# REGIMEN OF THE SEA OR NAUTICAL COMPENDIUM

## CHRONOLOGICAL AND ANALYTICAL LIST

### of various Tables or Treatises on Navigation intented to facilitate Nautical Computations and accelerate ships' position finding

by

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## FOREWORD.

By means of the important data in possession of the International Hydrographic Bureau, I have tried to collect, as regards certain nautical questions, some of the scattered elements which, after examination and study, give a fair idea of the development and progress of the various problems which navigators are called upon to solve.

They deal in particular with five questions which are of primary importance for the safety of navigation.

1°) The orientation of the ship on the sea horizon by means of the compass.

2°) The rapid determination of the depth under keel by means of echo soundings.

3°) Ships' conducting into harbours taking into account local tide predictions.

4°) Information concerning isolated possible dangers in various oceans.

5°) Various means and methods for finding ships' position at sea.

The first of these questions was dealt with in pamphlets of mine entitled:

a) " Introduction à l'examen des compas gyroscopiques, mécanique élémentaire, description schématique " (Introduction to the study of gyroscopic compasses, elementary mechanics). Imprimerie H. Béranger, Paris 1921.

b) " Historical and Bibliographic index concerning the development and improvement of the sea compass " International Hydrographic Bureau, Monaco, February 1941.

The second question was dealt with in various articles which appeared in the Hydrographic Review from 1924 to 1942, and in Special Publication N° 33, which I completed in 1939, at the International Hydrographic Bureau, and which is entitled : " A Summary of echo sounding apparatus ".

The third question was considered in some articles which appeared in the " Hydrographic Review " " a calendar of fundamental Harmonic Tides and Diagrams for their prediction ", Monaco 1937-1942 and in the Special Publication N° 26 of the International Hydrographic Bureau, which I completed in 1940, under the title " Tides, List of Harmonic Constants " which gives information in respect of the entrance to 2235 harbours or roadsteads of the world.

The fourth question is studied in the Special Publication N° 20 of the International Hydrographic Bureau, which I edited in 1932-38, under the title of " General List, arranged by Oceans, of shoals of doubtful existence, and of shoals the positions of which are doubtful or approximate, with historical cards " in 5 parts.

Finally, the fifth question and its constituent elements, now collected thanks to very important data supplied to the International Hydrographic Bureau by the Hydrographic Offices of its States Members, is considered in the present publication.

A methodical analysis of the various treatises or tables of navigation, so varied and numerous, may be theoretically summed up very briefly: a more or less simple splitting up of the position spheric triangle into two auxiliary right-angled spheric triangles permitting, for purposes of solution, the application of simple trigonometric formulae, which induced my worthy chief, Ingénieur Hydrographe Général E. FICHOT, Head of the French Hydrographic Office, to say that henceforth any invention of so called new methods for determining a ship's position should be prohibited. But fashion as well as practice had decided otherwise: each nautical operator may, as suggested by an examination of our nomenclature, give free play to his fancy in initiating new ways of splitting up the spheric triangle, selecting parameters and formulae and consequential compensation. However, improvements and merits only hold good to the extent in which practical tables can be published. Each navigator makes the best of them, in his own way, according to his custom or training. Our definite purpose is to draw up here a table of the various effective means available for navigators formerly and at the present time without anticipating the future.

The latest tables supply, in a convenient form in the view of their adepts, rapid elements of computation or simple determination by inspection

in this respect, the field of possibilities remains very vast and improvements are still open to investigations especially at a time when aerial navigation requires new expeditious methods.

The International Hydrographic Bureau, whose essential rôle is to render navigation easier and safer in all the seas of the world, has endeavoured to publish in its Hydrographic Review bibliographical information as complete as possible on various questions affording special interest to navigators and, on this score, it occupies a special position, among the nations of the world, as a centralizing body.

We thought it more useful, for these last few years, to group such information by subjects, so as to facilitate research work. On the other hand, a chronological order is necessary in order to follow the development of questions more easily. Finally and with the same object in view, we have completed an alphabetical index of names of authors to whom we are indebted for various later improvements.

In such a vast field, we have endeavoured to point out the most outstanding works; still, as omissions may have occurred, we should be grateful to those who are interested in the subject to draw our attention, in this connection, to supplementary or more definite information which might be thought necessary and which might eventually appear in an addendum to this publication.

The list is divided into three parts :

1°) Precursors before 1800, a purely historical and documentary part;

2°) From 1800 to 1900, a period of development towards modern methods;

3°) From 1900, leading to the present regimen.

In the following list and from the year 1850, we have used the following signs for the classification of works.

| | | |
|---|---|---|
| General Treatises on navigation with or without tables | | (T) |
| Logarithm tables | | (L) |
| Radiometric tables | | (R) |
| Instruments and Machines | | (I) |
| Graphs, diagrams, nomographs | | (G) |
| Azimuth Tables | | (Az) |
| Position tables. | Unsplit position triangle | (Δ) |
| » | Position triangle split up by drawing a perpendicular from the zenith | (Z) |
| » | Position triangle split up by a perpendicular drawn from the heavenly body | (M) |

Position tables. Longitude method ..... (Long)
» Altitude method ..... (Alt)

This classification is purely conventional; we have however adopted it as being somewhat in keeping with previous custom as practiced by various authors.

As regards the most outstanding tables, a few brief explanations have been given concerning their use and the calculating formulae on which they are based.

H. B.

FIRST PART.

# PRECURSORS BEFORE 1800.

640 B. C. — **Thalès,** of Milet, teaches the sphericity of the earth and obliquity of the Ecliptic.

VIth Century B. C. — **Pythagoras,** of Samos, explains the motion of the earth and comets; draws up some "arithmetic Tables".

400 B. C. — **Eudoxes,** of Cnida, then **Apolonius,** of Perga, describe various types of planispheric astrolabes, used since by Arabian navigators.

IInd Century B. C. — **Hipparch,** of Alexandria, works out an Astrolabe, improved later by **Ptolemy.** He produces "the first Tables of the sun" mentioned in history with the precession of the equinoxes.

140 A.D. — The Greek astronomer **Ptolemy,** of Canopus, is the author of the "Almagest" a mathematical and geographical treatise, which was a standard work during the whole of the Middle-Ages.

It was translated into Arabic in 827: *Syntaxis Mathematicae - al meguiste,* then translated into latin, at Venice, in 1515. It considered the earth as the center of the world. His system was subverted by that of Copernicus (Treatise on the Revolutions of the celestial worlds, 1543).

400 A.D. — **Sûrya-Siddhânta** — A hindu mathematical work giving rules for determining the altitude of the sun at any hour of the day.

880-928 A.D. — **Al batani** discovers the fundamental relation of the spherical triangle.

$$\cos a = \cos b \cos c + \sin b \sin c \cos A$$

attributed by mistake to Euler (1707-1783).

975 — The Arabian astronomer **Abul Feda,** notes the lunar inequality of the variation the discovery of which is more generally attributed to Tycho-Brahé (1546-1601).

1252 — **Isaac ibn Sid** (Rabbi Zag) a Jew, of Toledo, compiles the "Alphonsine Tables" astronomical tables drawn up by order of Alphonso X, King of Castile, called astronomical almanacs of Madrid or of the declinations of the sun "Libros del Saber de Astronomia de Alfonso X, Regimento da altura do Polo al meio-dia".

They were printed for the first time at Venice in 1483.
Other editions 1488, 1492 (after Erhard Ratdolt).

1263-1308 — **Jacob ben Machir** (Prophatius) — Provencal Jew, from Montpellier compiled in manuscript form some "Taboas astronomicas judaïcas" or "hebraïcas" of the sun.

1272 — **Raymondo Lulle,** a Majorcan — Astrolabii nocturni — Sphaera horarum noctis: a table giving the time by night, from the Northern Star and the "Urse menor" (estrela horologial) or Buzina.

1295 — **Raymondo Lulle** — Arte de Navegar — on the occasion of a description of the astrolabe invented in the second century by the Greek astronomer Hipparch, of Alexandrie gives the Tables of the Sun compiled by him.

End of the XIIIth century. — **Azarquiel** (al Zarkah) an Arabian astronomer, of Cordua — Libros del Saber de Astronomia del rey Alfonso X de Castela (Toledo), describes some spherical and plane astrolabes and various types of Arabian astronomical dials.

These "Libros del Saber" contain also some solar tables: "Tabla de Saber en qual grado del zodiaco es el Sol" and a "Tabla de la declination del Sol".

1306 — Almanaque Perduravel para achar os verdadeiros lugares dos planetas nos signos (aussi 1321).

1342 — The Catalan Jew **Levi ben Gerson** gives the first description known as "Baculo de Saô tiago" (Jacob's staff) or "Balestille" for determining the altitude of heavenly bodies; Jorge Purbach (1423-1462) calls it "virga-visoria" and Regiomontan (1472) "radius-astronomicus".

1375-77 — **Abraham Cresques** — The Catalan chart compiled by the Majorcan Jew Abraham Cresques, who kept a bathing establishment and, in his leisure time, dabbled in hydrography, gives rules "para o conhecimento das horas da norta pela ursa menor".

1435 — **Bojador** — lays stress on the utility of astronomical observations.

1436 — **Andrea Bianco** — Toleta de Marteloio, is the first "position table" which is known of. It is given in Andrea Bianco's Atlas, but its origin must go back to 1390. It is accompanied by a sort of "quadrant of reduction".

In 1509, the Manuel of Munich gave an amplification of it entitled "Regimento or Cañon das leguas", the computation of which in attributed to Mestre José Vizinho (1483) who edited the nautical portion of this text book and which was eventually, more or less reproduced by various authors.

1423-1461 — **Georg Peuerbach** — Theorica de motibus planetarum novae (1472).

1436-1476 — **Regiomontanus** (John Müller von Koenigsberg) a German astronomer, who died in London. He computed ephemerides for the years 1475 to 1506 and the "Calendarium eclipsium" from 1483 to 1530 for Nuremberg.

