

An Observer of Observatories

The Journal of Thomas Bugge's Tour of
Germany, Holland and England in 1777



EDITED BY
KURT MØLLER PEDERSEN
AND PETER DE CLERCQ

AARHUS UNIVERSITY PRESS

An Observer of Observatories

An Observer of Observatories

The Journal of Thomas Bugge's
Tour of Germany, Holland and England in 1777

Edited by Kurt Møller Pedersen and Peter de Clercq

An Observer of Observatories
The Journal of Thomas Bugge's Tour of Germany, Holland
and England in 1777

© The authors and Aarhus University Press, 2010

Graphic production: P.J. Schmidt A/S

Cover: Jørgen Sparre

Illustration: "View of the Royal Observatory,
Greenwich", water colour, c. 1770.

© National Maritime Museum, Greenwich, London.

eISBN 978 87 7934 346 7

Aarhus University Press

Langelandsgade 177

DK-8200 Aarhus N

Fax: +45 89 42 53 80

www.unipress.dk

White Cross Mills

Hightown, Lancaster, LA1 4XS

United Kingdom

www.gazellebookservices.co.uk

PO Box 511

Oakville, CT 06779

www.oxbowbook.com

This book is published with the financial support of
The Aarhus University Research Foundation
The Carlsberg Foundation

Foliation in the journal manuscript is indicated as [3 recto].

A scan of the original manuscript is accessible at

www.kb.dk/permalink/2006/manus/659/dan.

Bugge often added words in the margin. These have been
inserted in the text between * *.

Contents

Preface	vii
Thomas Bugge (1740–1815)	ix
Travel journals	xiii
Bugge's journal of 1777	xvii
Summary of the journal	xxi
A note on money	xxiii
The Journal	1
Appendix 1. Travel expenses	175
Appendix 2. Books bought in London	181
Appendix 3. Instruments bought in London	191
Appendix 4. Data of astronomical observations	197
Bibliography	203
Photo credits	213
Name index	215
Subject index	219

Preface

When Thomas Bugge (1740–1815) was appointed professor of mathematics and astronomy at the University of Copenhagen in January 1777, he became responsible for the observatory, which in the seventeenth century had been built on top of the Round Tower. Later that year he travelled to Holland and England to acquaint himself with the state of astronomy and instrument-making in these countries. After his return four months later, he began to renovate the observatory.

During his tour he kept a journal in which he noted what he saw, whom he met and which books and instruments he bought. It comprises five quarto notebooks with a total of 94 folios, filled on both sides with text and drawings. In 1969, this journal was discovered in the Royal Library in Copenhagen by the first editor of the present volume, associate professor Kurt Møller Pedersen. He brought it to the notice of Cdr Derek Howse (1919–1998), then head of the department of Navigation and Astronomy at the National Maritime Museum, Greenwich. Howse flew to Denmark especially to study the manuscript and judged it of such historical interest that he advised publication. In 1975, on the 300th anniversary of the foundation of the Royal Observatory, Greenwich, Bugge's journal was exhibited there for several weeks and received much attention from the hundreds of historians of science gathered for this important event.

This positive response was encouraging for Pedersen. Together with his secretary, Mette Dybdahl, he made a transcription of the Danish manuscript and an English translation. Soon cop-

ies began to circulate among scholars, who quoted and used it in their publications. In 1997, a modestly produced edition was issued by the History of Science Department of the University of Aarhus, entitled: *Thomas Bugge, Journal of a Voyage through Holland and England, 1777*. This was emphatically no more than a preliminary edition, and in his preface Pedersen expressed the hope that 'someone more qualified than I will undertake to improve the English translation and provide annotations of the instruments described and drawn by Bugge, so that a proper scholarly edition of this valuable source for 18th century astronomy may eventually be available.'

In 2001 the second editor, Dr Peter de Clercq, came forward and offered his assistance. He began to make textual improvements and annotation, a prolonged process that at times came to a standstill as there was no clear prospect of publication. This editorial work was greatly facilitated when, in 2006, the Royal Library in Copenhagen made a scan of the manuscript available on its website: www.kb.dk/permalink/2006/manus/659/dan.

In the spring of 2008, Aarhus University Press agreed to publish the book, on condition that financial support would be found. Proposals were sent to the Aarhus University Foundation and the Carlsberg Foundation. It was a great moment for the editors when, in the autumn of 2008, both funds agreed to supply the necessary funding, and they deserve gratitude for this contribution to a better understanding of the history of science in Europe.

