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Review

ASTRONOMERS AS SKETCHERS AND PAINTERS: THE EYE – THE HAND – THE UNDERSTANDING¹

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Today we are accustomed to seeing the objects of the universe in magnificent digital pictures vividly before our eyes. But before the invention of photography, the art of painting and drawing played an important role in scientific research. Those who were powerful astronomers of this art had the advantage. This article substantiates this thesis by means of selected examples. The drawings and the related discoveries of Galileo Galilei (1564–1642), Johannes Hevelius (1611–1687), Tobias Mayer (1723–1762), Johann Heinrich Mädler (1794–1874), Julius Schmidt (1825–1884), Giovanni Schiaparelli (1835–1910), Eugenios Antoniadi (1870–1944), William Parsons alias Lord Rosse (1800–1867), Ernst Wilhelm Leberecht Tempel (1821–1889), Etienne Trouvelot (1827–1895) and Walter Löbering (1895–1969) and showed their most important drawn observation documents. It can be seen that thanks to their art and the associated highly developed ability to perceive it, astronomers' drawings have made astounding discoveries that others have been denied. Finally, some thoughts on the role of drawn or painted astronomical motifs in the present are developed.

Key words: astronomy; painters; photography; Galileo Galilei; Johannes Hevelius; Tobias Mayer; Johann Heinrich Mädler; Julius Schmidt; Giovanni Schiaparelli; Eugenios Antoniadi; Lord Rosse; Ernst Wilhelm Tempel; Etienne Trouvelot; Walter Löbering

INTRODUCTION

In many respects, art and science are a mismatched couple. And yet, time and again artists have used their own means to reflect on the objects of science, while scientists have drawn inspiration from the artists' ideas and used them for scientific purposes. Now, if visual artist and scientist are the *same person*, something very special can happen - and this is what this article is about. Our focus here is on astronomers as painters at the service of astronomical research, but also on painters as astronomers.

IT ALL BEGAN WITH GALILEI

Due to his training at the Florence Academy of Arts, Galileo Galilei obtained research findings

that he probably would not have gained without the skills he acquired during his artistic studies. The importance of Galilei's artistry for his scientific insights has recently been mapped out for the first time in the compelling in-depth study [1] by the Berlin-based art historian Horst Bredekamp. It is well known that Galilei was one of the first persons to use a telescope to observe the moon and other astronomical objects. He sketched in ink what he saw, using his trained eye and hand, and later engraved his observations in copper. What is more, Galilei drew the correct conclusions from what he saw. This is shown most clearly in the following quote from his letter to Antonio de Medici dated January 7, 1610: "Indeed one can clearly see that the moon surface in fact is not even, smooth or clear... but rather rough and uneven..., that it is full of elevations and indentations similar to but much

¹Shortened version of a lecture presented by the author on April 15, 2013 at the Macedonian Academy of Science and Arts in Skopje. Translated from the German version into English by Judith Blank

bigger than the mountains and valleys dispersed over the earth's surface". [2]

His three-dimensional interpretation of light-dark phenomena as mountainous landscapes is far

from trivial, as shown by the example of the Englishman Thomas Harriot who observed the moon by telescope even *before* Galilei without identifying what he saw as mountains and valleys.



Figure 1. Galilei statue in Florence (photo: author)



Figure 2. Ink drawing of the moon by Galilei 1610 (photo: Deutsches Museum, München)

FROM HEVELIUS TO FAUTH

However, Galilei was not an exception. Also in later centuries, astronomers used the art of sketching for their research.

When Johannes Hevelius decided to draw up a large map of the full moon, he learned that his friend Gassendi in Paris was pursuing the same project with the help of an experienced drawer and copper engraver. Hevelius set out his plans to Gassendi who wrote back that Hevelius should be the one to complete the work since he was observer, sketcher and engraver in one person. Hevelius' lunar map prevailed until the arrival of Tobias Mayer.