1475 — De Triangulis planis et sphaericis libri quinque, cum Tabulis Sinuum et Tabulae Directionum (table des tangentes).
— Epitome in Almagestum Ptolemaei (translation begun by his colleague G. Peuerbach).
— In 2474, he had printed in the printing works which he set up at Nuremberg, the "Ephemerides" (1474-1506) in which he gives the principle of the determination of the longitude by lunar distances.

1448 — Now that meridional navigation in developing along the coasts of Africa, they begin to construct in *Casa de Africa* of Lagos (later *Casa da Minia*, then *Casa de la India*) some "Cartas de marear" available for see voyages in conjunction with the "Regimentos da altura do Polo", on rectangular skeleton maps (Marin de Tyr's projection) in which the parallel of Lisbon is taken as equal to 4/3 of the meridian degree.

Benincasa's chart 1460,
Toscanelli's chart 1474,
Cantinho's chart 1502,
Pedro Runel's chart 1505,
Diego Ribeiro's chart 1529.

1457 — **Gutenberg** — prints a thin booklet entitled "Conjunctiones et oppositiones Solis et Lunae" which in the first almanac ever printed.

1457— **Juda ben Verga** — "Astronomical tables of the Sun" —They served as a basis for those of **Abraham Zacuto,** compiled from 1473 to 1478 and published in 1496, (only tables extant).

1473-1553 — **N. Copernicus,** a Polish astronomer — "Treatise on the Revolutions of Celestial Worlds" (1543).

His system was condemned by Pope Paul V as contrary to the Scriptures. — His eclipse predictions were often erroneous by one hour, Tychó Brahé in 1610 improved Copernicus lunar tables, heving discovered the variation and annual equation.

1474 (June 25th) — Letter and Chart by **Toscanelli** on the westward route to the Indies, a document said to have been in Columbus's hands.

1475-1506 — **Regiomontan** (Jean Müller von Koenigsberg) — Ephémérides pour les années de 1475 à 1506.

1483-1530 — **Regiomontan** — Calendarium éclipsium pour les années de 1483 à 1530.

1483 — Tabula astronomica Alfontii regis Castelle (1252) — imprimées à Venise en 1483.

1484 — **John of Portugal** — convened a " junte " (of which Martin Behaim was a member) entrusted with the construction of in astrolabe, the computation of sun declination tables and the coaching of pilots in the art of navigating by the altitude of the sun.

1486 — **Bartholomew Diaz** gives the first certain example of ocean navigation in the Atlantic,

later in 1493 C. Columbus totalized 33 days at sea,
and in 1497, Vasco de Gama, 78 days.

1487-88 — **Bartholomew Diaz,** used an astrolabe when rounding the Cape of Good Hope.

His sailing officer was the pilot Pedro de Alemquer (according to the Imago Mundi, of Pierre d'Ailly).

1492 — **Martin Behaim's** globe (Martini of Bohemia), a German cosmographer and navigator, of Nuremberg (1459-1506) and Lisbon.

He introduced the use of the astrolabe on board of vessels. During the " Junte " of Badajoz, other coloured models were presented " posto que tais globos haja muito ouro: e muitas banderas, Alifantes e Camelhos ".
cf. (Martini de Bohemia — Its life and globes. - E.G. Ravenstein, London, 1908).

1493 and 1494 — **Christopher Columbus** and **Amerigo Vespuce** are supposed to have endeavoured, during their voyages, to observe, on land, some conjunctions or oppositions of planets, predicted by Regiomontan for Nuremberg, with a view to determining their longitudes.

Andrés of St. Martin, Magellan's best pilot, did the same, according to instructions drawn up by Francisco Faleiro for the expedition and containing precepts for deducing longitude by occultations of stars or oppositions of the Moon and Venus.
Alonzo of Santa Cruz, Charles V's cosmographer, also recommends the observation of eclipses of the moon.

1495 — **Blanchini's** tables.

1496 — **Abraham Zacuto** (Rabi) — Almanach perpetuum celestium motuum, cum canones — Leira.

This work by the Jew expelled from Salamanca in 1492, was compiled from 1473 to 1478 (Ha-jibbur Ha-gadol) and translated from hebrew into Latin by Mestre José Vizinho (Junta dos mathematicos of Don João II — facsimile by J. Bensaude 1915). — It contains the sun's positions for the 4 years 1473-1476, with a declination table and one of the time equations (Tabula equationis Solis) with corrections for 34 cycles, that is 136 years.
Zacuto also computed quadrennial solar tables 1497-1500 for Vasco de Gama's voyage.

1497-1498 — **Vasco de Gama,** became acquainted through an Arabian pilot, with an apparatus fitted with rectangular plates and a piece of string called " Kamal " for determining by inspection the altitudes of heavenly bodies or stars, known under the name of " Tables of the Indies ". He himself used a large astrolabe.

1505-1507 — **Duarte Pacheco Pereira** — Esmeraldo de Situ Orbis — (regras de altura do polo ao meio dia) Lisboa.

He also gives rules for determining the tide by taking the simultaneous azimuth bearings of the Moon and Sun along the coasts of Spain, etc., on the day of the new moon, which process implies the knowledge of the moon's age. — The ancient Portulans also indicated, for each port, the rumb of the moon corresponding to the high tide of the new moon, which expressed in terms of time, gives the tide table.

1509 — **Francisco Faleiro** — Regimento do Astrolabio e do Quadrante — Tractado da spera do Mundo, Lisboa — fac simile J. Bensaude, Munich, 1914 (Regimento o Manual de Munich)

by means of a wheel, gives the Polar corrections and a single solar table for ordinary and leap years (Regimento do Sol e do Norte - (polar), a reproduction of the single solar table of Zacuto's perpetual almanac, with a Portuguese translation of Sacrobosto's Treatise on the Sphere, by José Vizinho, who drafted the nautical part and acted as technical adviser to Don João II of Portugal.

1513 — **Paracelse** (Bombast von Hohenheim 1493-1541) de Salzbourg.

1513 — **Conrad Peutinger** (1465-1547), an antiquarian of Augsbourg, possessed a road map with distances for the Roman Empire, known under the name of "Tabula Peutingeriana". This is a mere topographic sketch.

1514 — **Joâo de Lisboa** — Livro de Marinharia, tratado da agulha de marear — Lisboa.

This work together with the "Esmeraldo" of Situ Orbis (1505) and Evora's Manual (1519) constitutes one of the first examples of nautical directions "Roteiros" evolved for the purpose of navigation along the african coast.

1514 — **John Werner,** of Nuremberg (1468-1528) in "Commentaries on Ptolemy's geography"

describes various astronomical instruments used for navigation such as: cross bow, arbalestrille, Jacob's staff, "cross-staff", geometrical cross or golden rod, astronomical beam, astronomical staff. He outlines the lunar distances method called the "prothaspheritic" method.

1518 — **Valentim Fernandes** — Repertorio dos Tempos —

includes solar tables for 1520 according to Zacuto's treatise. The 1521 edition describes a nautical astrolabe: the 1563 edition describes a nautical quadrant; another edition came out in 1585.

1519 — **Fernandez de Enciso** — Tratado da Spera do Mundo... etc. — Regimento da declinaçâo do Sol — Lisboa (Regimento o Manual de Evora, fac-simile, J. Bensaude, Munich, 1914).
"Regimento para se saber as horas da noite pela estréla do Norte e suas guardas..."

contains a second translation of Sacrobosto's treatise and some solar tables from 1517 to 1520 after Zacuto.

He outlines a tables of rules for ascertaining the hour of the tide (Portuguese navigation treatises at the end of the XVIth century gave the high tide at Lisbon for the different ages of the moon).

1520 — **André Pirès** — Regimento de Navegaçâo.

1524 — At the Badajoz meeting, in connection with the "demarcation" consequential to the Treaty of Tordesillas (1494) the maritime committee studied different methods for determining longitude.

1530 — **Gemma Frisius,** a Dutch astronomer (1508-1555) published the "Ray astronomique et géométrique" in which he refers to lunar distances and small portable clocks called "watches" (montres).

1533 — **Peter Apian** (von Bennevitz, 1501-1552) a German astronomer of Ingolstadt

suggests in his "Cosmography" (1533) the observation of moon-star distances for the determination of longitudes (edition by Gemma Frisius, Antwerp 1581).

1534-1535 — **Petro Apiano** (von Bennevitz) — Instrumentum Sinuum, seu primi mobilis. Norimbergae — (edition 1541).

1534-1537 — **Pedro Nunez** — De Arte atque Ratione Navigandi —

imagines the rumb line known as "loxodromy", or oblique course of the vessel. — Mercator knew of Pedro Nunez's treatises prior to the construction of his Globe in 1541.

Edition in 1546, 1566 and 1573. — Additions in 1592 — Inventor of the Nonius or Vernier (see: Pierre Vernier, 1631).

1535 — **Francisco Faleiro** — Tratado del Esphera y del Arte de Marear — Sevilla.

(Munich facsimile, 1915) gives quadrennial declination tables for 1529-1532, computed after Evora's Manual (1519).

1537 — **Pedro Nunez** (Petri Nonii Salaciensis) cosmographe — Tratado da Sphera com a Theorica do Sol e da Lua em defensam da Carta de marear — Tratado sobre certas duvidas da navegaçâo — Coimbra (fac simile, J. Bensaude, Munich, 1915).

He gives quadrennial solar tables for 1537 and a quadrant of reduction for determining the number of leagues in a parallel degree.
He describes an "instrumento de Sombras", a sort of horizontal sun dial for measuring the shadow or altitude of the sun and allowing the application of the "equal shadows" method, that is of "corresponding altitudes".

1541 — Mercator's globe (**Gerard Kremmer** 1512-1594), cosmographer, cartographer, engraver and astronomical instrument maker, at Ruppelmonde, by special appointment to this Majesty Charles V, first a pupil of and then assistant to Gemma Frisius at Louvain from 1530 to 1552.

On this globe are traced loxodromies of 8 rumbs to each quadrant, from different points in various latitudes.

1542 — **Orontius Finaeus** (Oronce Finée) le Delplinato, de Briançon — De Mundi sphaera sive cosmographia, cum sinuum Tabula - Paris. De XII caeli domiciliis et horis inaequitatibus libellus (1553).

1543 — **N. Copernic** (1473-1543) — Traité sur les Révolutions des Mondes célestes.