The Carlsberg Foundation supplied additional funding to allow the book to appear in two separate, but essentially identical editions: one in Danish, the other in English. This meant significantly more work for the editors, but it was undertaken with pleasure as, forty years after its discovery, Bugge's journal will now be available both in transcription and in an English translation, each fully annotated.

Many friends and colleagues, librarians, archivists, museum curators and others have contributed in a variety of ways. For supplying information and photographs, for commenting on parts of the edition, and for supporting the application for the funding of this publication, we wish to thank Jørgen From Andersen, Martin Beech, Jim Bennett, Jonathan Betts, Dan Charly Christensen, Gloria Clifton, Tiemen Cocquyt,

Diana Crawforth-Hitchins, J.Th. van Doesburg, Rob van Gent, Willem Hackmann, A.J.E. Harmen, Helge Kragh, Leif Kahl Kristensen, Peter Louwman, Anita McConnell, Alison Morrison-Low, Joshua Nall, Keld Nielsen, Erling Poulsen, David Riches, Sara Schechner, Bruno Svindborg, David Thompson, Anthony Turner, Jan van Wاندelen, Jane Wess, Diederick Wildeman and Huib Zuidervaart, as well as those we may have failed to mention.

Finally, we thank the librarian at the Department of Science Studies, Susanne Nørskov and Aarhus University Press, and in particular Claes Hvidbak and Sanne Lind Hansen, for their expert handling of this project.

Aarhus and London, Autumn 2009
Kurt Møller Pedersen and Peter de Clercq

Thomas Bugge 1740–1815

Some forty years ago, a biography of Bugge was published, written by the Director of the Geodetic Institute to commemorate the 150th anniversary of his death.¹ More recently, a large amount of information on Bugge, especially on his astronomical activities, became available in a three-volume overview of four centuries of astronomy in Denmark.² As both publications are in Danish, those unable to read that language must look elsewhere for information on Bugge. They may turn to a commemorative volume on the Royal Danish Academy of Sciences and Letters, which he had served as its secretary for many years.³ There is the introduction to a modern edition of his journal on the Parisian scientific scene of 1798.⁴ And there are a few pages on Bugge in a recent book on the history of science in Denmark, which characterizes him as 'one of the most famous scientists of his time', and states that 'Thomas Bugge did not produce any scientific work of similar originality, but his overall contribution to the natural sciences in Denmark was far greater than Wessel's was'.⁵ It makes one wonder why he

was not included in the authoritative, multi-volume *Dictionary of Scientific Biography*.⁶

Thomas Bugge was born in Copenhagen on 12 October 1740 as the son of Peder Bugge and his wife Olive, born Saur. His father was a scribe taking care of the financial accounts of the royal wine cellar, and was later appointed chamberlain and superintendent of the royal household. They belonged to a line of a noble family but were unable to live as such because of insufficient means. At the age of sixteen, Thomas enrolled at the University of Copenhagen to study theology, graduating in 1759. During these years, he also studied pure and applied mathematics, supervised by Professor Christen Hee (1728–1782). He worked as an assistant to Christian Horrebow (1718–1776), the director of the observatory whom he was later to succeed. In 1761, he was sent to Trondheim in Norway to observe the Venus transit.

Bugge is primarily known for his work as director of the survey of Denmark, a project under the supervision of a special surveying commission of the Royal Academy of Sciences. At the age of twenty-two, Bugge became one of its first geographic surveyors. He immediately began surveying and lecturing on the subject and quickly became its driving force.⁷ He was inspired by the

1 Andersen 1968

2 Thykier 1990. The sections most relevant to Bugge are vol. 1, pp. 94–104 (on his directorate of the observatory), vol. 2, pp. 184–187 (instrumentation of the observatory during his directorate) and 214–215 (line-drawings of the observatory and the main instruments in Bugge's time, based on Bugge 1784) and vol. 3, pp. 445–458 (including a list of Bugge's publications, which incidentally is not complete). There is an English summary on pp. 583–589.

3 Pedersen 1992

4 Crosland 1969

5 Kragh and others, pp. 151–154. The comparison is to the surveyor and mathematician Caspar Wessel (1745–1818).

6 Published in the 1970s under the auspices of the American Council of Learned Societies in fourteen volumes, with later supplements. It *does* have an entry on Wessel (vol. XIV, pp. 279–281).

7 He published a book on the theory and methodology behind the project, whose title translates as 'A Description of the Surveying Method used for the Danish Geographical Maps'; it was later also translated into German. Bugge 1779a.



