

# APPENDIX A.

## AN ENUMERATION OF THE WORKS ON THE ART OF NAVIGATION

### PREVIOUS TO AND DURING THE AGE OF ELIZABETH.

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Markham, Albert Hastings. "An Enumeration of the Works on the Art of Navigation previous to and during the age of Elizabeth" included with *The Voyages and Works of John Davis, the Navigator*. The Hakluyt Society, No. LIX., London, 1880:340-367

The following enumeration of works on navigation previous to and during the Elizabethan age is intended, first, to show the position taken by the *Seaman's Secrets* of Davis, and, in the second place, to furnish a key to the history of the progress of nautical science. England, when her sons first began to undertake voyages of discovery, was obliged to look to other more advanced countries for the needful knowledge. The first works enumerated in this list are little more than paraphrases of Ptolemy. Muller (or Regiomontanus) began to take independent observations, and soon the Spaniards and Portuguese produced works for the use of mariners. The English were at first dependent on translations of Spanish books, but discoveries and improvements in the art of navigation followed rapidly on the first voyages of discovery, and all through the reign of Elizabeth books with new inventions or improved methods continued to supply an ever-increasing demand. When a good work on navigation was published, edition followed edition in rapid succession. The List is an attempt to enumerate the principal Spanish and other foreign publications, and all the English works on the art of navigation belonging to the age of Elizabeth.

The arrangement of the list is chronological as regards

authors, but all editions are enumerated together. At the end there is an alphabetical list of authors for more ready reference.

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### WORKS BEFORE OR SOON AFTER THE VOYAGES OF COLUMBUS.

**SACROBOSCO** (John Holywood) "De Sphaera mundi".<sup>1</sup>— This was once the universal text-book in all schools of navigation, especially in Spain and Portugal. There were editions in 1472 (Ferrara), 1478 (Venice), 1480 (Bologna), 1482 (Venice), 1485 and 1488 (Vienna), 1494 (Paris), 1498 (Paris), 1508 (Cologne), 1526 (Avignon), 1527 (Paris), 1537 (Venice), 1538 and 1543 (Cologne). In 1545 a new Spanish edition appeared at Seville in 4to., "J. Sacrobusto. Tractado de la Sphera con muchas addiciones agora nuevamente traduzido de Latin en lingua Castellana por el Bachiller Hieronymo de Chaves." Hakluyt mentions Chaves as having been one of the examiners in navigation at Seville (*Dedication to Principal Navigations*, 1598). Then followed other Italian editions—Venice (1554 and 1576), Florence (1579), and Paris (1577).

Sacrobosco was an English mathematician of the 13th century, contemporary with Roger Bacon. He is said to have been a Yorkshireman from Halifax. He was admitted a member of the University of Paris in 1221, where he spent most of his life, but he resided for some years at

<sup>1</sup> There were Englishmen who wrote on astronomical subjects even before the time of Sacrobosco. In the first half of the twelfth century, Athelard or Adelard, a Monk of Bath, wrote on the astrolabe. He had travelled in the East, and returned about 1130. See Hakluyt, *Prin. Nav.*, p. 5. In the twelfth century, Alexander Neckam, Monk and Schoolmaster of St. Albans, was undoubtedly the first writer in the west who mentioned the compass in his "De Utensilibus". This fact was brought to light by M. d'Avezac (*Bulletin de la Soc. de Geog. de Paris*). Roger Bacon mentioned the load-stone in his "Opus Majus" and "De Cosmographia".

Oxford. He died at Paris in 1256. The “De sphæra mundi” is a paraphrased translation of part of Ptolemy's *Almagest*. It was first printed in 1472 ; and passed through more than twenty editions.

**THE ALPHONSINE TABLES.**—An astronomical work which appeared in 1252, under the patronage of Alfonso X, King of Castillo. The Tables contain the places of the fixed stars, and the methods and tables then in use for computing the places of the planets. But the Tables were not made from original observations. They were constructed for the meridian of Toledo, and the year 1256. They formed, except in a few points, a body of Ptolemæan astronomy, and continued to be used for several centuries. First printed at Venice in 1483, again in 1488, 1492, 1517, 1521, 1545, and 1553.

**JOHN PECKHAM**, a native of Sussex, a Franciscan, afterwards Archbishop of Canterbury, A.D. 1279–1292, wrote a treatise called “De Sphæri.”

**GEOFFREY CHAUCER**, the Poet, wrote a treatise on the Astrolabe, addressed to his son Lowis, in 1391. It is plain, from what is said at the beginning of this treatise, that the printed copies do not contain more than two of the five parts of which it was intended to consist. The title is “Tractatus de Conclusionibus Astrolabii.” Underneath, [“Bred and Mylk for Children”], and it is addressed to his son “Litell Lowys”. Chaucer obtained his materials from the Latin translation of the treatise of the Jew “Má shea Allah Al Misri” (Messahala<sup>2</sup>) entitled “Compositio et Operatio Astrolabii”. Chaucer's Treatise was first printed in 1532 (folio), then followed editions in 1542, 1551, 1561, 1598, 1602, 1687, 1721. Mr. A. C. Brae published an edi-

<sup>2</sup> Or Maschalla. He was a learned Jew at the Court of the Khalifas from the time of Almanzor to that of Almamun, a.d. 754 to 813. See an account of his works in *Casiri*, p. 484. His treatise on the astrolabe, translated into Latin, was printed at Venice, in 1493.

tion in 1870, and the Rev. W. W. Skeat, for the Chaucer Society, in 1872.

**ROBERTUS ANGLICUS** (seu De Cestria).—According to Leland he flourished in 1390. “De Astrolabio Canones Incipiunt.” (Perugia, 1476, 4to., 42 leaves.) Edited by U. Lunciorinus.

**NICHOLAS DE LYNNE** was a Franciscan Friar, and an excellent mathematician of Oxford, who made a remarkable Arctic voyage in 1364. See Hakluyt’s *Principal Navigations*, p. 248. I have referred to this voyage in my *Northward Ho!* p. 10. Nicholas wrote several treatises of more or less value to navigators in those days, namely, “De Natura zodiaci”, “De Planetarum Domibus”, “De Mundi Revolutione”, and “De usu Astrolabii”.

**WILLIAM BATCOMBE** was Professor of Mathematics at Oxford in the reign of Henry V. He wrote “De Sphæra Concava”, “De Fabrica et usu ejusdem”, and “De Operatione Astrolabii”.

