Nihon Seiko telescopes were marketed in most major markets, and under several trade names (MERIDIAN, POLAREX, SEIKO SCOPE, UNITRON, WELTBlick) until the discontinuation of routine telescope production in 1992.

In early 1950's Lawrence Fine went to Japan looking for high quality products to market in the US; the company began dealing with was Nihon Seiko Trading Company. Lawrence Fine began importing telescopes as the United Trading Company (UNITRON)¹¹.

The first Unitron advertisement appeared in the October 1951 issue of Sky and Telescope magazine; featuring models: the NS 127, NS 114, and NS 128 (Figure 1).

Fine registered the Unitron trademark in the United States under United Scientific CO, 204 Milk Street, Boston, Massachusetts. The registration file was filed on March 22, 1954, with first commercial use on February 25, 1952¹².

In April 1952, the announcement was made for the 3" Equatorial, Model 142; it was finally made available for \$435US in June 1952; United Trading Company.

In the early 1960's United Instrument Company expanded into the microscope line through the KUNOH TRADING COMPANY, and UNION OPTICAL in Tokyo, Japan. This included the importing of the first inverted Japanese microscopes into the US.

In January 1953, Unitron introduced the first full page spread showing all its models. In March 1953, they announced the Model 145 3" Photo-Equatorial with a price of \$550US. In April 1953, the Model 140, 3" Alt-Az and the Model 150, 4" Alt-Az were announced. In May 1953, the Model 152, 4" Equatorial was announced as leading a line of nine Unitron Models¹³ (Figure 2).

In January 1955 the "first of a series of test models of the forthcoming Unitron 6-inch refractor"; the Rotary Eyepiece Selector, and the weight driven clock drive for the 4-inch Equatorial Model 155 were announced (Figure 3 and 4).

¹⁰ Largely based on <https://www.unitronhistory.com/>

¹¹ The UNITRON brand name was derived from the company's largest supplier of microscopes, UNION OPTICAL.

¹² In February 1952 United Trading Company started using Unitron Model numbers instead of Nihon Seiko (N-S) numbers for the three telescope models it was marketing: Unitron 127, Unitron 114, and Unitron 128.

¹³ November 1953 featured the first Unitron back cover advertisement in Sky and Telescope.

At Last! — A Telescope You Can Afford!



1.6-INCH REFRACTOR
Model No. NS 127

A wonderful instrument for the beginner and young people interested in astronomy.

Objective: 46-mm. (1.6") diameter, 790-mm. (27.2") focal length, f/17.5.
Eyepieces: 9 mm. (.35") for 73x
18 mm. (.71") for 39x
(100x eyepieces available at extra cost. Other sizes of eyepieces available.)

COMPLETE with tripod and slow-motion device, view finder, star diagonal, wooden case. **Only \$75**

Precision Refractors at Unbelievably Low Prices

Three models to choose from. Each is made from the finest materials and imported from one of the world's largest manufacturers of optical instruments.

—LENSES are FULLY CORRECTED for spherical and chromatic aberration and are COATED for maximum brilliance and clarity of image.

—Each model is equipped with a sturdy TRIPOD and SLOW-MOTION device, low-power VIEW FINDER, STAR DIAGONAL for convenience in observing at all altitudes, RACK AND PINION FOCUSING, TWO EYEPIECES, and comes complete with WOODEN CARRYING CASE. In addition, an ERECTING PRISM SYSTEM for terrestrial observation and a SUNGLASS for solar observation are included with NS 114 and 128.

—These accessories are included with your telescope . . . There are no costly extras to buy. If these instruments were manufactured in this country, they would cost at least twice our low price.



2.4-INCH EQUATORIAL
Model No. NS 128

The complete instrument for the active amateur.

Objective: 60-mm. (2.4") diameter, 900-mm. (36.6") focal length, f/15.
Eyepieces: 9 mm. (.35") for 100x
18 mm. (.71") for 50x
Higher powers available at extra cost.

COMPLETE with equatorial mounting and slow-motion controls, tripod, view finder, star diagonal, erecting prism system, sun-glass, wooden case. **Only \$225**

2.4-INCH ALTAZIMUTH REFRACTOR
Model No. NS 114

Not illustrated. Identical with Model NS 128 but with altazimuth instead of equatorial mounting. Same accessories included. **Only \$125**

Write today for further information or send check or money order to

UNITED TRADING CO.
204 Milk St., Dept. T-8, Boston 9, Mass.
Fully Guaranteed

*Telescopes Shipped Express Collect
25% deposit required on C.O.D. shipments*

Figure 1- Unitron advertisement appeared in the October 1951 issue of Sky and Telescope magazine.

The Model 166, Pier mounted 4" Photo-Equatorial was previewed on the back cover of the June 1955 issue of Sky and Telescope; October 1955 issue announced it went on sale.

In October 1957, the back cover of Sky and Telescope featured the famous comparison photo of the 6" and 4". The price of the 6" was in the neighbourhood of \$5000.

The 5" Unitron Models 510 and 530 were listed as models available for the first time in the November 1961.

In the 1970's Unitron added compact reflector telescopes, spotting scopes to the line. It expanded its microscope line as well.

The last issue of Sky and Telescope that Unitron had the back cover was published in December 1971; Celestron SCT's took it over in January 1972¹⁴.

In January 1976 the company listed as Unitron Scientific Inc. 66 Needham Street, Newton Highlands, Mass. In June 1976, the first Unitron Instruments, Inc. advertisement showing Ehrenreich Photo-Optical Industries, Inc.

In March 1977, the new Model 131-C, 3 Inch Compact Refractor was introduced in a two-page spread (Figure 5).

¹⁴ Lawrence Fine sold off the business in 1975 to Ehrenreich Photo Optical Industries, Inc for the reported sum of \$2.4 million.

Lawrence and Ellen Fine died on 3 August 1978. They were killed in a private plane crash that Lawrence was piloting.

UNITRON Leads in Value and Quality

It's Yours for the Asking - - the New Illustrated Catalog of UNITRON Refractors!

The overwhelming choice of leading universities and active amateurs the world over. The most complete selection of telescopes ever offered.



2.4-INCH ALTAZIMUTH
UNITRON Model 114

Same optical specifications, eyepieces, and accessories as the 2.4-inch Equatorial described in the third column, but with altazimuth mounting and micrometric, spring-loaded, slow-motion controls for both altitude and azimuth.

Only \$125

1.6-INCH ALTAZIMUTH
UNITRON Model 127: Not Illustrated.
Objective: 42-mm. (1.6") diam., 100-mm. (47.2") focal length, f/13.2.
Eyepieces: 2x, 5x, and 20x included.
100x: \$8.95 extra.

COMPLETE with tripod and altazimuth mounting, slow-motion controls for both altitude and azimuth, view finder, star diagonal, sunglass, eyepieces, wooden cabinet. **Only \$75**

3-INCH ALTAZIMUTH
UNITRON Model 148: Not Illustrated.
Same optical specifications and accessories as the 3-inch Equatorial but with altazimuth mounting. 17x, 13x, 9x, 6x, 4x eyepieces supplied. Sunscreen not included, but available as necessary. **Only \$265**

4-INCH ALTAZIMUTH
UNITRON Model 159: Not Illustrated.
Same optical specifications, eyepieces, and accessories as the 4-inch Equatorial, but with altazimuth mounting. Sunscreen not included, but available as necessary. **Only \$465**

EASY PAYMENT PLAN
UNITRON refractors may be purchased on an easy payment plan. Write for details.

NEW CATALOG AVAILABLE!
If you have not already received your copy, we shall be glad to rush one to you. All models are illustrated and fully described. A special section contains valuable information to help you choose a telescope. Learn why the most wanted telescope in America today is a UNITRON. Don't miss the free summer observing. Write for your free catalog at once.
Please address your card or letter to the attention of Dept. TA-3
Microscope catalog also available.

- LENSES are FULLY CORRECTED for spherical and chromatic aberration and are COATED for maximum brilliance and clarity of image. AIR-SPACED CELL insures freedom from "clouding" with age.
- EYEPIECES of the HIGHEST QUALITY . . . Orthoscopic, Achromatized Ramsden, Huygens.
- FINEST MATERIALS throughout, DURALUMINUM TUBE. Moving parts of BRASS carefully machined to close tolerances, and finished in CHROMIUM.
- MODERN DESIGN based on time-tested engineering principles. HANDSOME APPEARANCE to which no illustrations can do justice.
- STURDY TRIPOD may be folded for convenient storage.
- EQUATORIAL MODELS have slow-motion controls for both declination and right ascension.
- ALTAZIMUTH MODELS have slow-motion controls for both altitude and azimuth.
- VIEW FINDER with crosshair eyepiece gives wide field.
- RACK-AND-PINION FOCUSING.
- STAR DIAGONAL for easy observing at all altitudes.
- SUNGLASS for solar observation.
- ERECTING PRISM SYSTEM for TERRESTRIAL OBSERVATION may be used with any of the eyepieces to give the same complete range of terrestrial magnifications as for celestial observation.
- FITTED WOODEN CABINETS.

*Setting New Standards
for Excellence -*



4-INCH EQUATORIAL REFRACTOR
UNITRON Model 152

Objective: 101.5mm. (4.12") diam., 1,330-mm. (60.24") focal length, f/13.
Eyepieces: 25x, 21x, 17x, 13x, 9x, 6x, 5x, and 3x eyepieces available at extra cost.

COMPLETE with equatorial mounting and slow-motion controls, tripod with levels, eyepiece shelf with battery-operated illuminator, setting circles and verniers, view finder (42-mm., 10x), sun projection screen, sunglass, star diagonal, erecting prism system, eyepieces, pocket eyepiece case, wooden cabinets. **Only \$785**

3-Inch and 4-Inch Photographic Equatorials also available.