In an autobiographical outline, Mayer gives a detailed account of how he started to become interested in sketching and painting at a very early age. Having set his eyes upon a painting of the crucified Christ, he would copy it again and again, until achieving a decent reproduction. [3] But this

self-study was more than a transient passion; rather, it was to accompany him for the rest of his life. Later he also became concerned with the question of colour mixing when using natural colours, giving lectures and even publishing an academic paper about this topic.

Undoubtedly, his talent and experience in drawing and painting became particularly evident in the field of lunar cartography. Besides, Mayer – and in this respect he surpassed his predecessors – not only sketched what he saw but also used a special procedure to measure the position of individual objects on the moon, making his representations of the moon even more valuable compared to other portrayals published by then - a typical example for the combination of art and science. Eventually, his work resulted in a 19.4-cm-diameter moon map which was found in his estate after his death and finally published by Georg Christoph Lichtenberg in 1775.

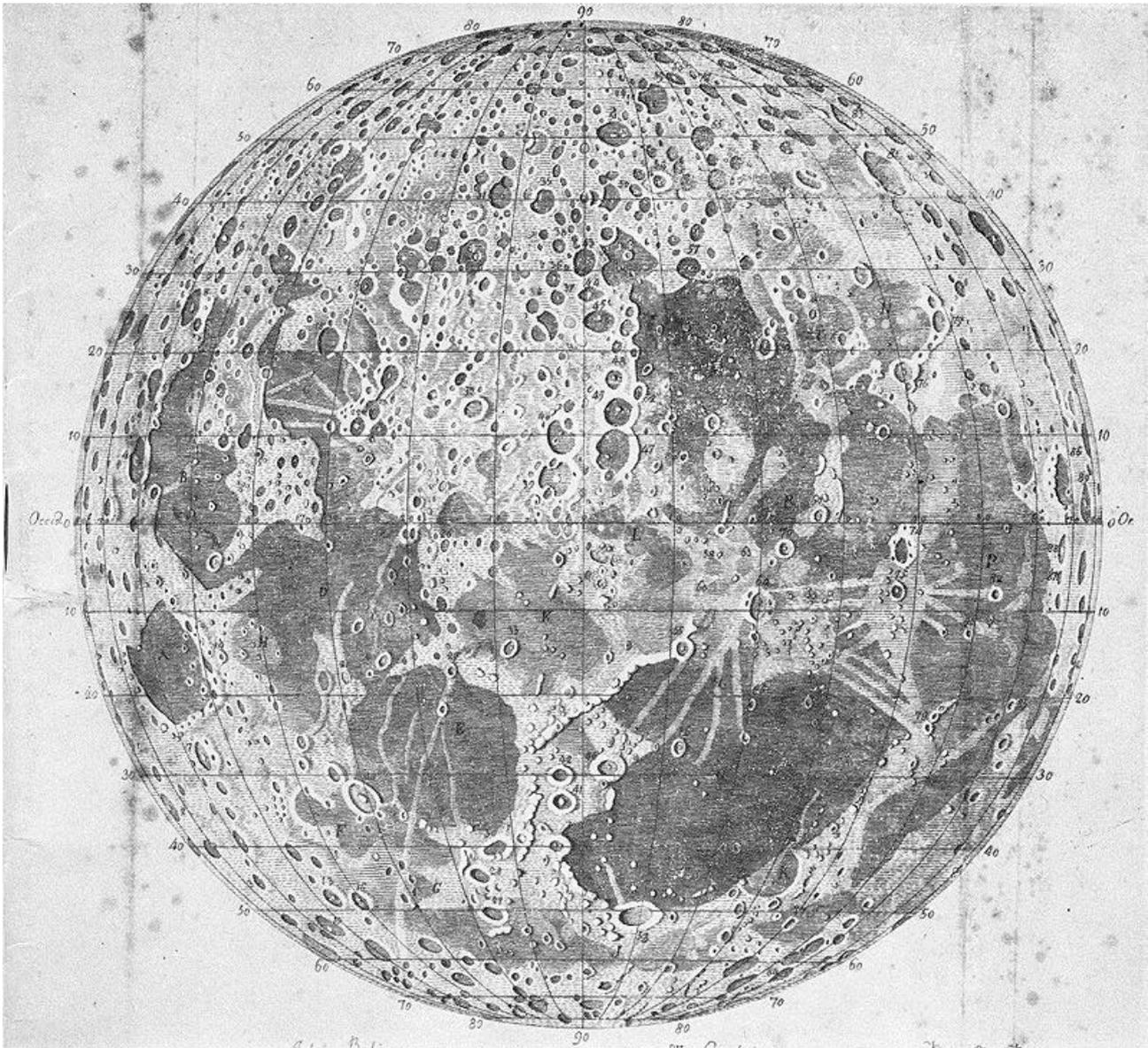


Figure 3. Tobias Mayer's moon map (author's archives)

The Berlin-born astronomer Johann Heinrich Mädler is also known for his great accomplishments in the field of lunar cartography. It is fair to assume that his talent for drawing and his artistically trained eye played an important role here. For Mädler, before starting his career as astronomer, had worked as calligraphy teacher in Berlin and had published a textbook on the art of calligraphy as early as in 1827. He had also put to press several other publications on this topic [4]. Surely this must have furthered his eye-hand coordination beyond usual standards.

We also know that the author of the largest and probably finest moon map of the 19th century, Julius Schmidt, had a special gift for drawing. His

