La Verdadera Longitud Por Mar y Tierra Demostrada y Dedicada A Su Majestad Católica Felipe IV

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Cosmógrafo y Matemático de su Majestad en Flandes

1644

Con las censuras y pareceres de algunos renombrados y famosos Matemáticos de este siglo, ordenados por las fechas en que se hicieron

With the censure and opinions of some renowned and famous Mathematicians of this century, ordered by the dates in which they were done

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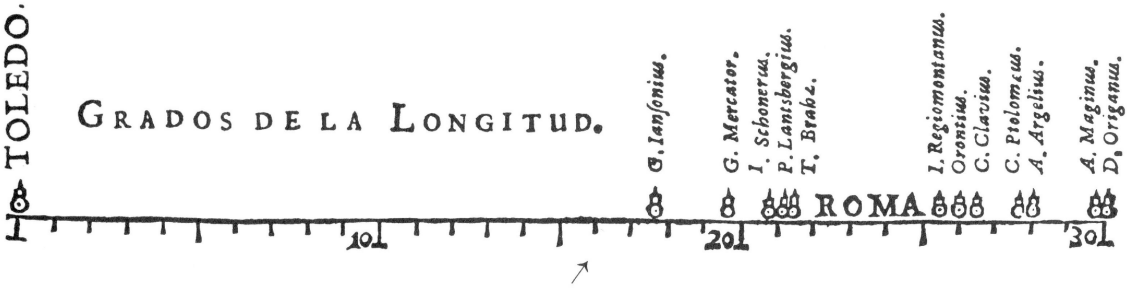
Miguel Florencio van Langren Matemático y cosmógrafo de su Majestad presenta las siguientes consideraciones de la Longitud por Mar y Tierra; y dice que su Padre y Abuelo fueron astrónomos y geógrafos, y en particular su padre asistió a las observaciones celestes realizadas por el famoso astrónomo Ticho Brahe, de quien recibió sus primeras observaciones, como consta por las obras del dicho Ticho. Así mismo su padre sirvió a su majestad como cosmógrafo en Flandes. Y el dicho van Langren, a imitación de sus antepasados, ha ejercitado en esas artes y descubierto cosas que no se sabían sobre la verdadera longitud por mar y tierra,

Michael Florent van Langren, his Majesty's Mathematician and cosmographer, presents the following considerations about Longitude by Sea and Land; and says that his Father and Grandfather were astronomers and geographers, and particularly his father attended the celestial observations carried out by the famous astronomer Tycho Brahe,[1] from whom he received his first observations, as mentioned in the works of said Tycho. Additionally, his father served his Majesty as the cosmographer in Flanders. And said van Langren, emulating his ancestors, has also practised in those arts and discovered things that were not known about the

*Roughly transcribed to modern Spanish and translated to English by his humble servants, Joquín Ibáñez Ulargui, Michael Friendly and Gustavo Vieira. All errors in this document are surely ours, and should not reflect ill on our Master.



apoyándose más en lo esencial que en lo especulativo. Y habiéndolo propuesto a la infanta Isabel, muy aficionada a dichas artes, ella le recomendó al rey por una carta en 1629 (página 9 de este documento), para que le encargase corregir la geografía. Su majestad lo aprobó por una real cédula, debido a los enormes errores que muestran las distancias calculadas por eminentes astrónomos y geógrafos entre Toledo y Roma, tal como se muestra en esta línea, por la cual se pueden conjeturar los errores entre lugares más distantes.

Una vez que VAN LANGREN informó a la infanta Isabel del invento de la longitud, se mando para que lo examinasen a ERYCIO PUTEANO y GODOFREDO VENDELINO, los cuales lo aprobaron, como consta al final de este documento (en latín en la página 10). Después la infanta Isabel envió a VAN LANGREN a España e n 1631 para informar directamente al rey, muy aficionado a estos estudios, y participó en observaciones celestes con VAN LANGREN. El rey ordenó que se publicasen las observaciones de VAN LANGREN con el título LUMINA AUSTRIACA PHILIPPICA, y también ordenó se le diese dinero tanto para la publicación como para lo tocante a la Geografía.

Por un Real Decreto del Consejo de Indias de la Corona de Castilla, VAN LANGREN escribió un memorial con las reglas teóricas y prácticas para que los pilotos calculasen los grados de longitud, a partir del modo del punto fijo y por navegación a latitud constante. Y habiendo enmendado la Geografía podrán saber cuantos grados hay entre el navío y el lugar donde se desea ir, sin necesidad de fantasía ni escuadra, como se venía haciendo hasta ahora, con gran daño y pérdida de muchos navíos. Siendo todo tan exacto que el error será menor de dos o tres leguas en latitudes medias y menor de cuatro o cinco leguas en el Ecuador.

