Edvard E. Neovius's Star Map and Message to the Martians

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Abstract. Over time, the original mythological meanings behind the constellation names have faded from common knowledge. In 1882, Edvard Engelbert Neovius, a Finnish mathematics and topography teacher, embarked on an innovative project. He created a star map based on the Finnish national epic, *Kalevala*, covering the portion of the sky visible in Finland. Neovius aimed to make constellations more memorable for the local audience by not only renaming them but also structuring them into thematic groups. Beyond his cartographic pursuit, Neovius delved into another space-themed publication. He published a pamphlet outlining a method for communicating with Martians using light signals. In addition to estimating the required light beacons and batteries, he drafted a message encompassing basic mathematics, logic, the physics of the Solar System, and more complex concepts.

Introduction

At the 1928 General Assembly of the International Astronomical Union (IAU), the constellations were officially defined. The 88 constellations cover the entire sky, with boundaries drawn along lines of right ascension and declination. At the same time, constellations were stripped of their earlier, symbolic meanings; the official constellations no longer include figures—neither stick figures nor any other images.

A constellation is the celestial equivalent of a geographical place name. If someone asks where I live, I don't respond with coordinates. I might simply give the name of my hometown, and that suffices. Similarly, saying that a star belongs to a certain constellation only means it lies within defined boundaries. It doesn't imply that the star is part of any specific star pattern.

While the official definition may sound unimaginative, it allows freedom to depict constellations however you like. There is no right or wrong image to draw; you can envision Orion however you wish. However, this freedom has always existed. Even though most Western

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constellations have a long history, there have always been variations in how they're depicted. [1]

Different representations of Orion

Let's take Orion as an example. In *De le stelle fisse* (1540), Alessandro Piccolomini depicted Orion by simply drawing the stars, without any superimposed image.[2] This was a rare exception, as most old star maps contain illustrations. Piccolomini's map resembles modern maps, where no images are drawn—although most modern maps connect the stars with lines. The first to use geometric figures in star maps was Alexandre Ruelle in his *Nouvelle Uranographie* (1786).[3]

Starting from the Greek star catalogues of antiquity and the early medieval start maps, the mythological figure of Orion has been connected to the particular constellation of stars. In the maps, there have been many variations in how he is portrayed. Orion is most often shown from the back, though sometimes he faces the viewer. He frequently holds a club and a lion's skin, though sometimes he is shown with a shield instead of the skin. Another major difference is the perspective of the entire atlas. Is the view from within the celestial sphere, as an observer might see it? Or is it a 'God's-eye view' from outside the celestial sphere?[4]

Sometimes, Orion's image was modernized. While he might still hold a club, he might also carry a sword at his side. Instead of a simple garment, he sometimes wears full armour. When Erhard Ratdolt printed his sky maps in 1482, he focused less on the precise locations of stars than on the images. Ratdolt used illustrations from now-lost medieval manuscripts, portraying Orion as a medieval nobleman in full battle armour.[5] Similarly, in 1532, Johannes Honter abandoned classical images in his *Imagines Constellationum Borealium*, giving Orion a Renaissance look.[6] Honter's

[1] Nick Kanas, *Star maps: History, artistry, and cartography* (Chichester: Springer-Praxis, 2007), p.117.

[2] Nick Kanas, 'Alessandro Piccolomini and the first printed star atlas (1540)', *Imago Mundi* 58, no 1 (2006): pp.70–76.

[3] Michael Mendillo, *Saints and Sinners in the Sky: Astronomy, Religion and Art in Western Culture* (Chichester: Springer-Praxis, 2022), pp.24–25.

[4] Kanas, 'Star Maps', p.13.

[5] Bernadette Brady, 'Images in the heavens: a cultural landscape', *Journal for the Study of Religion, Nature and Culture* 7, no 4 (2013): pp.461–84.

[6] Brady, 'Images in Heavens', p.473.