obituary reads: "With his keen eyes for the more subtle nuances of shape, tints of light and colour and his exquisite sketching talent, he soon recognised the scientific value of his observations..." [5] Unfortunately, we have not been able to establish whether or not Schmidt had ever had any training in this field. Also as an astronomer he was self-taught, but this in no way impaired his career which culminated in his appointment as director of the Observatory of Athens. The results of his research, in particular his moon map measuring almost 2 metres in diameter, are considered outstanding achievement in the field of lunar cartography.

SKETCHES TRIGGER MARS FEVER

One of the astronomers whose drawings caused a lively scientific debate that was to last for decades was Giovanni Schiaparelli. As is well known, he observed Mars during the planet's approach to the Earth in 1877, discovering and sketching many thin straight lines some of which extending over several thousand kilometres. Schiaparelli referred to them as "canali", thinking at first of natural watercourses on the planet. He at once discovered forty formations of this type. Many of these lines intersect in darker, surface-like formations that at the time none other than E.C. Pickering mistook for water. Many observations by others seemed to *confirm* the "canal" thesis. While in the end, with improving observation techniques, the "canals" turned out to be an illusion, they must

have been visible to good observers, considering the stage of development of the instrumentation technology at the time. Schiaparelli's talent for observing and drawing had to do with the fact that initially he had studied "civil engineering" at the University of Turin. Architectural studies at the time would have included classes in descriptive geometry, perspective drawing with light and shadow, as well as training in artistic imagination and cartography [6].

At least the Martian canals acted as a powerful stimulus to Mars research. The last advocates of this hypothesis published their opinions as recently as in the 1940s. It was not until the age of space travel with the pictures of the Martian surface taken by Mariner 4 (1965) that the excitement over Martian canals received its death blow.



Figure 4. Schiaparelli and "his" Mars canals on an Italian stamp (2010)