El importante secreto de la longitud ha sido investigado por eminentes científicos. Como los reyes católicos han ofrecido mucho dinero al que lo resolviese, ha habido muchos que lo han intentado resolver, dando lugar a muchos gastos y abusos, dando lugar a que los reyes desconfíen de las promesas de los que dicen tener la solución. Cuando VAN LANGREN estuvo en Madrid, explicó el secreto de la longitud a dos eminentes matemáticos. Pero fue en vano, porque se pens-

true longitude by sea and land, based more in the essential than in the speculative. And having conveyed it to the infanta Isabel,[2] very interested in said arts, she recommended him to the king by letter of 1629 (page 9 of this document), for him to be entrusted with correcting the geography. His Majesty approved him by royal decree, due to the enormous errors shown in the distances between Toledo and Rome calculated by eminent astronomers and geographers, as can be seen in this line,[3] by means of which one can conjecture larger errors between more distant places. p.4

Once VAN LANGREN informed infanta Isabel about the invention of longitude, it was sent to ERYCIO PUTEANO and GODOFREDO VENDELINO for analysis, who approved it, as seen at the end of this document (in Latin on page 10). Later infanta Isabel sent VAN LANGREN to Spain in 1631 to report directly to the king, very interested on these studies himself, having participated in celestial observations with VAN LANGREN. The king ordered VAN LANGREN's observations be published with the title LUMINA AUSTRIACA PHILIPPICA,[4] and also ordered that he was given money both for the publication as well as for the matters relating to Geography.

By a Royal Decree of the Council of Indies of the Crown of Castile, VAN LANGREN wrote a memorandum with the theoretical and practical rules for pilots to calculate the degrees of longitude, from the fixed-point method[5] and by navigation at a constant latitude. And having corrected the Geography they could know how many degrees there are between the ship and the place where one wants to go, without the need of dead reckoning or square,[6] as it had been done until now, with large damages and losses of many ships. All being so accurate that the error will be less than two or three leagues[7] in medium latitudes and less than four or five leagues at the Equator.

The important secret of longitude has been investigated by eminent scientists. As the catholic kings have offered a lot of money to whom solved it, many have tried to solve it, resulting in many expenses and overtures, and in kings suspecting the promises of those who say they have the solution. When VAN LANGREN was in Madrid, he explained the secret of longitude to two eminent mathematicians. But it was in vain, because it was thought that it was impossible to find a so-

aba que era imposible encontrar una solución.

El primero que trató de resolver el problema de la longitud del mar por la brújula en este siglo fue el portugués Luis de Fonseca Coutiño; El rey Felipe III le prometió por Real Cédula 6.000 ducados de renta perpetua anual, con la promesa de otros 2.000 ducados más de por vida.

El doctor Arias de Loyola, castellano, le propuso resolver el problema de la longitud en 1612, que no contento con los 6.000 ducados anuales, el rey le prometió 2.000 ducados más de por vida.

En 1629 se presentó el jesuita P. Cristóval de Bruno Milanez, con una variación de la brújula, después de haber navegado por todo Oriente.

En 1630 se presentó el genovés Antonio Ricci, que pretendía observar la longitud sin necesidad de ver el Cielo.

En esa misma época propuso otra solución don Juan Caramuel Loscowitz, natural de Madrid, Abad Disembergense en el Palatinado inferior, pidiendo 100.000 ducados al contado.

El gran músico Pedro de Herreña, experto en geometría, quiso resolver el problema a partir del movimiento de la Luna, pero murió antes de publicarlo.

En 1631 el Señor Conde Duque le dijo a van Langren que el matemático florentino Galileo Galilei había propuesto una solución basada en las Estrellas Mediceas.

van Langren propuso el secreto de la Longitud el 7 de enero de 1632, cuyo memorial llegó al Consejo de las Indias el 10 de mayo de 1633. Los representantes fueron Marquez de Oropeso y Lorenzo Ramirez de Prado, que aconsejaron al rey dar a van Langren 4.000 ducados, como consta por un papel impreso que entregó a los amantes de las Matemáticas para preservar su reputación, antes de volver a Flandes en 1634 por orden del rey. van Langren sospecha que Fernandez de Contreras, secretario del Consejo no ha presentado la opinión de esos representantes en el Consejo.

En 1635 vino cierto Veneciano que se volvió a su país, sin proponer nada.

En 1637 lo intentó Joseppe de Moro, que después de haber dado dos vueltas al Mundo, propuso resolver el problema de la longitud a partir de la variación de la brújula.

The first who tried to solve the problem of longitude at sea with the compass in this century was the Portuguese Luis de Fonseca Coutiño; King Philip III promised him by Royal Decree 6,000 ducats[8] of perpetual annual income, with the promise of another 2,000 ducats more for life.

Doctor Arias de Loyola, castillian, proposed to solve the problem of longitude in 1612, not satisfied with the 6,000 annual ducats, the king promised him 2,000 ducats more for life.

In 1629 the Jesuit P. Cristóval de Bruno Milanez presented a variation of compass, after having navigated all over the Orient.

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In 1630 the Genovese Antonio Ricci was presented; he intended to observe longitude without the need to see the sky.

In that same period, Don Juan Caramuel Loscowitz, native of Madrid, Abbot of Disibodenberg in the lower Palatinate, proposed another solution asking 100,000 ducats in cash.

The great musician Pedro de Herreña, expert in geometry, wanted to solve the problem by the movement of the Moon, but died before publishing it.