2.4-INCH EQUATORIAL
UNITRON Model 128

Objective: 62-mm. (2.4") diam., 900-mm. (35.4") focal length, f/15.
Eyepieces: 100x, 50x, 25x included.
150x: \$14.75; 125x: \$8.95
72x: \$6.75 extra.

COMPLETE with equatorial mounting and slow-motion controls, tripod, view finder, star diagonal, erecting prism system, sunglass, eyepieces, wooden cabinets. **Only \$225**

3-INCH EQUATORIAL
UNITRON Model 142

Objective: 75-mm. (3") diam., 1,200-mm. (47.2") focal length, f/16.
Eyepieces: 20x, 13x, 9x, 6x, 4x included.
17x: \$8.95 extra.

COMPLETE with equatorial mounting and slow-motion controls, tripod, setting circles and verniers, view finder (30-mm., 6x), sun projection screen, sunglass, star diagonal, erecting prism system, eyepieces, pocket eyepiece case. **Only \$435**

ACCESSORIES

VIEW FINDER: 42-mm. (1.6") coated achromatic objective. Illustrated on Model 122. 11x crosshair eyepiece. Furnished with mounting brackets. A wonderful accessory for your present telescope. . . . **Only \$18.95**

GUIDE TELESCOPE: 62-mm. (2.4") coated achromatic objective, 100-mm. (27.5") focal length. 13x crosshair eyepiece. Furnished with mounting brackets. Convert your present telescope for astrophotography **Only \$75.00**

EQUATORIAL MOUNTINGS

The equatorial mountings of the 3" and 4" refractors are available separately for those who already own the optical components. All parts are "oversized," insuring utmost stability. Exceptional values.
3" Mounting and tripod **Only \$198**
4" Mounting and tripod **Only \$278**

All Instruments Fully Guaranteed
Send check or money order or 25% deposit with balance C.O.D.
Telescopes shipped Express Collect.

UNITED SCIENTIFIC CO. 204-6 MILK ST. BOSTON 9, MASS.

270 SKY AND TELESCOPE, August, 1953.

UNITRON Leads in Value and Quality

CLOSEUPS of the most wanted telescope in America today . . .



UNITRON Model 155 set up for observing.



TRIPOD SHELF holds eyepieces and accessories while observing.



Battery-operated LAMP casts a reddish light on the shell.

Many of the components of UNITRON 4" Refractors are available separately — see our advertisement on page 278.

Use our time payment or lay-a-way plans to obtain a large telescope right from the start! No red tape — application form available on request. And if you haven't already received a copy of our free catalog, we should be happy to rush one to you. A special section tells you how to choose a telescope. All instruments fully guaranteed. Shipment via express collect. Send check or money order or 25% deposit with balance C.O.D. Write to Dept. TC-6.

The UNITRON 4" Photographic Equatorial

for visual observation and astro-photography

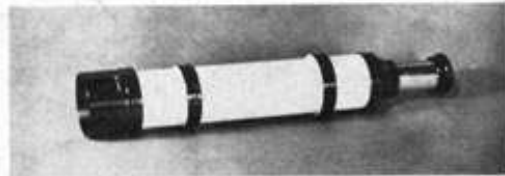
In an unbelievably short time, the UNITRON 4" Equatorial Refractors have firmly established themselves as the overwhelming choice of university observatories, the U. S. Government, and discriminating amateur astronomers everywhere.

This enviable reputation has been built by the outstanding quality and value of the instruments themselves — their superior performance, precision workmanship, and modern design.

MODEL 155 COMPLETE as illustrated with equatorial mounting and tripod, 2.4" photographic guide telescope with star diagonal and crosshair eyepiece, 10x, 42-mm. view finder, 6 eyepieces, sun projecting screen, sunglass, solar aperture diaphragm, star diagonal, erecting prism system, dewcap, dustcap, pocket eyepiece case, wooden cabinets, etc. **Only \$890**

MODEL 152 as above but without guide telescope. **Only \$785**

An **ASTRO-CAMERA** and **CLOCK DRIVE** are in the final design stage and will be available shortly as separate accessories. A **FIXED METAL PIER** will be offered for permanent installation.



Large 10x. 42-mm. (1.6") VIEW FINDER.



EQUATORIAL MOUNTING with micrometric slow motion controls for both R. A. and declination, setting circles and verniers, and latitude adjustment.

. . . and there are 8 other UNITRON Models to choose from!

UNITED SCIENTIFIC CO. 204-6 MILK ST. BOSTON 9, MASS.

Figure 3- 1954 advertisement describing the 4" Photo-Equatorial telescope (Model 155).

UNITRON

Previews for 1955

An introduction to some new items that you'll be hearing a good deal more about in '55

It doesn't seem to be any secret that most telescopes of the "durable variety" sold these days are UNITRONS. What has, however, been a secret until now are the UNITRONS that haven't as yet been put on the market. Here we thought we would give you an inside look at some of the items that are currently occupying the attention of our research division.

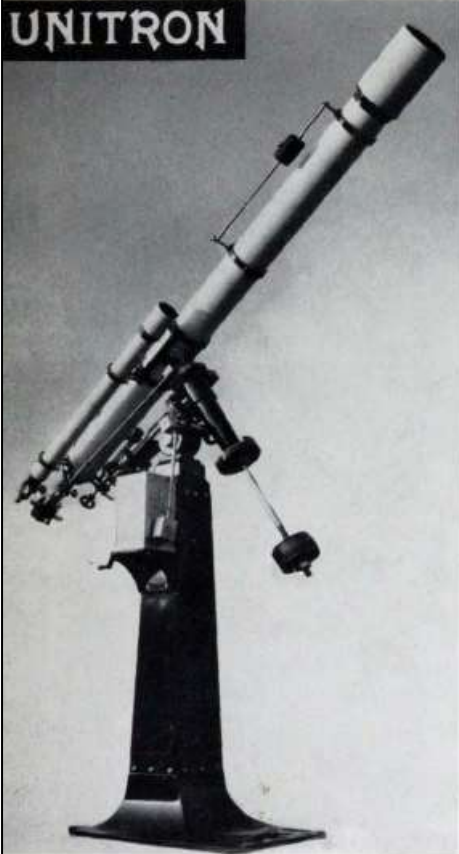
We'll continue to keep you posted through these pages, and if you have written for our catalog on any previous occasion you will automatically receive by mail all forthcoming information as it becomes available.



Six magnifications at your fingertips! No eyepieces lost in the dark! Change eyepieces instantly while the object stays centered in the field of view! UNITRON owners will bless this accessory, which is very soon to be offered. When you want to change magnifications merely rotate a new eyepiece into position.

At the moment, for temporary lack of a better name, we refer to this handy gadget as a "Rotary Eyepiece Selector." If you can think of a more appropriate name, preferably incorporating the idea of the six eyepieces, let us know. If we use your name, we'll send you as a gift one of these eyepiece selectors just as soon as they are available for sale.

UNITRON



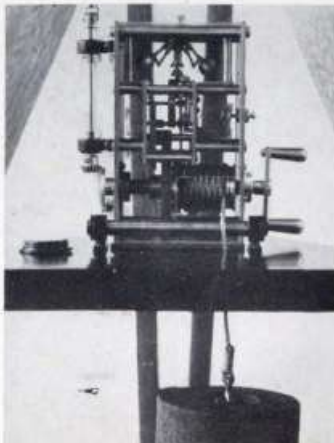
Pictured above is the first of a series of test models of a forthcoming UNITRON 6-inch Refractor, with pier and drive. This instrument will be a complete observatory installation and will incorporate every convenience for observing and for astro-photography. Auxiliary equipment will include a 3-inch guide telescope, a large view finder, two astro-cameras (not shown), about 10 eyepieces and a rotary eyepiece selector, and a spectro-scope, as well as the standard UNITRON accessories.

Every UNITRON instrument offered is the culmination of extensive design and redesign, exhaustive testing and retesting, to preserve the distinguished UNITRON reputation.



The tripod shelf on the UNITRON 4-inch Equatorial, Model 155 pictured above, has been found invaluable for holding eyepieces and accessories (as well as for storing a midnight snack for observers). It will also hold the neat little clock drive shown in detail below. This drive will also be used with the fixed pier we are offering soon for the 4-inch.

Attached to the Model 155 is the first of a number of astro-cameras that are in the works. This one (shown at the right) uses the objective of the telescope as the camera lens, with or without the eyepiece, for photographing the sun, sunspots, the moon, solar and lunar eclipses, and (with a clock drive) stars, nebulae, clusters, and comets.



None of the new instruments and accessories shown here is as yet for sale. But as you know, there are already 9 UNITRON Refractors, which are pictured and priced on page 108.

Our catalog on these instruments is essential reading for telescope buyers, and is yours for the asking. Write for your copy to Dept. T-1.

*United
Scientific Co.*

204-206 MILK STREET
BOSTON 9, MASS.

Figure 4- January 1955 advertisement previewing model 600 series 6" refractor, the Unihex, the Astro camera and the Weight driven Clock Drive.

In 1981, Nippon Kogaku, the maker of Nikon cameras and microscopes, acquired Ehrenreich Photo Optical Industries. Unitron became part of the Nikon Instrument Group and continued as part of the Nikon Instrument Group for five years at which time it was taken private by a management led buyout.

In 1983, The Leisure Products Division was established as a division of Unitron with the goal of bringing the same “excellence by design” to the area of optics in the consumer market in addition to its high-quality telescopes.



Figure 5- Two-page advertisement of Model 131-C, 3-Inch Compact folded Refractor (March 1977).

Optical Quality

Unitron is well known for supplying high quality air-spaced Zeiss type achromats in diameters from 40 to 150 mm (1.6 to 6 inch). The smaller models 1.6- and 2.4-inch model Nihon Seiko telescopes were supplied with one focus knob (right side of the focuser). The large refractors have standard two-knob focusers. In addition to the long (F/15-F/16) refractors Unitron also made compact folded refractors¹⁵.

