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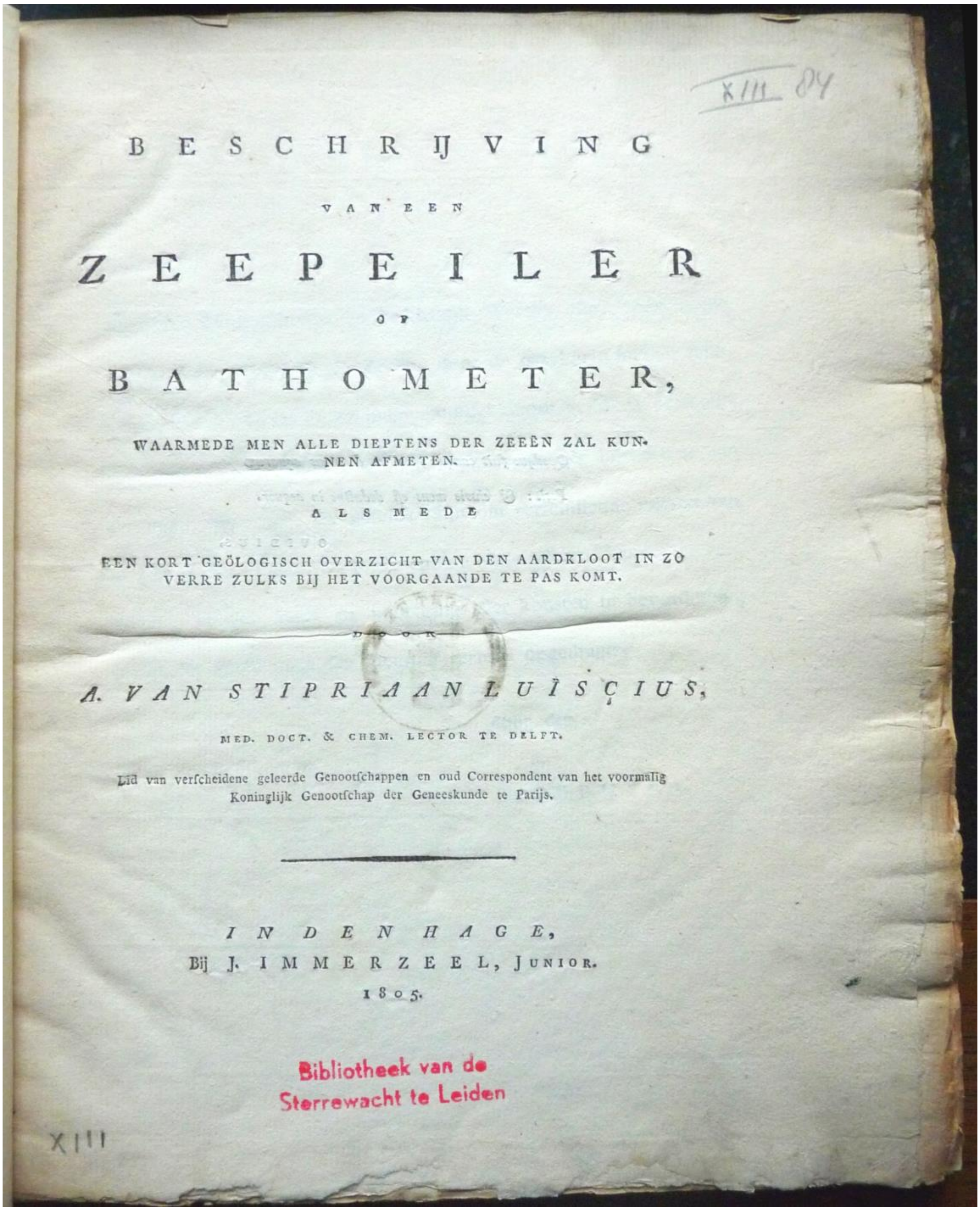

BESCHRIJVING

VAN EEN

ZEEPEILER

OF

BATHOMETER,

WAARMEDE MEN ALLE DIEPTENS DER ZEEËN ZAL KUNNEN AFMETEN.

ALS MEDE

EEN KORT GEÖLOGISCH OVERZICHT VAN DEN AARDKLOOT IN ZO VERRE ZULKS BIJ HET VOORGAANDE TE PAS KOMT.