In 1631 Conde Duque told van Langren that the Florentine mathematician Galileo Galilei had suggested a solution based on the Medicean Stars.[9]

van Langren proposed the secret of longitude on January 7, 1632, such memorandum having arrived at the Council of the Indies on May 10, 1633. The representatives of the Council were Marquez de Oropeso and Lorenzo Ramirez de Prado, who advised the king to give van Langren 4,000 ducats, as it is stated in a printed paper that he delivered to the fanciers of the Mathematics to keep his reputation, before returning to Flanders in 1634 by order of the king. van Langren suspects that Fernandez de Contreras, secretary of the Council, has not submitted the opinion of those representatives in the Council.

In 1635 came a certain Venetian who returned to his country without proposing anything.

In 1637 Joseppe de Moro made an attempt, who after having gone around the World twice, proposed to solve the problem of longitude from

tir de las variaciones de la brújula. Se hicieron muchas reuniones de nobles y matemáticos, y el rey le prometió grandes mercedes, pero como su solución se basa en la variación de la brújula (como casi todos los referidos), VAN LANGREN no se extrañó que haya fallado el intento de Moro.

En Holanda varias personas intentaron resolver el problema, como JUAN HEINDRIXE LUY en 1615 a partir del rumbo del navío en el mar, pero después mucho gasto y de haberlo probado en el Océano, se comprobó que no funcionaba. A VAN LANGREN le gustaría que este propósito se considerasen los interesantes estudios de R.P. DELLA FAILLE.

En Francia hizo muchos estudios el doctísimo JUAN BAPTISTA MORIN, profesor matemático del rey, que tuvo muchas discusiones con los Matemáticos de Francia en 1634, y quiso imitar lo que Vernero y Oroncio habían escrito hace mucho tiempo, observando la Luna en el meridiano respecto de alguna estrella, sin poder resolverlo por la dificultad de la paralaje y la refracción de la Luna, y porque no aceptaban las teorías del movimiento de la Luna elaboradas tanto por los antiguos, como por los modernos. Estando el secreto de la longitud (como todo el mundo sabe) en conocer la verdadera longitud y latitud de la Luna, tanto en el cielo como en las tablas Astronómicas, sin que ningún astrónomo lo haya podido resolver exactamente.

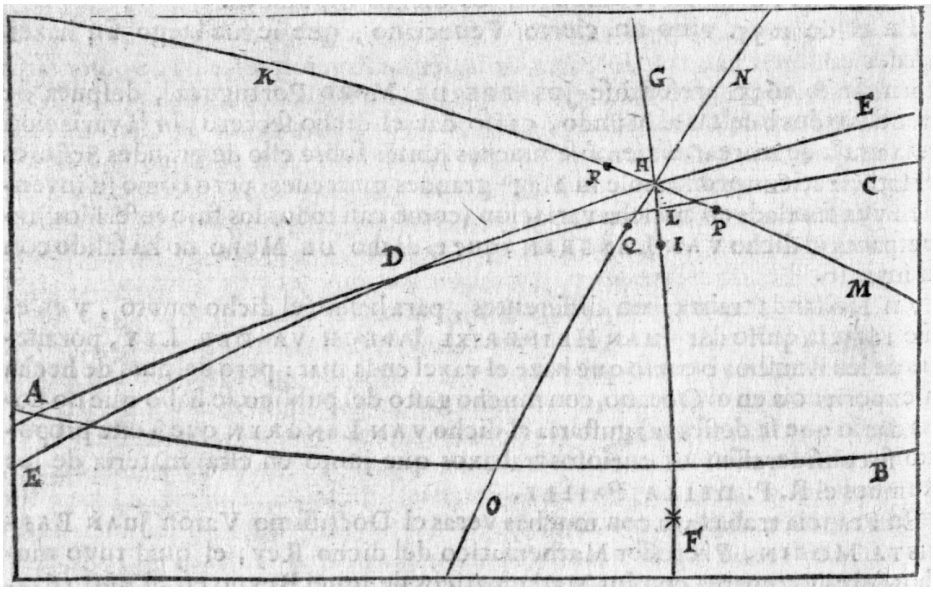
VAN LANGREN inició el estudio de la Longitud por mar y tierra por medio de la Luna en el año 1621. En 1625 informó a la infanta Isabel acerca de este método para calcular la Longitud, así como de un segundo método que VAN LANGREN había descubierto (que está escrito más adelante en letras oscuras), como se conoce por una carta que escribió la infanta Isabel a su Majestad en el mismo año de 1625.Pero como VAN LANGREN estuvo ocupado en un viaje por España, hubo de esperar al 5 de marzo de 1631, en que por orden de la infanta Isabel, realizó la demostración del cálculo de la Longitud en el meridiano ante los eminentes científicos E. PUETANO y GODEFREDO VENDELINO, como consta por la certificación y aprobación que le dieron. En esa exposición, VAN LANGREN mostró el método de la Luna con otros dos modos nunca oídos, que se fundamentan en poder hallar el verdadero lugar de la Luna,

the variations of the compass. Many meetings were held with noblemen and mathematicians, and the king promised him big awards, but as his solution is based on the variation of the compass (like almost all the above-referred), VAN LANGREN was not surprised that Moro's attempt has failed.