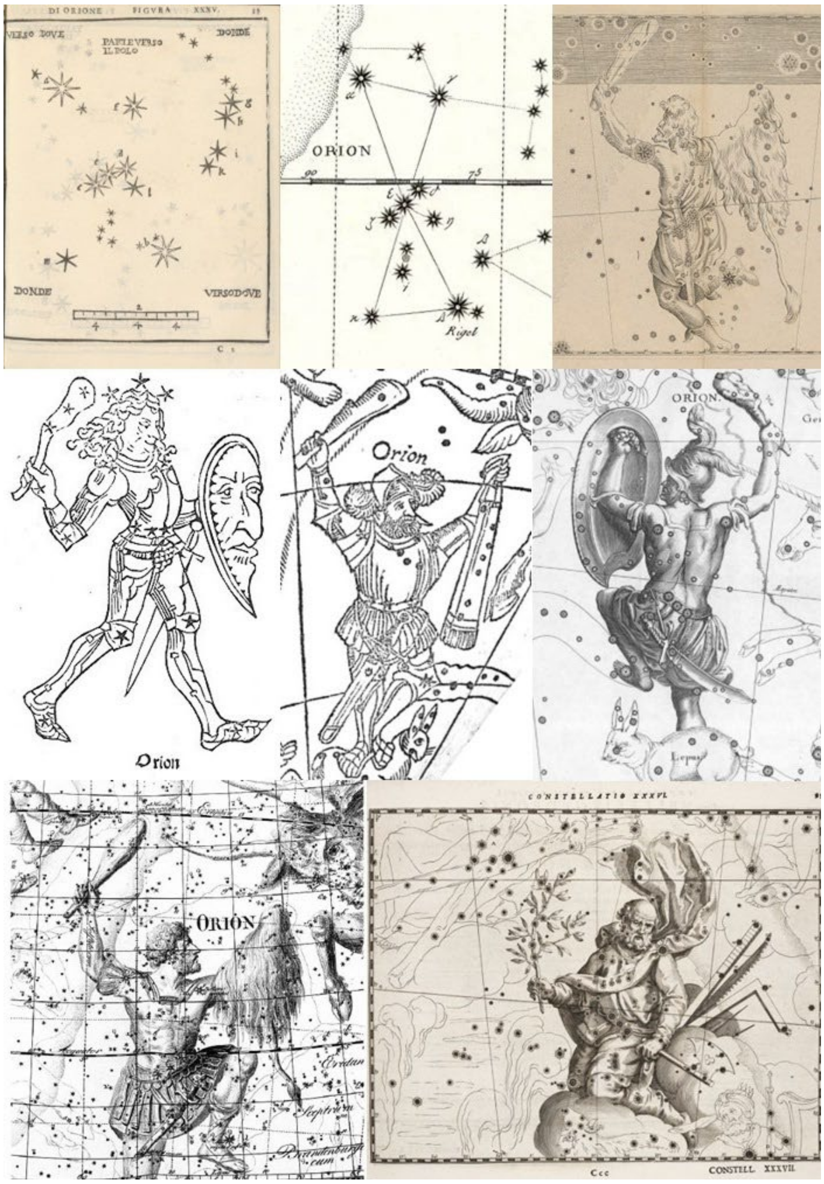

Fig. 1. Different representations of Orion: Piccolomini (1540), Ruelle (1786), Bayer (1661), Ratdolt (1482), Honter (1532), Hevelius (1690) Bode (1801), and Schiller (1627). Images in public domain (Wikimedia).

Orion has a thick beard and resembles a Northern European warrior more than a Greek hero.[7]

Since Orion's name and figure are not inherent to the stars themselves, there is freedom to impose a completely different image on the constellation. For example, Julius Schiller replaced Orion with St. Joseph in his star atlas, *Coelum Stellatum Christianum* (1627), as part of his ambitious project to Christianize the night sky. Schiller reimagined the Twelve Apostles as the constellations of the Zodiac, populated the southern sky with figures from the Old Testament, and the northern sky with those from the New Testament.[8]

Schiller's atlas was both beautiful and astronomically accurate, but his idea of Christianizing the heavens never gained wide acceptance.[9] His biblical constellations might have faded into obscurity sooner had Andreas Cellarius not included them in his *Harmonia Macrocosmica* (1660).[10]

Later in the same century, Erhard Weigel made another attempt to reimagine the constellations, replacing mythological figures with the heraldic arms of European noble families in his *Coelum Heraldicum* (1688). For instance, he transformed Orion into the double-headed Austrian Eagle.[11] Weigel also incorporated the coats of arms in his celestial globes.[12]

Innovation: Edvard Engelbert Neovius

In 1882, a lesser-known attempt to replace traditional constellations was published anonymously in Finland. The star map, titled *De i Finland synliga stjernornas lägen, förtydligade genom berättelser ur Kalevala* in Swedish and *Suomessa näkywien tähtien asemat, selitettyinä kuwilla Kalewalan mukaan* in Finnish, which translates to *The Stars Visible in Finland, Explained with Images from Kalevala*. As indicated by the title,

[7] Anna Friedman Herlihy, 'Renaissance Star Charts', in David Woodward, ed., *The History of Cartography*, vol. 3 (Chicago, IL: University of Chicago Press, 2007), pp.99–122.

