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A Sense of Direction –
New Researches in the History of Navigation

National Maritime Museum, Greenwich, London
Thursday 6 and Friday 7 May 2010

ROYAL INSTITUTE OF NAVIGATION

Thursday 6 May

13.30 Registration

14.00 Welcome and introduction

14.15 **Session One** **Chair: Dr Richard Dunn**

Dr Derek Irwin
Navigational aids in the ancient Greek world

Dr Antonio Sánchez Martinez, Spanish National Research Council
Atlantic cartography and magnetic declination in sixteenth-century Spain: Seville's School of Navigation

Dr Henrique Leitão, University of Lisbon
The origin of the rhumb line

15.30 Tea

16.00 **Session Two** **Chair: Professor Andy Norris**

Dr Wolfgang Köberer, Frankfurt am Main
The earliest German manual of navigation – a mixtum compositum *of Portuguese nautical science and English practical seamanship*

Richard Blakemore, University of Cambridge
'To further that so much deserving Science of Navigation': the London maritime community as a forum for the development of navigation, 1550–1650

16.50 Close

17.00 Drinks reception

Friday 7 May

09.30 Coffee

10.00 Introduction

10.15 **Session Three** **Chair: David Broughton**

Nicolàs de Hilster
The early development of the Davis Quadrant

Ted Gerrard
Isaac Newton's invention of the reflecting quadrant – its possible construction

Dr Danielle Fauque, University Paris-Sud 11
Using reflecting sextants and circles in navigation: a comparative study between English and French handbooks in the second half of the eighteenth century

11.30 Coffee

12.00 **Session Four** **Chair: Dr Gloria Clifton**

José Manuel Malhão Pereira, University of Lisbon
The Portuguese contribution to the knowledge of terrestrial magnetism

Dr Vidar Enebakk, University of Oslo
Christopher Hansteen and the mapping of magnetism

12.50 Lunch in the Orangery of the Queen's House

14.00 **Session Five** **Chair: Keith Hope-Lang**

George Huxtable and Ian Jackson
'Journey to Work': James Cook's transatlantic voyages in the brig Grenville, *1764–1767*

Dr Günther Oestmann
The establishment of nautical teaching in Prussia in the eighteenth and nineteenth centuries

14.50 Tea

15.20 **Session Six** **Chair: Terry Hayward**

Olivier Sauzereau
Establishing a network of marine observatories in France in the years 1810–1820

Dr Alison Morrison-Low, National Museums Scotland
Showcasing seamarks: the Northern Lighthouse Board's presence at late-nineteenth-century international exhibitions

16.10 General discussion and closing remarks

16.30 Close

A Sense of Direction –
New Researches in the History of Navigation Conference
National Maritime Museum, 6-7 May 2010

Abstracts

Richard Blakemore, University of Cambridge

'To further that so much deserving Science of Navigation': the London maritime community as a forum for the development of navigation, 1550–1650

Based upon research undertaken during a summer internship in July 2009 at the Royal Observatory, Greenwich, this paper will explore the ways in which navigation was discussed, developed and refined in the interrelated media of printed texts, practical experimentation, and (both official and personal) teaching, dialogue and exchange. I will argue that while mathematical and scientific practitioners played an important role in this process of development, they by no means monopolised it; that it was, in effect, a public process, involving a wide variety of members of the maritime community.

Firstly the paper will discuss the usage of the word 'navigation' in the early modern period, considering the implications of its varying meanings, and how these meanings indicate the existence of a concept of navigation as a public body of knowledge and practices, a concept which many different people drew upon for a range of scientific, artistic and political purposes. I will go on to analyse the means by which this public body of knowledge and practices was continually and collaboratively debated, contributed to and refined both by members of the maritime community and others. This will include a discussion of the increasing number of navigational manuals published from the 1560s onwards; the proliferation of designs for navigational instruments, and their production; and the establishment of institutions with the teaching of navigation as a specific aim, such as Gresham College, or lectureships at the royal dockyards.

I will, finally, consider the network of people producing and contributing to this body of knowledge and practices; a network including mathematical practitioners, seafaring navigators, instrument- and map-makers, printers and publishers. I will in particular discuss the evidence of personal interaction within this network, and the important role it played in the development of navigation. The paper will conclude by studying how the London maritime community provided, in a geographical and social sense, a forum and an audience for this network and the concept of a science of navigation which it produced.