In Holland several people tried to solve the problem, like JUAN HEINDRIXE LUY in 1615 from the path of the ship at sea, but after much expense and having tested it in the Ocean, it was proven that it did not work. VAN LANGREN would like that for this purpose the interesting studies of R.P. DELLA FAILLE[10] were considered.

In France, scholar JEAN-BAPTISTE MORIN, mathematics professor to the king, did many studies and had many discussions with the Mathematicians of France in 1634,[11] and wanted to emulate what Vernero and Oroncio[12] had written a long time ago, observing the Moon in the respective meridian of a given star, without being able to solve it due to the difficulty of parallax and the refraction of the Moon, and because they didn't accept the theories of the movement of the Moon elaborated both by ancients and moderns. The secret of Longitude is (as everyone knows) in knowing the true longitude and latitude of the Moon, both in the sky and in the Astronomical tables, without any one astronomer having been able to solve it exactly. p.6

VAN LANGREN started the study of Longitude of sea and land by means of the Moon in the year 1621. In 1625 he informed the infanta Isabel[13] about this method to calculate Longitude, as well as a second method that VAN LANGREN had discovered (which is written later in code[14]), as it is known from a letter that infanta Isabel wrote to his Majesty in the same year of 1625. But as VAN LANGREN was busy on a trip to Spain, he had to wait until the 5th of March of 1631, when, by order of the infanta Isabel, he carried out the demonstration of the calculation of Longitude on the meridian before the eminent scientists E. PUETANO and GODEFREDO VENDELINO, as shown by the certification and approval that they gave him. In that demonstration, VAN LANGREN showed the method of the Moon with other two unheard-of methods, that are based on being able to find the true position of the Moon, either



ya sea en el meridiano o en cualquier azimut, cuando la vemos por la noche, porque el Sol dificulta su visión de día. VAN LANGREN había realizado ese tipo de observaciones, tanto en Madrid como en Bruselas, como se muestra en la siguiente figura. En esas observaciones VAN LANGREN no tuvo problemas con la paralaje o refracción de la Luna, con la cual todos los Astrónomos han tenido muchas dificultades, como se conoce por sus escritos.

Por ejemplo, sea AB la línea Equinoccial y AC la línea Eclíptica, y sabiendo por las tablas que Caput Draconis está en D, se traza la línea DE que es el recorrido de la Luna; según valga el ángulo CDE, la Luna aparecerá en el meridiano sin o con estrella conocida como F, trazándose por ella la línea meridiana FG en la esfera celeste, con lo que se cortará el camino de la Luna en H, que es el verdadero lugar de la Luna, aunque visualmente parezca que está en I, más abajo que H.

Trazando la línea HL, perpendicular a la línea eclíptica AC, se obtiene que la verdadera longitud de la Luna es L, y que su latitud es LH. De la misma manera, aunque veamos a la Luna en algún Azimut Oriental, como los puntos P y R de la línea KM, u Occidental, como el punto Q de la línea NO, el verdadero lugar de la Luna estará donde su camino se cruce con el círculo vertical.

on the meridian or on any azimuth, when we see it at night, because the Sun hinders its vision by day. VAN LANGREN had carried out this type of observations, both in Madrid and in Brussels, as shown in the following figure. In these observations VAN LANGREN overcame had no problems with the parallax or refraction of the Moon, with which all the Astronomers have had many difficulties, as one knows from their writings.

For example, let AB be the Equinoctial line[15] and AC the Ecliptic line,[16] and knowing from the tables that Caput Draconis[17] is at D, line DE is drawn, which is the path of the Moon; according to the value of the angle CDE, the Moon will appear on the meridian with or without the star known as F, drawing through it the meridian line FG in the celestial sphere, which will cross the path of the Moon at H, which is the true position of the Moon, although visually it seems that it is at I, lower than H. p.7

Drawing the line HL, perpendicular to ecliptic line AC, it is obtained that the true longitude of the Moon is L, and that its latitude is LH. In the same way, although we see the Moon in some Eastern Azimuth, as the points P and R of the KM line, or Western, as point Q of line NO, the true position of the Moon will be where its course crosses the vertical circle. Thus it does not matter

De manera que no importa saber los minutos de la Paralaje o Refracción de la Luna.

Cotejando dicho lugar de la Luna, L, con las tablas de la Luna calculadas por los más famosos Astrónomos sobre cualquier meridiano de la Tierra, se obtendrá la verdadera Longitud por la diferencia que hay entre el dicho meridiano Radical y en el que se hace la observación, proyectada sobre la línea Equinoccial.

Pero como la mayoría de tablas Astronómicas varían entre ellas y son para diferentes Cielos, VAN LANGREN ha dedicado muchos trabajos para hallar la verdadera Teoría, recorrido y movimiento de la Luna, que son tan diferentes de los de PTOLOMEO, COPERNICO, TICHO, LOGOMONTANO, LANTSBERGIO y Vendelino, que presume que su Teoría no varía en nada con el Original, pues gracias a sus trabajos conoce todos lo beneficios que se observan en el Cielo, y explicará esta materia de manera tan fácil, que los Marineros podrán aplicarla sin grandes cálculos tanto en mar como en tierra, como si fuesen Matemáticos (aunque deberán conocer las estrellas, instrumentos y algo de Aritmética).