1543 — **A. Brucioli** — Trattado della sphera, nel quale si dimostrano e insegnano i principii della astrologia, raccolto da G. di Sacrobusto e altri astronomi - Venezia.

1545 — **Pedro de Medina** (1493-1567) de Séville — cosmographe à la "Casa de Contratacion" de Séville.
Arte de Navegar, en que se contienen todas las Reglas, Declaraciones, Secretos, y Avisos, que a la buena navegacion son necessarios, y se deven sabar.
Dirigida al Serenissimo y muy esclarescido senor Don Phelipe principe de Espana, y de las dos Sicilias. — Valladolid.

Traduction française de Nicolas de Nicolai, du Dauphiné en 1554. — Guillaume Rouville, Lyon, édition en 1569.
Traductions italiennes - Venize 1554. 1557, 1609.

1548 — **Gemma Frisius** (Phryson) — De principiis Astronomiae et Cosmographiae deque úsu Globi Cosmogr. (De Annali Astronom. usw. - Antwerpiae. — Il donne la description du Ray astronomique et géométrique, édition 1578 - Coloniae.

1551 — **Martin Cortes** — Breve Compendio de la Sphera y de la Arte de navegar, con nuevos instrumentos y reglas, exemplificado con muy subtiles demonstraciones - Séville.

1552 — **Pedro de Medina** — Regimento de Navegacion, en que se contienen las reglas, declaraciones y avisos del libre del Arte de Navegar - (abréjé de l'Arte de Navegar, 1545) - Sevilla (édition en 1563).

1556 — **Gemma Frisius** — De astrolabio catholico, et usu ejusdem.

1558 — **Maurolicus,** père Sicilien (Joachim Rhaeticus). — Theodosi Sphaericorum Elementorum, libri III - Messinae.

He gives a table of secants which, together with Regiomontan's sine table, had facilitated Mercator's work.

1568 — **Bartolomeu Velho** — Principio da verdadeira Cosmographia... E muitos instrumentos neçessarios para a navegaçâo.

French translation with Regimen of the North and South together with many nautical tables.

1569 — **Mercator** (Gerard Kremmer) plots at Duisbourg his famous reduced chart: Nova et aucta orbis terrae descriptio ad usum navigantium; with an " Organum Directorium " for the graphic solution of the dead reckoning problem.

Breslau facsimile, by the International Hydrographic Bureau, Monaco 1932. Special publication. Reproduction in actual size. Text and translation of the chart legends (see also the " Hydrographic Review. Volume VIII, N° 1, Monaco, May 1931. Origin of Meridional parts).

1569 — **John Collins** — The mariner's scale new plain'd.

1577 — **William Bourne** — A Regiment for the Sea - London.

In this treatise, reference is made for the first time to the log " which pilots do not all throw in the same manner "! to the log theory in added a process for the calibration of log-glasses. (Mentioned in 1607 by Purchas in " Voyage aux Indes Orientales ").

1580 — **F. Viéte** — Œuvres (1540-1630) concernant l'algèbre, mathématicien, membre du Conseil Privé du Roi Henri IV. - Opera mathematica. - Lugduni Batavorum 1646.

1581 — **Coignet** — Hémisphère nautique: Sorte de demi-sphère armilaire réalisant les cercles principaux de la sphère locale.

1581 — **Rodrigo Zamorano,** cosmografo y Piloto mayor en la Casa de Contratacion de las Indias. — Compendio del Arte de Navegar - Sevilla. (4me édition - Séville 1588).

1582 (15th October) — Introduction to the Reform of the new gregorian calendar.

1583 — **Lucas Waghenaer** — Publication of the first maritime Atlas, Rotterdam.

1584 — **Galileo** (1564-1642) — At Florence, in 1632, he collects in a single book all the proofs in support of the truth of Copernicus system.

1587 — Ortelius's World Map.

1589 — **Blundeville** — Briefe Description of Universal Mappes and Cardes. — A new and necessary treatise on Navigation.

1590 — **Jobst Bürgi** — Juste Byrge and Stirelius are supposed to have made particular use of " logarithms " in about 1606.

1592 — **Robert Hues** — Tractatus de globis et eorum usi - London (Dutch translation in 1597).

1594 — **John Davis** — The seamen's secrets,

describes a reduction quadrant called " English quadrant " or " Davis quadrant " a kind of nautical quadrant with graduated arc and sight vane to observe the altitude of heavenly bodies (Davis backstaves).

1594 — **Edw. Wright** — Tables of Meridional Parts —

It was he who in that year of Mercator's death discovered the correct method of dividing the Meridian into Meridional Parts (see 1599).
(Edition in 1610, with the minute of arc as an argument).

1595 — **Joao Baptista Lavanha,** cosmographo mor de El Rey (1555-1625) — Regimento Nautico, Lisboa.

We are indebted to him for the first table of sun amplitudes: Taboas do lugar do Sol e largura de leste-oeste (1600).

1597 — **W. Barentz** — in his voyage to the Spitzberg used an astrolabe and an " astronomical circle ".

1599 — **Simon Stevin** — Haven finding Art.

1599 — **Edw. Wright** — Certaine errors in Navigation detected and corrected - London.

(See Hydrographic Review, Vol. VIII, N° 1, Monaco, Mai 1931, page 85). Origin of meridional Parts and First Table of Meridional Parts. Fac simile of the original text (1610, 1657 editions).

1600 — **Bartholomeus Pitiscus** — " Trigonometria ", éditions en 1614 et 1630.

1600 — **R^de P^dre Bruno** ou **Borro O.J.** — Tratado da Arte de navegar e em particular de Leste-Oeste.

1602 — **Pedro de Siria** (de Valence). — Arte de la verdadera navegacion. En que se tratta del modo de navegar por circulo menor, por la linea recta sin declinacion ni rodeo... etc. - Valencia.

This professor of law and mathematician refused, on account of his age, the appointment of Chief pilot. For the determination of the longitude, he advocated the compilation of Tables of Compass Declination and the observation of lunar distances.

1603 — **Guillaume le Nautonier,** sieur de Castelfranc-sur-Lot, en Languedoc, dédie à Henri IV " La Mécométrie de l'Eymant " ou " l'Art de trouver la longitude par la déclinaison de l'Eymant ".

1603 — **Manuel de Figueiredo** — Chorographia, Reportorio dos Tempos - Lisboa.

He describes the nautical quadrant and balestille. He gives a table of ortive amplitudes.

1605 — **Adrien Metius** — Astronomiae Instituto.

1606 — **Simão d'Oliveira** — " Arte de Navegar ", Lisboa.

He describes a nautical astrolabe such as used by Vasco de Gama in 1407 (an apparatus with a 3 hand diameter) at the Angra de Santa Helma. — He also describes the " armillia nautica ".

1607 — **Barthelemi Crescentius** — describes a string reel for the dead reckoning of distances run.

1608 — **Simon Stevin** — " Hypomnemata Mathematica ".

He gives a table of Loxodromies after Edw. Wright (charts called paradoxal) it was he who invented the terms " loxodromy " and " orthodromy " (see 1610).

1608 — **Manuel de Figueiredo** — " Taboa do apartamento do Sol ao nascer de Leste, Oeste, & ao por em qualquer altura.

These tables of amplitude (up to 45°) were translated into French by Nicolas Le Bon, of Dieppe, with extension to 55° (1608-1614); then in 1631 by Jean Le Tellier, of Dieppe, with extension to 66°. - (see 1631).
In 1608 Manuel de Figueiredo also produces a treatise on Hydrography for pilots examinations.

1609 — **Anthonie Lynton** — " Newes of the Complement of the Art of Navigation ". - London.

1609 — **G. Antonio Magini** — " Primum Mobile duodecim libris contentum ". - Bologne.

1610 — **Simon Stevin** — Havenfinding art. (cf. 1599 et 1608).

1610 — **Tycho Brahe** (1546-1601) — Astronomiae instauratae progymnasmata - De restitutione motuum Solis et Lunae, stellarumque inerrantium, et praeterea De nova stella. Anii 1572 - Francofurti.

By his discovery of the variation and annual equation he improved Copernicus tables of the moon (eclipses).

1611 — **Dounod** de Bar-le-Duc — Confutation de l'invention des longitudes - Paris.

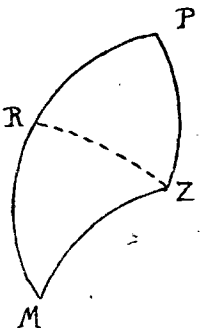
1614 — **Gunther** — Gunther's scales (see 1765).

1614 — **Jean Neper** (John Napier) (Joanne Nepers) baron of Merchiston (1550-1617) invented logarithms " Mirifici logarithmorum canonis descriptio...". Andrew Hart, Edimburgh, calculated on the « e » basis, logarithms called " natural ".

A second volume was published after his death in 1619.
The invention of logarithms is also attributed to Stirelius or Juste Byrge (1606).
See also Henry Briggs (1618 and 1624) and Henri Gelibrand (1633).

1617 — **Henri Briggs** — "Logarithmorum Chilias prima" - London.

1620 — **Edm. Gunther,** professeur d'astromonie — Canon Triangulorum, sive Taluae Sinuum et Tagentium artificialium ad Radium 10 000 & ad scrupula prima quadrantis - London.




for the computation of these tables, Gunther splits up the astronomical triangle by dropping a perpendicular from the zenith to the heavenly body declination circle.

1620 — **Jöbst Burgi** ou **Byrgi,** mathématicien Suisse (1552-1632) de Cassel — "Arithmetische und Geometrische Progresstabulen... - Prague.

1623 — **Edm. Gunther** — Description and use of the Sector, Crosse-staffe etc. - A Table for the Division of the Meridian line, by addition of secants - Rumb Tables - Gresham.
(cf. W. Leybourn - The Works of Edmund Gunther, London, 1673).

1624 — **Willebrord Snellius a Royen,** Rudolphi Filius — Tabulae canonicae parallelorum — Tiphys Batavus, sive Histiodromice, Lugduni Batavorum.