Portrait at the observatory in Copenhagen of Thomas Bugge. Artist unknown.



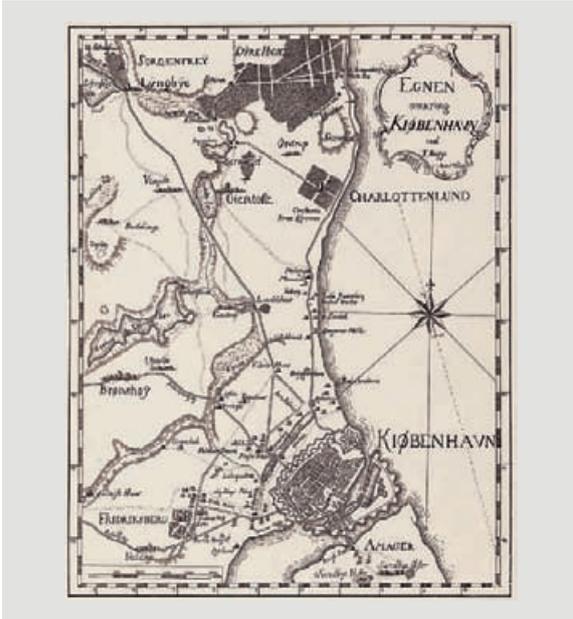
Title page of Thomas Bugge's description of the Danish surveying project, here from the German edition 1787.

French surveying activities directed by César-François Cassini de Thury (1714–1784) who produced 182 maps of France on a scale of 1:86,400. Bugge used 1 metric inch on his plane table = 2000 feet in the field or 1:20,000. The topographical maps drawn on the plane table were then put together, engraved and published as 1:80,000, 1:120,000 and even 1:320,000. Bugge avoided Cassini's skew numbers like 1:86.400 by using a more practical decimal system that made calculations easier.⁸ This work involved advanced astronomical observations and many trigonometrical calculations. In 1780 Bugge became de facto leader of the geographical, trigonometric and economic survey of Denmark. It was important to provide the military with reliable maps. It was equally important for a new land register, as the open fields, in which the land was communally owned by all farmers in a village, were being divided into individual fields. Bugge was also engaged in setting up methods for evaluating the

site quality of each single field. The organization, teaching of surveyors, map production and funding must have consumed much of Bugge's time and energy. The project was much criticized after his death, but he was nevertheless the man who accomplished the country's first modern survey. It resulted in an immensely improved topographical knowledge of Denmark and generated an expertise in the field of surveying that had not previously existed.

In 1773, Bugge also became president of the Royal Agricultural Society (Det Kongelige Landhusholdningselskab), which he was to remain for ten years. The second half of the eighteenth century saw in many European countries a growing interest in stimulating farming productivity, and the Royal Agricultural Society played an important role in proposing new strategies. His continuous interest in agricultural matters is evident from his journal. When he passed through Holstein on his way to Holland and England, he carefully noted how farms were constructed and how the mediaeval open fields were divided among the farmers, leading to a revolution in the farming system.

⁸ More about the decimal system used during the surveying of Denmark is found in Kristensen 2001.



Bugge's map of Copenhagen and its environs 1766.



The original copperplate, 20.5 x 29 cm, is now with hundreds other plates at the Steno Museum in Aarhus.

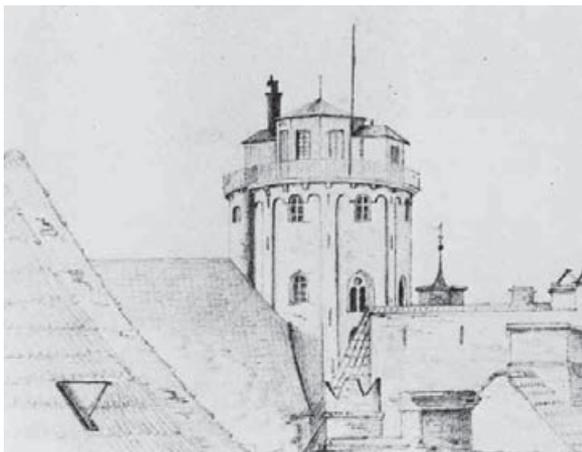
On 30 January 1777, Bugge was appointed professor of mathematics and astronomy at the university and director of the observatory, situated on top of the Round Tower. This striking building, 36 meters high, with a spiral stairway wide enough for a horse-drawn carriage, had been erected as a prestige project at the behest of King Christian IV and had been completed in 1642. The very next year, the tower had been fitted with a telescope, which makes it one of the very first university observatories in the world, predating the observatories in Paris and Greenwich. However, its location in the heart of Copenhagen was not ideal, a far cry from the quiet of the nearby island of Hven, where Tycho Brahe (1546-1601) had built his Uraniborg. Before Bugge, a succession of Danish astronomers had used the Round Tower observatory, including Longomontanus (1562-1647), Ole Rømer (1644-1710), who also had a private observatory outside the city), Peder Nielsen Horrebow (1679-1764) and finally his son and successor, Christian Horrebow (1718-1776).