**GEORGE PURBACH** was born near Linz in 1423, and became Professor of Astronomy at Vienna, where he constructed many astronomical instruments. In his days the Greek manuscript of Ptolemy was unknown, and there only existed two Latin versions of the *Almagest* translated from the Arabic, besides the treatise on the sphere by Sacrobosco. Purbach wrote on the theory of the planets, *Theoriæ Novæ Planetarum* (Venice, 1488), *Tabulæ Eclipsium* (Vienna, 1514), and commenced the translation of Ptolemy. He died at Vienna in 1461.

**JOHANN MÜLLER** or **REGIOMONTANUS** was born at Konigsberg in Franconia in 1436, and was the pupil of Purbach, whom he succeeded as Professor of Astronomy at Vienna. In 1461 he went to Rome to study Greek, and thence to Ferrara and Padua. In 1465 he returned to Vienna. While in Italy he wrote “De Triangulis Planis et Sphæricis” (Nurnberg, 1533, fol.), containing two tables of natural

sines. He also completed Purbach's translation of Ptolemy's *Almagest*, the first edition appearing at Venice in 1496 (folio), the second at Basle in 1543. Removing to Nuremberg in 1471, he was assisted by a wealthy citizen named Walter, in constructing several astronomical instruments. With their aid he drew up Tables which were first published in 1544, and exposed the errors of the Alphonsine Tables. He also published the first almanac "Calendarium Novum", for years 1475 to 1566. He died at Rome in 1475.

**MARTIN BEHAIM** was born at Nuremberg in 1436, and was a pupil of Regiomontanus. He was a merchant, and in 1479 went from Antwerp to Portugal, being a skilful cosmographer and constructor of maps. In 1484 he accompanied Diogo Cam on his voyage of discovery, when that explorer reached the mouth of the Congo. He afterwards married at Fayal, one of the Azores, and resided there, and was employed in making charts, occasionally visiting Lisbon and Madeira. He died at Lisbon in 1506 ; leaving no work behind but a famous globe, and many charts and maps. The globe is preserved at Nuremberg. Martin Behaim invented the application of the astrolabe to purposes of navigation in 1480.

**JOHN WERNER**, of Nuremberg, was born in 1468. A great mathematician. He wrote five books on trigonometry ; and in 1522 he published his "Opera Mathematica". Werner was the first author who described the cross-staff and its use ; in his Annotations on the first book of Ptolemy's *Geography*, printed in 1514. He died in 1528.

**JOANNES STOEFLERIUS** was Professor of Mathematics at Tubingen. He was the author of Ephemerides for the years 1494 to 1551, and of a work entitled "De fabrica et usu Astrolabiæ". He died in 1531, aged 78.

**SEBASTIAN MUNSTER** was born at Ingelheim in 1489. He was the pupil of Stoeffle at Tubingen, and afterwards taught Hebrew and theology at Basle, where he died of the

plague in 1552. His chief geographical works were a new edition of the Latin version of Ptolemy (1540, fol.) "Sphaera Mundi et Arithmetica" (Basle, 1546, 4to.), and the "Cosmographia Universalis", (Basle, 1550, folio), in German, which went through several editions. (See EDIN and BELFOREST.) Munster was called the "German Strabo".

**PETRUS APPIANUS**, of Leipsic, Professor of Mathematics at Ingolstadt, 1524. Author of a great work on cosmography. See GEMMA FRISIUS.

**ANGELAS**.—Published astronomical almanacs or ephemerides from 1494 to 1500.

## SPANISH AND PORTUGUESE.

**ALONZO SANCHEZ DE HUELVA**.—Andaluz. "Compendio del Arte de Navegar", 1484. This is the first book mentioned by Stratico (*Bib. Mar.* Milano, 1823, 4to.) Alonzo Sanchez is the pilot who was supposed to have discovered America before Columbus. See note at p. 24 of the first volume of *G. de la Vega* (Hakluyt Society's Series, 1869.)

**PEDRO NUNEZ**, or **NONIUS**, was born at Alcazar, in Portugal, in 1497. He wrote "Sol e da Lua, pello Doutor Pero Nunes, Cosmographo del Rey dõ Joaõ ho tercyro : Empri-  
mir cidade de Lisboa per Germao Galharde emprimidor : primeiro dia do mes de Dezembro, 1537" (fol.) In 1567 a Latin edition was published at Basle with the addition of a second book, the whole entitled "De Arte et Ratione Navigandi" (1530). Nunez, the first of the Portuguese cosmographers, exposed the errors of the plane chart, and gave the solution of several astronomical problems, including the determination of the latitude by sun's double altitude. A complete edition of the Latin treatises of Nunez was published at Coimbra in 1573. His treatise on Algebra, in

Spanish, was printed at Antwerp in 1567. Nunez was Professor of Mathematics at Coimbra. He died in 1577, aged 80.

**MARTIN FERNANDEZ ENCISO.**— "Suma de Geografia que trata de todas las partidas y provincias del mundo en espeal de las Indias, y trata largamente del arte del marear juntamente con la esfera en romance, y con el regimiento del sol y del norte." 1st edition, Seville, 1519 (fol.), 2nd edition, Seville, 1530. "Agora nuevamente emendada de algunos defectos que tenia en la impresion passada." Bound up with Cortes. A third edition, 1546.

The work consists of definitions, tables of declination, and a description of the countries of the world. The Bachiller Enciso was the partner of Alonzo de Ojeda, and afterwards went out to the Darien Isthmus in the expedition of Pedrarias, as Alguazil Mayor of the province of Castilla del Oro. See *Travels of Cieza de Leon*, p. 34, note, and *Narrative of Andagoia*, pp. ii, and 2, note, the Hakluyt Society's volumes for 1864 and 1865. The "Suma de Geografia" may be considered as the first navigation book.

Enciso says of England that there is no wine or oil, by reason of the moist and cold climate, but that the people get wine from Spain. They make beer from barley and wheat, as in Flanders, which they use as wine. The people are well made, red and white complexions, warlike, quarrelsome, and cruel. In England there are trees, the leaves of which, when they fall on the water, turn into fish, when on land, into birds. This is the land whence came the tales of King Arthur and the Table Eound, and of the divinations of Merlin. Of the Dutch he gives a better character. He says they are loyal and valiant, of good conversation, quiet and peaceful among themselves. Their country is damp, and with good pasture lands.