Nihon Seiko Kenkyusho, Japan, originally manufactured Unitron refractors that were distributed in the US (3-inch and 4-inch). In Europe the same refractors were sold under the name Polarex. 4-inch Unitron objectives were made by different companies. Some of these refractors were of poor quality. The best original objectives (1952-1954) had only three screws. The first modification occurred in 1954. Unitron added three lock screws close to each retaining screw (these push out the retaining ring

¹⁵ Ré, P. (2022). Unitron 131-C 75 mm F/16 folded refractor. http://pedroreastrophotography.com/UNITRON_131C_FOLDED_REFRACTOR_20221116_PRe.pdf

and lock it in place). The best optics were produced by Unitron in the 1950's. Most were hand figured and polished to perfection. Good quality objectives were produced during more than 30 years.

Altazimuth and equatorial Unitrons are one of the most sought-after vintage telescopes by many amateurs and collectors. Each Unitron was supplied with 4 to 6 eyepieces, including several designs (Achromatized symmetrical, Kellner and Orthoscopic). These eyepieces work well with Unitron's long focus refractors.

The Unitron equatorial mounts are considered today "works of art "(beautiful, very solid and functional). Some can be driven with accurate clock drives (mechanical or electric). Slow motion controls were also included.

I have in my private collection several Unitron/Polarex/Weltblick telescopes and accessories:

- 1- Unitron Spotting scope 50mm
- 2- Polarex Spotting scope 60mm
- 3- Unitron Spotting scope 70mm
- 4- Polarex Spotting scope 80mm
- 5- Polarex 102 F/15 refractor (OTA)
- 6- Unitron 102 F/15 refractor Model 132
- 7- Unitron 75mm F/16 folded refractor (model 131-C)
- 8- Weltlick 75mm F/16 refractor
- 9- 2X Polarex 75mm F/16 refractor OTA
- 10- Polarex 60mm F/15 refractor OTA
- 11- Polarex 60mm F/11.6 Alt-azimuth mount
- 12- Unitron 50mm F/14 Alt-azimuth mount
- 13- Unitron 220 Unitron/Polarex eyepieces 2X40mm, 4X25mm, 4X18mm, 4X12.5mm, 4X9mm, 3X7mm, 3X6mm (0.965") 3X Unitron/Polarex eyepiece turret Unitron 35mm, 2X25mm, 10mm, 7.5mm, 8mm, 6.5mm (1 ¼")
- 14- 2X Unitron/Polarex Solarwedge
- 15- 3X Unitron/Polarex Unihex
- 16- Unitron 220B camera



Figure 6 – Unitron 50 mm Spotting Scope. Pedro Ré's private collection.



Figure 7- Polarex 60 mm and 80 mm Spotting Scopes. Pedro Ré's private collection.



Figure 8- Unitron Spotting Scope. Pedro Ré's private collection.



Figure 9 - Unitron 102 F/15 refractor. Pedro Ré's private collection.



Figure 10- Unitron 75mm F/16 folded refractor (model 131-C). Pedro Ré's private collection.



Figure 11- Weltlick 75mm F/16 refractor. Pedro Ré's private collection.



Figure 12- Unitron 60mm F/15 OTA. Pedro Ré's private collection.



Figure 13- Unitron 60mm F/11.6 Altazimuth mount. Pedro Ré's private collection.



Figure 14- Unitron 50mm F/14 Altazimuth mount. Pedro Ré's private collection.



Figure 15- Unitron 102 F/15 refractor Model 132. Pedro Ré's private collection.



Figure 16- Unitron 102 F/15 refractor Model 132. Pedro Ré's private collection.



Figure 17- Unitron 220B camera. Pedro Ré's private collection.



Figure 18- Unitron/Polarex Unihex. Pedro Ré's private collection.



Figure 19- Unitron/Polarex porro prisms. Pedro Ré's private collection.



Figure 20- Unitron/Polarex 0.965" eyepieces. Pedro Ré's private collection.



Figure 21- Unitron/Polarex Sun & Moon filters. Pedro Ré's private collection.



Figure 22- Unitron/Polarex 1 ¼" eyepieces. Pedro Ré's private collection.



Figure 23- Unitron/Polarex solar wedge. Pedro Ré's private collection.



Figure 24- Polarex 75 mm and 60 mm objectives. Pedro Ré's private collection.



Figure 25- Weltblick 75 mm objective. Pedro Ré's private collection.



Figure 26- Polarex 102 mm objective. Pedro Ré's private collection.

<http://pedroastrophotography.com/>
<http://astrosurf.com/re/>

1X TELESCOPE FINDERS

PEDRO RÉ

<http://pedroastrophotography.com/>

The Telrad 1X telescope Finder was first conceived in the 70's by Steve Kufeld of Huntington Beach, California. The Telrad sight concept involves projecting a sight pattern (reticule) onto a transparent window.

It has two components: 1) Sight, and 2) Base. The Sight houses the power supply (two "AA" batteries), an on-off rotary switch, which can also vary the brightness of the display, a red LED lamp, the Telrad reticule, a mirror to divert the light up towards the 45-degree display window and a lens to bring the image of the reticule to focus on the window.



Figure 1 – Telrad 1x Finder.

The Telrad optical arrangement is very simple. It provides a distinct pattern, adjustable in brightness, that is projected by a red-Light Emitting Diode onto the display window. When the window is viewed by the observer the pattern will appear to float, apparently suspended in front of the stars or other objects in the sky background (Figure 1 and 2).



Figure 2 – Telrad 1x Finder.

TELRAD SPECS

Window dimension	41.3 x 35 mm
Magnification:	1x (zero power)
Housing:	Black finish, ABS plastic construction
Retaining thumbscrews	6-32, ½ inch long
Length overall length:	21.3 cm
Height overall (on Base):	12.7 cm
Weight with Base and batteries:	308 g
Batteries required:	Two "AA" 1.5 Volt, in series

To locate an object, move the telescope so that a bright star or other object near the desired object comes into the display of the Telrad's window. If the object is bright enough to be seen in the Telrad sight, centre the object in the red circle. If the object is fainter than what can be seen with the naked eye, then use the Telrad to navigate onto the target by "star hopping". There are three control knobs at the rear for adjustment of the reticule on the display window.

Other Red Dot 1X finders project a single red dot and can be used for finding objects with different telescopes (Figure 3 to 6).



Figure 3- Celestron Star Pointer



Figure 4- Sky-Watcher Red Dot Finder.



Figure 5- Explore Scientific Red Dot Finder.



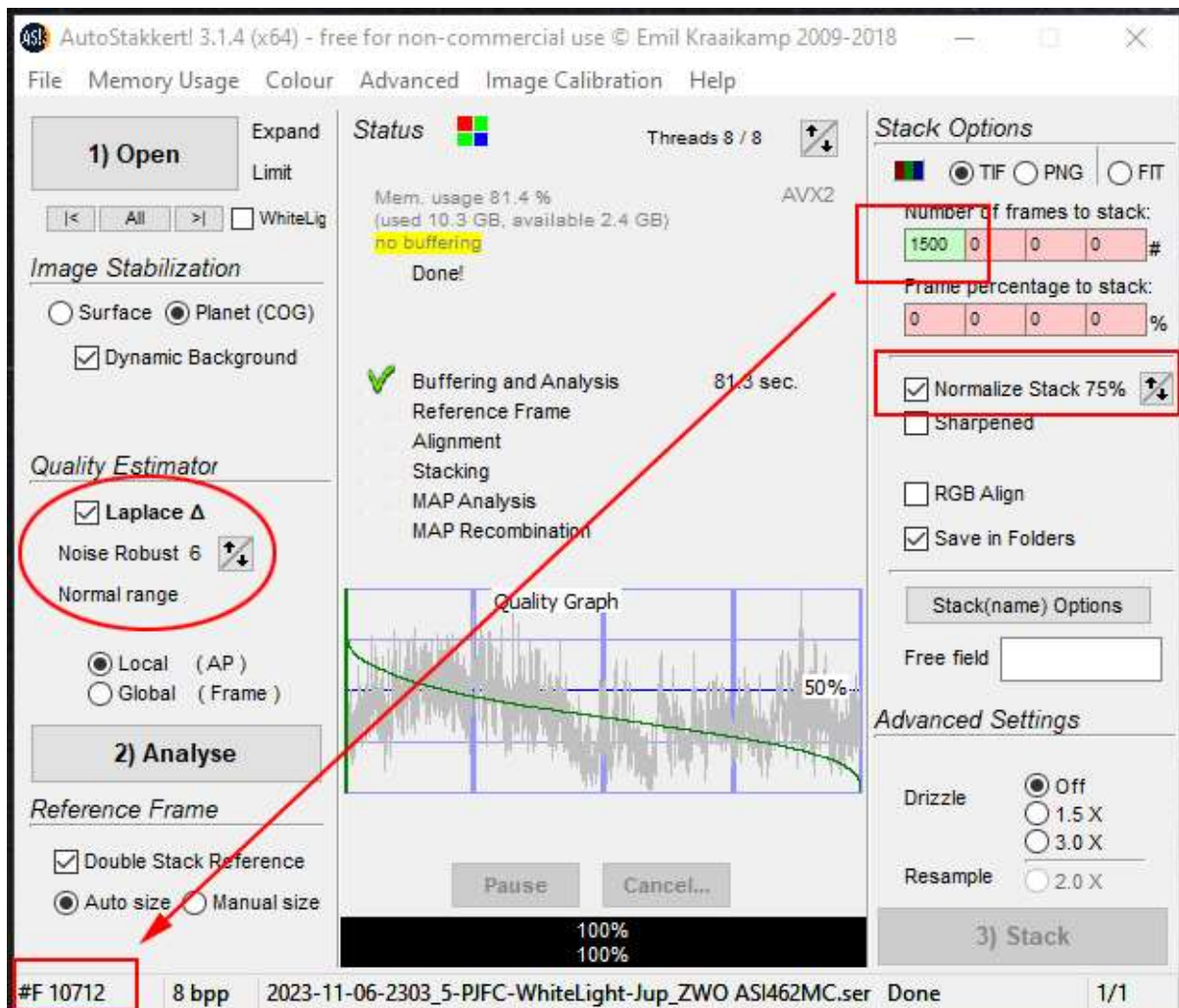
Figure 6 – TeleVue Starbeam finder.