[8] Michael Mendillo and Aaron Shapiro, 'Scripture in the Sky: Jeremias Drexel, Julius Schiller, and the Christianizing of the Constellations', in *The Inspiration of Astronomical Phenomena VI,* 2011, pp.81–195; Mendillo, 'Saints and Sinners', pp.54–55.

[9] Kanas, 'Star Maps', p.142.

[10] Mendillo, 'Saints and Sinners', pp.46–49, 120, 229.

[11] Brady, 'Images in Heavens', p.477.

[12] Werner Horn, 'Der Heraldische Himmelsglobus des Erhard Weigel', *Der Globusfreund* 8 (1959): pp.17–28.

the map depicted only the northern sky as seen from Finland, featuring figures from the Finnish national epic, *Kalevala*.[13]

The reason for the map's anonymity is unclear, but it may have been due to the political climate. At the time, Finland was an autonomous Grand Duchy within the Russian Empire, where a strong Finnish national movement was growing. Creating a Finnish star map could have been perceived as nationalist propaganda—likely acceptable for a regular citizen, but potentially inappropriate for a Russian (Finland was then ruled by Russia) army officer.

The map's creator was Edvard Engelbert Neovius, an instructor at the Hamina Cadet School.[14] Though not a professional mathematician, Neovius was a highly skilled mathematics instructor who wrote several textbooks and published a couple of scientific articles.[15] At that time, Finland had no polytechnics, and the Cadet School in Hamina trained officers not only for the military but also for engineering and other civilian careers.[16]

In addition to mathematics, Neovius taught topography and astronomy, equipping him with all the skills needed to create a star map. Known as 'Newton' by his students, Neovius was a respected teacher—strict yet able to combine compassion with firmness, even in the disciplined environment of the Cadet School.[17]

Neovius was also the first to advocate for the metric system in Finland.[18] His proposal was innovative: he suggested that the sizes and weights of coins align with metric measurements, so that coins could double as

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[13] Edvard Neovius, *De i Finland synliga stjernornas lägen, förtydligade genom berättelser ur Kalevala* (Helsinki: G.W. Edlunds förlag, 1882).

[14] Hugo Schulman and Sigurd Nordenstreng, eds, *Finska kadettkårens elever och tjänstemän: Biografiska anteckningar 1812–1912* (Helsinki: Aktiebolaget Lilius & Hertzberg, 1912).

[15] Gustav Elfving, *The history of mathematics in Finland 1828–1918* (Helsinki: Societas Scientarium Fennica, 1981), pp.107–08.

[16] Panu Nykänen, *Käytännön ja teorian välissä: Teknillisen opetuksen alku Suomessa* (Jyväskylä: Gummerrus, 1998), pp.44–45; J.E.O. Screen and Veli-Matti Syrjö, *Keisarillisen Suomen kadettikoulu 1812-1903: Haminan kadetit koulussa ja maailmalla* (Helsinki: Tammi, 2003), pp.247–51.

[17] Olli Lehto, *Erhabene Welten: Das Leben Rolf Nevanlinnas* (Basel: Birkhäuser, 2008), pp.12–14; G.A. Gripenberg, *Finska kadettkåren och dess kamratskap* (Helsinki: Aktiebolaget Lilius & Hertzberg, 1912), pp.76–77.

[18] Heikki Nevanlinna, *Neovius–Nevalinna – erään suvun kronikka* (Helsinki: Societas Scientiarum Fennica, 2022), pp.49–50.