1624 — **Henry Briggs,** professor of mathematics in London — "Arithmetica Logarithmica" to 14 places of decimals on the 10 basis.
Gives logarithms called "common" for numbers from 1 to 20 000 and from 90 000 to 100 000.
These tables were completed in 1628 by Adrien Vlacq and in 1633 by Henri Gelibrand.

1625 — **Wm. Johnson Blaeuw** — Sea-Mirrour, containing a brief Instruction in the Art of Navigation... etc. - Amsterdam.

1625 — **Thomas Addison** — Arithmetical Navigation — This work makes use of the logarithms of Gunther's canon triangulorum.

1627 — **J. Kepler** (1571-1630) — Table of altitude and longitude of the Nonagesimal. - Regensburg.

1628 — **Adrien Vlacq** — Logarithmic Arithmetic (Arithmetica Logarithmica). - Gouda.
Works with 10 places of decimals for numbers from 1 to 100 000, with sines, tangents and secants from minute to minute up to 90°, which supplement Briggs' tables (1624). In 1633, he published "Trigonometria Artificialis" sive magnus Canon Triangulorum Logarithmicus — Gouda — Rectilinear and spherical tables with 10 places of decimals with Sines and Tangents from 10 seconds to 10 seconds up to 90° (see also in 1748). Gabriel Mouton, an astronomer of Lyons, had determined the log, sin and log. Tan from 1" to 1" for the first 4 degrees of the quadrant. The result of this calculation was only published in 1770 in Father Pézenas table to 7 places of decimals.

1628 — **Antonio de Najera** — Navegacion Especulativa, y Practica, Reformadas sus Reglas, y Tablas por les observaciones de Ticho Brahe, com emienda de algunes Jerros essenciales - Lisboa. — avec Table des Amplitudes d'après Manuel de Figueiredo.

1631 — **Jean Le Tellier,** de Dieppe — "Le vray moyen de trouver la variation de l'aymant par la Table des Amplitudes avec une observation sur le Bussole au lever ou au coucher du Suleil" — Dieppe.

1631 — **Pierre Vernier,** of Dormans, describes the scale which bears his name in a book entitled: The construction, use and properties of the new Dial. - Brussels, 1631.
The name of "nonius" comes from Pedro Nuñez (1534) the Vernier was really used only after 1742, because Halley himself did not use it when he invented the octant in 1731.

1631 — **Adrien Metius** — Primum Mobile. De Doctrina Sphaerica - Amsterdam.

gives position loxodromic tables, reproduced in Father Fournier's treatise on Hydrography (1643).

1631 — **Richard Norwood** — Trigonometrie or the doctrine of triangles - London.

In 1635 and 1639, Norwood measured the difference in latitude between York and London, in order to measure the earth's radius and to subject measurements to the length of the degree and not to that of the barley corn (1 finger = 3 grains butt joint) (1661 edition).

1636 — **P. van Merle** (Paul Merula) — Cosmographiae, partes II - Amsterdam.

1637 — **Richard Norwood** — Seaman's Practice (édition 1676). - London; il publie les 1res Tables de Point estimé.

1641 — **Janz Cornelis Lastman** — Tables.

1642 — **Antonio de Maris Carneiro** — Regimento de Pilotos e Roteiro das Navegaçâoes da India Oriental - Lisbon. — (The part concerning navigation in a reproduction of Manuel de Figueiredo's Hydrographia. (1608).

1643 — le Père **Georges Fournier** — " Hydrographie " - Paris (édition en 1679).

He describes the log used by the English as well as various magnetic compasses and instruments.

1645 — **Richard Norwood** — Epitome of Navigation - London.

1645 — **Henry Bond** — Norwood's Epitome.

He indicates that Wrights meridian co-ordinates were proportional to log tang 1/2 Lat. + 45°, instead of secants.

1647 — **Roberto Dudleo** — Dell'arcano del Mare. Nel qual si tratta della navigazione scientifica, e perfetta, cioe spirale, o di gran circoli. - Firenze (édition 1661).

1650 — **Henry Bond** — Seamen's Kalendar.

1657 — **John Davis** — The Seamen's Secrets, wherein is taught the three Kindes of Sayling, Horizontal, Paradoxal, and Sayling upon a Great Circle.

1659 — **John Collins** — Navigation by the Mariners Plain Scale new plain'd; or, a Treatise of Geometrical and Arithmetical Navigation; wherein Sayling is performed in all the three Kindes by a right line, and a Circle divided into equal parts - Francis Cossinet, London.

1659 — **Christianus Martini anhaltin** — Slot en Sleutel van de Navigation ofte Groote Zeefahrt - Amsterdam.

1661 — **Js. Bapt. Riccioli** — Geographiae et Hydrographiae reformatae - Bononiae.

1661 — **Street** — publishes the Tables of the Moon

which were well known, but were critisized in 1680 by Flamstead and in 1710 by Halley, because they contained errors of 10' or leagues in the longitude (5 degrees). The errors in the position of the moon are carried over from 27 to 30 times according to its location, for the longitude, in relation to the stars or to the sun.

1662 — **Joost van Breen** — Stiermans Gemack, ofte een Korte Beschryvinge voor de Konst der Stierlieden - 'S.-Gravenhage.

1665 — **Andrew Wakeley** — The Mariners compass rectified: containing Tables showing the True Hour of the Day, the Sun upon any point of the Compass - London (1st edition).

Is the first publication of azimuth nautical tables (The Regiment of the Pole Star).

1666 — **Hooke** — invents an astronomical instrument with a single mirror to observe distances from stars to the moon by reflection, the two objects meeting " at the point of a pin ".

1668 — **Cassini** — Publication of ephemerides for the eclipses of Jupiter's satellites, for the determination of longitudes.
(they were given by the " Nautical almanac " as from 1690).

1668 — Foundation of the Paris Observatory.

1669 — **Huygens** — First directions given for the use of clocks at sea.

1669 — **Samuel Sturmy** — Tables of Latitudes.
This is what he says about their compilation :
" Now how Mr. Gunther's and Mr. Norwood's Tables are made which are true " meridional parts, is by the help of Mr. Edward Wright's Tables of Latitudes. Mr. " Gunther is an Abridgement, consisting of the Quotient of every sixth number, " divided by six and two Figures cutt off; Mr. Norwood's Tables of M.P. is an " Abridgement of Mr. Wright's Tables of Latitudes, namely every six numbers " cutting off for Figures to the right hand. — My Tables are also an Abridgement " of Wright's, cutting off the three last figures ".
(The Mariners Magazine, London, 1669).

1671 — **Blondel de Saint-Aubin** — L'Art de Naviguer par le Quartier de Réduction.

1673 — **Don Lazaro de Flores** — Arte de Navegar. - La Havane.

1674-1677 — **Claude François Millet Deschales** — Ars Navigandi, liber VII - Lyon.
Tabula Latitudinum Crescentium - Loxodromicae cum differentia Longitudinis et millianbus italicis - (édition en 1690).

1675 — **Flamsteed** assumed the direction of Greenwich Observatory, as astronomer Royal, **Halley** succeeded him in 1720.

1676 — **Bond** — The Longitude found.

1678 — **Beckborrow** — The Longitude not found.

1678 — **Jacques Robbe** — Traitté de Navigation (carmélites près St. Malo).

1679 — 1re Edition de la " Connaissance des Temps " - Paris.

1681 — **Luis Serrao Pimentel,** cosmografo-mor. — Arte Pratica de Navegar - Lisboa.
other edition in 1699, 1712... etc.

1685 — **Sir Isaac Newton** (1642-1727) revealed to the scientific world his Law of Universal gravitation.

1686 — **Antonio Cavalho da Costa** — Compendio Geografico, 1a parte - Da projecçâo das espheras em plano, construçâo de mapas, e fabrica de cartas hydrographicas - Lisboa.
In 1676, he had published a Table of meridional parts.

1687 — **Newton** — published his Lunisolar theory of tides.

1692 — **Antonio Gastaneta** — Norte de la Navegaçion, described the Quadrant of reduction.

1695 — **Halley** — showed in " Philosophical Transactions " that the stereographic projection of a loxodromy on the equator in a spiral.

1698 — **Bouguer** — Traité Complet de Navigation.
1753 — Nouveau traité de Navigation.
1781 — Traité complet de Navigation.

1699 — **Képler** — Tables Rudolphines.

1699 — **Galileo Galilaei** — Systema cosmicum in quo de duobis maximis mundi systematobus, Ptolemaico & Copernico rationibus utrinque propositis differitur.
Lugduni Batavorum.

1699 — **Newton** — in a memorandum preserved by Halley and revealed in 1742 at the death of the latter, gave a description of the octant.

1700 — **Edm. Halley** — Nova et accuratissima totius terrarum orbis tabula nautica variationum magneticarum index juxta observationes anno 1700.

1702 — **Wm. Jones** — A new Compendium of the Whole Art of Practical Navigation... etc., with new Tables of the Sun's Declination - J. Matthews - London.

1706 — **La Hire** — Tables de la Lune.

1713 — **Sir Isaac Newton** — Theory of the Moon, of which he calculates the elements by means of observations made by Flamsteed within 2' or 3' (that is 2° 5 on the longitude).

1714 — **Jeremy Thatcher,** of Yorkshire, used for the first time the appellation of " chronometer ".

1714 — Setting up of the Board of Longitude, at the request of several shipowners " for a useful method of finding longitude at sea ".

1715 — **Girolamo Albrizzi** — Introduzione all'arte nautica e Tabula Latitudinum crescentium - Venedig.

1720 — **Wm. Whiston** — The Longitude and Latitude found by the Inclinatory or Dipping Needle, etc.

1720 — traduction portugaise du **P. Francisco da Costa** — Arte de Navegar, Tratado da Hidrographia - Breve Tratado do uso da Carta de Marear Globlosa e compasso triangular.

1723 — **Byon** — invented the parallel rule, the rolling rule was invented in 1771 by Echardt.

1725 — The French Academy proposed to investigate at sea the equality of movement of water-clocks or hour-glasses (which gave rise to the projected construction of a water-clock with spheric flow by Daniel Bernouilli).

1726 — **Sully** — Description d'une horloge d'une nouvelle invention - Paris.