PROCESSAMENTO DIGITAL DE IMAGENS DE JUPITER

Paulo Casquinha

Existem tantas abordagens ao processamento de imagens quanto astrofotografos, cada um com a sua perspectiva estética única. Este artigo apresenta uma delas, que embora tenha sempre uma preocupação estética, prioriza acima de tudo a utilidade científica do resultado final.

Começamos pela aquisição de imagens, as câmaras disponíveis hoje em dia permitem a captura de videos a velocidades muito elevadas, frequentemente acima das 100 fps, minimizando assim os efeitos negativos da instabilidade atmosférica, o que torna possível conseguir resultados uteis na maioria das noites de céu limpo, mas exigindo um maior cuidado na fase de processamento dos vídeos sendo necessário ajustar os parâmetros do software de acordo com a qualidade dos dados obtidos. Para a aquisição de imagens foi utilizado o software [FireCapture](#) de Torsten Edelmann e para o processamento do vídeo o [AutoStakkert](#) de Emil Kraaikamp.

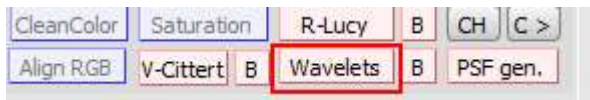


Neste caso temos um vídeo capturado com uma câmara a cores numa noite com condições de estabilidade pouco favoráveis, podemos ver que o vídeo contem 10712 frames, das quais apenas 1500 foram selecionadas para produzir o resultado final. O método de análise selecionado foi Laplace, que na generalidade apresenta os melhores resultados, com um nível de ruído de 6 numa escala de 8. A soma total das imagens foi normalizada a 75% do valor máximo de forma a permitir um pós-processamento sem saturar nenhuma das áreas mais luminosas do planeta. Numa noite com boa

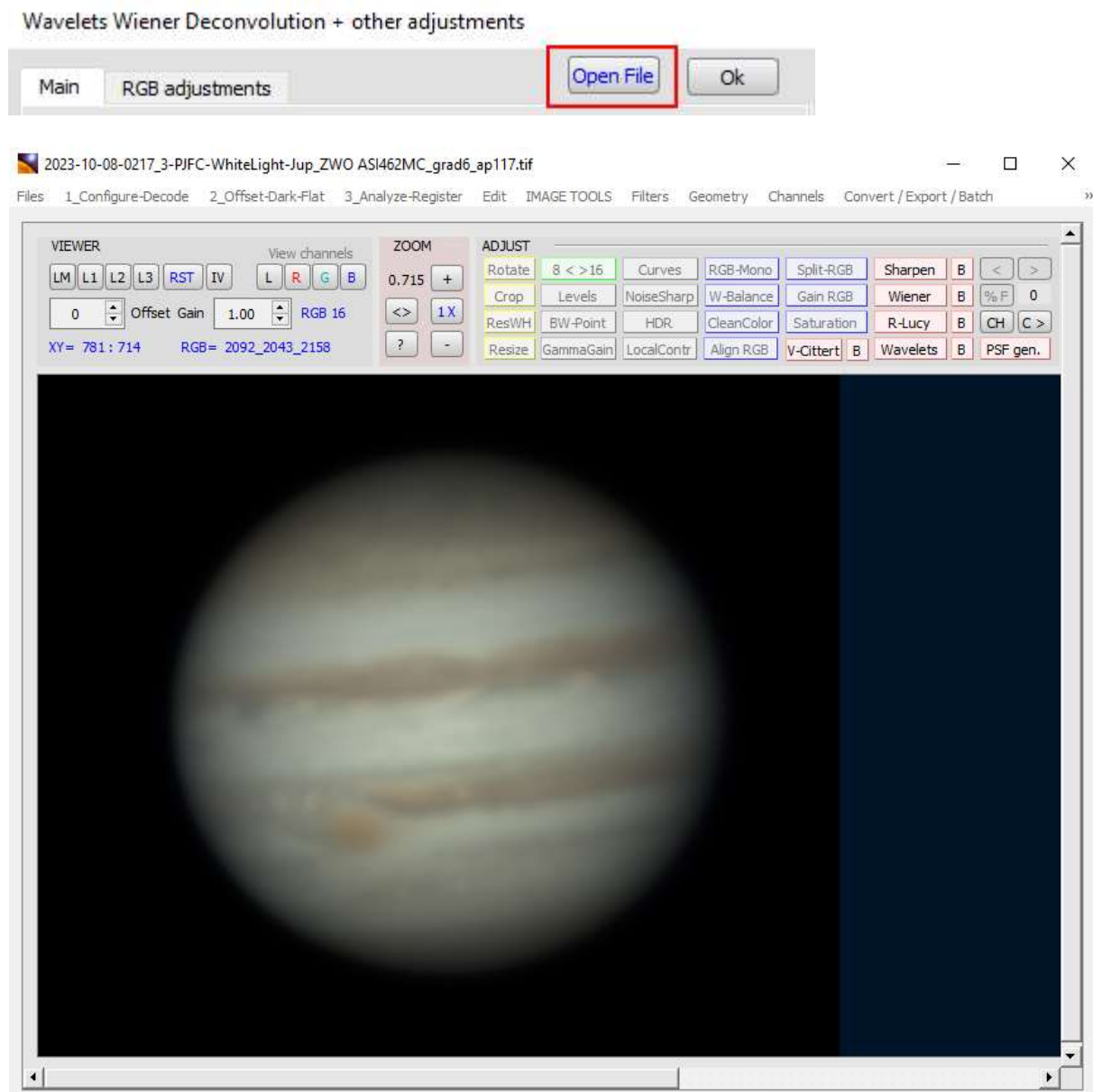
estabilidade atmosférica o nível de ruído no *Quality Estimator* seria reduzido para 4 ou 5 e o número de frames somadas aumentado em função do resultado desta análise chegando frequentemente aos 50% ou 60% do total, garantindo que este valor fique acima dos 50% no gráfico de qualidade, produzindo assim uma imagem final com uma melhor relação sinal/ruído.

Depois de processados os vídeos, normalmente vários vídeos de curta duração (60 a 90 seg.) obtidos em sequência e com um curto intervalo de tempo entre eles, passamos ao processamento das imagens obtidas. Vamos utilizar o software [Astrosurface](#), para que possam acompanhar o processo podem fazer o download das imagens utilizadas no seguinte link: <https://wbb2qu.s.cld.pt>.

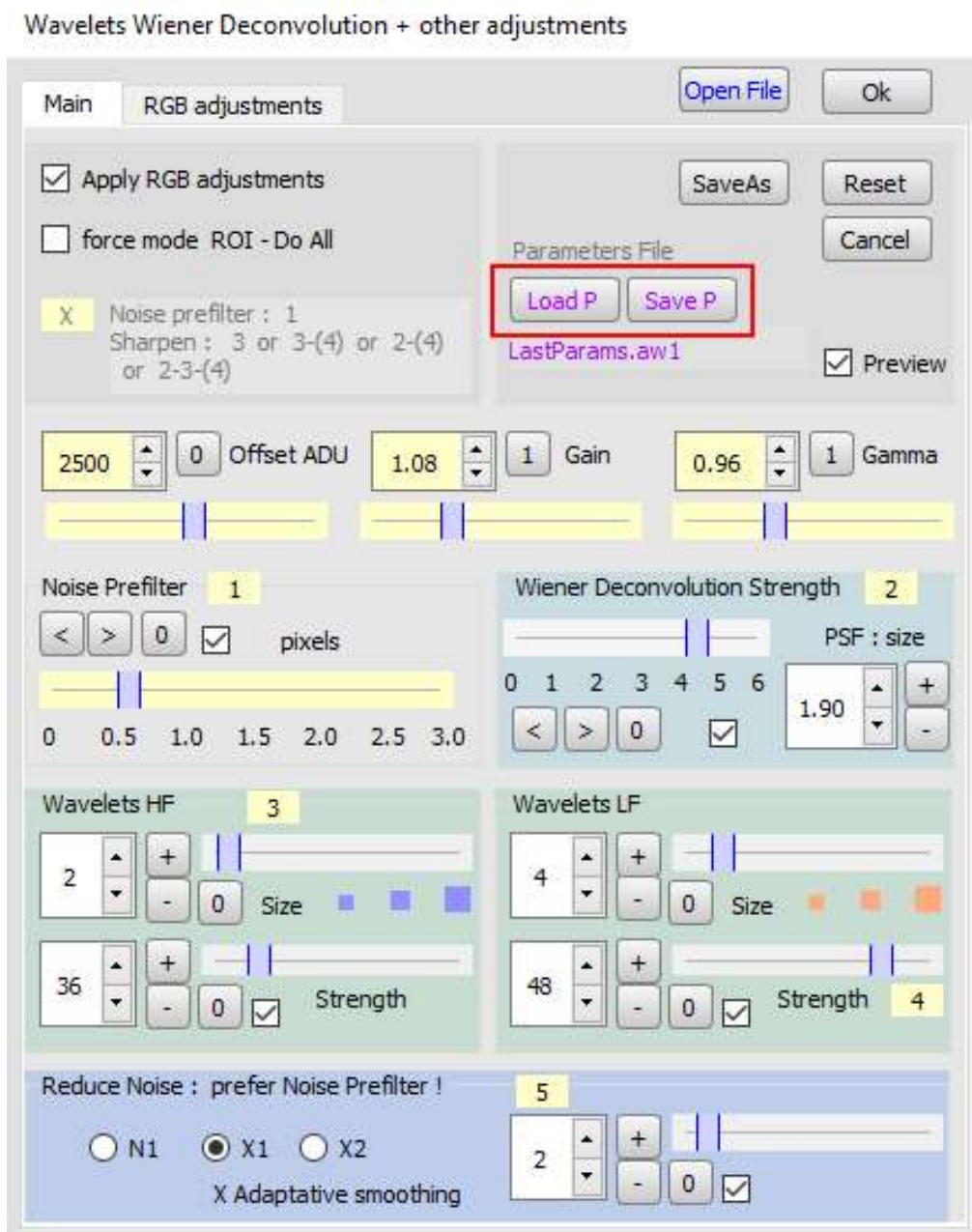
No ecrã inicial selecionar *Wavelets*



Em seguida já no quadro dos *Wavelets*, *Open File* e selecionar a imagem pretendida.