**ANTONIO DE GUEVARA.**—A Franciscan monk of good family from Alava, Bishop of Mondonedo. His works were first

published at Valladolid in 1539 (folio). At Antwerp on 1550 appeared "Libros de los inventories del arte de marear y de muchos trabajos que se passan en las galeras." Another edition at Pampalona, 1579 (8vo.) The English translation was printed in 1578: "A booke of the Invention of Navigation, and of the great travelles by the famous Sir Anthonie of Guevara, Bishop of Mondonnedo, Preacher, Chronicler, and Counseller unto the Emperour Charlesthe Fift. Translated by EDWARD HELLOWES. Imprinted at London for Ralph Newberrie, dwelling in fleete Streete, a little above the Conduit, Anno 1578." 8vo., 27 leaves. (Arber, ii, p. 303.) There is a copy in the Pepys Library at Cambridge (*Sea Tracts*, vol. I) Guevara also wrote many religious works. He died in 1544.

**ALONSO DE CHAVES.**— "Relacion de la orden que observaba en le examen y admission de pilotos y maestros de la carrera de Indias", 1561. A manuscript never published, at Simancas. See *Navarrete Bibliotheca Maritima Española* (Madrid, 1857), i, p. 17. See also *Herrera*, Dec. iii, p. 219, and iv, p. 30.

**RODRIGO ZAMORANO** was Cosmographer to the Council of the Indies at Seville. He wrote "Carta de marea" (Seville, 1588); "Los seis libros primeros de Enclides traducidos en lengua Española" (Seville, 1576, 4to.) "Cosmographia. Compendio del arte de Navegar" (Seville, 1586, 4to.) Other editions in 1588 and 1591. Translated into Dutch, in 1598, by EVERART.

**GEROMINO DE CHAVES.**— "Tradao de la Esfera que compuso el Doctor Juan de Sacrobusto con muchas adiciones traducio con escolios y figuras" (*Hispani*, 1545, 4to.) "Chronologia ó Repertorio de los Tiempos" (Seville, 1554, 1574, 1580). He was also the author of a map of Seville and its territory, which was used by Ortelius in his "Theatrum Orbis Terrarum". Geronimo de Chaves is



mentioned by Hakluyt in his dedication. (See SACRO-BOSCO).

Hakluyt, in his dedication to the Lord High Admiral, in advocating the establishment of lectures on navigation in London, says that Charles V not only appointed a Pilot Major for the examination of such as sought to take charge of ships in the voyage to the Indies, but also founded a notable lecture of the art of navigation in the "Casa de Contratacion" at Seville. He adds that the learned works on this subject, of Alonzo and Geronimo de Chaves and Rodrigo Zamorano, had come long ago to his hands. Hakluyt's dedication is dated 7 Oct. 1598.

The course of instruction which was ordered to be given to pilots and other sea officers at Seville was laid down in the *Ordenanzas del Consejo Real de las Indias*, printed in 1636. It included the "De Sphaera Mundi" of SACRO-BOSCO, the ALPHONSINE TABLES, the theory of the planets of PURBACH, and the book of triangles by REGIOMONTANUS; together with the use of instruments, and the art of navigation.

**MARTIN CORTES.**—"Breve compendio de la sphaera y de la arte de navegar, con nuevos instrumentos y reglas exemplificado con muy subtiles demonstraciones, compuesto por Martin Cortes, natural de Burjalaros en el regno de Aragon y de presente vezino de la ciudad de Cadiz; dirigido al invictissimo monarca Carlo Quinto, Rey de las Hespañas, etc.: Señor Nuestro" (Seville, 1551).

This work opens with a dedicatory letter to Charles V, followed by a prologue addressed to Don Alvaro de Bazan, Captain General of the Royal Fleet. Then follow chapters containing the usual definitions, and a table of the minutes in a degree of longitude on each parallel of latitude. The second part describes the motions of sun and moon, divisions of time, the machinery and use of clocks, and the tides. There is also a chapter on the St. Elmo lights. The

third part describes the several winds, the construction and use of plane charts, of the compass, the astrolabe, and cross staff. Cortes was the first to suggest a magnetic pole, different from the pole of the earth.

The second edition of Cortes appeared at Seville in 1556 (95 leaves, folio).

The work was translated into English by RICHARD EDEN in 1561, at the suggestion of the famous Arctic navigator and pilot, STEPHEN BURROUGH, and dedicated to the Company of Merchant Adventurers for the discovery of lands unknown, who paid the expenses. Eden gives a preface of 13 pages. Other editions of the English translation of Cortes appeared in 1584, 1588, 1589, 1600, 1609, and 1615. In the edition of 1600 the title is "The Art of Navigation, by Martin Curtis".

**PEDRO DE MEDINA** — "Arte de Navegar" (Valladolid, 1545, folio). The next edition was published at Venice in 1554 (4to). Then "Regimiento de Navegacion contiene las cosas que los pilotos han de saber para bien navegar" (Seville, 1563, 4to). Next there were two Lyons editions, in 1569 and 1576, and one at Rouen in 1579. The English edition was published in London in 1581, in folio, "The Arte of Navigation, by Pedro de Medina, translated out of Spanish by JOHN FRAMPTON". The first Dutch edition was printed at Antwerp in 1580. This was followed by another Dutch edition, translated by MARTEN EVERAERT BRUG, and printed at Amsterdam in 1598. The Dutch edition of 1580 is very interesting, because a copy, in quarto, was found at the winter quarters of Barents. There is a copy in the British Museum. The treatise of MICHEL COIGNET is bound up with it.

Medina was born at Seville. Besides his works on navigation, he wrote a short chronicle of Spain, and a chronicle of the Dukes of Medina Sidonia. He also wrote a "Tabula"

Hispaniæ Geopgraphica”, which was used by Ortelius in his “Theatrum Orbis Terrarum”.

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### ITALIAN

**PORTOLANO.**—“ Questa e una Opera necessaria a tutti li naviganti chi vano in diverse parte del mundo. Venetia por Bernardino Rizo da Novaria” (1490, 4to. Second edition, 1528, 8vo.)

**MICH. ANG. BLONDUS.**—“De Ventis et Navigatione Libellus” (Venice, 1546, 4to.)

**GIOVANNI BAPTISTA RAMUSO.**—“ Navigazioni i Viaggi”, in three volumes, the first published in 1550, second in 1559, and third in 1556. Ramusio was born at Trevigi in 1485. He was secretary to the Council of Ten at Venice, and afterwards retired to Padua, where he died at 1557.

**CAMILLO AGRIPPA.**—“Nuevo inventione sopra il modo di Navigare” (Rome, 1595, 4to.)

**APPOL CALDERINI.**—“Modo di usare il bossolo” (Milan, 1598, 8vo.)

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### DUTCH, FLEMISH, AND GERMAN

**REINERUS GEMMA FRISIUS** was born at Dokkum in Friesland, in 1508, and studied at Groningen and Louvain. He devoted himself to the study of geography, and also constructed instruments and understood the art of engraving. He died at Louvain in 1555. He wrote “Arithmeticae practicae methodus facilis” (Antwerp, 1540) He invented a new crosse staff, which he described in a work called “De radio astronomico et geometrico liber” (Antwerp, 1545). In 1548 appeared his “De annuli astronomic usu”, and “De principiis astronomae, et cosmographiae”. In 1556 “De astralobio catholico et usu ejusdem”, which was brought out by his son Cornelius Gemma. “ Charta sive mappa mundi, qua continetur totius orbis descriptio.”