También explicará algunas de sus observaciones sobre el Sol y los Planetas, representadas por líneas fáciles, desembarazadas de los métodos antiguos, mostrándose muy fácilmente con hilos y perpendiculares, los minutos de su situación o lugar, en mejor forma que la realizada por hombres eminentes; como PUTEANO, VENDELINO, DELLA FAILLE, CARAMUEL, GOITSICHOVEN, COECE y BODEGNE; los cuales también han participado en la demostración referida anteriormente sobre la observación de la Luna sin paralaje, satisfaciendo con estas curiosidades la gran afición de Don ANDRE CANTELMO, Maestre General de Campo, CHIFLETIO, DE BIE, BLITTERSWICK y DUDINGIO, que también han elogiado los métodos empleados por VAN LANGREN para observar los Eclipses Lunares, por medio de las Montañas e Islas (de la Luna) que él ha descrito hace muchos años, y los (eclipses) Solares con las Oscilaciones de un perpendículo (cuerpo que oscila suspendido de un hilo o varilla a modo de péndulo) de hierro, que mide tiempos muy cortos e iguales, que descubrió en 1627, mucho antes de la publicación de GALILEO, como se puede demostrar por sus observaciones, y que PUTEANO y VENDELINO es-

to know the minutes of the Parallax or Refraction of the Moon.

Comparing this position of the Moon, L, with the tables of the Moon calculated by the most famous Astronomers on any meridian of the Earth, the true Longitude will be obtained by the difference existing between said Radical meridian and the one on which one makes the observation, projected over the Equinoctial line.

But as most of Astronomical tables vary among themselves and they are for different Skies, VAN LANGREN has done many works to find the true Theory, path and movement of the Moon, which are so different from those of PTOLEMY, COPERNICUS, TYCHO, LONGOMONTANUS, LANTSBERG and VENDELINO[18] that he assumes that his Theory varies in nothing from the Original, because thanks to their works he knows all the benefits observed in the Sky, and he will explain this matter in such an easy way that the Sailors will be able to apply it without big calculations both at sea and in land, as if they were Mathematicians (although they shall have to know the stars, instruments and something of Arithmetic).

He (VAN LANGREN) will also explain some of their observations on the Sun and the Planets, represented in easy lines, untangled from the old methods, showing the minutes of their location very easily with threads and plummets, in a better way than the one carried out by eminent men; like PUTEANO, VENDELINO, DELLA FAILLE, CARAMUEL, GOITSICHOVEN, COECE and BODEGNE; who have also participated in the previously referred demonstration about the observation of the Moon without parallax, satisfying with these curiosities the great fondness of Don ANDRE CANTELMO, General Field Master, CHIFLETIO, DE BIE, BLITTERSWICK and DUDINGIO, who have also complimented the methods used by VAN LANGREN to observe the Lunar Eclipses, by means of the Mountains and Islands (of the Moon) that he described many years ago, and the Solar (eclipses) with the Oscillations of a plummet (body that oscillates suspended by a thread or rod by means of a pendulum) of iron, that measures very short and equal times, that he discovered in 1627, much before the publication of GALILEO, as can be demonstrated by his observations, and that PUTEANO and VENDELINO much

timáran mucho en 1631.

Con ese instrumento tan simple (perpendículo), él ha observado muchas veces los diámetros del Sol y sus manchas, y la Luna con sus manchas, y hallado su longitud y latitud en los globos celestiales por aquel método, con las diferencias ascensionales de algunas estrellas fijas, y también la distancia entre Jove y sus compañeros, con el ángulo aparente de su grandor.

Él también explicará algunos eclipses Lunares y Solares, con demostración natural del aspecto, precisando la verdadera figura de la sombra Lunar en el planisferio de la Tierra, de una manera similar a como lo hizo en el Eclipse del Sol del ocho de abril de 1633 (fecha del nacimiento de aquel gran Monarca) en presencia de su Majestad, del cual han tenido noticia todas las personas referidas.

También publicará un método admirable y nunca oído para medir las distancias de una estación, junto con otras cosas no vulgares, lo cual servirá para adornar y cumplir con su obligación de satisfacer el Real deseo.

El dicho VAN LANGREN suplica muy humildemente que su Majestad se sirva mandar que todo lo anteriormente dicho sobre la longitud sea considerado por sus Reales Consejos y por los más eminentes Matemáticos, Cosmógrafos y Pilotos, para que juzguen si como buen y fiel Vasallo merece la honra del premio de la Longitud navegante, cuya merced y gracia remite a la benigna clemencia y voluntad de su Real grandeza.

VAN LANGREN asegura que ni su Majestad ni sus Reales Consejos, han visto jamás una demostración tan buena de la Longitud, aprobada por los más eminentes Matemáticos y Astrónomos de este tiempo, como consta por los escritos que su Majestad será servido de leer al final de este documento

VAN LANGREN también pide muy encarecidamente a los Profesores de las Matemáticas y a los amadores de la Astronomía y Navegación, que le honren con sus pareceres, y que una vez recibidos los pueda imprimir, en Bruselas en casa del Conde Lamoral de TAXIS, Correo mayor de su Majestad.

esteemed in 1631.