No quadro dos *Wavelets* existem muitas opções de ajuste, desde deconvolução a *Wavelets* de alta e baixa frequência, filtros de ruído etc. os seguintes valores funcionam bem nestas imagens, noutras circunstâncias em que exista uma relação sinal ruído diferente terão que fazer algumas afinações.

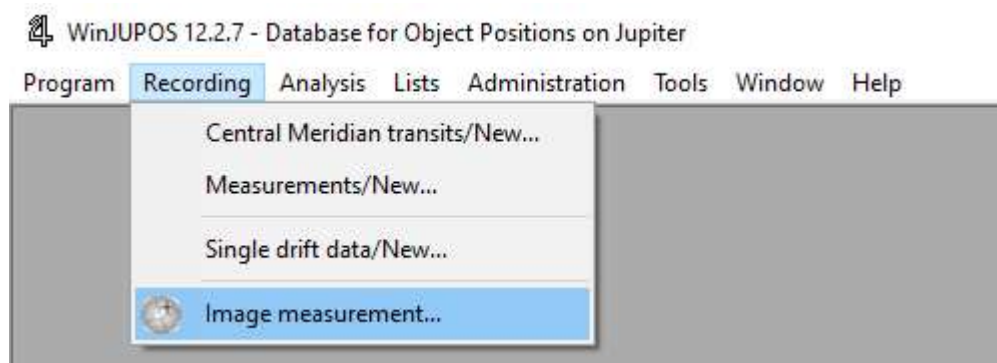


Quando conseguimos um conjunto de parâmetros que funciona bem, podemos salvar esse perfil em *Save P*, e sempre que o queiramos voltar a aplicar é só carregá-lo em *Load P*. Quando formos salvar a imagem processada é importante manter o formato do nome actual, uma vez que mais á frente no processo este é reconhecido pelo software Winjupos e assume automaticamente a data e hora do registo. Este é o resultado obtido quando aplicamos o processamento ilustrado em cima, á imagem carregada.

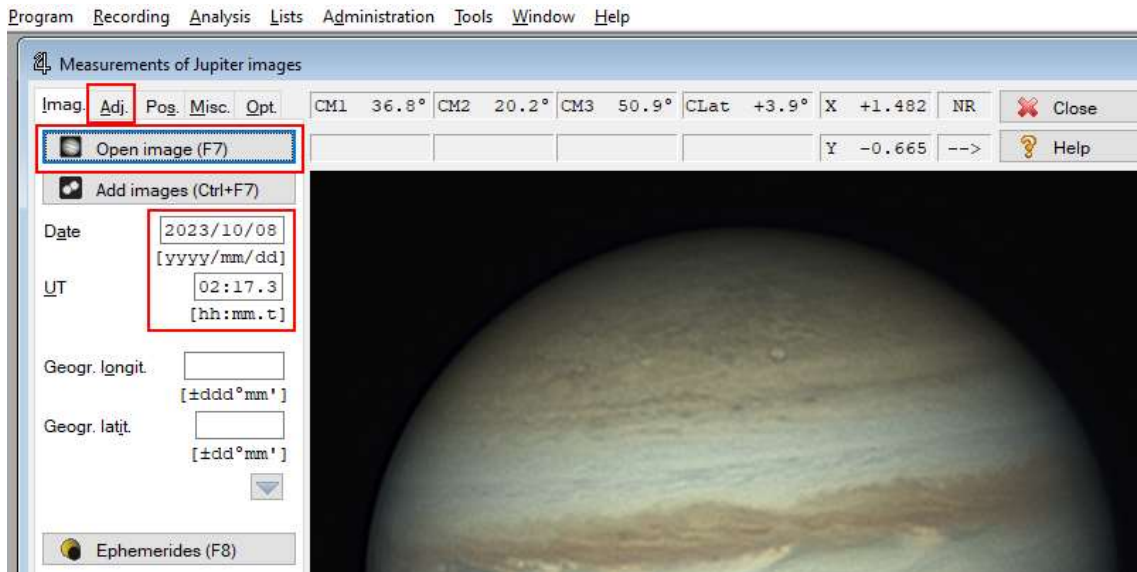


Repetimos o processamento para as restantes imagens da sequência. Agora temos 5 imagens idênticas mas que não podem ser simplesmente alinhadas porque os detalhes na atmosfera não coincidem devido á rápida rotação de Júpiter durante o intervalo de tempo em que os vídeos foram gravados. Vamos então utilizar o software [Winjupos](#) para medir as imagens, e deixar que o programa faça o alinhamento compensando essa rotação, a este processo chama-se *De-rotation*.

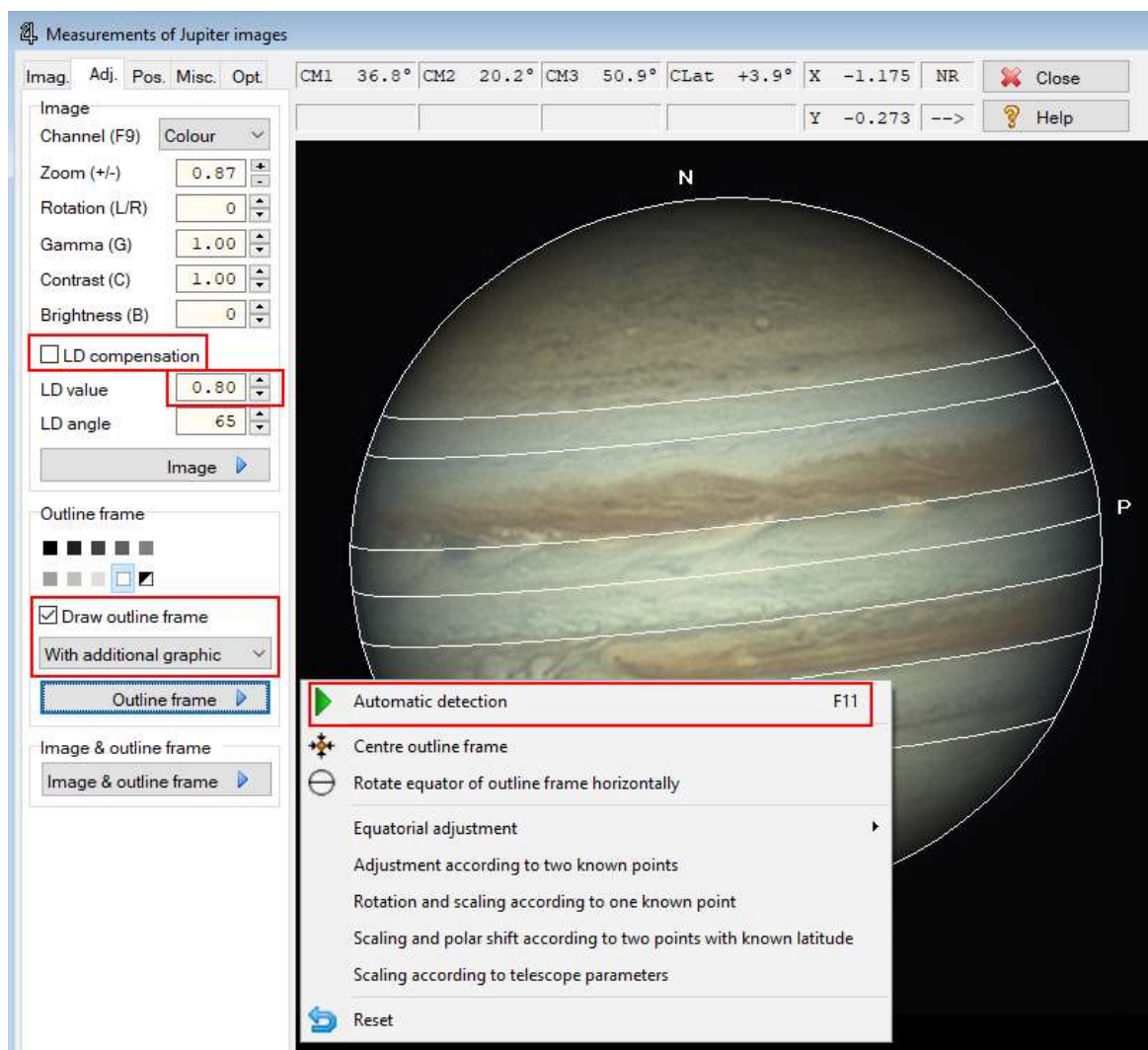
No menu inicial do *Winjupos* selecionar *Recording* e em seguida *Image measurement*.