1727 — **Radouay** — Remarques sur la Navigation - Paris. — Il critique notamment la valeur du " nœud " qu'il estime trop court.

1728-1749 — Father jesuit **Pézenas,** professor of Hydrography at Marseille and Director of the Observatory in his " Mémoires de Mathématiques " described a certain number of instruments for measuring altitude or calculating the hour-angle.

1728 — **Nicholas Fascio de Duillier** (Basel 1664 - Worcester 1753) — Navigation improved - London.

1729 — **Euler** — Solutio problematis astronomici (Comm. Ac. Det. IV).

1729 — **John Collier** — Daily Practice of the whole Art of Navigation; whereby all the problems of navigation and astronomy practicable at sea are easily, expeditiously, and exactly performed only by tabular inspection.

1730 — **Joseph Harris** — Treatise on Navigation.

1730 — **Elton** conceived the idea of fitting a clinometer on Davis quadrant (1594).

1731 — **Richard Graham** — The description and use of an instrument for taking the latitude at any instant of the Day - Royal Society, London.

1731 — **Hadley** — presented to the Royal Society of London, two models of reflecting instruments.

1732 — **Thomas Godfrey,** maker of glass, of Philadelphia, had conceived a quadrant in 1730, as an improvement on that of Davis and showed it in London in 1732.

1733 — **Kelly** — The modern navigator's complete tutor or a treatise of the whole art of navigation in its theory and practice - London.

1736 — **John Harrison**

experimented at sea his first longitude clock, improved in 1761 and severely criticized in 1767 by Nevil Maskelyne, astronomer Royal, until the time of Cook's voyage in 1772, when it did wonders. However, Harrison died in 1776; it was in 1773 at the age of 83 that he completed his 5th chronometer.

1739 — **James Atkinson** — A Table of Logarithms - Artificial Sines, Tangents and Secants - Dublin. Epitome of the Art of Navigation, Dublin 1742.

1739 — D'après **de Mannevillette** — Le nouveau quartier anglais - Paris.

1740 — **Cornelius Douwes,** a Dutch navigator —

found latitude by two altitudes and their interval and published "Logarithmis Solar tables" to facilitate calculations (by Richard Harrison in 1759 - London), see: 1747.

1740 — **Seller** — Practical Navigation — London.

He described a Sea-ring or Universal ring-dial.

1742 — **Gardiner** — Edition to 7 places of decimals of Tables of Vlacq's logarithms

giving sines from second to second for the first 72 minutes. In 1770, Father Pézenas re-published them at Avignon adding tangents and for the first four degrees.

1745 — **Pedro Manuel Cedillo,** directeur de l'Académie Navale de Cadiz — Tratado de la Cosmografia y Nautica, avec tableaux de calculs - Cadiz.

1745 — La Connaissance des Temps (Nautical almanac) contains 140 geographical positions, 205 in 1749, 228 in 1778.

1747 — **Cornelius Douwes,** professeur au Zeemannscollege — Verhandling om buiten den Middag op zee de ware middags Breedte te vinden - Harlem.

formule de Douwes :

$\sin h = \cos(\varphi - \delta) - \cos\varphi \cos\delta \sin \text{vers } t$ (logarithmus rijzing)

1748 — **Adrian Vlaco** — Tabellen der Sinuum, Tangentium und Secantium, wie auch der Logarithmorum für die Sinus Tangentes, und die Zahlen von 1 bis 10 000. Sammt Art und Weise, leichtlich durch derselben Hülffe allerley Drey-Ecken, gerad-linische und sphärische, auch viel andere schwere astronomische Fragen aufzulösen. - Franckfurt und Leipzig. (voir aussi 1628, 1633).

1748 — **Bouguer** — proposed to extend the field of the heliometer to a few degrees in order to measure lunar distances.

1749 — **Léonard Euler** — Scientia Navalis seu Tractatus de Construendis ac Dirigendis Navibus - Petropoli.

1750 — **Giovanni Pagnini** — Trattado della Sfera ed Introduzione alla Navigazione, etc. (Tavola lossodromica) - Venedig.

1751 — **John Harrison** — invented the chronometer (Philosoph. Transact. for 1751, Vol. X., p. 284).

1751 — **de la Condamine** — measured the first three degrees of the Meridian in the southern hemisphere - Paris.

1753 — **Tobias Mayer** (1723-1762) of Götingen — drew attention to the principle of the repetition of angles.

1st edition of his tables of the Sun and of the Moon, which constituted the first of Ephemerides. An other edition appeared after his death in 1770. Maskelyne improved them by means of Bradley's observations (1780-1787).

1753 — **Euler** — Principles of Spherical Trigonometry, presented the basic $\sin h =$ equation.
(Memorandum Roy. Ac. of Science. Vol. IX, p. 253, Berlin).

1753 — **Bouguer** — Traité de Navigation.
Autre édition en 1698, en 1781.

1754 — **Pingré** — published a State of the Sky resembling the "Nautical Almanac".

1754 — **John Robertson** — Elements of Navigation.
1764 Edition containing "History of Navigation" up to 1750 by Dr. James Wilson. Other editions in 1772, 1780, 1784, 1796 and 1805.

1755 — **La Caille** — Ephémérides (1755-1759).

1755 — **Wm. Emerson** — Navigation; or the Art of Sailing upon the Sea - Innys & Richardson, London.

1755 — **Francisco Xavier do Rego** — Tratado completo da Navegaçâo - Lisboa.
2ª edição 1764 — 3ª edição 1779.

1758 — **Eusébio da Veiga** — Taboas perpetuas e imudaveis - Lisboa. - (Les premières Tables de point portugaises).

1759 — **Richard Harrison** published the "Logarithmic Solar Tables" of Cornelius Douwes - London.

1762 — **Jean-Baptiste Legrip,** professeur d'hydrographie — Cayez de Navigation, le cadran sphérique, navigation par logarithmes sinus, etc. Le Hâvre-de-Grâce (manuscrit).

1762 — **Manoel Pimentel** — Arte de navegar em que se ensinam as regras practicas e os modos de cartear, e de graduar a balestilha por via de numeros, e muitos problemas uteis a navegaçâo... etc. - Francisco da Silva - Lisboa.

1763 — **Ferdinand Berthoud** — Essai sur l'Horlogerie; dans lequel on traite de cet art relativement à l'usage Civil; à l'Astronomie et à la Navigation, en établissant des Principes confirmés par l'expérience. - Paris.

1763 — **Nevil Maskelyne** — British Mariner's Guide. - London.

1764 — **Samuel Bamfield** — Treatise of Astronomy - Exeter.

1764 — **Edmund Halley** — Logarithmische Tabellen für Seefahrer über den Unterschied in der Breite und Abweichung auf Minuten und Zehendtheile. - Stockholm, Leipzig.

1765 — **John Harrison** constructed his time keeper or chronometer.

1765 — **Charnières** — constructed an instrument with half lenses called "megameters" for measuring arcs from 10° to 12°.

1765 — **J.H. Lambert** — A contribution to Mathematics.

1765 — **Baradelle's** rules, 64 cm. long, engraved on copper and giving logarithms.
See also: Gunther's scales 1614 or 1616.

1765 — The Royal Observatory is directed from 1765 to 1810 by Nevil Maskelyne, by John Pond from 1810 to 1835, by G.B. Airy from 1836 to 1881.

1766 — **Le Père Pezenas** — Astronomie des Marins. - Avignon.

1766 — **M. Le Roy** — Mémoire sur la meilleure manière de mesurer le temps en mer. - Paris.
Auteur des "Etrennes chronométriques".

1766 — **Coubard** et **Lemonnier** — Abrégé de Pilotage. - Paris.

1766 — **Lemonnier** — Institutions Astronomiques. - Paris.

1766 — Tables requisite to be used with the Astronomical and Nautical Ephemeris.

Editions en 1781, 1799, 1802.

1767 — **John Harrison** — Principles of Harrison's watch. - London.

1767 — **Nevil Maskelyne,** astronomer royal and **Mr. Lyons** — issue of the 1st volume of the Nautical Almanac

giving tables of lunar distances for the year 1769.

1767 — **Rochon** — by placing prisms in front of Bouguer's heliometer objective constructed an instrument which, by means of prism rotation, permitted the measurement of angles from 0° to 20°.

1768 — **Rochon** — Mathematical pamphlets - Brest.

He proposed to measure sea currents by means of hour angles.

1768-1769 — **Fleurieu** — (see 1773).

1768 — **Courtanvaux** — Diary of the "Aurore's voyage". - Paris

gives an account of the tests made with Le Roy's A and S chronometers.

1769 — First exploring voyage by Cook and Bougainville 1766.

1770 — **Archibald Patoun** — Treatise of Practical Navigation.

1770 — **M. Cassini** — Voyage en 1768 pour éprouver les montres marines inventées par M. Le Roy avec le mémoire sur la meilleure manière de Mesurer le Temps en mer, contenant la description de la montre à Longitude, 1766 par M. Le Roy - Paris.

1770 — **le Père Pézenas** — Logarithmes des Sinus et tangentes de seconde en seconde à 7 décimales, calculées par Gabriel Mouton, astronome lyonnais (1618-1694).

1771 — **Dalrymple,** suggests the method of substended angles, developed later by Beautemps-Beaupré (1808).

1771 — **Eckhardt,** invents the rolling parallel rule (see 1723, Byon).

1772 — **Shepherd** — Lunar reduction tables with logistic logarithms - Cambridge. — (Tables for correcting the apparent distances of the Moon and Stars).

1772 — **John Robertson** — Elements of Navigation (edition 1780-1796).

1772 — Académie de Marine — Tables et instructions propres à la détermination des longitudes en mer pour l'année 1773 - Brest.

1772 — **Charnières** — Traité et pratique des Longitudes à la mer - Paris.

1772 — **John Hood** — Tables of Difference of Latitude and Departure for Navigators - Land Survey, Dublin.

1773 — **F. Berthoud** — Traité des Horloges marines - Paris (voir aussi 1802).

1773 — **Le Roy** — Précis des recherches faites en France depuis 1730 pour déterminer la Longitude à la mer par la mesure artificielle du Temps - Amsterdam.