DOOR

A. VAN STIPRIAAN LUÌSÇIUS,

MED. DOCT. & CHEM. LECTOR TE DELFT.

Lid van verſcheidene geleerde Genootſchappen en oud Correspondent van het voormalig Koninglijk Genootſchap der Geneeskunde te Parijs.

IN DEN HAGE,

Bij J. IMMERZEEL, JUNIOR.

1805.

Van Stipriaan Luïsçius, A., 1805. Beschrijving van een zeepeiler of bathometer, waarmede men alle dieptens der zeeëen zal kunnen afmeten, alsmede een kort geölogisch overzicht van den aardkloot in zo verre zulks bij het voorgaande te pas komt. J. Immerzeel Jr., In den Hage, pp.48. Description of an unknown early wireless sounder, with price list (see article).

Kees J.M. Kramer: The '*Zeepeiler*' or Bathometer of Adriaan van Stipriaan Luïsçius. I.

Introduction

In 1805 A. van Stipriaan Luïscius published a monograph with a description of his invention, an early device for sounding the depth of the sea, which operated without a lead-line. He called it a '*Zeepeiler*' [sea-sounder] or Bathometer (not in McConnell, 1982; not in Carpine, 1996). This monograph is in Dutch, but in the same year and at the same printers a French edition was published (Van Stipriaan Luïcius, 1805a,b), calling it a 'Sonde de Mer ou Bathometre'. Few years later a shorter description became available in German (Van Stipriaan Luicius, 1809), using 'Meeressonde oder Bathometer'. No edition seems to have appeared in English.

A. van Stipriaan Luïsçius (in the literature also written as Lucicius, or even Van Styprian Luiscius [Lucius]) was born in Oudewater, 10 October 1753, as Abraham van Stipriaan. In 1784 he entered the Leidsche Akademie to study medicine. His doctoral exam was in 1787, and the defence of his dissertation in 1788. The same year he moved to Delft, practiced as medical doctor and married Theodora Jacoba Luïscius (1766-1793). On request of his father in law he added Luïscius to his name (else the Luïscius clan would die out). In 1789 he became lecturer in chemistry in Delft. His career would be mostly a mix of chemistry and medicine (e.g. purification of air, the decay of food, improvement of putrefied water, vaccination of cowpox) for which he was internationally well know; he received academic prizes and joined several learned societies. Interestingly, his work on the Bathometer is a rather out of box activity. Abraham died in Delft, 2 May 1829 (Anon., 1829; Van der Aa, 1865).

In his monograph on the '*Zeepeiler*' Van Stipriaan Luïsçius in his introduction reminds the reader about the importance of knowing the temperature and the depths of the world's oceans. Then there is a text concerned with underwater topography, especially submarine mountains, and animal life. Following Van Stipriaan explains reasons why sounding involving ropes or lines would be inaccurate (due to buoyancy of the rope, currents).

Early sounding instruments

An overview is presented of attempts made to develop sounding instruments operating without a line. Attention is given to the first to describe such an instrument: Robert Hooke (1635-1703) (Figure 1).

Hooke (1667) in section 5 ("*To found the deepest Seas without a Line, by the help of an Instrument, represented by Figure 2*)" describes: "*take a Globe of* Firr*, or* Maple*, or other light wood, as A, let it be well secured by Vernish, Pitch, or otherwise, from imbibing Water, then take a piece of Lead or Stone, D, considerably heavier, than will sink the Globe. Let there be a long Wire-staple B, in the Ball A, and a springing wire C, with a bended end F, and into the said Staple, press in with your fingers the springing Wire on the bended end: and on it hang the weight D, by its hook E, and so let Globe and all sink gently into the Water, in the posture represented in the said* Figure*, to the bottom, where the weight D touching first, is thereby stopt;*