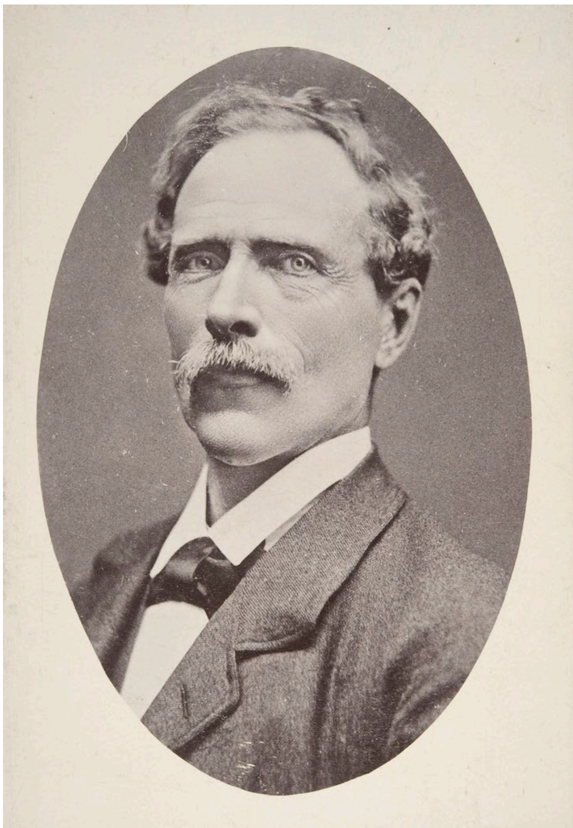

Fig. 2. Edvard Engelbert Neovius in circa 1880. Public domain (Finnish Heritage Agency).

measuring tools. For example, he proposed coin diameters of one, two, three, and four centimetres.[19]

Though the proposal was appreciated, it was deemed impractical, as the four-centimetre coin was considered too large. Ultimately, the monetary and metric reforms were implemented separately.

Neovius's expertise led to his appointment by the Senate to a committee preparing for the adoption of the metric system. After retiring as a major-general from the Cadet School in 1885, he was appointed Inspector of Weights and Measures.

[19] Edvard Neovius, *Förslag till det franska metriska systemets införande i Finland* (Helsinki: Finska Litteratur-sällskapets tryckeri, 1862).

Message to Martians

The star map wasn't Neovius's only space-related project. In 1875, he published a pamphlet proposing both a method and a language for communicating with Martians, which attracted significant attention.[20] The belief in intelligent life on other planets was not uncommon. In the nineteenth century, the true conditions on other planets were still unknown, and Mars was considered to be quite Earth-like. Neovius was influenced by other thinkers of the time. The French astronomer Camille Flammarion had expressed his belief in inhabited worlds.[21] According to the Danish physicist Hans Christian Ørsted, the thinking and observational abilities of beings on other planets would evolve in a similar way to humans, thanks to the same natural laws.[22] Neovius's pamphlet, titled *Vår tids största uppgift* (*The Greatest Task of Our Time*), begins with the idea that each era has its own task. The greatest task of our time is to communicate with other inhabited worlds.

Mars is the best target for communication because, according to the knowledge of the time, it appeared to be Earth-like with seas and continents.[23] Furthermore, Neovius adopted the idea that the outer planets are more developed. The accumulation disk around the Sun was believed to have organized itself starting from the outer edges. Therefore, the outer neighbouring planet Mars would be a better target than Venus.[24]

Neovius thought that for too long humanity had been content with merely discussing the existence of intelligent beings on other celestial bodies without taking any action. Humanity had much to learn from exchanging ideas with Martians.[25] What makes Neovius's proposal special is that he designs both the technical implementation of light signals and the symbolic language used for communication. Previously, there had been thoughts around the world of drawing attention from the Moon's inhabitants by, for example, drawing huge illuminated geometric patterns

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[20] Edvard Neovius, *Vår tids största uppgift*, 2nd edn (Helsinki: Finska Litteratur-sällskapets tryckeri, 1876); Raimo Lehti, 'Edvard Engelbert Neovius, an early proponent of interplanetary communication', *Acta Astronautica*. 42, no. 10–12 (1998): pp.727–38.

[21] Neovius, *Största uppgift*, p.7.

[22] Neovius, *Största uppgift*, pp.13–14.

[23] Camille Flammarion, 'Mars, by the Latest Observations', *Popular Science Monthly* 4 (1873): pp.187–93.

[24] Neovius, *Största uppgift*, pp.30–32.

[25] Neovius, *Största uppgift*, pp.12–13.

on the Earth's surface.[26] Neovius knew the Moon was barren, and he did not settle for merely attracting the attention of Martians. For communication to be possible, the technology had to enable complex and reliable messaging.

One earlier proposal has much in common with Neovius's suggestion. In 1869, the French scientist Charles Cros proposed using large mirrors to reflect light beams to Martians. Cros was using a system of periodic pulses of flashes in his proposed message.[27]

Neovius was likely not aware of Cros's proposal. He mentions several sources of inspiration in his work, but he does not mention Cros.