1773 — **Nathaniel Bowditch** — Original Tables (cf. 1802, 1826 etc... 1938).

1773 — **Fleurieu** — Voyage fait en 1768 et 1769 pour éprouver les montres de F. Berthoud - Paris.

1774 — **F. Berthoud** — Eclaircissements sur les machines à longitude sur mer. (cf. 1802).

1775 — **le Père Pézenas** — Histoire critique de la découverte de la Longitude. (édition 1785).

1775 — **Magellan** — left a complete treatise on English octants and sextants.

1775 — **Borda** secured the construction of his first repeating circle in accordance with the principle expounded by Tobie Mayer (1752). In 1801 Mendoza proposed another model.

1776 — **Levêque** — Tables Générales de la Hauteur et de la Longitude du Nonagésime - Avignon.

1776 — 1st edition of the "Astronomisches Jahrbuch" - Berlin.

1777 — **Robert Waddington** — An Epitome of Theoretical and Practical Navigation, containing a complete system of that Art, greatly improved. - J. Nourse, London.

1778 — **Verdun de la Crenne, Borda** et **Pingré** — Voyage en 1771-1772 pour vérifier plusieurs méthodes et instruments servant à déterminer la longitude et la latitude, suivi de recherches pour rectifier les cartes hydrographiques - 2 vols. - Paris.

1779 — **Cornelis Douwes** — Zeemanns tafeln - Amsterdam. (cf. 1740, 1747).
Editions en 1795, 1810, 1817.

1780 — **Robertson** — The elements of Navigation - (edition 1772, 1796).

1781 — **Bezout** — Cours de Mathématiques - Paris.

1781 — **Bouguer** — Traité complet de Navigation (voir: 1698, 1748, 1753).

1781 — **Gaigneur,** hydrographe — Le Pilote instruit - Nantes.

1781 — **Nevil Maskelyne,** astronomer Royal (1765-1810) — Tables requisite to be used with the Nautical Ephemeris for finding the Latitude and Longitude at Sea.

He points out that 5 places of decimals in logarithms are sufficient for the requirements of navigation, with the exception of lunar distance calculations.
Maskelyne's rules are synthesized in the following formulae :—

$$\log \sin x = \log x'' + \log \sin 1'' - \tfrac{1}{3} \log \sec x$$

$$\log \tan x = \log x'' + \log \tan 1'' + \tfrac{2}{3} \log \sec x$$

He introduced the notion of the "supplementary versed sine" or suvers. $a = 2 \cos^2 \frac{1}{2} a$.

1783 — **Callet** — Edition portative des Tables de Logarithmes de Gardiner (1742) pour les 2 premiers degrés; autre édition en 1795 pour les 5 premiers degrés.

Tables de Logarithmes des nombres de 1 à 108 000 et des lignes trigonométriques à 7 décimales (30° × 60' × 60")..

**(Long.)** 1783 — The calculation of the true longitude was made, by means of dead reckoning, pari passu with latitude by dead reckoning. The method, called by English authors "Time Sight method" amounts to calculating time by the altitude observed.
The formulae are as follows :—

$$P = 90^\circ \pm D$$

heure
$$\begin{cases} 2S = 90 - L + D + h \\ \sin^2 \dfrac{t}{2} = \dfrac{\cos S \sin (S - h)}{\cos L \cos D} \text{ ou } \operatorname{hav} t = \cos S \sin (S - h) \sec L \sec D \end{cases}$$

azimut
$$\begin{cases} \sin Z = \sin t \cos D \sec h \text{ (time } \textit{azimuth formula}) \quad \text{ou} \\ \operatorname{hav} (180 - Z) = \sec h \sec L \cos S \cos (S - P) \quad \text{(altitude } \textit{azimuth formula}) \end{cases}$$

These formulae are calculated by means of the usual logarithm tables or tables of 1/2 sinus verses (haver sine)*

* $\text{haversine } A = \frac{1}{2} \text{ versine } A = \frac{1}{2} (1 - \cos A) = \sin^2 \frac{1}{2} A$

26 × 19 cm. tables include about 150 pages.

1785 — **de la Coudraye** — Dissertation sur l'observation de la Longitude - Bordeaux.

1785-1788 — Lapérouse's expedition. — In 1791 d'Entrecasteaux set out in search of him.

1786 — **Antonio Cognoli** — Cose Trigonometriche.

1787 — **Thomas Mayer** — Lunar Tables.

1787 — **Borda** — Description et usage du Cercle de réflexion. - Paris.

1789 — **Wm. Garrard** — Trigonometrical Tables intended to complete the requisite Tables to the Nautical Almanach.

1790 — **James Atkinson** — Epitome of the whole Art or Navigation.

1790 — **George Margetts** — Longitude and Horary Tables - 2 vols. (edition 1827),

he put Shepherd's lunar tables in graphic form (1772) — 1793 edition.
French version by Maingon and Rochon.

1791 — The Hydrographer to the Duke of Clarence — The practical Navigator and Seaman's New Daily Assistant.

1791 — **Richer** — Triangle de Richer ou Compas Sphérique destiné à la résolution des triangles.

1792 — **Nevil Maskelyne** — Table of logarithms, with Préface and Precepts.

1792 — **J. Mendoña y Rios** — Tables de Logarithmes. (voir 1795, 1800, 1805, etc.).

1792 — **Taylor** — Tables of Logarithms.

1793 — **Andrew Mackay** — Theory and Practice of finding the Longitude at Sea or Land, with New Tables. (edition 2 vols. 1810).

1793 — **Jérôme Lalande** — Abrégé de Navigation, historique, théorique et pratique, où l'on trouve les principes de la manœuvre et ceux du pilotage, les méthodes les plus simples pour se conduire sur mer par longitudes et latitudes, avec des tables horaires pour connaître le temps vrai par la hauteur du soleil et des étoiles dans tous temps de l'année, et à toutes les latitudes à 61°. - Paris.

Horary tables were also compiled by Cassini (1770) and Thomas Lynn (1827) etc.
— 1829 — Tables of Logarithms.
— 1845 — Catalogues of Stars.

1794 — **Georg F. Véga,** major bombardier à l'Armée du Rhin. — Thesaurus logarithmorum Completus — Vollständige Sammlung grösserer logarithmich - trigonometrischen Tafeln nach Adrian Vlack's "Arithmetica Logarithmica" (edition 1800) (Goudae, 1628) und "Trigonometria Artificialis" (Goudae, 1663).

1re édition stéréotype — Istituto geografico militare, Firenze, 1889 (2me édition 1895). (Tables de logarithmes des nombres et des lignes trigonométriques à 10 décimales).

1794 — **Borda** — Decimal tables.

1795 — **Mendoza** — Memoria sobre algunos methodos de calcular la Longitud. - Madrid.

He disclosed his process, which enabled him to issue his tables in England in 1805. — French editions in 1842: Mendoza Principal Tables. - Paris.
(Mendoza hanged himself because an error of calculation was found in his Tables).

1795 (12th August) — Order in Council creating the Hydrographic Department at the Admiralty in London.

1795 — **John Hamilton Moore** — Practical Navigator, an Epitome of Navigation. (cf. 1799).

1795 — **Abraham G. Kästner** — Mathematischen Geographie - Göttingen.

1795 — **François Callet** — Tables portatives de logarithmes, contenant les logarithmes des nombres depuis 1 jusqu'à 108 000, etc. - Paris.
The first were stereotyped by Firmin Didot — printing in 1837, edition in 1842.

1796 — **John Robertson** — Elements of Navigation - J. Nourse, London. (cf. 1772 & 1780).

1796 — **J.H. van Swinden** — Verhandeling over het Bepaalen der Lengte op Zee door de Afstanden van de Maan tot de Zon of vaste Sternen - Amsterdam.

1796 — 1st issue of the "Annuaire du Bureau des Longitudes" - Paris.

1798 — **François Callet** — Supplément à la Trigonométrie Sphérique et à la Navigation de Bezout. - F. Didot, Paris.

1798 — **Richer** — Compas trigonométrique pour la détermination des azimuts.

1799 — **Thomas Mudge** — A description of the Time-Keeper invented by the late Mr. Thomas Mudge. - London.

1799 — **Jonathan Williams** — Thermometrical Navigation - Philadelphia.

1799 — **John Hamilton Moore** — "New Practical Navigator" — first american edition prepared on the direction of Nathaniel Bowditch.

SECOND PART.

# FROM 1800 TO 1900.

1800 — **José de Mendoza y Rios** — Coleccion de tablas para varios usos de la navegacion. - Madrid.

(éditions: 1792, 1795, 1805, 1809, 1850... etc., 1907).

1801 — **Burg** — in reply to a proposal by the "Bureau des Longitudes", compiled some "New Lunar Tables".

They were examined in 1802 by a Committee appointed by the First Consul and consisting of Laplace, Lagrange, Méchain and Delambre: the errors fell to 15" or 20", they were 3 times more accurate than Mayer's tables (1753) and sixty times more than those of Street (1661).

1801 — **Vincent Dulague** — Leçons de Navigation - 5me édition, augmentée par Prudhomme - Rouen - An IX.

(I) 1801 — Captain **Joseph Huddart** invented the "Station pointer".

(L) 1802 — **Jérôme Lalande** — Tables de logarithmes à 6 décimales pour les Nombres et pour le Sinus. Firmin Didot Stéréotype, 1805 - tirage en 1857.

1802 — **Nevil Maskelyne,** astronomer Royal (1765-1810) — Tables requisite to be used with the Nautical Ephemeris for finding the Latitude and Longitude at Sea.

1802 — **Nathaniel Bowditch** — Tables - (Original 1773, etc.).

(I) 1802 — **F. Berthoud** — Histoire de la Mesure du temps par les Horloges (cf. aussi: 1773).

1803 — **John William Norie** — A complete set of Nautical Tables, containing all that are requisite with the Nautical Almanach, in keeping a ship's reckoning at sea etc. To wich is prefixed a copious explanation of the fables; likewise astronomical problems for finding the latitude by double altitudes of the Sun, and the longitude by lunar observations, or by a chronometer or time-keeper. - London.

3me édition, 1813; édition: 1846, 1873, 1914, 1917 (cf. 1846).