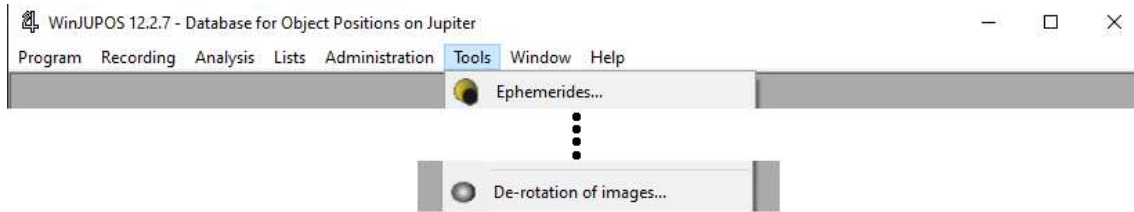


Vai abrir o seguinte quadro.



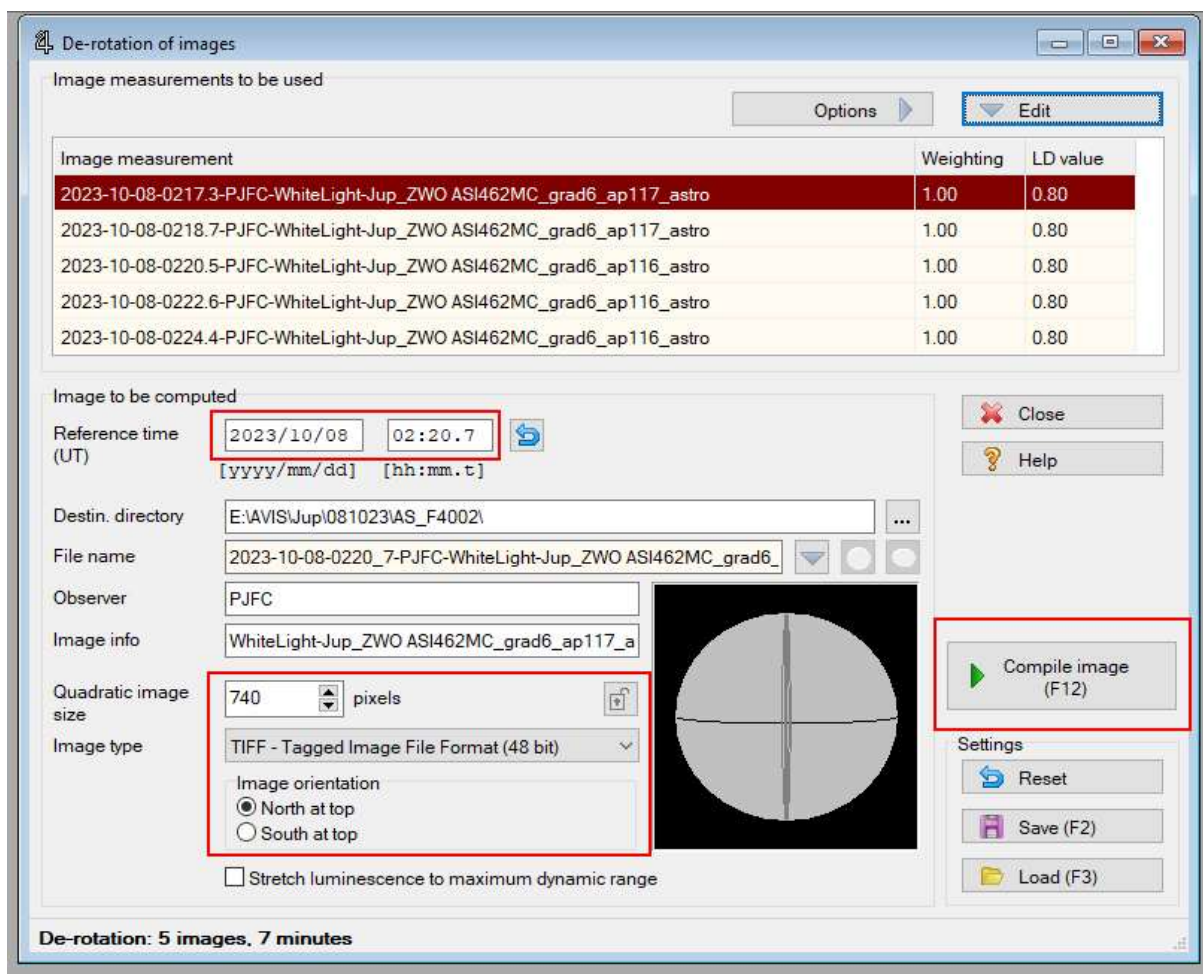
Clicando em *Open Image (f7)* selecionamos uma imagem, se o nome não foi alterado o programa coloca automaticamente a data e hora do ficheiro. Em seguida no separador *Adj.* Vamos ajustar alguns parâmetros.





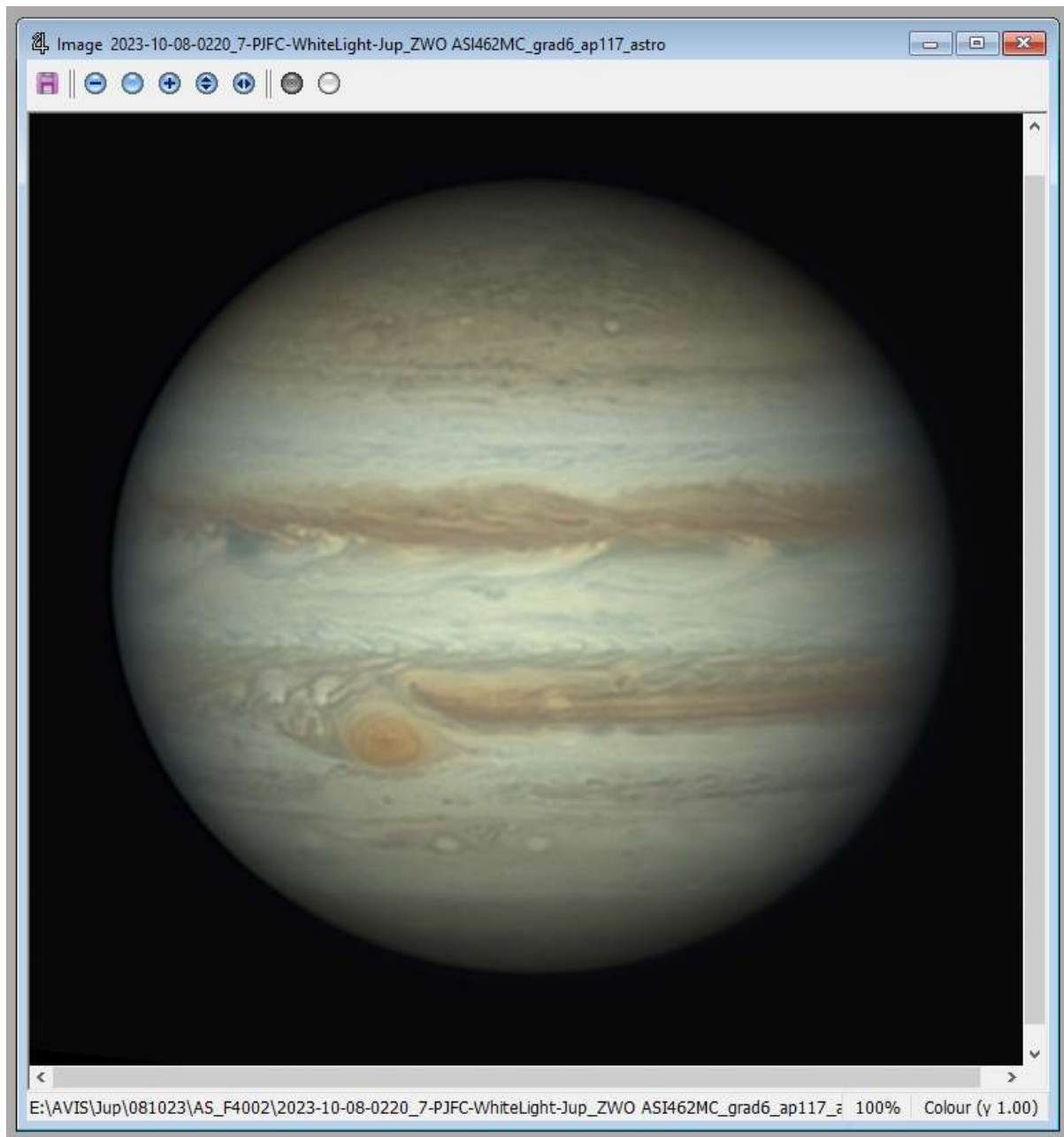
LD compensation (Limb Darkening) deve ser selecionado, normalmente um valor de 0.8 funciona bem, quando for feita a media das imagens este parâmetro vai compensar o escurecimento de fase do planeta devido a posição relativa Júpiter, Terra, Sol. Selecionar também a opção *Draw outline frame* e escolher por baixo a opção de gráficos adicionais, quando esta opção estiver selecionada a tecla F11 desenha automaticamente estas linhas sobre a imagem, as linhas horizontais devem ficar paralelas às bandas da atmosfera de Júpiter e a linha exterior deve coincidir com a circunferência exterior do planeta. O método automático (*f11*) nem sempre faz um trabalho perfeito e pode ser necessário ajustar. As opções de gama, contraste e brilho podem ser alteradas para termos uma melhor percepção no ajuste das linhas. Para efectuar as correções, *Page Up* aumenta o círculo, *Page Down* diminui. *N* roda no sentido horário e *P* no sentido inverso. Quando tudo nos parecer bem alinhado, voltar ao separador anterior, *Imag*, e salvar o ficheiro, basta clicar em *Save* ou utilizar a tecla (*f2*) e este será guardado na mesma pasta das imagens. Este processo tem de ser repetido para as restantes imagens. Em seguida no menu *Tools* selecionamos *De-rotation of images*

Vai abrir o seguinte quadro, na opção *Edit* selecionar *Add* e adicionar os ficheiros com as medições das imagens produzidos anteriormente.