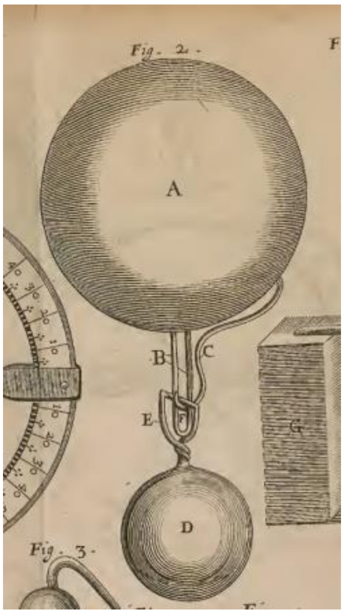

Figure 1. Sounder by Hooke (1667)

but the Ball, being by the Impetus *it acquired in descending, carried downwards a little after the weight is stopt, suffers the springing Wire to fly back, and thereby sets itself at liberty to re-ascend.*
And by observing the time of the Ball's stay under Water (which may be done by a Watch, having Minutes and Seconds; or by a good Minute-Glass*; or best of all, by a* Pendulum*, vibrating Seconds; … .) You may by this way, with the help of some Tables, come to know any depth of the Sea.*"

Van Stipriaan has knowledge of the improvements made by Hooke: he refers to the section in Derham (1726) related to 'Sounding of Great Depth of the Sea' instrumentation, copying the nice expression '*explorator profunditatis*'. Derham also recorded the term 'waywiser', a term copied from the surveyors' instrument on land, and used by Hooke in his lecture of 16 December 1691, for a sounder with a set of cogwheels to record the water depth.

The next inventor treated by Van Stipriaan is Stephen Hales (1677-1761) who with John Theophilus Desaguliers (1683-1744) designed a series of depth sounding instruments based on a pressure gauge, independent on the time it was below the surface (Desaguliers and Hales, 1729). This instrument consisted of an instrument including a vacuum tube inverted over a bottle containing mercury, on top of which honey floated. Increasing water pressure forced the mercury up the tube; when after surfacing pressure had dropped, the honey marked the highest pressure level, hence the depth (McConnell, 1982).

The third concept that influenced Van Stipriaan was the sounder concept of a man called Greenstreet, who – being unable to prove the design at sea - sold the design to John Charnock (1756-1807). The latter reported on the performance of this ‘Sea Gage’ in shallow-water trials (Charnock, 1795). Again, it consisted of a float, in Figure 2 (O), a wooden shaft (A), and a detachable weight (L).

The mechanism: “*To the long piece of wood A* [Figure 2] *is attached the hollow trunk B, in which to which is fitted a wooden spiral worm, or endless screw, C, (Fig. 2.) which fills the trunk so completely, as scarcely to admit of any water passing between it and the fides of the cavity. On the axis of this worm is continued one of brass, D, which turns the large wheel E, which wheel is graduated in thirty-fix divisions, expressing six fathoms, or thirty-fix feet; being the distance the machine descends while that wheel makes one revolution. On its axis is a small pin, which, each time the wheel makes one revolution, moves forward the second wheel F, one tooth. This second wheel has thirty-six teeth, one revolution of it therefore expresses a depth of two hundred and sixteen fathoms; the axis of it is furnished with a pin, like that of the first, and every revolution of it moves forward the third wheel G one tooth; which third wheel has forty-one teeth, consequently a complete revolution of that wheel will measure a perpendicular depth of ten miles fifty-six fathoms. H and I are two indexes, which point out the depth the machine has descended and keep two wheels from varying*”. See also McConnel (1982).

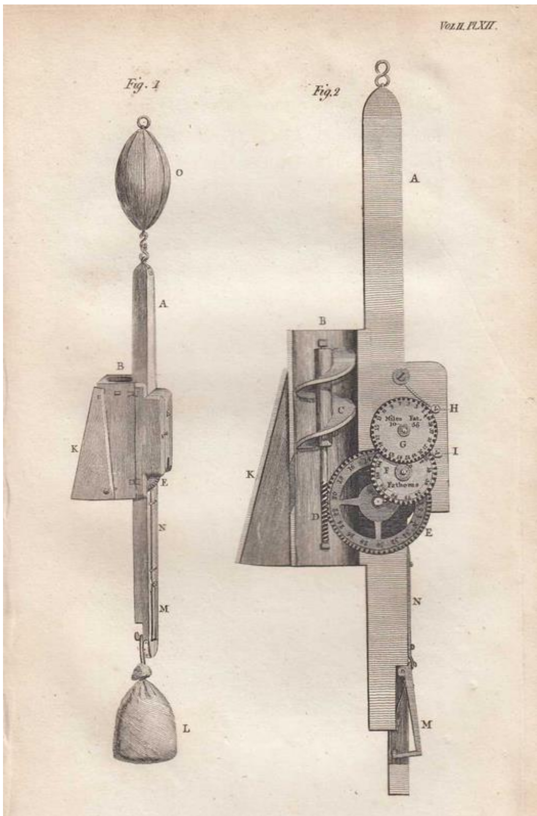

Figure 2. Sounder by Charnock / Greenstreet (1795)