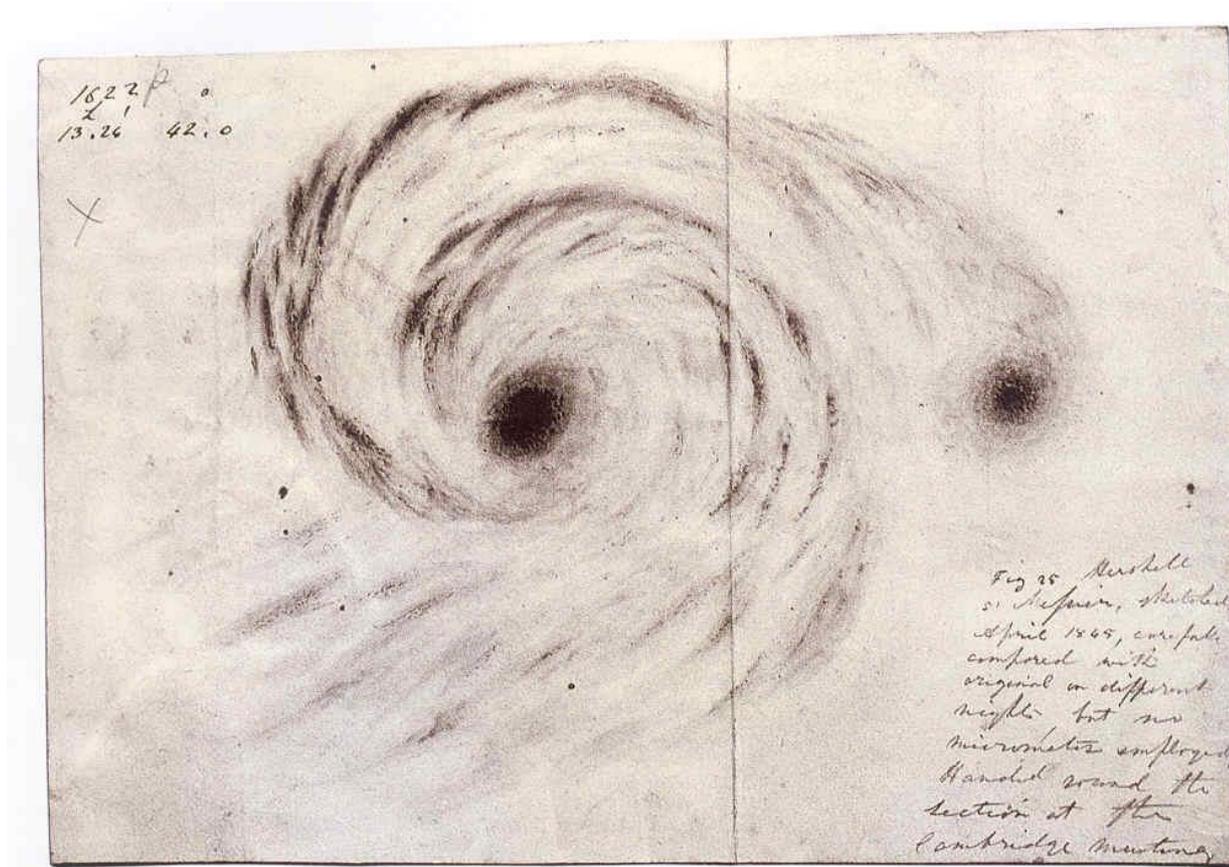
CONQUERING EVEN GREATER DISTANCES

We are well acquainted with the drawings of astronomical objects far out there in space made by the Irish nobleman, telescope builder and astronomer Lord Rosse long before the discovery of extragalactic worlds by Hubble in the 20th century. Little is known about Rosse's life, so we do not know whether he ever studied drawing or had a special talent for drawing. However, any competent art historian can easily see the quality of his eye and hand on the basis of the sketches themselves. Lord Rosse's main contribution to

astronomy is his discovery of the structures of extragalactic objects, obtained by observations with the 72-in mirror "Leviathan" that he himself had built. Admittedly, the true nature of the drawn objects remained a mystery to Rosse. His probably best known representation is the one of the M 51 nebulae in Canes Venatici. This object had already been drawn by John Herschel, but Herschel saw much less than Lord Rosse. In the history of astronomy, it has generally been argued that this was due to the larger size of Lord Rosse's instrument. Of course the size of "Leviathan" with its 72-in mirror played an important role in the discovery of detailed structures. However, the

combination of Rosse's eye, hand and the large telescope would seem to have been crucial for his breaking into new ground in science. Rosse did not rely on observation techniques alone, but he understood very well the importance of the artist's

eye and of his ability of portraying what he saw. This is also reflected in the fact that he employed the trained artist Samuel Hunter specifically to assist him as observer and drawer.



a)



b)

Figure 5. a) Drawing of the M 51 object by Lord Rosse (source: Wikipedia);
b) Picture of M 51 (Hubble Space Telescope)

In his contribution to "Astronomical Notes" in 1888, Hermann Carl Vogel compared Rosse's drawings with lithographs from photos, claiming that the photos made using the recently developed silver bromide-gelatine dry plates showed much more details than Rosse's drawings [7]. Vogel had more confidence in photography than in drawing and the more the nebula drawings of others resembled photographs, the more he valued them. But if we compare modern images of M 51 with Rosse's drawings, we see immediately that Rosse's drawings were much closer to reality than the photos taken in 1888.