With such a simple instrument (plummet), he has observed many times the diameters of the Sun and its spots, and the Moon with its spots, and found its longitude and latitude in the celestial globes by that method, with the ascendant differences of some fixed stars, and also the distance between Jupiter and its companions, with the apparent angle of their size.

He will also explain some Lunar and Solar eclipses, with natural demonstration of the aspect, determining the true figure of the Lunar shadow in the planisphere of the Earth, in a similar way as he did in the Solar Eclipse of April 8, 1633 (date of birth of that great Monarch), in presence of His Majesty, of which all the referred people have had news.

He will also publish an admirable unheard method to measure the distances of a station, along with other non vulgar things, which will serve to adorn and to fulfill his obligation of satisfying the Royal desire.

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Said VAN LANGREN very humbly implores his Majesty to order all of the above said about the longitude to be considered by his Royal Councils and by the most eminent Mathematicians, Cosmographers and Pilots, so that they judge if, as a good and faithful Vassal, he deserves the honour of the prize of the navigating Longitude, whose mercy and grace remits to the benign clemency and will of his Royal greatness.

VAN LANGREN assures that neither his Majesty nor his Royal Councils, have ever seen such a good demonstration of Longitude, approved by the most eminent Mathematicians and Astronomers of this time, as noted in the writings that his Majesty will be served to read at the end of this document.

VAN LANGREN also asks very kindly to the Professors of the Mathematics and those lovers of Astronomy and Navigation, that they honour him with their opinions, and that once such are received he can print them, in Brussels at the house of Count Lamoral of TAXIS, Post major of his Majesty.

M. F. van Langren

IL PROPOSICION

De la Longitude Navegante, que proposo el dicho VAN LANGREN a su Majestad como consta por el memorial, quefue leido en el R. Consejo de las Indias; Y es en la forma figuiente, que explicara quando lo mandare su Majestad.

Of the Navigating Longitude, said VAN LANGREN proposed to his Majesty as noted in the memorandum that was read in the R. Council of the Indies; And it is in the following manner, that he will explain when his Majesty orders.

ImIeV9 ap3Apa Ihrr5e tlSmeIf9 5lesEortEr 5e eadnu9c Rtl9e9T omgupea Nſnnd cAlveMa
dfneagL p9rIir5 rEant tdTeo9Im nc5T9t noqCtuN veroQn nnmEef alarRl 9kIe raIman
Me4tn eqtIu u4xV eu ulriqDa ſuVne etſelId ſe5tſ couAu 9f9Vldu lir5te Tce4o vEe7oſnE
i5uameg Ebſe lodRa 9ebtſl Sa95u rVcmai AenprIt a9dL3do9 9nRt e3enqQe cun5ef
Etſot dEr 5emus Oeacdſae 5ucſoMe e9lrrI9 acnuoEd umr92 L5d9a5 eI9cnai dnneNt t4pAIeai
gPrmrO e5e VnſzbmF oaenſeS5 uſlOnt teoDe p9noIl l9lo Enen trEge59 cut To 9uned
V9neq ItduLau Deum NamDe nEerEmſ9 9LmdVl eR99mEe e5nOu rdTd9 oOedu
I9oVa5 nqnp ntEaE eerlVrt lLrT9 5etoſ Y9ntl Sfrnae eG9a6 rſaiIau uulAnoTtp 9qVe ruIcſeT
t9pOu erE9 leLſln Ecedo EſrNn eMeſu 3Nove Ar9ſ VmdtS qcVeueEd oVn9nufu R9fenPe
utrTl 5eAten Aftca qTe9u prSa a5trOl rle5ef hRſ95 eDluſ Iert5 eoVa ſ9qc lS u elalet
eſ9Oſd qtuuef eſ9pero tmuaaru mumeuen yſtdm aeeuNr 9tlne eſnmſt pTdaſ 9n3t taMe
qnſutu euDalnſa depesE rſeedtm9 l9tVe5e ſrſaeu H9uia aſnſet tReſrc ſe eomſ9p ſtAle v9du
Qdc95 3dLloe eu5ale uea4Rrfe ſ9l5na4 dAme 5nnr neoeſR nrtcaro oe7uſOn uuoer9r pſtc
tEn9e rnresEa aoplna afrſa lSe9 Eecrſoae nTff4l teoolLt 9atlq elnr eeuſlCn elune e3frLo 97mneb
9tE9r teaena aduNue ſ4tf9Ve ytm ccpaNe ſnled9 lCln ladXedr ſS9eſ tſe5u uepuIſ p9todNo
re9tnl etlpLe eaeſ rqeEurua aeE9alau qCnmu te5Snſ lom9t Ce5em gRoeenr dPl9ea
dNq9 9nTſeos nyMed 4ru9al ec9uoeE Inuold ue uurdeD.

Note: In the above transcription of van Langren's cipher, hyphenated words were completed on the initial line of the original.