Van Stipriaan observed a number of problems in the design by Charnock, e.g. that the calibration of one revolution of the spiral worm equals 1 fathom would require many trials, the use of wood in the construction (will become saturated with water, affecting the speed of sinking/rising) and that the detachment mechanism of the weight may often fail (uneven bottom, presence of plants or corals, strong Figure currents). A final point of criticism is the (assumed) accelerated motion of the spiral, once it has been set in motion, as “the water will hardly provide resistance with this shape”. He aims to solve such ‘problems’.

The ‘Zeepeiler’ or Bathometer

The Bathometer (also called Batometer by Van Stipriaan) consists essentially of a floating body [c] with banner [a], a ‘measurer’ [odometer, d] and a sinker [e] (see Figure 4). Interestingly, the figures in Plate I depict the (scale) Model of the bathometer (the dimensions and adaptation of the normal size bathometer are also provided in the text). The floating body [c] is water tight and made of thick copper sheet (to prevent compression at greater depth]. The measurer [d] is a flat copper box, with openings to allow the water to pass. Inside a rotating vane wheel is mounted, the axis of which is connected to cogwheel with 5 teeth, driving a 50-teeth cog; the latter is connected to a silver display on the outside, with 10 main divisions and 50 sub-divisions (each revolution is 5 units, 10 revolutions is a full circle) [1]. The sinker [e] consists of a copper tube, with at the bottom side a ball-shaped (lead?) weight [f]. Through the entire length of the sinker a sliding iron rod (push rod) is mounted with at its upper end a cone, at its lower end a small copper ball serving as bottom contact [h]. Van Stipriaan mentions that in order to reduce the price varnished parts could be used.