Bright lights with electricity

In the time before wireless radio transmissions, light signals were a natural choice for communication. Neovius was ahead of his time in this regard. He proposed the use of electric light. In 1875, electric lights had not yet been seen in Finland, and Edison had not yet patented his light bulb. Neovius did not envision the incandescent bulb but rather its predecessor, the arc lamp. This lamp produced light from an electric arc between two carbon rods. An arc lamp powered with 44 Bunsen batteries would produce light 1170 times brighter than an ordinary stearin candle.

Simply pointing the lamp at the red planet was not enough. The conditions needed to be right: both the sender and the receiver must be located on the night side of their respective planets. This also meant that Mars would need to observed in an unusual way. Attention should be focused on Mars's night side, and the bright day side should be covered.[28]

A lot of lamps would be needed, and their light would have to be collected and directed with parabolic mirrors. In the first edition of his pamphlet, Neovius calculated that up to 22,500 lamps should be placed on high mountains, each powered by forty Bunsen batteries. This would make the light visible from Mars as bright as a magnitude six star.[29]

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[26] Florence Raulin Cerceau, 'Fraction of civilizations that develop a technology that releases detectable signs of their existence into space, f_c, pre-1961', in Douglas A. Vakoch and Matthew F. Dowd, eds, *The Drake Equation* (Cambridge: Cambridge University Press, 2015), pp.205–26.

[27] Florence Raulin Cerceau and Bénédicte Bilodeau, 'A comparison between the 19th century early proposals and the 20th–21st centuries realized projects intended to contact other planets', *Acta Astronautica* 78 (2012): pp.72–79; Cerceau, 'Fraction of civilizations ', pp.205–26.

[28] Neovius, *Största uppgift*, pp.18, 32–38.

[29] Lehti, 'Early proponent', p.732.

Since each lamp would need its own alignment device, the project would be incredibly expensive. Neovius's proposal was not just an intellectual exercise for him; he seriously hoped it would be carried out. So, he made new calculations.

In the second edition, which was also translated into French and Russian, Neovius stated that 24 lamps would be needed if each had 880 batteries. The light would be equivalent to a magnitude 16 star, visible through a large telescope such as William Herschel's telescope. He also suggested that a single lamp with 970 Bunsen batteries might suffice. The light would be detectable with even larger telescope like Lord Rosse's giant tube.[30]

Language of flashing lights

Neovius was optimistic that funding could be found for the project. After all, large sums were already being spent on various scientific or technological endeavours, such as arctic exploration, or transatlantic telegraph cable. Neovius's project was not about proving the existence of Martians. He considered that self-evident. The costly project would be worth the investment for the knowledge we could gain from communicating with the Martians.[31]

Communication would be carried out using light flashes of varying lengths. These flashes would form letters, the letters would form words, and the words would form sentences (see Fig. 3). In the transcription of the message of flashing lights, one to seven short pulses were denoted with numbers (1, 2, 3, 4, 5, 6, 7), and they represented numbers. One to eight longer light pulses were denoted with letters (a, b, c, d, e, f, g, h). Single letters were used as mathematical symbols, and combinations of letters were words. One to three even longer pulses were denoted with upper case letters (A, B, C), and they represented equality (mathematical of other kind). A very long pulse was denoted with cursive A, and its meaning was 'etc.'. A very short flash was denoted with o, and it meant either zero or negation. Long pulses with increasing or decreasing intensity were denoted with Tillt and Aft, and they represented less-than or greater-than signs.[32]

To ensure the message was accurate, it could be implemented by embedding brass plates into a gutta-percha tape. The electricity would flow

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[30] Neovius, *Största uppgift*, pp.18–20.
[31] Neovius, *Största uppgift*, pp.22–25.
[32] Neovius, *Största uppgift*, pp.57.

1, 2, 3, 4, 5, 6, 7, 𝔄. —— 1 A 1, 2 A 2, 3 A 3, 4 A 4, 𝔄; 1 Tillt 2, 2 Aft 1, 1 Tillt 3, 3 Aft 1, 2 Tillt 3, 3 Aft 2, 𝔄. ——