COPIE

D'VNE LETTRE ESCRITE DE LA

Sereniſſime Princeſſe ISABELLE CLAIRE EVGENE

Infante d'Eſpañe, a ſa M^té^ Catholique

MONSEIGNEUR

Michel Florencio van Langren Mathematicien de V. M^té^ ayant trouvé depuis naguerres une invention fort belle & utile au publicq, comme elle a eſté recognue par le Conſeillier Puteanus & Godefroy Vendelinus, comme perſonnages bien entendus en cette matiere: I'ay trouvé convenir de l'envoyer vers V. M^té^ pour luy en faire la premiere ouverture, & la publier ſoubs ſon Royal nom. Ladicte invention qui eſt celle de la longitude, ſervira grandement pour rectifier la diſtance des lieux terreſtres, redreſſer toute la Geographie, qui eſt un chemin pour venir á la longitude navigante. Et comme la peine qu'il a prins á cette occaſion a eſté fort grande, & que d'ailleurs il a frayé beaucoup, comme il devra encores faire aux inſtrumens requis pour dreſſer ſes obſervation: Ie ſuis occaſionné de requerir V. M^té^ de luy accorder un traictement autant digne & liberal que la rareté & utilité de ladicte invention, dont il eſt le premier & ſeul Auteur, ſemblera meriter, pour l'encourager tant plus á decouvrir ladicte longitude navigante, qui a fatiguée tant de bons eſprits, Ie prie ſur ce le Createur de combler V. M^té.^ Monseigneur de tout heur & proſperité á longues & tres-heureuſes années. A Bruxelles le 5. de luillet 1634

DE V. Mté

Tres - humble Tante

A. ISABEL

CENSURÆ

Virorum aliquot in Matheſeos Arte illuſtrium, ſuper correctione longitudinis, tum terreſtris, tum maritimæ, excogitata á MICHAELE FLORENTIO LANGRENO Belga, latae quondam Serreniſſimæ Principis ISABELLÆ CLARÆ EUGENIÆ, Hiſpaniorum Infantis, ac deinde Regis Catholici juſſu

PRIMUM modum praxi eſſe accomodatum. nec incommodis ullis obnoxium, eoq longitudines locorum investigari poſſe, tam accuraté, ut vix uno horæ minuto (cui quarte unius gradus particula correſpondet) a veris aberrent, quo temporis ſpatio crupuloſiús exigi cum ratione nihil poßit. Secundum veó modum præter effectus parem cum primo certitudinem ab inventi ſubtilitate magis commendari. Tertium denique ingenioſißimum, ſummæq utilitatis; ut, vc. Lovanii 5. Martii M.DC.XXXI.

EURYCIUS PUTEANUS, Conſil. & Hiſtoriog. Regius

GODEFR. VENDELINUS, I. V. D. Paſtor in Betz.

MICHAEL Florentius van Langren é Belgio venit, ut Regi repræſentet á ſe duobus modis inventam eſſe rationem inquirendi locorum longitudines; Vnum pro terreſtri locorum longitudine, ut ejus beneficio Tabulæ Geographicæ reſtituantur, quæ innumeris ſcatent erroribus, ut ille manifeſte oſtendit, cuitibet conſtat, varias inter ſe tabulas comparanti. Alterum, qui navigantibus ſubſerviat, quód hujus inventi ignorantiâ tantum detrimenti ars náutica patiatur, ut glorioſæ memoriæ PHILIPPUS III. *magna inventori præmia propoſuerit. Primum inventum jam in Belgio viſum, doctißimorum virorum calculo approbatum, mihi, pridem oſtendit, poſtulatam á me approbationem obtinuit, cujus examen cúm diu dilatum fuerit, vereaturq eandem moram ſecundo injiciendam, utrumq inventum eidem ſubjicere examini decrevit; quod ue faciliús aſſequatur, ſecundum ſub ſecreti fide nihi modó aperuit, cenſuram ſcripto ſivi tradſi poſtulavit. Dico itáque inventum mihi detectum verum eſſe, non ſolium huic fini aptum, ſed meo juicio inter omnia quæ hactenus vidi, maximé ſecurum, facile, uſui accommodatum, præcipué, quód inventor reipsâ experientiâ probaturum ſe illa aſſerat, quæ ad executionem neceſſaria erunt. In quórum fidem has meâ manu ſubſcripſi. Matriti 17 Ianuarii 1633.*

IOANNES DELLA FAILLE, SOC IESU in Collegio Imperiali Regius Matheſeos Profeſſor

Historical and translation notes

1 The grandfather, Jacob Floris van Langren, was an Amsterdam globe maker who produced a series of important terrestrial and celestial globes beginning in 1586. His son and Michael's father, Arnold Floris van Langren (ca. 1571–1644) worked as engraver and globemaker in the family enterprise. To develop their celestial globes, Arnold was sent to visit with Tycho Brahe at his Uraniborg observatory in Hven in 1590, in order to copy Brahe's observations of stellar positions. See: Peter van der Krogt (1993). *Globi Neerlandici: The Production of Globes in the Low Countries*. Utrecht: HES Publishers, for further details on the van Langren family and their globes.