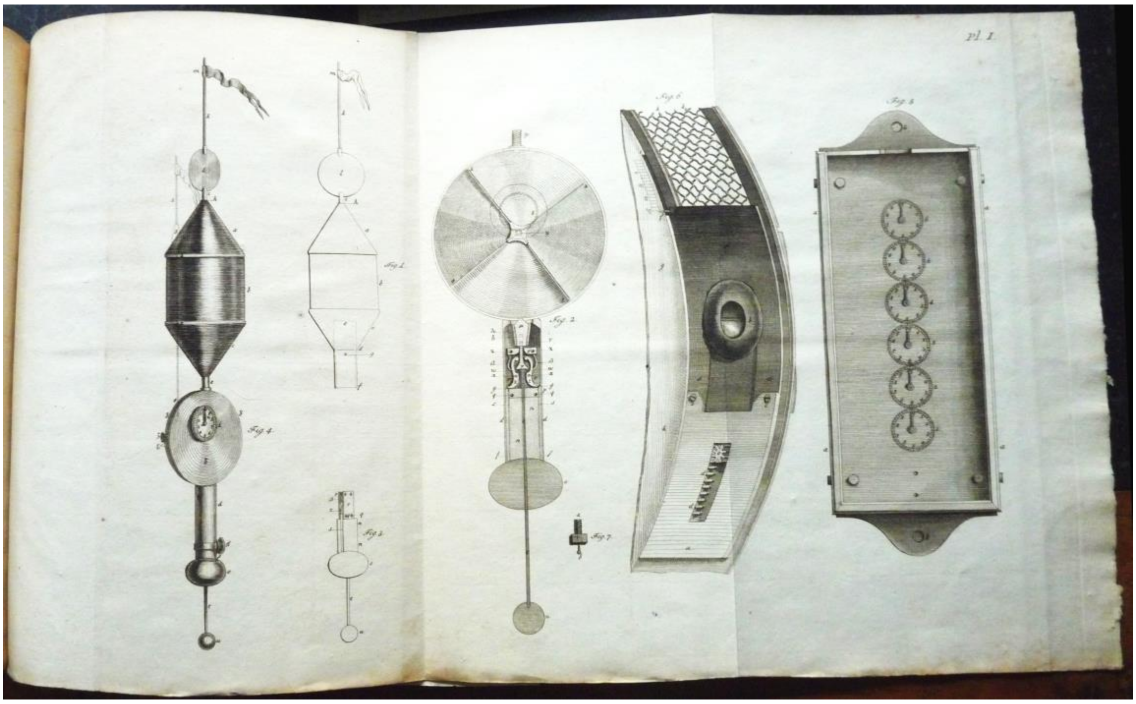

Figure 3. Plate I of Van Stipriaan (1805a). Far right is the gearbox of the full scale model intended for greater depths; to its left the side of the 'measurer' box with a slide to increase/decrease the water flow through the mesh, the 'moderator'

After a detailed description of the intricate mechanism of the sinker [e] Van Stipriaan explains the working principle. Once the system is carefully entered in the water (for operation at (calm) sea it is advised to work from a boat with two men) the bathometer will – due to its weight – sink; the small buoy [b] is automatically detached to mark the start of the operation (it was thought that after resurfacing of the bathometer the 'current' could be established). While sinking, the vanes inside the measurer will revolve corresponding to the water column passed and 'the density of the liquid'. The moment the bottom contact [h] touches the sea floor the instrument, by its weight, continues to sink (it glides down the rod [g]). By doing so, it unlocks the spring secured detachment mechanism of the sinker, and at the same time pushes a conus in the measurer, preventing further rotation. Floating body and measurer (with the intricate mechanism) start rising to the surface, where the vane attracts attention. The lower part of the sinker and the bottom contact remain on the sea floor.

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[1] For the full scale model a more complex gearbox is defined with six indicators, the first indicating 10 revolutions, the next x10, and so forth (until 1,000,000) (Figure 3).