“*Cosmographia Petri Apiani*” (Antwerp, 1550). The new edition of Appianus and Gemma was produced at Antwerp, by Joannes Bellerus, in 1584 (4to.) Cornelius Gemma, the son, was born at Louvain in 1535, and followed the same career. He died in 1579.

**GERARD MERCATOR**, or **GERHARD KAUFFMANN**, was born at Rupelmonde on March 5th, 1512 ; and studied first at Bois le Duc, afterwards at Louvain. He studied mathematics with the aid of Gemma Frisius; and in 1541 presented to Cardinal Granvelle his terrestrial globe. This globe was often repeated and much used. Yet only two examples of it are known to exist, one in the Royal Library at Brussels, and the other at Vienna. He published many maps, and in 1569 he completed his chart of the world, on the projection which bears his name. He did not, however, disclose the principle of the projection, which was discovered and first described by EDWARD WRIGHT. Mercator published “*De usu annuli astronomici*” (Louvain, 1552), and “*Tabulas Geographicae ad meutem Ptolemæi restitutæ et emendatæ*” (Cologne, 1578, fol.). He died and was buried at Duisburg in 1594, aged 82.

**ABRAHAM ORTELIUS** belonged to a family of Augsburg. His grandfather, William Ortelius, came to Antwerp, and there Abraham was born in 1527. He was wealthy, and able to carry out his literary designs. In his youth he travelled into Italy, and visited England with his cousin Emanuel de Meteren, the historian. He conceived the idea of uniting all the best maps by different authors, in one atlas. The result was his famous “*Theatrum Orbis Terrarum*” (Antwerp, 1570, folio), the base of all subsequent geographical studies. He also published “*Synonymia geographica*” (Antwerp, 1578), and “*Thesaurus geographicus*” (1596). Ortelius was a friend of Mercator. He died on June 28th, 1598, aged 71.

**MARTIN EVERART BRUG.**—Ephemerides from 1590 to

1618. (Printed at Leyden, 1597, 4to.) Translator of Medina in 1598, and Zamorano in the same year.

**JOHANNES STADIUS.**—Author of Ephemerides or Almanacs during a series of years, from 1554 to 1576. See page 270 (*note*). (*Cologne*, 1560, 4to.)

**DAVID OBIGANUS.**—Author of Ephemerides for years 1595 to 1650 (*Frankfort*, 1599, 4to.) His meridian was Wittenberg. Used by Baffin in 1615.

**JODOCUS HONDIUS**, an engraver, was born in 1546. On the breaking out of war in the Netherlands he went to London, and worked at his business. Here he learnt the true principle of constructing charts on the so-called Mercator's Projection, from Edward Wright. Eventually he returned and settled at Amsterdam, where he published many maps, and brought out new editions of the works of Mercator. He published a globe in 1597, which he announced as containing the discoveries of Frobisher, Davis, Barents, Virginia by Harriott, Guiana by Raleigh, and discoveries in South America and China, described by Texeira. He died in 1611, aged 65.

**PETER PLANCIUS** was born in 1552. He was a Calvinistic preacher, pastor of the church at Amsterdam, and a member of the Synod of Dordrecht in 1619. But his chief title to fame is his service to geography. He maintained the existence of an open polar sea, and he induced the people of Amsterdam to despatch an expedition to seek a passage north of Novaya Zemlya, under Willem Barents. He also promoted the despatch of subsequent expeditions, and assisted with his advice. He died on May 25th, 1622.

**MICHEL COIGNET** was a native of Antwerp. He wrote "Nouvelle Instruction des pointcs plus excellents et nécessaires touchant l'art de naviguer" (Antwerp, 1581, 4to.) This treatise is bound up in the Dutch editions of Medina ; forming a supplement, in which Coignet exposes the mistakes of Medina. He invented a method of sailing

on a parallel of latitude, by means of a ring dial and a 24-hour glass, of which he was very proud. Coignet died in 1623.

**ADRIAN GERRITZ**, of Haarlem, was an instructor of pilots. After his death was published a work which is now very rare. "Dee zeevaert ende onderwysinge der gantschert oostersche ende westersche zeevaert water door den vermaerden Pilot ende leermeester der stuerluyden Adriaen. Gerritz van Haarlem":—" in which is explained all the secrets of navigation from cape to cape, all courses, makings of landfalls, rivers, harbours, and streams, warnings of shoals and rocks, and how men may pilot to the land, with many beautiful teachings to the profit of all seafaring people" (Comelisz Claesz at Amsterdam, 1588). Gerritz died in 1580.

**NICOLAES PIETERSZ**, of Deventer. Author of a work entitled, "Globe of Cloot:" with problems and demonstrations, 1588.

**MATHIJS SYVEBTS** or **SOFRIDUS**, of Enckhuysen. Author of a treatise "very necessary for seafaring men", which was translated into English and printed in 1598, by John Wolfe. The title is — "A treatyse very necessarye for all seafaringe men, in the which by waye of conference betwene two Pilotes are many necessarye thinges disclosed ; besides the most desired arte of shooting East and Weste, and the observations of the sune, by Mathias Sijverts Lake-man *alias* Sofridus".

**ADRIAAN VEEN**, of Amsterdam, wrote a book called the "Napasser", 1594, on pilotage and navigation.

**JACOB FLORISZ VAN LANGEREN**, a maker and seller of globes. He had a grant of exclusive privilege to sell one in 1596. He was a rival of Hondius.

**GERRIT STEMPELS**, of Gouda, a mathematician, published, in 1598, a work entitled "Astrolabium tam generale quam particulare nee non Annulus Astronomicus."

**HENRICH JARICHS VAN DER LEY** wrote a book which was published at Leeuwarden in 1615. "Het Gulden Zeeghel des Grooten Zeevaerts", a navigation book, but of little note.