The King donated 7,000 rigsdaler to a renovation of the observatory and acquisition of new

and better instruments.⁹ This was not a small sum; the surveyors working in the field for the Danish mapping project were each paid 300 rdl. per year. But it was not a luxury budget either. Building and equipping the new Radcliffe observatory in Oxford, which Bugge visited, cost more than twenty times that amount.¹⁰ Admittedly, the two projects are not entirely comparable. In Oxford, a large new building was erected, including a private home attached to it for the astronomy professor. Bugge only had to erect a shed on top of the Round Tower. Perhaps more to point is a comparison with what had been spent on the five main instruments, that the eminent London instrument-maker John Bird (1709-1776) had supplied to the Radcliffe observatory. His two mural quadrants, transit instrument,

9 Bugge 1784, p. XXVII, § 14.

10 Guest 1991 gives two different totals for the expenses on building and equipping of the Radcliffe observatory in the period 1773 to 1799 (when it was finally completed): £ 31,661 (p. 246) and £ 35,750 (p. 508, note 1). Either way, this is incomparably more than the 7,000 rigsdaler, which equal £ 1400. On the equation 1 pound = 5 rigsdaler, see below, page xxiii, A note about money.



Bugge's observatory on top of the Round Tower seen from east, c. 1780. The Royal Library, Copenhagen.

zenith sector and equatorial sector had cost almost exactly as much as the entire royal donation to modernize the Copenhagen observatory.¹¹

When he published his observations six years later, Bugge preceded his tables with a detailed description of the renovated observatory and its instruments, illustrated with fine engravings.¹² An octagonal room of 25 feet diameter housed a 6-foot mural quadrant and a 12-foot sector, and was flanked by two smaller rectangular rooms, the western one housing a 6-foot transit instrument, the eastern one a 4-foot diameter portable astronomical circle. The last angular measurement instrument that Bugge mentioned is a portable 3-foot quadrant on a tripod. All five had been constructed by the instrument-maker Johannes Ahl (1729–1795), who had been an apprentice and later a partner of the eminent Swedish instrument-maker Daniel Ekström (1711–1755), but had then left Sweden and set up a workshop in Copenhagen. Ahl had already worked for the

11 These five instruments had cost £1392, see Morrison-Low 2007, p. 138.

12 Bugge 1784. In the British Library are two presentation copies (shelf-marks 5013 and 434g1) with Bugge's handwritten dedications. One is to King George III, whose private observatory at Richmond he had visited; the other to Sir Joseph Banks, the President of the Royal Society.

mapping project, and in his journal Bugge refers to 'the Danish geographical instrument' made in 1762 that he had used in the survey. There were also time-keepers by Mudge and Dutton from London, Jahnson from Copenhagen and Le Paute from Paris, and telescopes by Dollond from London and other makers. In later years, Bugge would also acquire telescopes by among others William Herschel and Nairne and Blunt.¹³

But in spite of his efforts to reorganize and modernize the observatory, Bugge did not bring astronomy in Denmark to a very high international standard. He studied Algol and found that it rotates in 2 days, 21 hours and 7 minutes, and that Saturn rotates in 6 hours, 4 minutes (the modern value is approximately ten hours). His interest in geomagnetic theories also led him to make systematic measurements of magnetic intensities. He contributed four papers to the *Philosophical Transactions of the Royal Society*, but many of his findings never found their way into international journals. However, Bugge communicated many of his results in private letters to scientists all over Europe. This correspondence is now in the Royal Library in Copenhagen as a bequest by Bugge – which also included the manuscript of his travel journal – and deserves to be studied to find out more about his scientific work.¹⁴

Ardent and competent as he was, he also became correspondent for the *Societas Meteorolog-*

13 Of these, only the portable quadrant (Round Tower Museum), and the 1762 geographical instrument (Kroppedal Museum) survive. Thykier 1990, pp. 186–187.