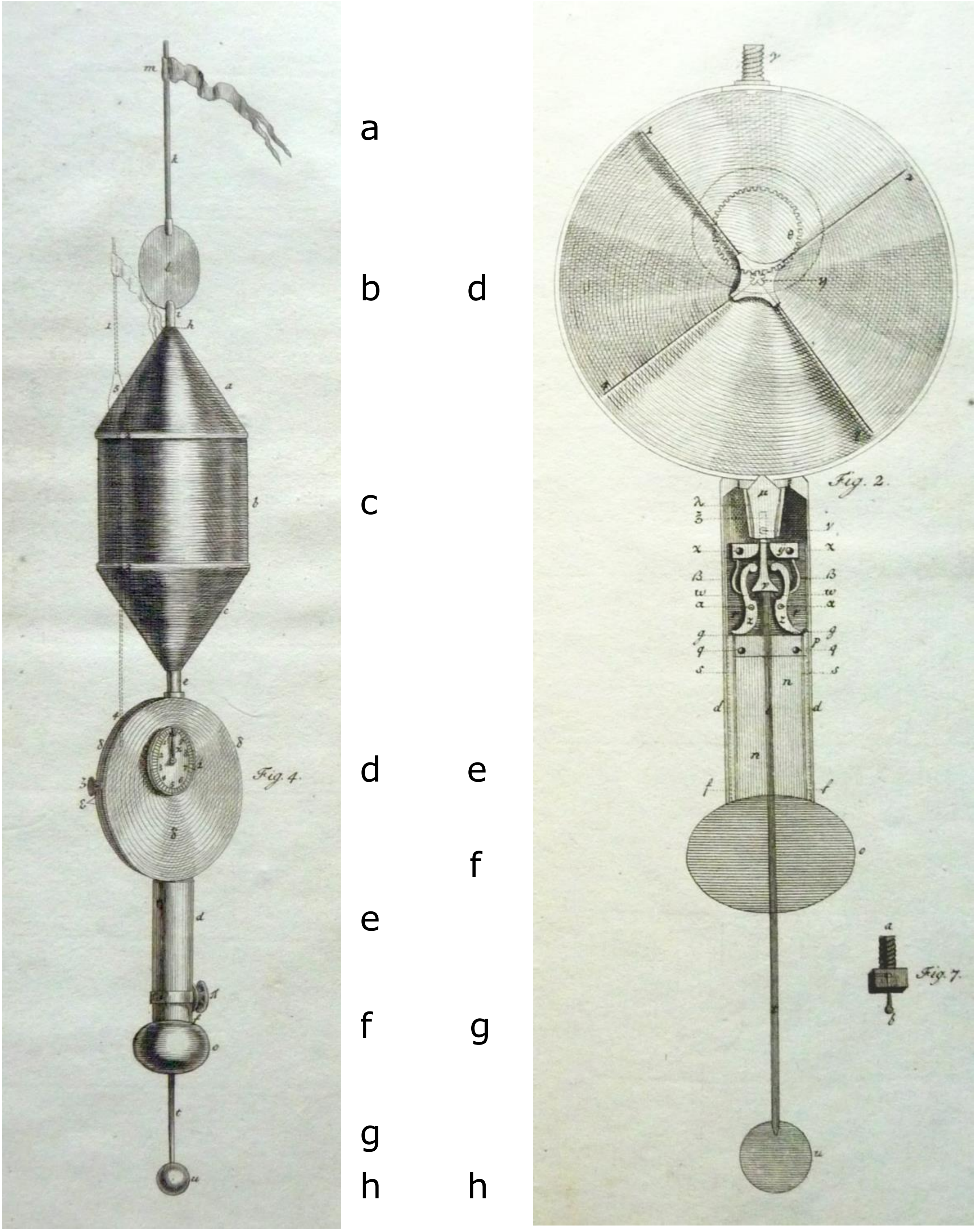

Figure 4. From Plate I of Van Stipriaan (1805a). a) banner; b) to the left a small buoy; c) floating body; d) measurer; e) sinker; f) weight; g) rod; h) bottom contact.

Commercialisation?

The last two pages of the monograph are a price list of the Bathometer and of its individual components, to be purchased at the factory of J.H. Onderdewyngaart Canzius, in Delft. A complete small model in copper, contained in a mahogany wooden box costs 68 florins. A complete large copper model, contained in a painted box would be fl. 230.

Jacob Hendrik Onderdewyngaart Canzius (1771-1838) was a lawyer who ran a scientific instrument factory and shop in Delft from 1797-1810 (Clercq, 1996). This was quite an enterprise with many machine shops for the production of mathematical, physical, anatomical, chirurgical and other instruments (Onderdewyngaart Canzius, 1800). In 1807 the company became '*Manufacturier des Konings*' [Royal Warrant of Appointment] under Lodewijk Napoleon (1778-1843), King of Holland. A company catalogue dated 1804 lists a truly large number of instruments (Onderdewyngaart Canzius, 1804). This catalogue was issued one year prior to the publication of the book of Van Stipriaan, but no *Zeepeiler* or Bathometer is listed. This not necessarily means that it was not available, as instruments that were of lesser importance were sometimes left out of the catalogue (pers. comm. T. van der Spek).

The question then is: was the Bathometer actually produced (and sold)? Van Stipriaan mentions that he tested the model scale instrument successfully in the river Meuse, as well as in a tube made of wood (20 feet long, 4 inches wide), filled with well water and with water with a salinity four times that of common seawater. It is also stated, that the large model "that we have in our possession" was tested, again, in the river Meuse, hence at rather shallow depth (Van Stipriaan Luïsçius, 1805a).

So far no large model of this Bathometer has been discovered in a Dutch science museum collection (or via the internet elsewhere). It is hoped that this may only be due to the fact that it is a rather obscure instrument of which it's purpose may not be readily recognised. Luckily a model version of a copper Bathometer in its mahogany box, as offered in the pricelist of Onderdewyngaart Canzius, can be found in the collection of the Museum of the American Philosophical Society in Philadelphia (USA). It was donated by Thomas Jefferson in 1803 [2], thus prior to the publication of the book by Van Stipriaan (Figure 5). The museum description incorrectly states that the time between launching and resurfacing was used to determine the depth of the sea.