**LUCAS JANSZ WAGENAAR.**—*"Spiegel der Zeevaardt van de Navigatrie de Westersche Zee."* (Leyden, 1584, fol.) This was the first marine atlas ever published, and there have been many editions. The English version appeared in 1588. "The Mariner's Mirrour, together with the rules and instruments of navigation, first made by Luke Wagenaar of Enchuisen, and now fitted with necessarie additions by ANTHONY ASHLEY." (London, 1588, folio.) This book contains a folio sheet with the arms of Sir Christopher Hatton, to whom the translation is dedicated. The second Dutch edition, with new maps, appeared in 1585 (1 vol., folio), another in 1586. The fourth Dutch edition, with forty-nine charts, is excessively rare. It contains two charts of Ireland and one of Norway, by Willem Barents, with observations on his first two expeditions to the north. This fourth edition was published at Amsterdam by Cornelisz Claesz in 1596 (folio). A French edition was published at Antwerp in 1591.

Wagenaar was born at Enckhuysen in about 1550, and served at sea from his boyhood. He was one of the best pilots in Holland. In 1577 he published a chart of the anchorage at Enckhuysen, and others followed in the following years. He had the exclusive right, for ten years, of publishing his sea charts. They were brought together in an atlas called *"Tresoor van de zeevaart"*. With it is included a very curious old *"Lees-Caertboeck"* of Wisby. (Leyden, 1592. 4to.) Second edition by Comelis Claesz, 1596.

**SIMON STEVINUS.**—On March 8th, 1599, a privilege was granted to Christoffel Raphelingius to print and publish a book by Stevin, called *"De Havenvinding"* (Leyden, 1599).

It was printed in Latin by Grotius, with the title "Portuum Investigandorum Ratio". In the same year, EDWARD WRIGHT translated it into English, with the title, "The Haven Finding Art". Stevinus raised some objections to the principles laid down in Wright's "Certain Errors", to which Wright gave a full answer in his second edition of 1610.

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### FRENCH

"**LE ROUTIER DE LA MER** iusques an fleuve de jourdain nouvellement imprime a Rouen". At the end, "Cy finissent les ingemens de la mer, des nefes, des maistres, des mar-rinners, de tout leur estre avecques le Routier. Imprimé a Rouen pour Jacques le Forestier, demourant an dict lieu devant nostre dame a l'enseigne de la fleur de lis" (29 fol.) This is the earliest example known to us, from which all succeeding Rutters took their rise. The date is the commencement of the 16th century. The book is very rare, and no example is known in England.

**JAN ALFONCE**.—"Voyage aventureux: les tables de la declination du Soleil" (Poitiers, 4to, 1559).

**FRANCOIS BELFOREST** was born in 1530. He edited, with additions, the cosmography of MUNSTER, "La Cosmographio Universelle de tout le Monde" (Paris, 1575, 2 vols., folio).

**ANDRÉ F. THEVET**.—"Cosmographie du Levant" (1556). An account of the author's voyage to Constantinople. "Les singularitez de la France Antarctique autrement nommée Amerique" (1558). An Italian edition was published at Venice in 1561. "Cosmographie Universelle" (Paris, 1572). This was a work of little value, and was never in much esteem. It is only interesting because Frobisher was supplied with it in his northern voyage of 1576.

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## ENGLISH

“**THE RUTTER OF THE SEA, with the LAWS of the YLE of Auleron.** Translated and imprinted by Robert Coplande at the costes and charges of Richard Bankes” (London, 1528, 12mo.) This is the earliest known translation of the Routier into English. No copy is known to exist, but it is referred to by Ames (*Typ. Ant.*)

“**THE RUTTER OF THE SEA,** with the havens, rades, and soundyngs, kennynge, wyndes, floodes, and ebbes, daungers and costes of dyvers regions, with the lawes of the Yle of Auleron, and the iudgements of ye sea. Lately translated into Englyshe. Imprinted at London in Poules Chyrche yard, at the sygne of ye Maydens Hed, by me, Thomas Petyt. The yere of our Lorde God M.D.XXXVI. The xxviii daye of Marche.” There is a copy in Lincoln's Inn Library.

“**THE RUTTER OP THE SEA**”, title as above, translated by Robert Copland. “With a Rutter of the Northe, compyled by RYCHARDE PROUDE, 1541”, added to the same. Rutter, 25 leaves ; judgements of the sea, 12 leaves. Rutter of the Northe Partes, 5 leaves” (12mo.) There is a copy in the British Museum, and another in the Pepys Library at Cambridge. A note in the latter, in Mr. Pepys's writing, as follows : “ That ye only Fellow to this book I find extant is among Mr. Selden's in ye Bodleian Library at Oxford” (April 1693).

“**THE RUTTER OF THE SEA**”, another edition, printed by William Copland in 1560 ? (12mo.)

“**THE RUTTER OF THE SEA**”, etc., printed by John Audeley, 1565 ; another edition in the Pepys Library (No. 4i), 1580 ; another in Arbor's list, 1587.

**WILLIAM CUNNINGHAM.**—“The Cosmographical Glasse, conteyning the pleasant principles of cosmographie, geographic, hydrographie, or navigation.” (J. Day, London, 1559. fol.)

**RICHARD EDEN** was the translator of Cortes and other valuable works. His first translation was "A Treatyse of the New India" from the Latin of SEBASTIAN MUNSTER (London, 1553, 8vo.) Next came P. Martyr's "Decades of the New World", from the Latin (1555, 4to.) His translation of "The Arte of Navigation, containing a compendium description of the sphere, with the making of certain instruments and rules of navigation, by MARTIN CORTES, Englished by Richard Eden": appeared in 1561 in 4to., and was much used. There were editions in 1561, 1578, 1580, 158-1, 1588, 1589, 1596, 1600, 1609, and 1615. It was undertaken at the request of Stephen Burrough. There are copies of the 1584 and 1596 editions in the Pepys Library. Then "Decades of Voyages", from the Latin of Kertomannus (1576, 8to.), and "History of Travayle in the West and East Indies and other countreys, etc., gathered in parte and done into Englishe, by Rd. Eden" (1577, 4to.), edited by Willes. Lastly, "A very Necessary and Profitable Booke concerning Navigation, from the Latin of JOANNES TAISNERIUS" (1579, 4to.), printed by Jugge. In the Pepys Library at Cambridge (*Sea Tracts*, ii. No. 11) there is "A very Necessary and Profitable Book, translated by Richard Eden", on the loadstone.

**STEPHEN BURROUGH**, to whom Eden's translation of Cortes is due, was born at Northam, in Devonshire, in 1525. He sailed in the expedition of Sir Hugh Willoughby and reached Archangel; and made several subsequent voyages as pilot. See *Hakluyt*, i, p. 274-290. He was afterwards one of the four principal pilots in ordinary of the Queen's Royal Navy, and conducted the fleet, with Leicester's expedition, from Harwich to Flushing in 1585. His interesting account of this service has been printed by the Camden Society in the volume of Leicester's Correspondence. He died on July 12th, 1586, and was buried in Chatham Church, aged 60.