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Nicolàs de Hilster, Netherlands

The early development of the Davis Quadrant

This paper will look at the development of the Davis Quadrant in the late sixteenth and seventeenth centuries. It will look at the development of the diagonal scale, how and when the instrument got its name (and the consequences for early texts on the

instrument), the construction of the frame and its link to Thomas Harriot, and Robert Hooke's claim to have invented the Flamsteed lens.

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Vidar Enebakk, University of Oslo
Christopher Hansteen and the mapping of magnetism

In 1819 Christopher Hansteen, a Norwegian mathematician, astronomer and director at the observatory in Christiania (today Oslo), published his *Untersuchungen über den Magnetismus der Erde* accompanied by a beautiful magnetic atlas. Here he presented his geomagnetic observations and research summed up as a modified version of Edmond Halley's four pole theory. The aim was to improve navigation by mapping the magnetic forces all over the world, and Hansteen later produced what is usually considered the first world map for magnetic intensity. He also constructed a new magnetometer, and this small and portable oscillation instrument was multiplied by Hansteen's instrument maker and used by various researchers and explorers during the 1820s to make standardized observations and measurements on trips all over the world. The instrument was essential on Hansteen expedition to Siberia 1828-30 trying to locate the second magnetic pole in the northern hemisphere, and Hansteen's approach to the study of geomagnetism later influenced Edward Sabine and the formation of the "Magnetic Crusade". In my talk I will explore the relationship between navigation and Hansteen's mapping of magnetism.

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Danielle Fauque, University Paris-Sud 11
Using reflecting sextants and circles in navigation: a comparative study between English and French handbooks in the second half of the eighteenth century

In the second half of the eighteenth century, methods, tables and navigational instruments became available with which seamen could determine their longitude at sea, by lunar distances. The development and diffusion of that method occurred more or less simultaneously in England and France. The aim of my project is a comparative study of this process in handbooks of art of navigation, especially with regard to the training in the use of reflecting instruments at sea.

In Britain the sextant was adopted for measuring lunar distances, while in France Jean-Charles de Borda improved Tobias Mayer's design of a reflecting circle. The reflecting circle was adopted in France for surveying, for voyages of exploration and discovery, and for hydrography.

French handbooks on the art of navigation show that the octant remained the standard reflecting instrument that pupils had to learn to use at sea for measuring the altitude of celestial bodies. Only a few of such books, written by independent authors tried to persuade their readers to nse the more accurate sextant and circle at sea. This seems to contradict what most historians up to now have assumed, who claim that circles were widely used for navigation. This aspect needs new research and a fresh look.
Despite the innovation of methods to determine the longitude at sea, both British and French handbooks did usually not develop the use of sextant or circle until the end of

the eighteenth century. We propose to describe this process, based on the study of more than ten handbooks (and several issues) by British and French teachers of navigation.

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Ted Gerrard
Isaac Newton's invention of the reflecting quadrant – its possible construction

Commander Edmond Halley RN used Isaac Newton's revolutionary brass twin-mirrored angle-measuring device to determine latitude and (indirectly) longitude during the first *Paramore* Atlantic expedition in 1698. An improved version was exhibited at a Royal Society meeting in 1699. Robert Hooke claimed prior invention.

Total silence until 1742 when the RS published Newton's hand-written proposal for a twin-mirrored device discovered amongst Halley's papers after his death. Newton's description did not match the artist's drawing which did not match the published steel engraving. Neither illustration depicted a useable instrument.

The journals of *Paramore's* three expeditions under Halley's command provide proof that Newton's actual instrument was very sophisticated. For example six verifiable position latitudinal noon sights with an average error of 4 minutes of arc on the first voyage and twenty with an average error of 1½ minutes with the improved instrument on the other two. Accuracy not to be matched for more than 50 years.

This illustrated presentation will explain how I constructed a similar device, using tools and scale division methods available to Royal Mint metallurgists and engravers in 1696.

This instrument will be available for the audience to examine and test.

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George Huxtable and Ian Jackson
'Journey to Work': James Cook's transatlantic voyages in the brig* Grenville *1764–1767

Before achieving fame, James Cook had spent the years 1764 to 1767 surveying the coast of Newfoundland each summer. Ice made that coast untenable in winter, so Cook spent each winter in London, assembling his charts. We show track-charts of his two crossings of the North Atlantic each year, in the brig *Grenville,* seven such passages in all.