(T) — Author in 1835 of the "Complete Epitome of Practical Navigation - The Complete Navigator" (expounding the methods of Douwes, Ivory, Borda, Kraft, G.B. Airy etc.).

Edition in 1844, followed by an edition in 1856 accompanied by nautical tables mentioned above.
Extensive Set of Tables improved by A.B. Martin in 1872.
in 1899 new edition by W. Bolt — Norie & Wilson, Minories, London.
in 1908 new edition — Imray, Laurie — Norie & Wilson Ltd., Minories, London.

1805 — **Joseph de Mendoza Rios** — Tablas de Navegacion y Astronomia Nautica.

Traduction anglaise — A Complete Collection of Tables of Navigation and Nautical Astronomy - London 1809.
Traduction française — L. Richard - Brest, 1842, et L. Lobo - Madrid 1873. (Origine 1792, autres éditions jusqu'en 1907).

(T) 1805 — **John Robertson** — The Elements of Navigation, 2 vols. - London.

(T) 1805 — **Benjamin Workman** — Navigation improved; a Treatise on the Defects of Middle Latitude and Mercator Sailing.

1806 — **Bureau des Longitudes** — Tables Astronomiques - Paris.

(T) 1808 — **J.B. du Bourguet** — Traité de Navigation - Paris.

1809 — **J. Mendoza Rios** — A Complete Collection of Tables for Navivation. London (cf. ci-dessus 1800, 1805).

(T) 1810 — **Andrew Mackay** — The Theory and Practice of finding the Longitude at Sea or Land; to which are added various methods of determining the Latitude of a place and variation of the compass, with new tables. - London.

1811-1812 — **Burkhart** — Tables de la Lune, Paris.

New tables, more accurate than those of Burg. They served for the compilation of the "Connaissance des Temps" from 1817 to 1861, when they were replaced as from 1862 by those of Hansen.

(T) 1812 — **Robert Woodhouse** — Elementary Treatise on Astronomy.

1812 — **K. de Vries** — Schat Kammer of Kunst der Stuurliden... etc. - Amsterdam.

(L) 1812 — **Carl, Frederick, Gauss** — Tables des logarithmes d'addition dits de Gauss.

1813 — **Breguet** replaces **Berthoud** as clockmaker to the Navy. In 1822, **Motel** was awarded the same title.

(T) 1814 — **Delambre** — Traité complet d'Astronomie Théorie et Pratique - 3 vols. - Gauthier-Villars, Paris.

(T) 1814 — **Rossel** — Traité de Navigation de Bezout (1781), avec de nouvelles Tables de Rossel - Gauthier-Villars, Paris.

(Q) 1815 — **C. Bonner** — Description of the Quadrant of Reduction or Sinical Quadrant, and its use in the Solution of Problems of every kinds of Sailings.

1815 — "Instruction pour les bâtiments à bord desquels sont embarquées des montres". Ce n'est qu'en 1845 que l'on délivrera, en France, des compteurs aux bâtiments.

(T) 1816 — **Guépratte** — Traité de Navigation et Vade-mecum du Marin - Brest.

He succeeded Rochon and de Maingon as Director of the Naval Observatory at Brest. Other edition in 1835.

(I) 1816 — **Borda** — Description du Cercle de Réflexion - Paris.

1816-1818-1820 — **M. Gauttier** — Positions géographiques en Méditerranée, Archipel, Marmara et Mer Noire.

1817 — **Delambre** — Histoire de l'Astronomie ancienne - Gauthier-Villars, Paris.

1821 — Histoire de l'Astronomie moderne — Gauthier-Villars, Paris.

1819 — **L. Puissant** — Traité de Géodésie, ou Exposition des Méthodes Trigonométriques et Astronomiques - Traité de Topographie, d'arpentage et de Nivellement - 2 vols., Paris

1820 — **A.L. Crelle** — Rechentafeln, welche alles Multipliciren und Dividieren mit Zahlen unter Tauzend ganz ersparen... etc. - Berlin.

4me édition Dr. C. Bremiker, 1875 — éditions: 1899, 1909.

1821 — **Rev. W. Lax.** — Tables to be used with the Nautical Almanach for finding the Latitude and Longitude at Sea - (edition 1834).

(T) 1821 — **L.B. Francœur** — Uranographie ou Traité élémentaire d'Astronomie - 3me édition - Paris.

(T) 1821 — **Rev. James Inman,** prof. Royal College, Portsmouth (1808-1839) — Treatise on Navigation and Nautical Astronomy - editions 1826, 1851, 1856.

1829 — Rev. James Inman — Nautical Tables designed for the use of British Seamen — editions 1837, 1856, 1864, 1869. — Reedited 1906 by William Hall, chaplain, naval instructor.

Preface p. XIX — Method half log haversine, t= f (L. D. h).

1821 — **Thomas Lynn,** Commander East India Company Service. — Star Tables for more readily ascertaining the Latitude and Longitude at Sea during the night.

1825 — Nautical and Astronomical Tables.

**(Long.)** 1827 — "Horary Tables" (repeated by H.S. Blackburne P & O) = hour angles for exact degrees of Latitude, Declination and Altitude.
Supplement to the Horary Tables for finding the Time *by inspection* to facilitate the operation for obtaining the Longitude at Sea by chronometers and lunar observations, calculated by Mr. Richard Farley, chief assistant of the Nautical Almanach Office computed according to Mr. Lyons's theory. (Premières tables "à vue") — Kingsbury Parbury & Allen - London.

**(Az.)** 1829 — "Azimuth Tables" showing the true Bearing of the Sun and other celestial object that is comprehended between the Twenty-fourth Parallel of North and South Declination for every Degree of Altitude, and for other convenient positions of Altitude between the Parallels of Sixty Degrees North and Sixty Degree South Latitude. (Tables en fonction de la hauteur et non du temps).

The "Horary tables" (T. Tables) include 242 pages, size 27 × 20 cm.
The "Azimuth Tables" (Z. Tables) include 364 pages. size 28 × 21 cm.
They supply the time values in terms of altitude, of Latitude by dead reckoning and of P = 90° ± D., in terms of rounded off degrees of Latitude, Declination (from 0 to 24°) and altitude (from 0 to 60°).
Later, they were completed for values of altitudes from 60° to 90°.

formula for the altitude: $\begin{cases} \sin^2 \frac{t}{2} = \cos S \sin (S - h) \sec L \sec D \\ 2\,S = 90 - L + D + h \qquad h = \text{altitude} \end{cases}$

formula for the azimuth: $\text{hav.}\ (180 - Z) = \sec h \sec L \cos S \cos (S - P)$

These tables require numerous interpolations and are limited to declinations of less than 24°, which excludes stars with a declination of more than this figure.

In 1899, Percy L.H. Davis used these tables as a basis for his "Sun Chronometer Tables".

1822 — **M. Hoorner** — Mémoire sur la Réduction des Distances Lunaires, et méthodes pour calculer les Latitudes d'un Lieu par les hauteurs de l'Etoile Polaire observées à toute heure. - Paris.

1823 — **John Tyrrell Baylee** — Method of finding the Longitude, Meridian, Time, Culmination of the Fixed Stars and the variation of the Compass.

1823 — **E.C. Ward** — Lunar Tables for correcting the apparent Distance of the Moon, Fixed Stars or Planets. - New-York.

1823 — **M. Girandi** — Nouvelle méthode pour réduire les distances de la Lune dans le calcul des Longitudes. - Gênes.

**(Q)** 1823 — **David Thomson** — Description and use of the Longitude Scale or Lunar Corrector.

1833 — Horary Tables (edition in 1854).

1823 — **C.F. Gauss** — Theoria combinationis Observationum erroribus minimis obnoxiae - Göttingen.

1825 — **Thomas Lynn** — Nautical and Astronomical Tables (cf. 1821).

1825 — **British Admiralty** — Publication of the 1st Catalogue of Charts by the British Admiralty, comprising 736 units.

1825 — **Baron de Zach** — Correspondance Astronomique, Géographique, Hydrographique et Statistique - 14 vols. - Gênes.

**(T)** 1826 — **Nathaniel Bowditch** — The New American Practical Navigator, being an Epitome of Navigation containing all the Tables necessary to be used with the Nautical Almanac, in determining the Latitude and Longitude by Lunar observations, etc. examples - 6th stereotype edition - New-York

Editions 1832, 1841, 4th reprint 1917. H.O. Publication N° 9 — U.S. Hydrographic Office, Washington (Original Tables - 1773).

(L) 1827 — **Ch. Babbage** — Tables of logarithms of the natural Numbers from 1 to 108 000 - London - this table gives logarithms which are approximated " in excess " and those approximated " by default ".
Reprint 1919.

1827 — **Francis Baily** — Astronomical Tables and Formulae.

1827 — **Wm. Galbraith** — Mathematical and Astronomical Tables - Edinburgh, editions 1834, 1860.

1828 — **P.J. Goulier** — Table des Principales Positions Géographiques du Globe.
1840 — Terminologie Géographique.

1828 — **Thomas Kerigan** — Mathematical and General Navigation Tables - (editions 1838, etc.).

1829 — **V. Bagay** — Tables Astronomiques et Hydrographiques.

(L) 1829 — **Jérôme Lalande** — Tables de logarithmes - Paris.

(T) 1830 — **Francœur** — Astronomie. (cf. 1821).

1830 — **Capt. Woodley** — New method for obtaining the Longitude at Sea.

(T) 1832 — **Nathaniel Bowditch** — (cf. 1773) 1826 etc... 1938).

(Long.) 1833 — **Thomson** — Horary Tables - (edition 1854).

(I) 1834 — **Wm. Fred. Simms** — Treatise on the Principal Mathematical Instruments employed in Surveying, Levelling and Astronomy - (editions 1849, 1865).

(T) 1834 — **Janet Taylor** — Principles of Navigation Simplified; with Lunar, Solar and Horary Tables with their application in Nautical Astronomy (edition 1854) - cf. 1842.

1835 — **T. Henderson** — Mean Declinations of 172 Principal Fixed Stars - Edinburgh.

1835 — Johnson's Catalogue of 606 principal Fixed Stars.