2 a 3 A 5, 5 b 3 A 2, 2 c 3 A 6, 6 d 3 A 2. —— 7 a 1 A 10 A 2 c 2 c 2; 10 c 10 A 100; 10 c 100 A 1000, 𝔄; 2 c 10 A 20, 3 c 10 A 30, 𝔄; 2 c 100 A 200, 𝔄; 10 a 1 A 11, 10 a 2 A 12, 𝔄; 100 a 1 A 101, 100 a 10 A 110, 100 a 10 a 1 A 111, 𝔄. —— 17 c 26 a 3 A 515, 17 c 7 a 1 A 152, 515 a 26 A 543, 152 a 7 A 161. ——

e Aft 3, e Tillt 26 d 7, e Aft 515 d 152, e Tillt 543 d 161 𝔄; e A f d g; g A 2 c h, f A 2 c e c h. —— e c h c h A aa. —— 4 c e c h c h c h d 3 A ab. 4 c e c h c h A ac. ——

ad, ae, af, ag, ah, 1ba, 2ba, 3ba, 𝔄 224ba, bb, bc, bd, be; ad A 40000000 c ah, ad A 4634300 c ag, ad A 1700 c bb; ad ab A 4634300 c ag ab, ad ac A 26620 c ag ac, ad h A 154 c ag h. – ah bf A 1235 c ah bg, ag bf A 555 c ag bg a ag bg d 4. ——

1 A 1, 1 oA 2, 2 oA 1, ag A ag, ag oA ad. —— ag B ab, ag oB aa, ad B ab, ad oB aa, e oB f, e B bh. —— 1 B bh, 2 B bh, 3 B bh, 𝔄, 1 d 2 B bh, 1 d 3 B bh, 2 d 3 B bh, 𝔄. — 1 B ca bh, 2 B ca bh, 3 B ca bh, 𝔄; 1 d 2 oB ca bh, 1 d 2 B cb bh; 2 d 3 B cb bh, 3 d 2 B cb bh, 𝔄. —— e oB ca bh, e oB cb bh, e B cc bh. —— ca bh oB cc bh, cb bh oB cc bh, ca bh B cd bh, cb bh B cd bh. —— e ceA f d g, e o ceA 543 d 161, e cfA 543 d 161. ag cfA af. ag bf cfA 555 ag bg a ag bg d 4. ——

ad C ad, ag C ag, 𝔄; cc bh C ocd bh; cd bh C occ bh. C cfC A; —— 1 b 1 A o, 2 b 2 A o, 𝔄; bh b cg bh A o . bh d cg bh A 1. —— ch C ocg, bh b ch bh oA o; bh d ch bh oA 1. —— da C o; da ca bh Tillt 1. —— o d o A db bh; db cb bh B cd bh. dc C odb oda; dc cb bh Tillt 1. ——

2 Tillt 3, 3 Tillt e dd 2 Tillt e. —— de bh Aft e, df cg bh Aft 3, dg e Aft 3. de bh oB cc bh, df cg bh B cd bh. —— db bh B dh cd bh, dh cc bh. db cb bh dh Aft 1, dh Tillt 1, ea 2 d 3 Tillt 1, 3 d 2 Aft 1. ——

eb cfC ea; dc ca bh Tillt e, ea 2; dc ca bh Tillt e, eb 1, 2, 3. —— ec cfC a, ed cfC oec, ea 1, 2 ec 3 Tillt e, ed 4 Aft e. —— ee cfC ec, ea ah Tillt ag, af ee Tillt ag, ed bb Aft ag. —— ef cfC cg, ea bh, ef Tillt e, ee Tillt 4; cd bh, ef Tillt 1, B cb bh, ed cd bh, ef Aft 1, B dh ca bh, dh cb bh. ——

f B cg, h ee B eg. h B eh eg; f B fa eg. aa B eh fb, ac B fa fb. ab B fc. —— fc fd 3 fe, fb fd 2 fe, eg fd 1 fe, ff fd o fe. —— fg B ff; db aa fd 1 fg; db ab fd ee 1 fg. —— ff, ef fh, ga eg; eg, ef fh, ga fb; fb, ef fh, ga fc. ag fh gb ad gc 1 ag bf, ag fh gb gd gc 1 ag bg; gd B g. bf B ge, bg B ee ge. bg A gf a gg, bf A gh a ha. gf B hb ge, gg B hc ge. ad B hb fc, ag B hc fc. gh B hd ge, ha B he ge. ad B hd fc, ag B he fc. ag B hf, db hf B hc ec he fc. ad oB hf. ad B hg, db hg B hb ec hd fc. —— 1hb cfC hb; 1hb fhb hh ad aaa ag gc ge, ef A 1 ag bg d 257. ——

Fig. 3. The front page of Neovius's 1875 pamphlet and the coded message to Martians. The different characters in the message stand for different lengths of flashes: o is a very short flash, numbers are short pulses, the lower case letters are long pulses, the upper case letters even longer pulses, Tillt and Aft are very long pulses with changing intensity (increasing and decreasing), and the cursive A is a very long flash. From Neovius, *Vår tids största uppgift*.

into the lamps at the locations of the plates. The size of the plate would correspond to the length of the light signal.[33] The message would begin with whole numbers. For this reason, Neovius uses an octal numeral system.[34] It is easy to interpret a series of flashes of the same length as numbers – though only up to seven. Neovius states that once communication is established, the next step should be to switch to a more efficient binary system for communication.[35]

Whole numbers are used to present equations and inequalities as well as basic arithmetic operations. Division and inequalities would be used to define pi. This would lead to the concepts of geometry.