Figure 5. The scale model of a Bathometer at the Museum of the American Philosophical Society in Philadelphia (Cat.Nr. 58.51)

[2] Thomas Jefferson (1743-1826) was installed as President of the American Philosophical Society March 3, 1797, a position he held until January 20, 1815. In 1807 Martinus van Marum (1750-1837) invited Jefferson to become a member of the 'Hollandsche Maatschappij der Wetenschappen', who accepted. https://www.geschiedenislokaal023.nl/bronnen/thomas-jefferson-lid-van-de-hmw/brief-van-thomas-jefferson/

Follow-up

In Anon (1806a), the book of Van Stipriaan was critically reviewed. It provides a summary of the text and summarises the three methods of depth sounding without a line: 1) the time required for sinking and rising (*cf.* Hooke); 2) pressure of the water column at the sea floor (*cf.* Desaguliers and Hales); 3) number of revolutions of a screw/wheel (*cf.* Greenstreet / Charnock). Van Stipriaan Luïsçius' Bathometer belongs clearly to the third class. The author has several doubts on the functionality of the Bathometer. He wonders, whether the recording of the depth only during the sinking phase will be sufficient: "without asking the question whether descent and ascent take place in the same time". There is concern about the robustness required for operation at sea, with – in the large version – 7 cogwheels, susceptible to bending or dirt. In addition, the revolving paddles in the 'measurer' may be clogged by dirt, wood or seaweed, thus leading to misreading. Then there is the high price: in case of currents it is well possible that the standard of the re-surfaced Bathometer is not seen because of drift or rough seas; possible loss must thus be expected. Finally the author elaborates on the discussion on whether the movement of sounders, up or down, is uniform or accelerating.

Without any surviving full scale model of the Bathometer one may wonder whether it was actually produced (apart from the instrument used by Van Stipriaan). However, in 1814(?) the *Soeverein vorst der Nederlanden* [Sovereign ruler of The Netherlands], Willem Frederik Prins van Oranje-Nassau (Willem I) (1772-1843), requested the Koninklijk-Nederlandsche Instituut van Wetenschappen, Letterkunde, en Schoone Kunsten (KIW [3]), 1st class (= science), to investigate the proposal (by Van Stipriaan) to trial the *Zeepeiler.* A Commission was formed, consisting of Jean Henri van Swinden (1746-1823), chairman of the KIW, Martinus van Marum (1750-1837), director of the Teylers' Museum and Jacob Florijn (1751-1818), mathematician. The conclusion of the Commission was that the Bathometer was an interesting and useful instrument to sound the so far unmeasurable depths of the sea, in favour of a better understanding of our globe; not only in support of its geology but possibly also with maritime use.

Sea trials

The 1st class of the KIW, in its report for 1815, hence suggested to the Secretary of State for Home Affairs, to conduct a trial of the instrument by capable men on board a navy ship (KNIW, 1815).

It took until 1825 before these trials would be carried out. The corvette Z.M. *Pallas*, under command of the hydrographer KLtz Julius Constantijn Rijk (1787-1854) made an instruction and scientific voyage to England and the United States of North-America in the period 15 March 1825 – 16 July 1827. The purpose was to visit a number of English and US harbours (to acquire knowledge on military (technological & navy) issues), as ship of instruction to train navy cadets and officers in seamanship and other maritime issues, and to test a number of appliances, including the Bathometer or *Zeepeiler*. De Rijk (1825) in his general report details in its appendix 3 on the trials with the Bathometer. Texts of this report were also published in 1832 (De Rijk, 1832), but without the text from appendix 3 (the editor considered that was not necessary due to the poor results obtained). Others that joined the mission kept journals: August Elize Tromp (1801-1871), *onder-constructeur* [shipbuilder-engineer], appointed as technical specialist, and cadet Gerhardus Fabius (1806-1888).

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[3] The *Koninklijk Instituut van Wetenschappen* [Royal Institute of Sciences) was founded in 1808 by Lodewijk Napoleon Bonaparte, King of Holland; it is the predecessor of the KNAW, the present Royal Academy of Arts and Sciences

Unfortunately, as a result of the Covid-19 pandemic event inspection of these manuscripts at the National Maritime Museum (Amsterdam) is pending. Details on the trials, as observed by De Rijk, Tromp and/or Fabius shall thus wait for the next issue of *ad HOC*.

Gerhard Cadée is acknowledged for his useful comments.

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