Our next example is Ernst Wilhelm Leberecht Tempel who was born in Niedercunnersdorf, Saxony. Tempel had trained as a lithograph, so there is no mistaking his qualifications as precise observer and drawer. He had also lived in Venice where he was admired for his detailed renderings for botanists and natural scientists. After astronomy had caught his interest, he became extremely successful also in this field. He discovered 21 comets and 5 minor planets, including the one he referred to as "Maximiliana". His numerous, finely-structured drawings of nebulous objects and his discovery of a reflection nebula around the star Merope in the Pleiades cluster made him famous among experts.

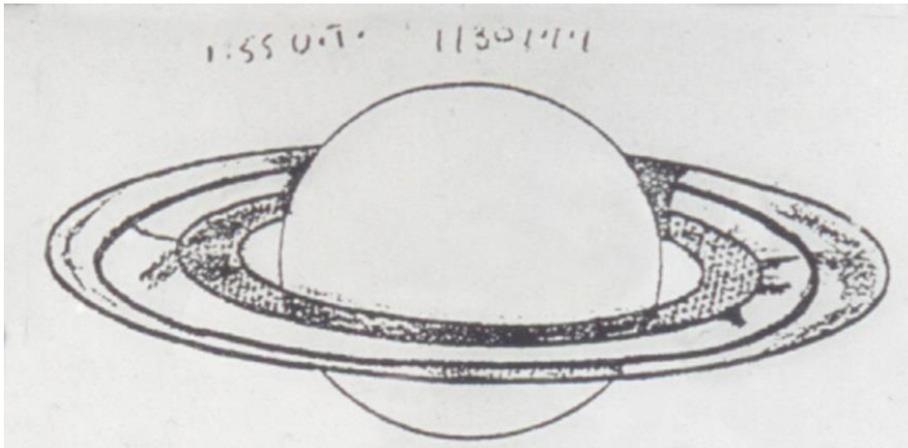
The surrealist graphic artist, painter and sculptor Max Ernst was so impressed by Tempel's life story and achievements that he dedicated to him his graphic cycle "Maximiliana". Tempel was a master in seeing details and translating what he saw into drawings and lithographs, and it must have been these abilities that fascinated the artist Ernst. Even back then, Ernst, who in his "Maximiliana" also included some of his own surrealist drawings to honour Tempel, foresaw that the importance of drawings for astronomy would decline with the technical development of photography.

A very special case of the hand-eye phenomenon in astronomy is that of the Frenchman Étienne Trouvelot. He made a name for himself in astronomy, even though he had never formally studied this field. He also ranks as a drawer and painter, probably also without ever having had any formal training. After Louis Napoléon's 1851 coup, Trouvelot left France where until then he had been engaged in political activities on behalf of the Republicans. In the US, he joined the Natural History Society and published several articles on entomology. In 1870, his delicate drawings of polar lights attracted the attention of the director of the Harvard College Observatory, Joseph Winslock. This was the beginning of a typical American

career. Winslock recruited him for Harvard where Trouvelot worked as a drawer. His drawings were published in the Observatory publications. As a result, other observatories invited him to observe and draw using also their instruments. These drawings gave rise to studies on sunspots, planets and the moon, some at the Washington 26-in refractor - with its 26-in aperture one of the world's largest refractors at the time. The total number of pictures reached about 7000. Trouvelot's astronomical drawings and paintings were printed and exhibited like an artist's works. But his keen eye also spotted details that caused a stir in scientific circles. For instance, in 1887 Trouvelot discovered radial structures within the Saturn ring system whose existence was definitely demonstrated only some 100 years later by the Voyager space probe [8]. In 1882, Trouvelot returned to France where he was immediately hired to work at the Meudon Observatory near Paris. There, he produced hundreds of drawings, especially of prominences and other phenomena on the solar surface. His observations of solar spots revealed details that could be photographed only much later using modern technical means in the light in specific spectral ranges.