**THOMAS DIGGES**. — The great mathematician. (See note at p. 234.) [Included here at the end of the present section.]

**WILLIAM BOURNE.**—“A Regiment of the Sea, conteyning most profitable rules, mathematicall experiences, and perfect knowledge of navigation, by William Bourne. Imprinted at London, nigh unto the three cranes, in the Vinetree, by Thomas Dawson and Thomas Gardyner for John Wight.” 1573. Second edition 1577. A large engraving of a full-rigged ship on the title page. A third edition in 1592, corrected by T. Hood. In 1596 a new edition, with this title: “A Regiment for the Sea, containing verie necessarie matters for all sorts of men and travaillers, wherunto is added an hidrographicall discourse touching the five severall passages into Cathay, written by William Borne, newly corrected and amended by Thomas Hood, D. in Phisicke, who hath added a new Regiment and Table of declination. Whereunto is also adjoynd the Mariner's Guide, with a perfect sea carde, by the said Thomas Hood.” (London: T. Este, for Thomas Wight, 1596.) This edition also has the large ship on the title page. Other editions by Hood in 1611 and 1628.

Bourne was the first to describe the log and line for estimating the rate of a ship. Their use is next mentioned by Purchas in the narrative of one of the early East India voyages. The “Regiment of the Sea” was designed as a supplement to CORTES, whom Bourne often quotes. Bourne published an almanac in 1571 for the years 1571, 1572, and 1573, and in 1580 an almanac for ten years.

Bourne also wrote “Inventions and Devices. Very necessary for all generalles and captaines or leaders of men, as well by sea as by land.” (London, 1578. 4to. 99 pages.) The first part treats of “Martiall affayres by sea.” In the same year appeared his “Booke called Treasure for Traveillers, divided into five bookes or partes, contayning very necessary matters for all sortes of travaillers, eyther by sea or by lande.” The fourth book treats of “the Arte of Staticke or weight, showing how you may knowe the wayght

of any shippe with all her ladyng.” This work was “Imprinted at London for Thomas Woodcocke, dwelling in Paules churchyarde, at the sygne of the Black Beare” (1578, 8vo.) It is dedicated to Sir William Winter. In 1587 Bourne published “The arte of shooting in great ordnance” (4to.)

**EDWARD HELLOWES.**—Translated the work of GUEVARA, which was published in 1578. See GUEVARA.

**DR. JOHN DEE** was born in London in 1527, and was of St. John's College, Cambridge. He also studied at Louvain, and lectured at Rheims, returning to England in 1551. He was persecuted, during Mary's reign, as one given to enchantments and sorcery, but was favoured by Queen Elizabeth, and he settled at Mortlake. Dr. Dee was the official adviser of the Muscovy Company. He wrote a learned treatise on the reformation of the calendar. Then followed his “General and rare Memorials pertayning to the perfect art of Navigation, annexed to the paradoxal compas, in playne : now first published twenty-four years after the first invention thereof. Printed at London by John Daye, Anno 1577.” (Folio, 80 pages.) There is a curious woodcut of Queen Elizabeth, enthroned in a ship named Ευρωπη. This book was intended as a prelude to a larger work, never published, but the manuscripts are in Trinity College, Cambridge, and the British Museum. In the Pepys Library at Cambridge (*Sea Tracts*, iv) there is a list of Dr. Dee's mathematical works relating to navigation. He died at Mortlake in 1608, aged 81. (See notes in Introduction and at page 234.)

**ROBERT NORMAN** was a compass maker at Ratcliffe. He printed the works of Borough. “Discourse of the magnet and loadstone”, by William Borough. “Discourse of the variation of the compas or magneticall needle” (London, 1581, 4to, second edition, 1596) ; in his own work, entitled, “ The newe Attractive, containing a Short Discourse of the Magnet or Loadstone, and among other his Vertues of

a new discovered secret and subtil propertie, concerning the declining of the needle touche, and therewith, under the plain of the horizon. Now first found out by Robert Norman, Hydrographcr. Hereunto are annexed certaine necessarie rules for the Arte of Navigation by the same R. N. Imprinted at London by J. East, for Richard Ballard, 1585." 4to. Other editions 1596, 1604. In 1590 appeared "The Safeguard of Saylers, or Great Rutter, containing courses, distances, depths, soundings, flouds, and ebbes, with the markes for entering certaine harboroughs, translated out of Dutch into English by Robert Norman, Hydrographer." Edition newly corrected and augmented by E. Wright," 1612. 4to. Norman invented the dipping needle in 1576, and described the occasion of his discovery in the "New Attractive."

**JOHN FRAMPTON** translated Medina in 1581. (See Medina.)

**RICHARD POLTER.** — "The Pathway to Perfect Sailing", 1586. He held that different loadstones communicated different degrees of variation to the magnetic needle. [Not published until 1644. An absurd little book.]

**JOHN BLAGRAVE.** — Second son of John Blagrove, of Bulmarsh Court, near Sunning. He was educated at Reading Grammar School, and St. John's College, Oxford. "The Mathematicall Jewell, showing the making and most excellent use of a singular Instrument so called by John Blagrove of Reading, gentleman. Imprinted at London by Thomas Dawson for Walter Kenge, dwelling in Fleete lane over against the Maidenhead." (1585, folio.) The same author published "Baculum familiare Catholica sive generale. A Booke of the making and use of a Staffe newly invented by the author, called the Familiar Staffe. London : Printed by Hugh Jackson, dwelling in Fleete Street, a little beyond the Conduit at the signe of the St. John the Evangelist." (1590, 4to.) "*Astrolobium Vranicum Generale.* — A Necessary and Pleasaunt solace and recreation for Navigators

in their long Journeying, containing the use of an Instrument or generall Astrolabe : newly for them devised by the author, to bring them skilfully acquainted with all the planets, starres, and constellacions of the Heavens : and their courses, movings, and apparences, called the Uranicall Astrolabe. In which, agreeable to the Hypothesis of Nicolaus Copernicas, the Starry Firmament is appointed perpetually fixed, and the earth and his Horizons continually moving from West towards the East once about every 24 hours. Fraught also by now devise with all such necessary supplements for Judiciall Astrology as Alkabitius and Claudius Dariothus have delivered by their tables. Whereunto for their further delight he hath anexed another invention expressing in one face the whole globe terrestrial with the two great English voyages lately performed round the world. Compiled by John Blagrove, of Reading, gentleman, the same well-wisher to the mathematicks. Anno 1596.”