Once the circle is introduced, Neovius suggests that the idea would naturally shift to celestial circles. Next, the bodies of the Solar System would be introduced. Here, the modern reader faces difficulty, as 148 bodies are included between the planets.[36] These were the objects of the asteroid belt, which were then considered planets as well.

The message continues until concepts such as summer, winter, bright, and light are introduced. In the future, Neovius hoped to introduce concepts like distance, large, small, human, or speak. Additionally, he wanted to define nouns and adjectives.

Neovius tested the message by giving it to his brother-in-law, Professor of Mathematics Lorenz Lindelöf, who returned the solution the very next day.[37] The message is indeed solvable by humans. For Martians, some words tied to our language, such as 'but' or 'which', might be difficult.

The basic idea of the message is clear. It starts with what is common. In Neovius's message, this refers to mathematics and logic. Since the message is directed at Martians, they would also have knowledge of the Solar System. Neovius used Solar System as a bridge from mathematics and logics to real-world concepts. When thinking about interstellar communication, one would need to find a different common ground to build the message on.

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[33] Neovius, *Största uppgift*, pp.16–17.
[34] For the message and its interpretation, see Neovius, *Största uppgift*, pp.40–58. See also commentary in Lehti, 'Early proponent', pp.733–37.
[35] Neovius, *Största uppgift*, pp.50–52.
[36] Lutz D. Schmadel, *Dictionary of Minor Planet Names* (Heidelberg: Springer, 2003), p.29.
[37] Lehti, 'Early proponent', p.733.

Kalevala on the sky

After this detour to Mars, it is time to come back to the topic of constellations. Orion, which we have been using as an example, was replaced by Neovius with Ilmarinen, the mighty blacksmith from *Kalevala*. The *Kalevala* is a collection of Finnish myths and legends. It was compiled by Elias Lönnrot in the nineteenth century. Lönnrot drew from old oral poetry. With his own edits and additions, he weaved together a coherent story. At its heart are the adventures of figures like the wise sage Väinämöinen, the skilled blacksmith Ilmarinen, the reckless Lemminkäinen and the tragic Kullervo. The *Kalevala* has had a profound influence on Finnish literature, art, and national identity, and is considered one of the most important works in Finnish cultural heritage.

The family Neovius was Swedish speaking, but there was definitely an interest in Finnish folk tradition. Edvard's nephew, Adolf Alarik Neovius, wrote down the poems of Larin Paraske. The verses collected from Paraske represent the largest collection of *Kalevala*-style poetry recorded from a single person.[38]

The *Kalevala* and folk tradition also interested Edvard Neovius. He published music for the double-kantele (kantele is a type of Finnish zither) to be played in four voices. However, Edvard did not participate directly in the major political disputes of his time, such as the nationalistic and language-political debate that concerned all social classes.[39]

Neovius's idea with the star map was that the ancient myths underlying the constellations were unfamiliar to many people. Replacing the figures in the constellations with characters from the *Kalevala*, without altering the boundaries of the star patterns, would help Finns better to get to know the night sky.[40]

To complement the beautiful map, Neovius had written a poem in both Swedish and Finnish. The Swedish version is smoother to read. In the Finnish version, he aimed for the *Kalevala* meter, i.e., trochaic tetrameter. The poem was intended to assist in learning the constellations, but unfortunately, due to its clumsiness, it does not entirely fulfil its purpose.

The figures were arranged in such a way that those located close together in the sky would form larger *Kalevala*-themed compositions. The map and the poem have four major parts centring on Ilmarinen, Kullervo,

[38] Nevanlinna, *Neovius–Nevalinna*, pp.34–36.
[39] Nevanlinna, *Neovius–Nevalinna*, p.48.
[40] Neovius, *I Finland synliga stjernor*, pp.2–5.

Fig. 4. Neovius, *The Stars Visible in Finland, Explained with Images from Kalevala.* Image in public domain (The National Library of Finland).

Väinämöinen, or Lemminkäinen. However, there are also connections between the different parts.