O Winjupos calcula automaticamente o tempo medio da imagem final, este valor pode ser modificado se pretendermos que as imagens sejam alinhadas num outro referencial de tempo.

Mais em baixo podemos alterar a dimensão do quadro da imagem final, bem como o tipo de ficheiro e a orientação do planeta, em seguida (*f12*) ou clicar em *Compile image* para produzir o resultado final.



Esta imagem pode agora ser aberta num programa da vossa preferência para uma correção de cor e contraste e mais alguns ajustes a gosto. Podem verificar aqui o resultado final

https://www.pcasquinha.com/symfony/public/uploads/images/jup231008_b.jpg

REDE NACIONAL DE OCULTAÇÕES DE ESTRELAS POR ASTERÓIDES

Rui Gonçalves ¹⁶

rui.goncalves@ipt.pt

A observação de uma ocultação de estrela por asteróide consiste no registo dos instantes em que a estrela-alvo é "tapada" e "destapada" pelo asteróide que lhe passa em frente. Estes instantes e a correspondente duração da ocultação são basicamente função da posição do observador em relação à passagem da sombra do asteróide na superfície terrestre (para além de muitos outros parâmetros). Nestes eventos a sombra é geralmente pequena, do tamanho do asteróide (mas maior, por efeito de perspectiva), e como os parâmetros são distintos de ocultação para ocultação, não há duas iguais, tornando cada evento único. Estas observações são extensíveis para além dos asteróides, aos planetas do Sistema Solar, incluindo as suas luas.

O objetivo das ocultações de estrelas por asteróides é a medição indirecta, com grande precisão, do tamanho e formato dos asteróides, tal como a sua posição astrométrica. Medimos tempo (instantes) e conseguimos converter essa informação em comprimentos, distâncias. Temos igualmente a possibilidade de detectar outras características muito importantes destes corpos do Sistema Solar, como sistemas de anéis [(10199) Chariklo, (2060) Chiron e (136108) Haumea], satélites [Romulus e Remus a orbitar o asteróide (57) Sylvia] ou uma atmosfera (Tritão, Plutão). Estas medições são possíveis de realizar com qualquer telescópio, no entanto - quanto maior for o seu diâmetro - mais fraca é a estrela-alvo que podemos detectar (ou maior é a taxa de amostragem de imagens que podemos conseguir). Telescópios da ordem de 20 cm de diâmetro já permitem observar bastantes ocultações. Mesmo ópticas mais pequenas, como lunetas de 80 mm permitem a realização de dezenas de ocultações por ano. Só precisamos sempre é que detectar a estrela-alvo com um razoável sinal (SNR da ordem de 4-5 pode ser suficiente para um bom registo). Em grande parte das ocultações nem sequer detectamos o asteróide, nem interessa. Queremos é registar quando o asteróide faz "desaparecer" e "reaparecer" a estrela. Quando o nosso equipamento "não vê" o asteróide e se dá a ocultação - a estrela-alvo desaparece completamente da nossa imagem. Quando pelo contrário, conseguimos detectar/individualizar o brilho do asteróide (por vezes perfeitamente visível antes e depois do evento) e ocorre a ocultação da estrela, o brilho do asteróide "substitui" o brilho da estrela durante a ocultação. É isto que sempre acontece numa ocultação positiva, o asteróide tapa a estrela-alvo. Quando o asteróide passa ao "lado da estrela", não ocorre ocultação e esta é negativa (um "miss"). Numa ocultação positiva, quanto maior for a queda de brilho durante a ocultação - mais fácil é o seu registo. O mesmo se passa para a duração da ocultação - ocultações mais demoradas - são mais fáceis de registar e também mais fáceis de analisar. Na figura 1 temos o exemplo do registo de uma ocultação, pelo asteróide Troiano, o (1873) Agenor, e na figura 2 um típico campo estelar, com indicação da estrela-alvo da ocultação.

¹⁶ Este artigo foi baseado no artigo online do site da SPA

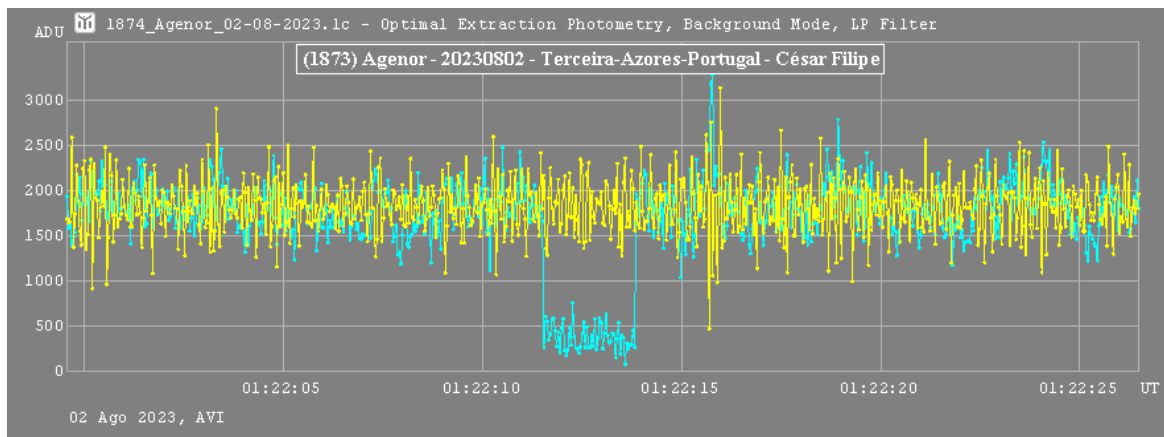


Figura 1 – Oculação de uma estrela de 11^a mag. pelo asteróide (1873) Agenor. Duração: 2,33 s +/- 0.03 s. Registo fotométrico (Tangra) a 25 img/s com C8 + Watec902H + IOTA-VTI. A azul o brilho da estrela-alvo+asteróide, a amarelo o brilho da estrela de comparação. (registo de César F. Pinheiro)

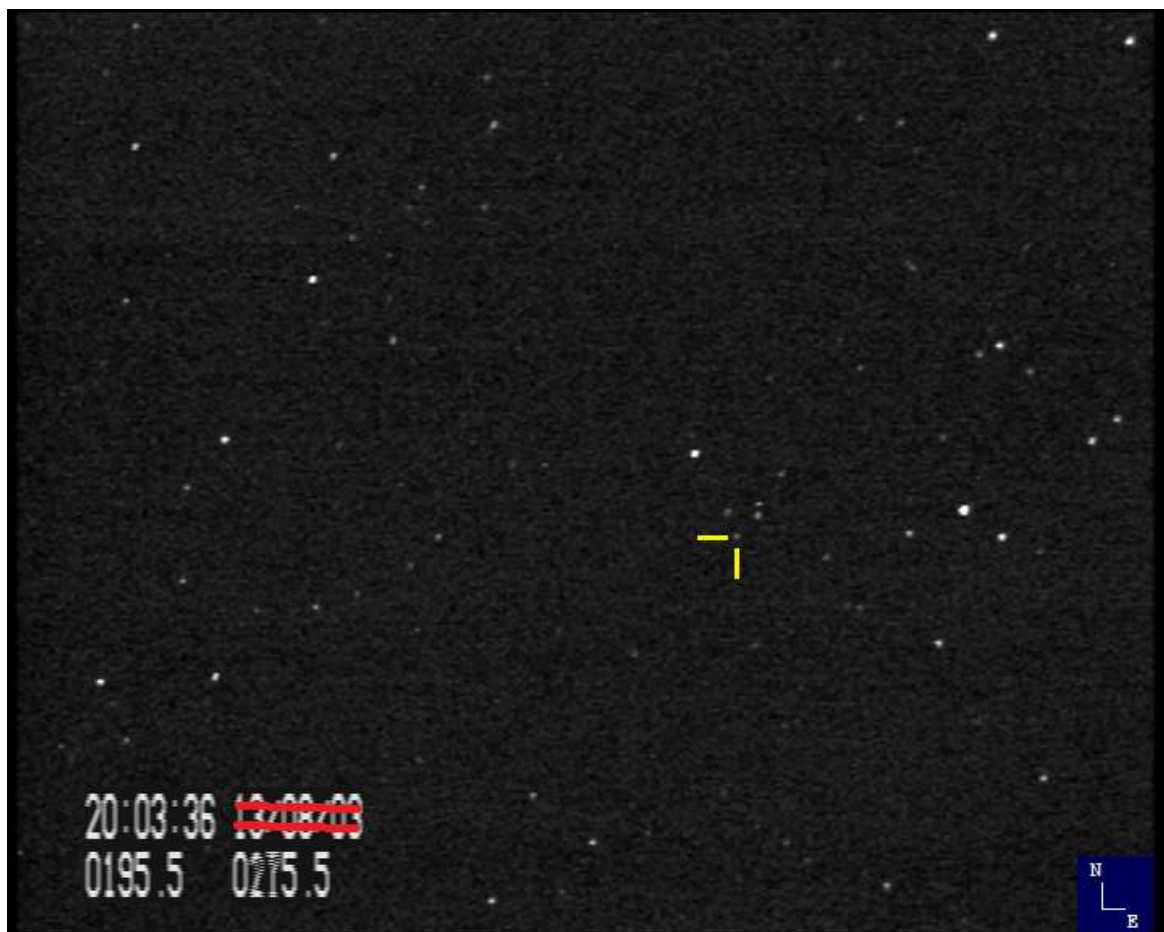


Figura 2 – Campo de observação da ocultação do asteróide TNO (19521) Chaos, no dia 29 Março 2023. Telescópio Newton de 25 cm, campo de 20'x15'. Watec910HX e GPSBOXSPRITE2-VTI, 0,32 s integração. Indicação da estrela-alvo, de 15^a magnitude. (Rui Gonçalves)