Although much attention has been given to Cook's subsequent travels, these rather-ordinary voyages have been somewhat overlooked. They were consistently efficient and fast; even when travelling directly Westbound against prevailing wind and current. Modern advice, for Westbound sailing vessels, warns that such direct passages are impracticable, and suggests going much further South for the Trade Winds. Fortunately for Cook, he lacked the benefit of such advice.

Those passages were made just before lunar-distance longitudes became feasible for mariners, so dead-reckoning was the only tool for determining longitude. Surprisingly, on each of the seven passages, *Grenville's* landfall was "ahead of her reckoning". Her track clearly shows how Cook was prepared to divert from the intended course, in mid-ocean, to get the best slant from contrary weather, and how precisely the intended latitude line was kept, as the destination neared.

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Derek Irwin, Greece

Navigational aids in the ancient Greek world

Thucydides tells us that 5th century BC Athens was so powerful and prosperous that the city imported produce from everywhere in the Greek world. In ancient times, the form of transport par excellence was the ship, and the vast majority of goods would have been transported by sea. From the Classical Period onwards, a large number of Greek merchant ships plied the Mediterranean Sea loaded with food produce and manufactured goods.

Contrary to what is sometimes believed, ancient Greek merchant ships were well built and very seaworthy, and would have been manned by competent sailors versed in the art of navigation. In this paper, I will examine the navigational aids that were available to ancient Greek sailors, ranging from natural and physical aids such as celestial bodies and geographical features to man-made features such as temples and lighthouses. I will also show that certain merchant ships were equipped with navigational instruments that would have certainly reduced the risks of open-sea navigation.

With this paper, I hope to demonstrate that ancient Greek sailors had several navigational aids available to them which allowed them to navigate in relative safety and with relative precision.

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Wolfgang Köberer, Frankfurt am Main

The earliest German manual of navigation – a* mixtum compositum *of Portuguese nautical science and English practical seamanship

Seafarers from the German coast did not partake in the voyages of discovery and in oceanic trade until well into the 19th century. From the 16th century on nautical instruction that was necessary - for instance for whale hunting and fishing in the northern seas - was conducted on the basis of Dutch manuals by Lastman, Gietermaker and others.

But the oldest German manual of navigation predates the Dutch books and was printed only a few years after the earliest genuine English book - William Bourne's *Regiment for the Sea* (1574). This manual was issued in Lübeck in 1578 and reprinted in 1592. It explains the basic rules of astronomical navigation that were developed in Portugal in the late 15th century with the necessary tables and examples. In addition to

that it contains the earliest mechanical device to cope with the main problem of navigation in northern waters: the tides.

This astonishing combination of Iberian nautical science and northern seafaring experience may be explained by the person who wrote this booklet: James Alday, a follower of Sebastian Cabot and a captain with seafaring experience in the Muscovy trade.

My talk will outline the content of the book and the conclusions which might be drawn about the dissemination of nautical knowledge from the Iberian peninsula to Northern Europe.

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Henrique Leitão, University of Lisbon
The origin of the rhumb line

The concept of 'rhumb line' (later called 'loxodromic curve') was originally proposed in 1537 by the Portuguese cosmographer and mathematician Pedro Nunes (1502-1578) and further developed by him in a series of works until 1566. The idea spread very rapidly in Portugal and elsewhere. In 1541 Gerard Mercator drew rhumb lines in a globe and in 1545 Gemma Frisius referred to the new concept. From a mathematical point of view the rhumb line introduced novel and very difficult problems, particularly those related to the asymptotic behavior near the poles. Nunes tried to overcome these difficulties in his 1566 publication, but finding a solution would challenge mathematicians for over a century. What is perhaps more interesting is that although presented as a mathematical concept, the idea of the rhumb line was deeply inspired in the actual practice of pilots and its early mathematical treatment was very much influenced by this origin. My objective in this presentation is to clarify how this fundamental concept of navigation appeared and to highlight the deep and subtle interplay between practice and theory that shaped its original proposal.

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Alison Morrison-Low, National Museums Scotland
Showcasing seamarks: the Northern Lighthouse Board's presence at late-nineteenth-century international exhibitions

Formed by Act of Parliament in 1786, the Northern Lighthouse Board remains in charge of Scotland's sea marking. Almost from the start, this body appointed an engineer, one Thomas Smith, who turned out to be the first in a dynasty made famous by his step-son and son-in-law, Robert Stevenson, and which was associated with the Board for over 150 years. Both the Board and the Stevensons used the international exhibitions from 1851 onwards to showcase their past successes and promote recent innovations with impressive apparatus and models aimed at selling their system overseas. Unusually, much of this material still survives. What can it tell us about the lighthouse service in the later Victorian period?