A similar career as astronomical drawer (without being an astronomer) was that of Walther Löbering [9]. He had completed formal studies at the Dresden Academy of Arts and had then settled down near Plauen in Fasendorf, Vogtland. There, he worked as an artist, but also as a teacher at the Plauen national art school. At the beginning of the 20s, he turned to astronomy, in particular to the planet Jupiter that he observed using mainly a 10-in reflector telescope. Löbering created a wealth of drawings of Jupiter's changeable atmospheric phenomena, drafting rotation maps and exploring in particular the Great Red Spot (GRS). Later, he built a small observatory and regularly published his observations in "Astronomical Notes", "Die Himmelswelt" and in the magazine "Die Sterne". In 1954, the German Academy of Sciences awarded him the Leibniz Medal for his extraordinary achievements apart from his actual professional activity. Finally, in Löbering's death year, a summary of all his observations between 1926 and 1964 made it into the Leopoldina treatises (the society is today referred to as national academy of Germany) [10].

As a painter, he expressly stated that in the Jupiter sketches he proceeded as if he was drawing portraits - portraits in which, nevertheless, some details needed to be verified by measuring the "objects".



a)

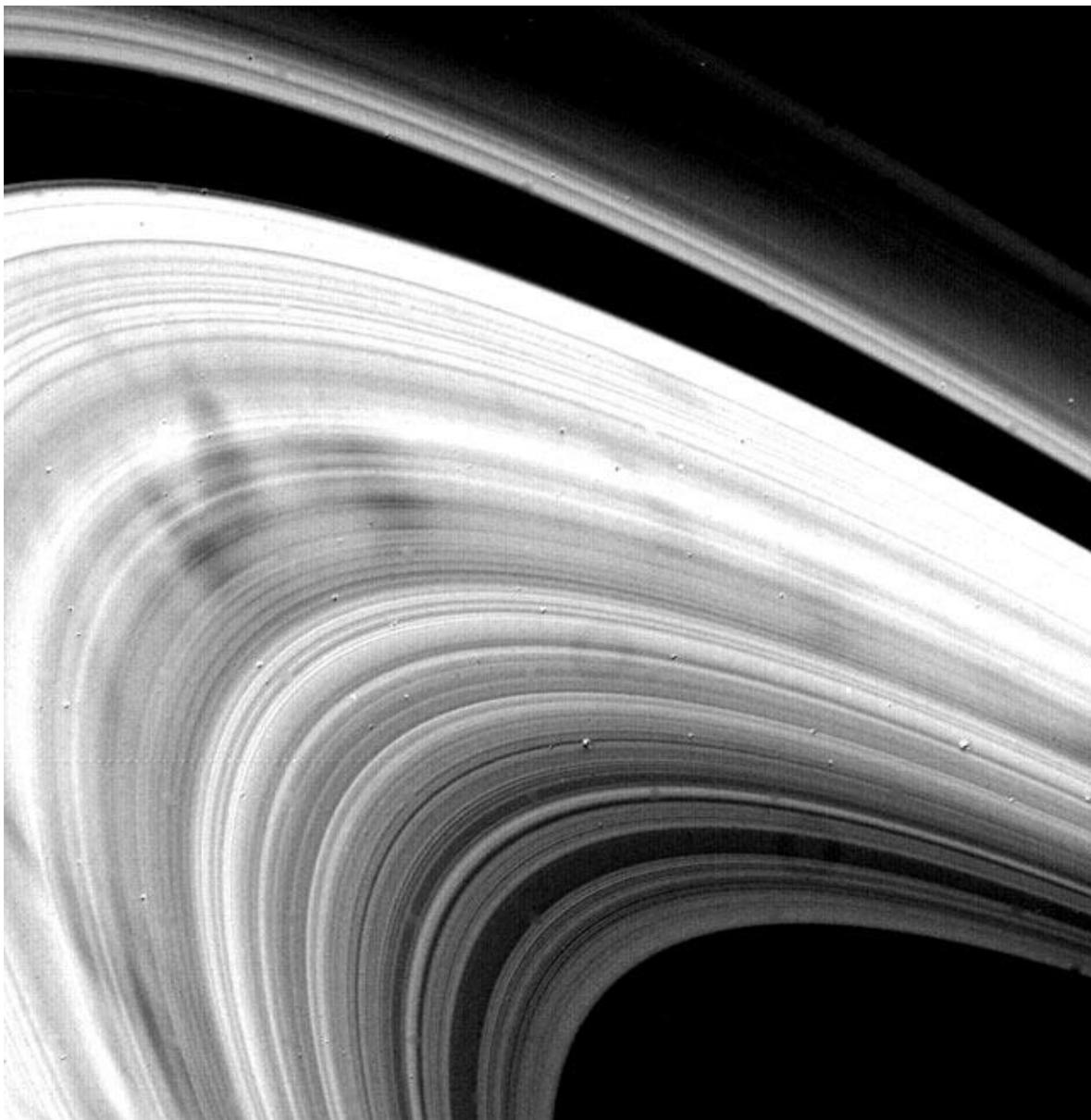


Figure 6. a) Drawing of the radial structures within the Saturn ring system by Trouvelot;
b) Photos of the radial structures by Voyager 1 (1980)