14 There are 84 letters from and to Bugge dated between 4 February 1779 and 6 April 1814 in Royal Library NKS 287, 1304 and 2749. The correspondents are Aeneae, Arnold, Banks, Dryander, Herschel, Hoppe, Hornsby, Huygens, Jones, Mackenzie, Magellan, van Marum, Maskelyne, Nairne (& Blunt), Parker, Phillips, Ramsden, Royal Society, van Swinden, Taylor and Wolff & Dorville. Based on a list drawn up by Jørgen From Andersen, curator of Hauchs Physiske Cabinet, Sorø. For other surviving correspondence with Banks, Bidstrup and Herschel, see Morisson-Low 2007, pp. 154–158.

ica Palatina, an international network for weather observations, organized from Mannheim.¹⁵ Bugge listed the instruments that had been supplied for the purpose, and published his weather observations.¹⁶

Bugge was rector of the university for three periods (1789–90, 1801–02 and 1810–11) as well as secretary of the Royal Academy of Sciences from 1801 until his death. He was a member of many academies throughout Europe. In 1788 he was elected a Fellow of the Royal Society, and among those who backed him were four men whom he had met during his visit to England a decade earlier: the astronomers Nevil Maskelyne, Thomas Hornsby and Anthony Shepherd, and the instrument-maker Jesse Ramsden.¹⁷

In 1798, Bugge went to Paris as Danish representative at the international conference for the introduction of the metric system of weights and measures. He was there for six months but, frustrated with the endless procrastination, left before the conference actually started.¹⁸

In September 1807 Bugge suffered a blow when the English navy bombarded Copenhagen in an attempt to stop Denmark from joining Napoleon's Continental System. Bugge's house was hit by 35 bombs and burnt down. He lost all his furniture and goods, his library of 7000 volumes, his collection of mathematical and physical instruments, his maps, in short: The fruits of a lifetime's work.

15 Cassidy 1985; for Bugge's participation from 1782 to 1788, see pp. 23–4.

16 Bugge 1784, § 48, lists a barometer, a thermometer, a hygrometer and a declinatorium, as well as two corresponding hygrometers made by Baron de Gedda, and an anemometer after the invention of Wilcke (which Bugge considered unreliable). His observations are § 79.

17 The original document, signed in April 1787, cat. no. EC/1787/21, can be seen at <http://royalsociety.org>, section Library and Archives. It was signed by nine men who proposed to accept his candidacy, the others were William Wales, George Shuckburgh, Charles Blagden, John Sinclair and William Watson.

18 Alder 2002, pp. 259–260

Bugge died on 15 January 1815 and was buried in the Assistens Cemetery in Copenhagen. When a member of the Royal Academy of Science died, it was customary that a member would assess his achievements in a public speech. This did not happen in Bugge's case, possibly because of his strained relationship with the man who succeeded him as secretary of the Academy. This was Hans Christian Ørsted (1777–1851), one of Denmark's most celebrated physicists. He was a generation younger, having been born on the day Bugge arrived in Bremen on his way to Holland and England. He graduated as a pharmacist in 1797, and received his doctor's degree in 1799 for a dissertation on Immanuel Kant's philosophy. He travelled in Germany in 1801–02, where he was much taken by the romantic philosophy, which was to some extent opposed to a Newtonian-Laplacian philosophy that was more to Bugge's liking.¹⁹ When Ørsted applied for a position as professor of physics, he was not successful, and Bugge in particular seems to have had his reservations. The two men were never thereafter on good terms. Ørsted was appointed extraordinary professor, and became ordinary professor of physics only in 1817. Three years later he made his discovery of the magnetic effect produced by an electric current, which was to open up a new chapter in pure and applied physics. In a way it is regrettable that Bugge, who himself had contributed so much to the natural sciences in his country, could not witness this epochmaking moment.

Travel journals

Travel journals are a valuable source of information for historians, and this includes those with a special interest in science and scientific instruments, to whom Bugge's journal will probably appeal most. Through the traveller's eyes, we see

19 In his 1796 textbook *De Første Grunde til den Sfæriske og Theoretiske Astronomi* ('First principles of spherical and theoretical astronomy'), Bugge wrote in § 113 that 'Newton's ingenious System' had changed from being a hypothesis to 'being a mathematical certainty.' The Bugge–Ørsted relation is described in Christensen 2009.