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Günther Oestmann, Germany
The establishment of nautical teaching in Prussia in the eighteenth and nineteenth centuries

The naval power of Prussia until the foundation of the Reich in 1871 was by no means significant. Neither the merchant marine consisting of small ships mostly operating in the Baltic and North Sea, nor the early attempts creating a Prussian Navy were of paramount importance. These facts are in contrast to a highly ambitious, albeit controversial program establishing sound, scientifically orientated nautical teaching, which started shortly after the defeat of Napoleon. A Royal director of the navigation schools in Prussia was installed, but due to the lack of qualified personnel the government had to rely on naval officers hired in Denmark, Norway and the Netherlands until the mid 19th century.

The conditions and prerequisites of the development of nautical teaching in Prussia have never been studied extensively, and a first delineation will be given.

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José Manuel Malhão Pereira, University of Lisbon
The Portuguese contribution to the knowledge of terrestrial magnetism

It is generally admitted that the magnet is known since very early in History, but the variation of the compass needle has only been recognized during the early years of European maritime expansion.

Rccently, many scholars have studied the terrestrial magnetism and the important variation of the compass, producing excellent works that allowed us to better understand geomagnetism as a whole.

For the knowledge of the local variation of the compass and later for its secular change, log books and navigation manuals of European nations have been studied, which allowed a clearer view of the problem and the arrival to important conclusions about this subject.

As well as other European sources, Portuguese sources were also used on the above referred studies. Nevertheless, some others have been recognized recently and can be useful for the study of variation as an important help for the safe management of ships. These sources can also help the study of its secular change and its acknowledgement by sailors, after this concept being published by Henry Gellibrand in 1635 and accepted by a wide audience, especially in land.

So, the purpose of my paper will be the introduction of some more information related to this subject, summarizing the Portuguese sources since the early Atlantic explorations, and extending the study with log books and Pilots of the 17 and 18 centuries, besides actions of the Portuguese State authorities related to the subject.

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Antonio Sánchez Martinez, Spanish National Research Council
Atlantic cartography and magnetic declination in sixteenth-century Spain: Seville's School of Navigation

European Renaissance cartography and navigation underwent methodological changes as a result of the new Atlantic routes. Explorations through an inhospitable sea and discovering a new continent changed the premises that until then had ruled European mapping. Given the scientific requirements of this new context, the Mediterranean portolan charts of Italian and Majorcan tradition were transformed into Atlantic nautical charts for a large ocean. If portolan charts were used in the Mediterranean Sea and other smaller European seas, the Atlantic nautical charts of the sixteenth century responded to the needs of a new space. Despite the efforts of the Portuguese nautical astronomy and the experience of the great transoceanic voyages, cosmographers concluded that the Atlantic nautical charts were inadequate representations of reality due, among other factors, to the phenomenon of magnetic declination. Some cartographers working at the House of Trade in Seville, like Diego Gutiérrez, attempted to remedy the deficiencies of nautical charts with the creation of double graduation charts. Very soon this type of instruments rivaled the official map of the House of Trade: the Pattern Chart. The Pattern Chart was a model chart prepared according to the new discoveries, a representation in progressive realization.

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Olivier Sauzereau, Centre François Viète, University of Nantes, France
Establishing a network of marine observatories in France in the years 1810–1820

The marine timekeeper is of confidential use in France in the late eighteenth century. But thanks to the solving of several technical constraints, it gradually becomes more common in the early nineteenth century. One of these constraints is the need for strict control of these timekeepers by astronomic observations. In the 1790's several projects of marine observatories are made for the ports of Brest and Toulon. Some of these early projects are ambitious, requiring the construction of important buildings. They were abandoned due to their cost as well as the political and economic context of the revolutionary period.

Until the 1810's, most timekeepers are first checked in the workshop of watchmaker Berthoud at Argenteuil. However, the risk is high that these timekeepers get disturbed between the place of setting and time of embarkation in a port, making such tests unnecessary. The few checks at ports are the work of Marine officers. The observation and work methods are different from one person to another and the quality of results is very irregular. From 1815, a network of marine observatories is created in France. The choice will focus on smaller institutions, dedicated to the marine timekeepers. The observatory will also become a great tool to train officers in new techniques of navigation. Thus, this network of small observatories in ports, far from being anecdotal of the marine history, proves to be an essential tool in the widespread of marine timekeepers in France.

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