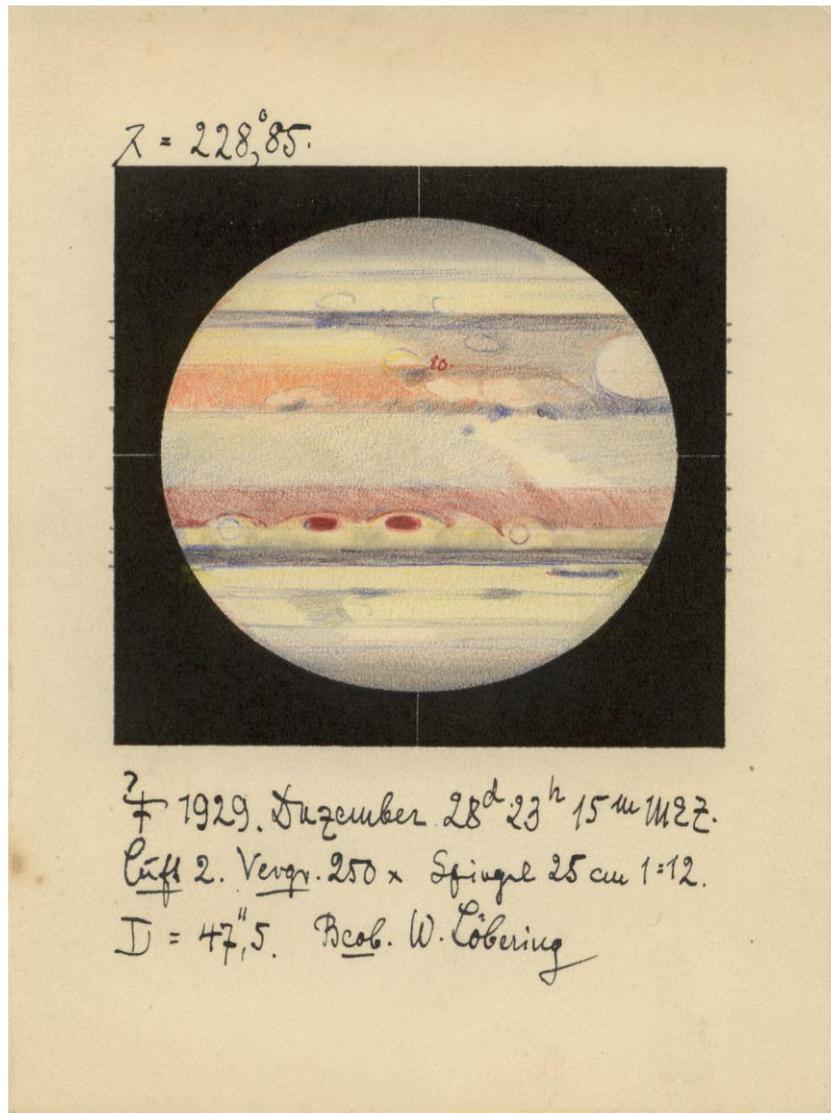


Figure 7. Drawing of Jupiter by Walter Löbering (archives of the Archenhold Observatory, Berlin)

For the exploration of Jupiter it is interesting that Löbering's observations indicated a left-turning vortex within the GRS. However, this observation was ignored by most of the scientific community. But the rotation profiles recorded later by the Voyager space probes indeed confirmed the GRS's left-turning vorticity. Löbering, with his painter's eye and hand, and B.M. Peek (1958) [11], who analysed amateur observations made over decades by the British Astronomical Association, were the only ones to notice [12].

END OF AN ERA

With photography and the ensuing development of electron-optical image converters, drawers at the telescope had to take a backseat. This is not negative but a sign of progress. Because

today, no drawer however gifted in observing would be able to perceive and record the wealth of information captured by the gigantic telescopes of our time, not to mention non-optic wavelength ranges.

However, there is no denying that over more than two centuries the drawers and painters among astronomers played a significant role in research. Galilei was their earliest ancestor. Certainly, none of the discoveries made later by drawing astronomers shook the world view the way Galilei's drawings did.

Even today, visual representations are essential to astronomical research, in particular false-colour images of digitalised observation files. But much of what we know cannot be photographed. Since Camille Flammarion's popular books with their fascinating pictures, drawers and painters have tried to translate this knowledge into pictures.