Finnish newspapers gave positive reviews of Neovius's map, but his proposed constellations were not adopted by other mapmakers. However, Neovius's work may have inspired the first star map in Estonian, created by Ado Grenzstein and published in 1886 as an insert in the Olevik newspaper. Like Neovius's map, Grenzstein's was an attempt to create a national star pantheon. While some of the constellation names had been used before, most were his own creations, many of which were inspired by Estonian mythology, which shares roots with Finnish mythology. As a result, names from the *Kalevala* also appeared on Grenzstein's map.

Unlike Neovius, Grenzstein did not illustrate his map with images. Instead, he used the geometric stick figures to represent the constellations.[41]

Principles of the substitution

Neovius did not aim to completely replace the traditional constellations; rather, he sought to make the sky more relevant to Finns. When assigning Finnish names to the constellations, Neovius worked to keep the new names as close as possible to the originals. Human figures were typically replaced by characters from the *Kalevala*, and animals were often substituted with other animals.

Some animals remained unchanged, only translated. For example, Aries, Capricornus, Canis Minor, Canis Major, Equuleus, Lepus, Lynx, Pisces, Taurus, Ursa Minor, and Ursa Major became ram, roe deer, small dog, big dog, colt, hare, lynx, fish, bull, big bear, and small bear.

Other animals were less fitting for the Finnish sky. For instance, Leo became the wolf, and Draco, which was still a dragon-like creature, was just renamed to the Serpent of the North. In the *Kalevala*, the North is the home of the main antagonists. Delphinus became the head of the pike, maintaining its aquatic connection. In one of the *Kalevala* poems, Väinämöinen makes a kantele from the jawbone of a pike.

Kantele is an example of another kind of natural substitution. The traditional Finnish string instrument replaced the lyra. The river Eridanus was downgraded to a creek, and Pegasus became a horse and sleigh.

The sky is full of constellations representing people. Most of these, Neovius re-identified as figures from the *Kalevala*. A few key examples include Väinämöinen (Ophiuchus), Ilmarinen (Orion), Lemminkäinen (Perseus), Joukahainen (Hercules), and Kullervo (Boötes). The most fitting substitution is Aino (Virgo), who was a young maid and Väinämöinen's love interest.

Sometimes, more creative substitutions were necessary for the story to work. For example, Cetus became the forge with bellows and spring. On Neovius's map, Serpens was not a snake but rather a wooden frame of the boat that Väinämöinen (Ophiuchus, the serpent-bearer) is building.

Much of the story of the *Kalevala* revolves around the Sampo, a magical object capable of producing wealth and prosperity. Its exact nature remains mysterious. In the *Kalevala*, the heroes attempt to steal the Sampo. from

[41] Andres Kuperjanov, 'Pseudomythological constellation maps', *Folklore* 32: pp.37–62; Charles Villmann, 'Esimene eestikeelne taevakaart, in *Teaduse ajaloo lehekülgi Eestist*, 1. Kogumik (Tallinn: Teaduste Akadeemia Kirjastus, 1968), pp.129–37.

the North, where Ilmarinen forged it as the price to marry the daughter of the Mistress of the North. However, during the battle, the Sampo is broken into pieces. These pieces are represented by the stars of Pleiades.

Fig. 5. A detail of Neovius's star map with explanations, showing Ilmarinen (Orion) and his forge.

Finally, Neovius notes that some of the less prominent or only partially visible constellations were not included in the narrative. No images were drawn, but the original Swedish and Finnish names were retained. These include the partly visible Sagittarius and Scorpius, as well as the dim constellation Cancer.

Conclusion

Edvard Engelbert Neovius was a truly remarkable man. His proposal for interplanetary communication was initially ignored, largely due to its cost. Later, optical telegraphy was surpassed by radio telegraphy, which would have been a far better way to communicate—if only there had been Martians. Neovius's ideas became fully obsolete when it was eventually discovered that Mars is not an Earth-like planet with life.

Similarly, Neovius's attempt to localize constellations using Finnish imagery did not gain traction. However, alongside the star maps by

Schiller, Weigel, and Grenzstein, it serves as a reminder that there is no single correct way to interpret the stars.

The current definition of a constellation as an area of the sky, rather than a connected group of stars, emphasizes our freedom to imagine any figure within it. However, geometric stick-figures have largely replaced the intricate illustrations that once adorned star maps. This shift appears to be practical: star maps are now less commonly used for decorative purposes. As a result, a constellation has been reduced to little more than an address in the sky.