2 The term "infanta" (princess) is the title given to the daughter of a reigning monarch who is not heir-apparent to the throne. Infanta Isabella Clara Eugenia was the daughter of Phillip II of Spain, and with her husband Albert VII, Archduke of Austria, appointed joint sovereign of the Spanish Netherlands in the Low Countries in 1601. She became Arnold van Langren's patron in Sept. 1609, naming him official Spherographer (globemaker) and would later become Michael's patron, actively supporting his work.

3 van Langren refers here to the line graph shown at the bottom of page 1, an earlier version of which he had presented in a letter to Isabella in 1628.

4 This is the title of the first detailed lunar map, published in 1645, identifying and naming 325 topographic features (craters, peaks) he identified on the surface of the moon. The goal was to be able to use observations of sunrise (lightening) and sunset (darkening) on these lunar features as an accurate method to determine longitude at sea. The book referred to would consist of a set of ephemeris tables, recording the onset in standard time of these events on the days of the lunar cycle, together with instructions on the calculation of longitude. As far as we know, this book was never completed.

5 To measure longitude a person needs to know the time difference between where they are and some other fixed point, because one hour of time difference corresponds to $360/24 = 15^o$ of longitude difference, relative to that location.

6 We interpret this from "punto de fantasía" as "dead reckoning," the process of estimating one's current position by advancing a previously known position based on direction and estimated speed; an escuadra is a right triangle or set square for drafting or drawing.

7 The Spanish League or *legua* was originally set as a fixed unit of distance of 5,000 varas (0.82 m each), or about 4.2 km (2.6 miles), but the unit had a common-sense interpretation as the distance a man could walk in one hour. Considering the vagueries of navigation, 2–3 leagues is a relatively large margin of error by later standards, but was relatively quite narrow in van Langren's time.

8 The ducat was a coin of about 3.5 grams or 0.1107 troy ounces of pure gold that was used as one standard throughout Europe, especially after it was officially imperially sanctioned in 1566. 6000 ducats would have amounted to 21 kg. of gold or 664 troy ounces. At a current price of $900 USD per troy ounce, that would be nearly $600,000.

9 The first four moons of Jupiter were discovered by Galileo in 1610 and described in *Sidereus Nuncius*; he named these moons the "Medicean Stars" to honor Grand Duke Cosimo de Medici (and his three brothers), from whom Galileo sought patronage. In 1612, having determined the orbital periods of Jupiter's satellites, Galileo proposed that with sufficiently accurate knowledge of their orbits one could use their positions as a universal clock, and this would make possible the determination of longitude. By June 1613 he tackled the problem of determining longitude at sea using observations of the eclipses of the Jovian moons. Galileo worked on this problem from time to time during the remainder of his life; but the practical problems were severe. The method was first successfully applied by Giovanni Domenico Cassini in 1668 and improved in 1681. See: Waters, D. W. (1964), "Galileo and Longitude: Fundamental Contributions to a Fundamental Problem," *Physis*, 6:287-302. It is therefore surprising (or perhaps disingenuous) that van Langren would not have heard of Galileo's proposals before 1631, since in 1613 Galileo entered into negotiations with the Spanish Crown to provide Spanish navigators with eclipse tables for the satellites.

10 Jean-Charles della Faille (1597–1652) was a Flemish Jesuit mathematician who became an advisor to King Phillip IV in Madrid around 1629, and was nominated a royal cosmographer by the Council of the Indies in 1638. His views on the problem of longitude and Langren's proposals would therefore have carried much weight. Della Faille became an enthusiastic supporter of van Langren and wrote numerous letters to the Council on his behalf. See: de Vyver, O. V. (1977), "Lettres de J.-Ch. della Faille, S.I., Cosmographe du Roi Madrid à M.-F. van Langren, Cosmographe a Roi Bruxelles, 1634–1645," *Archivum historicum Societatis Iesu*, 47, 73–183; e.g., letters 3,5.

11 In 1634, Morin (1583–1656), a catholic mathematician and astronomer, proposed some steps toward the solution of the longitude problem that were extensions of the lunar method to determine time at sea by the position of moon relative to tabulated star positions. His main contribution which van Langren cites here, was in attempting to correct for the apparent displacement of the moon (parallax) when viewed from different positions. It is of some interest that Morin is best known for being opponent of Galileo and the Copernican view of the solar system.

12 Oronce Finé (1494–1555), a French mathematician and astronomer also wrote on the use of lunar eclipses to determine longitudes.

13 van Langren first met Isabel in Dunkirk in 1625, most likely through an introduction by his father, Arnold.

14 "letras oscuras" clearly refers to the ciphered text printed at the bottom of page 8.

15 The equinoctial line is the celestial equator, or the great circle on the celestial sphere midway between the celestial poles; it is so-called because when the sun is on it, days and nights are of equal length in all parts of the world.

16 The ecliptic is an imaginary line in the sky that represents the plane of the earth's orbit around the sun. In van Langren's time, this was determined by marking the positions where solar and lunar eclipses occurred.

17 In the astronomy of the 15^{th} C., Caput Draconis ("Dragon's head") was the ascending or north-going node of the moon's orbit (i.e. intersection between the ecliptic and the moon's visible path in sky as seen from earth)

18 Christen Sørensen Longomontanus (1562–1647) was a Danish astronomer and chief assistant to Tycho Brahe.