Today, Flammarion's spiritual grandchildren and great-grandchildren are those artists that work at ESA, ESO or NASA creating much sought-after "artist's impressions" that help us imagine foreign planets, remote areas of the universe and other breath-taking phenomena. These representations of research findings are probably not very different from real photographs, if only we could take pictures of them.

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АСТРОНОМИТЕ КАКО СКИЦИРАЧИ И СЛИКАРИ: ОКОТО – РАКАТА – РАЗБИРАЊЕТО

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Денес сме навикнати пред нашите очи да гледаме објекти од универзумот во прекрасни дигитални слики. Но, пред откривањето на фотографијата, уметноста на сликање и цртање одигра значајна улога во научните истражувања. Оние астрономи што биле силни во оваа уметност имале предност. Статијава ја поткрепува оваа теза со помош на избрани примери. Цртежите и поврзаните откритија на Галилео Галилеј (1564–1642), Јоханес Хевелиј (1611–1687), Тобијас Мајер (1723–1762), Јохан Хајнрих Медлер (1794–1874), Јулиј Шмит (1825–1884), Џовани Шкипарели 1835–1910), Еугениос Антониади (1870–1944), Вилијам Парсонс алијас Лорд Роуз (1800–1867), Ернст Вилхелм Леберет Темпел (1821–1889), Етјен Тривелот (1827–1895) и Волтер Леберинг (1895–1969) ги покажаа најважните документи за набљудување. Може да се види дека благодарение на нивната уметност и поврзаните високо развиени способности за тоа да го согледаат, цртежите на астрономите создадоа зачудувачки откритија кои другите ги негираа. Конечно, сега се развиваат некои погледи за улогата на нацртаните или насликани астрономски мотиви.

Клучни зборови: астрономија; сликари; фотографија; Galileo Galilei; Johannes Hevelius; Tobias Mayer; Johann Heinrich Mädler; Julius Schmidt; Giovanni Schiaparelli; Eugenios Antoniadi; Lord Rosse; Ernst Wilhelm Tempel; Etienne Trouvelot; Walter Löbering