This map can be no other than the map by Hondius reproduced in “Drake's World Encompassed” (Hakluyt Society).

Devoting himself to his works on navigation, and mathematical studies, Mr. Blagrove never married. He lived at South cote Lodge, near Reading, and died there in 1611.

**ROBERT TANNER.**—“A Mirror for Mathematiques. A Golden Gem for Geo-metricians : a sure safety for Saylers ; and an ancient antiquary for astronomers and astrologians : containing also an order how to make an astronomical instrument called the Astrolab, with use thereof.” The head line is continuous, and runs thus “The Travailers joy and felicitie”. 1587.

**ANTHONY ASHLEY** translated Wagenaar in 1588. (See WAGENAAR.)

**EMERY MOLYNEUX**, Constructor of the Globes at the Middle Temple Library. (See Introduction.)

**THOMAS HOOD** delivered lectures on navigation in the house of Sir Thomas Smith. He was a Doctor of Medi-

cine, and also sold compasses constructed on Mr. Norman's principle, at his house near the Minories. (See NORMAN.) The copy of his speech made at the house of Mr. (afterwards Sir Thomas) Smith, in Gracious (now Gracechurch) Street, in November 1588, was published in the same year. It is in the British Museum. In 1590 appeared "The use of the Celestial Globe in piano, set forth in two hemispheres, by Thomas Hood." In the same year: "The use of the Jacobs Staffe, also a dialogue touching the use of the Crosse Staffe, (Imprinted at London for Tobie Cook and Robert Dexter, 1590", 4to.) Also "The elements of Geometrie, by La Ramee; translated by Thomas Hood." (London, 1590, 16mo.) In 1592 Mr. Hood published "The use of both the globes celestiall and terrestriall, most plainly delivered in forme of a dialogue: containing most pleasant and profitable conclusions for the mariner. Printed by Thomas Dawson." This book was written expressly for the Molyneux Globes. In the same year appeared "The Marriner's Guide set forth in forme of a dialogue, wherein the use of the plaine sea carde is brieflie and plainely delivered to the commoditie of all sort as have delight in navigation. Written by Thomas Hood." It is usually bound up with Bourne's "Regiment of the Sea" (see BOURNE). Dr. Hood was the editor of the later editions of Bourne's "Regiment for the Sea." In 1596 appeared "The use of the Mathematicall Instruments, the Crosse Staffe differing from that in common use with the Mariners, and the Jacobs Staffe. Imprinted at London by Robert Field for Robert Dexter. 1596." (4to.) In 1598 Mr. Hood published "The making and use of the Geometricall Instrument called a Sector."

Dr. Hood was a graduate of Christ College, Cambridge, and was employed by Sir Robert Dudley. The only specimen of the cartography of Hood that has come down to us is a manuscript chart of the West Indies dated 1592, preserved in Sir Robert Dudley's own copy of his *Arcano de Mare* at Florence. It was reproduced by Kunstmann

in the Atlas to his "Die Entdeckang Amerikas (Munchen, 1859, fol.)

**THOMAS BLUNDEVILLE** of Newton Flotman in Norfolk.— "A brief description of Universal Mappes and Cardes and of their use, and also the use of Ptolemy his tables. London, 1589." (4to.) In 1594 was published "M. Blundevile his exercises containing sixe treatises verie necessarie to be read and learned by all young gentlemen that are desirous to have a knowledge as well in cosmographie, astronomie, and geographic, as also in the arte of navigation. London, 1594." (4to.) This work was very popular, and there were new editions in 1597, 1613, 1622, and 1636. In 1602 followed "The Theoriques of the seven planets, the making and description and use of two instruments for seamen to find out the latitude of any place without the helpe of sunne, moon, or starre. First invented by Dr. Gilbert, and now set down by Master Blundevile. London, 1602." (4to.)

**SIMON FORMAN**.—"The Grounds of Longitude, written by Simon Forman, student in astronomy, with an admonition to all those that are incredulous and believe not in the truth of the same" (1591).

**ROBERT HUES** was born in Hereford in 1552, and studied at Oxford. He was the friend of Sir Walter Raleigh and his executor, and received a pension from the Earl of Northumberland. He devoted himself to the study of navigation and made more than one voyage. He wrote a treatise for the Molynoux Globes entitled "Tractatus de Globis et eorum usu, Londini editi sunt anno 1593, sumptibus Gulielmi Sanderson civis Londinensis conscriptus a Roberti Hues, Londini. Id ædibus Thomas Dawson, 1594". 8vo. At the end of the "Tractatus" there is a valuable chapter on the rhumbs by Thomas Harriott, who had charge of Raleigh's first expedition to Virginia. There is also a valuable "Index Geographicus" to the Globes, which serves equally well for the maps illustrating the present volume. Hues proposed the famous nautical problem,



“The difference of longitude and the distance being given, how to find the rhumb and the difference of latitude?” The problem was afterwards proposed by Halley (*Phil. Trans.*, vol. xix, No. 219). Hues died at Oxford in 1632, aged 79. The “Tractatus” of Hues was translated into Dutch by Pontanus, and afterwards into English.

**THOMAS HARRIOTT** was born at Oxford in 1560. He went with Sir Richard Grenville to Virginia, and, in 1588, was published his “Report on Virginia”. Also in Hakluyt, “Brief and true Report of the new found land of Virginia”. He was Mathematical Tutor to Sir Walter Raleigh, a most learned mathematician, and a voluminous writer. He was patronised by the Earl of Northumberland, and, with Hues, attended him during his long captivity in the Tower. Harriott corresponded with Kepler, and made improvements in algebra. His great work on algebra was published in 1601. His mathematical papers in manuscript are scattered. Some are in the British Museum (Pluto cxxiv), some at Sion House (*Hist. MSS. Comm. Report*), and many at Petworth, where they were examined by Dr. Zach in 1784. (*Appendix 6th Report Hist. MSS, Comm.*) He had a dreadful ulcer on his lip caused by a habit of putting instruments with verdigris on them into his mouth ; of which he died on July 2nd, 1621.

**JOHN DAVIS.**—“The Seaman's Secrets.” The first edition is entered in the Register of the Stationers' Company as printed by Thomas Dawson, on September 3rd, 1594 (Arber, ii, p. 312), but no example is known to exist. The second edition, of 1607, in the British Museum, is reproduced in the present volume. The fourth edition, of 1626, is also in the British Museum. The eighth edition, of 1657, is in the Pepys Library at Cambridge (*Sea Tracts*, iv. No. 18). The only copies known of “The Worlde's Hydrographical Description,” by John Davis, are in the Grenville Library at the British Museum (7278), and at the Lenox

Library at New York. It is reprinted in the second (1812) edition of Hakluyt.