A duração temporal de uma ocultação é da ordem de alguns segundos, tipicamente desde cerca de 0,1 s a dezenas de segundos. Asteróides mais pequenos e rápidos, como os Near Earth Asteroids - NEO, produzem breves ocultações. Nestes casos extremos precisamos de sistemas rápidos que possam realizar muitas imagens por segundo. O normal na maior parte das ocultações - é termos amostragens de algumas imagens por segundo, por vezes apenas 5-6 imagens por segundo (ou menos), o que se revela suficiente para a maior parte dos asteróides da cintura principal (Main Belt Asteroids - MBA) ou os objectos transneptunianos (Transneptunian Objects - TNO), muito mais lentos. Claro que quanto melhor for a nossa resolução temporal, melhor será a resolução espacial conseguida. Podemos ver uma típica previsão de ocultação de estrela por asteróide na figura 3, com bastantes dados inerentes ao fenómeno.

```

52 Europa occults UCAC4 350-112253 on 2023 Sep 23 from 20h 4m to 20h 10m UT
Star: (Dia = 0.1 mas)          Durations: Max = 17.5 secs
    RA = 17 46 33.505 (astrometric)   lra = 0.553 secs, lmas = 0.14 secs
    Dec = -20 3 32.505                Mag Drop: 1.5 [14]lv, 2.0 [14]lv
    (of Date) 17 46 24. -20 3 12]     Sun : Dist = 84
    Prediction of 2023 Aug 26.4       Moon: Dist = 15", llim = 4.4
    Reliable 0.9 (good)              Error 3.7 x 1.0 mas in RA 20"
Asteroid: (in DMST, ISAM)
    Dia = 304 ±10km, 125 mas
    Mag = 12.9
    Parallax = 3.423"
    Hourly MBA = 1.766
    dDec = -3.45"
    JPL123:2023-08-24, Known errors
  
```



Figura 3 – Exemplo de uma previsão de ocultação asteroidal, com o mapa da passagem da sombra (Occult software).

Para maximizar a precisão e exactidão das ocultações, são também necessários: uma localização exacta do observador e uma fonte temporal igualmente boa. Um sinal GPS permite obter estas duas componentes. Actualmente estes fundamentais parâmetros do registo são obtidos por dois tipos de equipamentos; sistemas baseados nas câmaras de vídeo analógico e sistemas baseados em câmaras digitais. Ambos estes sistemas podem ter uma datação directa das imagens ou uma datação indirecta (a partir do relógio do computador). O ideal é ter uma datação directa, pois afixa via sinal GPS, a hora exacta em cada imagem obtida, antes do seu registo/gravação no computador. É o caso dos sistemas analógicos baseados nos VTI (Video Time Inserter) que recebem e datam a imagem de vídeo analógico antes da sua digitalização e gravação pelo computador, como ilustrado na figura 2. Existem também

câmaras digitais com antena GPS, que datam todas as imagens antes de efectuar o download para o computador. Todos os restantes sistemas que datam as imagens via relógio do computador, mesmo que estejamos a usar um sinal GPS ou internet para acertar o relógio, introduzem pequenos atrasos temporais no processo (que podem ser variáveis ao longo do registo do evento) que teremos no fim de corrigir (temos de ir registando estes desfasamentos). Hoje em dia, com os sinais GPS garantimos exactidões das datações absolutas da ordem do milissegundo, mas o limite prático fica ditado pelo tempo de exposição do registo (que é muito menor que 1000 imagens por segundo!). Um exemplo de sistema analógico - é a câmara Watec910HX, que funcionando em modo video (p.ex. a 25 frames/s, 50 field/s) permite, no entanto, adicionar imagens fazendo integrações de 0,04 s, 0,08 s, 0,16 s ... até 5,12 s. Muito software existe para realizar estas gravações, inclusive especialmente dedicados a ocultações, como o IOTACapture. No sistema digital a câmara de sensor CMOS QHY174M-GPS permite definir livremente a exposição, com datação garantida via sinal GPS. Estes são os dois sistemas de aquisição actualmente mais aplicados no campo das ocultações, sendo que o sistema digital garante sempre uma melhor dinâmica de digitalização, tipicamente 12 bit comparativamente aos 8 bit do "sistema analógico". Existem também sistemas que se podem acoplar ao sistema óptico e que emitem um flash sincronizado por GPS (a 1 P.P.S - pulse per second), datando assim algumas das imagens da sequência de imagens adquiridas durante o registo da ocultação.

No caso de não termos uma datação directa, a alternativa é sincronizar o melhor possível o relógio do nosso computador, base da datação das imagens registadas. Existem vários softwares que permitem detectar um sinal horário, via net ou GPS, e acertam o relógio, para além de irem registando os desvios observados. Por exemplo o NMEATime2, disponível a partir da "VisualGPS", pode ser instalado e livremente testado por um curto período (preço ~20\$) e necessita de uma antena GPS-USB (preço ~20\$) para poder funcionar. O software de captura das imagens digitais terá de ter a capacidade de datá-las a partir do relógio do computador, como o SharpCap.

Para termos acesso às numerosas previsões que hoje são produzidas, existem actualmente várias ferramentas; umas de cálculo, outras de gestão das previsões e resultados.

OccultWatcher: <http://www.occultwatcher.net/> - mostra previsões para o nosso local de observação, indicado todos os detalhes da ocultação. Após a instalação, temos de ter um registo para obter um acesso com login. A ferramenta funciona dinamicamente, sendo actualizada periodicamente. Todos os parâmetros são indicados por nós. Permite saber quais os observadores que também tencionam observar determinada ocultação.

OccultWatcherCloud (OWC): <https://cloud.occultwatcher.net/> - é também acessível a partir das previsões do OccultWatcher ou directamente. Requer igualmente um registo com login.

Occult: <http://www.lunar-occultations.com/iota/occult4.htm> - é por excelência o programa que integra todas as valências das ocultações. É instalado no nosso computador e permite fazer previsões de todos os tipos de ocultações; lunares, asteroidais, etc, recorrendo aos catálogos estelares, orbitais, etc, mais recentes como o EDR3 do Gaia, Astorb, Mpcorb e AstDyS-2. Permite o acesso e é o repositório dos dados de todas as ocultações até hoje realizadas.

Várias páginas existem com compilações de previsões; algumas mundiais como de Steve Preston <https://www.asteroidoccultation.com/> outras regionais como da IOTA-ES <https://call4obs.iota-es.de/> para a Europa. Na página da IOTA (International Occultation Timing Association) - temos acesso a imensa informação sobre todo os tipos de ocultações, <http://www.lunar-occultations.com/iota/iotandx.htm>

Para a análise dos registos das ocultações, temos várias ferramentas que permitem construir a curva de luz (fotometria) do evento e a redução dos instantes da ocultação.

Tangra: <http://www.hristopavlov.net/Tangra3/>

R-OTE and PyOTE: <https://occultations.org/observing/software/ote/>

Limovie: <http://astro-limovie.info/limovie/>

Todos eles permitem analisar os filmes ou sequências de imagens datadas e construir a curva de luz da ocultação com interpretação dos resultados. Temos igualmente acesso à ferramenta de análise AOTA (incluída no programa Occult), que pode ser finalizada com a escrita de um relatório de ocultação, para submissão.

Até ao final do ano de 2022, as observações europeias de ocultações asteroidais (positivas ou negativas) eram reportadas para a plataforma Euraster (<http://www.euraster.net/>). Actualmente essa plataforma europeia foi substituída pela plataforma SODIS (para reportar observações - requer inscrição e login) <https://sodis.iota-es.de/>. A mailing-list Planocult é também um dos meios de comunicar e ter informações sobre ocultações asteroidais (<http://vps.vvs.be/mailman/listinfo/planocult>). A plataforma Ocultaas no Discord, é actualmente um meio importante de difusão destes fenómenos na Iberia.

Querendo ficar a par das investigações e resultados das ocultações (para além dos artigos científicos em revistas de astronomia) podemos confirmar o valor das contribuições de astrónomos amadores, no “Journal for Occultation Astronomy” (JOA), uma revista de acesso livre onde os astrónomos membros da IOTA divulgam trabalhos correntes e históricos. Podemos aceder às edições anteriores da revista através do link: <https://www.iota-es.de/joafree.html>

A criação de uma plataforma - rede de observação de ocultações - no nosso País, com colegas empenhados neste tipo de observações - permitirá uma maior e melhor cobertura destes importantes fenómenos e uma continuação de colaboração dos amadores com os astrónomos profissionais (nacionais e estrangeiros) no âmbito da SPA (Sociedade Portuguesa de Astronomia) e IA (Instituto de Astrofísica). Nesse sentido, existem alguns sistemas VTI disponíveis para colegas interessados usarem no registo destes fenómenos. De momento estão já dois IOTA-VTI nos Açores (grupo central e oriental) junto de colegas que observam ocultações. Estes IOTA-VTI foram-nos gentilmente oferecidos pelo investigador em ocultações, Marc Buie do SwRI (*Southwest Research Institute, EUA*). O Marc coordena as ocultações envolvendo os asteróides Troianos (<https://lucy.swri.edu/occultations.html>) que são

alvo da missão espacial Lucy (<https://lucy.swri.edu/>) e nos quais vários observadores nacionais já participaram, figura 4.



Figura 4 – Polymele’s shadow first crossed Spain and Portugal before crossing the United States, following the center of the pink curve, at times marked by the blue stars. The width of the pink curve shows the planned region where telescopes were deployed in the search for the satellite. The purple circles mark the locations of the 107 observers across two continents, with the two insets showing the 96 telescopes deployed in Kansas and the 10 telescopes deployed in Spain and Portugal. Credit: NASA/SwRI with Map Data from Google, INEGI. [adaptado do SwRI – campanha da ocultação do asteroide Troiano (15094) Polymele e seu satélite (“Shaun”) no dia 3 de Fevereiro de 2023].