**WILLIAM BARLOW**, a clergyman.—“The Navigator’s Supply, containing many things of principal importance belonging to Navigation” (London, 1597, 4to.) Mr. Barlow describes the azimuth compass with two upright sights, and dis-courses well and largely on the sea compass.

**EDWARD WRIGHT** of Garveston in Norfolk, was born in 1560; and was educated at Gonville and Caius College, Cambridge. He was a great mathematician and astronomer, and expert in making scientific instruments. He was lecturer on navigation for the East India Company, and delivered his lectures in the house of Sir T. Smith. He made the voyage with the Earl of Cumberland in 1589, of which he wrote an account. It is reprinted in the present volume. Wright was mathematical tutor to Prince Henry, and was appointed in 1616 to perfect the charts of the East India Company, with a salary of £50 a year ; but he died in the same year.

Wright discovered the principle of the projection for sea charts, generally known as Mercator's Projection. In 1599 he published his “Certain errors in Navigation detected and corrected” ; in which he fully explains the principle of the projection ; and gives a table of meridional parts. The second edition, dedicated to Prince Henry, appeared in 1610. The third, in 1657, was edited by Moxon. Wright also worked with Briggs at the introduction of the use of logarithms, and translated Napier's “Logarithmorum Descriptio”, which was published by his son Samuel Wright, and dedicated to the East India Company. He also translated the “Haven Finding Art” (*Portuum Investigandorum Ratio*) of STEVINUS in 1599, which was bound up with the third edition of the “Certain Errors”. Wright was almost certainly the author of the “New Map”, which is reproduced in the present volume. See Mr. Coote's Note.

**WILLIAM GILBERT**, a native of Colchester, was born in

1540. He was a Cambridge Graduate, and was a Doctor of Medicine. Dr. Gilbert discovered some properties of the loadstone, and wrote, "De Magneto Magneticisque corporibus et de magno magnete tellure, Physiologia nova" (London, 1600, fol.) It contained many suggestions for improvements in navigation. Dr. Gilbert died in 1603.

**ANTHONY LYNTON.**— "Newes of the complement of the Art of Navigation, and of the mightie empire of Cataia ; together with the Straits of Anian" (London, Felix Kynaston, 1602, 4to.)

**HENRY BRIGGS** was born in Yorkshire in 1556, and died at Oxford in 1630, where he was Professor of Geometry. He promoted the use of logarithms, and for this purpose made a journey to Edinburgh to discuss the matter with Napier. In 1624 Briggs published his "Arithmetica Logarithmica". In the second edition of Wright's "Certain Errors" are Briggs's "Tables for the Improvement of Navigation" 1610. He also published the six first books of Euclid in 1620, and a treatise on the North-West Passage in 1622. He was a great encourager and promoter of Arctic discovery.

**SIR ROBERT DUDLEY.**— "Dell Arcane de Mare di D. D. Ruberto Dudleo, Duca di Northumbria e Conte di Warwick. Libri Sei." (Firenze, 3 vols., folio, 1646 ; second edition, 1661.) This superb work contains a complete atlas of maps, treatises on navigation, and fine plates of all the instruments in use on board ship. (See Introduction.)

**HENRY HEXHAM.**— "Atlas or a Geographicke description of the regions, countries, and kingdomes of the world, through Europe, Asia, Africa, and America, represented by new and exact maps : translated by Henry Hexham, Quarter Master to the regiment of Colonel Goring" (2 vols., folio), Amsterdam by Henry Hondius and John Johnson. Dedicated to Charles I, 1636. In the preface, Hexham says that he undertook the translation at the request of Henry Hondius, in order to make known the laborious work of

Gerard Mercator and Jodocus Hondius. He says it is a translation of the Atlas Major, enlarged and augmented out of many worthy authors. This is a superb work. Hexham was a gallant soldier and accomplished writer. He began his military career as page to Sir Francis Vere at the siege of Ostend.

**RUDSTON, MASTER.**—A mathematician mentioned by Baffin as having worked out his observations taken during his voyage to Hudson's Bay in 1615. Among the Harriott MSS. there is a letter from Master Rudston, dated 1615, relating to the variation of the compass.

**SEARLE ?**—Mentioned by Baffin as the author of an Ephemeris which he used in 1615 in his voyage to Hudson's Bay.

**EDMUND GUNTER** was born in 1581, and was educated at Westminster under Busby, and at Christ Church, Oxford. In 1619 he became Professor of Astronomy at Gresham College, and he died while holding that appointment in 1626. In 1620 he published his "Canon Triangulorum", tables of artificial sines and tangents, with Briggs's logarithms of common numbers. In 1622 he discovered the variation or changeable declination of the magnetic needle. He also applied the logarithms of numbers, and of sines and tangents to straight lines drawn on a scale or ruler. This was called Gunter's Scale. He introduced the measuring chain, and was the first who used the term cosine for the sine of the complement of an arc.

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[The note below is from the *Seaman's Secrets* (1880:234–5)]:—

**THOMAS DIGGES.** —was the son of Leonard Digges, mathematician and surveyor, by Sarah (or Bridget?), sister of Sir Thomas

Wilford of Hartridge. He was born at Wotton, between Canterbury and Dover, which place he sold on the death of his father. He was at Oxford, and was afterwards appointed by the Earl of Leicester to be Muster Master General for the Queen's forces in the Low Countries, where he did most valuable service. He was a profound mathematician. In 1573 he published *Alse sive scalæ Mathematicæ*. In 1679 appeared his *Arithmetical Military Treatise, containing as much arithmetic as is necessary towards military discipline*, and also a geometrical treatise called *Stratisticos*, dedicated to Leicester. In 1592 was published his *Perfect Description of the Celestial Orbs, according to the most ancient doctrine of Pythagoras*, and in 1599 he wrote *England's Defence : a treatise concerning invasion*, which was not published until 1686. He left unpublished at his death treatises on the art of navigation, on naval architecture, and on artillery. Thomas Digges married Agnes, daughter of Sir William St. Leger, by Ursula, daughter of George Nevill, Lord Abergavenny, and had two sons, Sir Dudley Digges, the diplomatist, and Leonard. He died on the 24th of August, 1595, in London, and was buried in the church of St. Mary, Aldermanbury.

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Markham, Albert Hastings. "An Enumeration of the Works on the Art of Navigation previous to and during the age of Elizabeth" included with *The Voyages and Works of John Davis, the Navigator*. The Hakluyt Society, No. LIX., London, 1880:340–367.

[The Times and Tides of John Davis](#)  
(Single-page Index; PDF, 26 Kb)

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