(T) 1835 — **Capt. Sir Edw. Belcher** — Treatise on Nautical Surveying containing Tables usefull to the Seaman or Traveller.

(T) 1835 — **Guépratte** — Le Vade-mecum du Marin - Brest.

(T) 1835 — **John William Norie** — Epitome of Navigation (cf. 1803) Complete Set of Nautical Tables (later editions up to 1920).

(T) 1836 — **Edw. Riddle** — Treatise on Navigation and Nautical Astronomy (edition 1842, 1849, 1859).

1836 — **John G.C. Curtis** — Tables for correcting Lunar Distances; with rules for finding the Errors and Rates of Chronometers.

1836 — **Dépôt Général de la Guerre** — Collection de tous les tableaux à calcul - Tables et instruments en usage au Dépôt Général de la Guerre pour les opérations astronomiques - Paris.

1837 — **P. Bégat** — Aperçu général du système adopté au Dépôt de la Marine pour déterminer les positions des points qui se trouvent sur les Cartes et Plans du Pilote Français.

1837 — **Capt. J.T. Boileau** — Traverse Tables, showing the Difference of Latitude and Departure for every Degree and Minute of the Quadrant to five places of decimals. - Calcutta.

1837 — **Thomas H. Sumner**, of Boston — finds means of fixing ship's position by astronomic line (cf. 1843). A new and accurate method of finding position at Sea, by projection on Mercator's chart.

1838 — Kerigan's Mathematical and General Navigation Tables (cf. 1828).

1838 — **James Gordon** — Specimen of Nautical Tables for finding the Lunar Distances and the Longitude by chronometer (edition 1849). - Lunar and Time Tables.

1838 — **Caillet** — Leçons à l'Ecole Navale, recommande le tracé du grand cercle sur la carte pour la navigation orthodromique.

(L) 1838 — **Schrön, M.** — Logarithmische Tafeln. - Iena.

1838 — **Stephen Groombridge** — Catalogue of Circumpolar Stars - edited by G.B. Airy).

1839 — **Bégat** — Traité de Géodésie à l'usage des Marins.

1839 — **Chazallon** — Publication in France of the 1st Tide Year Book.

(T) 1839 — **C. Guépratte** — Problems of Nautical Astronomy and Navigation - 2 vol. - Brest.

1840 — **J. Griffin** — Chronometer's Companion, or Perpetual Solar Almanach.

(T) 1840 — **Lieut. Henry Raper** — Practice of Navigation and Nautical Astronomy (1st edition).

3rd edition 1850, 7th edition 1857.
1850 — Henry Raper — Maritime Positions.
Nautical Tables — 18th edition revised by Thomas A. Hull — Hydrographic Department, London 1898.
21th edition — London, 1920.

(L) 1840 — **Meidola** — Logarithmische Tafeln - Altona.

(T) 1842 — **Edw. Riddle** — Treatise on navigation (cf. 1836, 1849).

1842 — **E. Gustav Klint** — Nautiska och Logarithmiska Tabellen - Stockholm.

— Lärobok i Navigations-Vetenskapen - Stockholm.

(T) 1842 — **P. van Galen** — Praktische Zeevaart Kunde - Amsterdam.

(T) 1842 — **Nathaniel Bowditch** — American Practical Navigation - New-York. (cf. 1773 - etc... - 1938).

(T) 1942 — **Janet Taylor** — Epitome of Navigation and Nautical Astronomy; with improved Lunar Tables. (cf. 1834).

1842 — **L. Richard** — Principales Tables de Mendoza - Brest. (traduction française, cf. 1805).

1843 — **Capt. T.H. Sumner** — A new and accurate method of finding a Ship's Position at Sea, by projection on the Mercator's Chart (an explanation of his discovery made in 1837). - Thomas Groom and Co. Boston.

6th edition 1866. (cf. Barthet — Annales Maritimes, 1847).

1844 — **Rümker** — Handbuch der Schiffahrtskunde (edition 1850, 1857).

1844 — **P.W. Tegner** — Nautiske og astronomiske Tabeller - Copenhagen.

1844 — **D.D. Owen** — On Circummeridian Altitudes at Sea or on Shore.

(L) 1844-1849 — **R. Shortrede** — Logarithms of trigonometrical functions - Logarithmic Tables - Edinburgh.

(T) 1845 — **Matthieuw Fontaine Maury** — A new Theoretical and Practical Treatise on Navigation etc. - Philadelphia.

1845 — **Francis Bally** — British Association Catalogue of 8,377 Fixed Stars.

1846 — **George Coleman** — Lunar and Nautical Tables.

1846 — Norie's Nautical Tables - (cf. 1803).

Tables XXVII and XXVIII, called A.B.C. tables for Azimuths were published for the first time in the 1846 Nautical Magazine and reproduced in the 1873 issue.

$$A = \frac{\tan L}{\tan P}, \quad B = \frac{\tan D}{\sin P}, \quad C = \text{cotg Az} = \text{corr} \times \cos L.$$

later they were introduced and employed in France and Germany.
(Method of the haversine for the line of altitude and extra-meridians).
editions in 1914, 1917.

(G) 1847 — **J. Barthet** — " Méthode graphique pour faire le point à la mer " (Annales Maritimes et Coloniales, Paris 1847) donne un compte-rendu de la découverte du Capitaine Sumner (1837).

1847 — **Lalande** — Catalogue des Etoiles.

1847 — **Lacaille** — Catalogue des Etoiles de l'Hémisphère Sud.

1847 — **Louis Pagel** — La Latitude par les Hauteurs hors du Méridien - Paris (cf. 1863).

1847 — **Capt. C.F.A. Shadwell** — Tables for facilitating the approximate prediction of Occultations and Eclipses for any particular place. (cf. 1854).

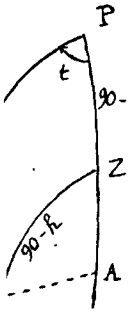
(T) 1848 — **Eduard Bobrik** — Handbuch der Praktischen Seefahrtskunde — 3 Bande — Logarithmische und Astronomischen Tabellen - Leipzig.

(T) 1849 — **Edw. Riddle** — Navigation and Nautical Astronomy (cf. 1836, 1842, 1859).

(T) 1849 — **H.W. Jeans** — Navigation and Nautical Astronomy Problems, with their solutions (editions 1853, 1858).

1847-1850 — **J.T. Towson & J.W. Atherton** — Tables to facilitate the Practice of Great Circle Sailing and the determination of Azimuths
editions 1848, 1854, 1861.
6th edition in 1912 (J.W. Atherton) — Hydrographic Department - London.
reprint 1916 — J.D. Potter, London together with Linear Index for azimuth determination.

(M) 1849 — **John Thomas Towson**, examiner MMB Liverpool — Tables for the Reduction of Ex. Meridian Altitudes. (Tables pour la réduction des hauteurs circumméridiennes) - London.
editions: 1852, 6th edition 1856, 20th edition 1906 — edition 1908.
These tables 16 × 24 cm. in size resolve Robertson's problem by means of the following formulae.




$\sin AM = \sin t \cos D$ Index = AS 1 à 54 et 55 à 108

$\cos PA = \sin D \sec AM$ Table I = PM ~ PA { same name — / contr. name + } f (D) 0° à 23°

$\cos ZA = \sin h \sec AM$ Table II = ZM — ZA always + f (h) 6° à 74°

table I gives correction I in terms of AM and D: 11 pages.
table II gives correction II in terms of AM and altitude: 11 pages - Total: 22 pages.

1850 — **Don José de Mendoza y Rios** — Coleccion completa de Tablas para los usos de la navegacion y astronomia nautica — 1 vol., Edicion D.J. Martinez de Espinosa y Tacon), Madrid. (cf. 1800).
Explication de las Tablas... etc. - Madrid, 1851.

1850 — **John Seaton** — Great Circle Sailing made easy - London.

1850 — **William Chauvenet** — A Treatise on Plane and Spherical Trigonometry (1st edition).

(T) 1850 — **Rümker** — Handbuch der Schiffahrtskunde — 5me edition — Hamburg (cf. 1844, 1857).

(I) 1850 — **Keller** — Double planisphere (Model constructed by Salleron), analogous to Saxby's spherograph improved by Gegan in the "Star identifier" for the resolution of spherical triangles (see Hue, Recherches sur les Chronomètres et Instruments Nautiques, 7me cahier, Paris 1864). Investigations on Chronometers and Nautical Instruments, 7th pamphlet, Paris 1864.

1850 — **Nautisches Jahrbuch** — Ephemeriden und Tafeln zur Bestimmung der Länge, Breite und Zeit zur See nach astronomischen Beobachtungen (1852-59) etc.

1851 — **Rev. F. Main** — Results of Right Ascensions of Stars observed by Dr. Maskelyne — Royal Greenwich Observatory.

1851 — **Sir J.F.W. Herschel** — Treatise on Astronomy - London.

1851 — **Hen. Burton Weston** — Tables for finding the Longitude by Chronometer at Sunrise and Sunset — Admiralty, London.

(T) 1851 — **Don José Sanchez y Cerquero** — Explicacion de las Tablas de Navegacion y Astronomia Nautica - Madrid.

1852 — **Arthur Breusing** — Kleine Steuermannskund - Bremen.

1852 — **Domke** — Nautische, astronomische und logarithmische Tafeln für die Koniglich Preusischen Navigation Schulen - Berlin (10e auflage. 1900).

1852 — **F.A. Paludan** — Laerebog i navigation - Kopenhagen.

1852 — **Robert Russel** — Great Circle Tracks and Distances, and Azimuths without calculation. (Naval Pamphlets, Vol. 36).

(T) 1852 — **William A. Norton** — An elementary treatise on Astronomy in four parts, containing a systematic, and comprehensive exposition of the theory, and more important practical problems; with solar, lunar and astrnomical tables - New-York.

(Az.) 1852 — **John Burdvood,** staff Comder R.N. — Tables of the Sun's True Bearings or Azimuths.
parts 1858, 1862, 1864, 1866 completed (cf. 1858).
editions: 1873, 1896, 1898, 1902, 1912, 1918.

(Q) 1862 — Diagram to facilitate the obtaining of Ship's Position by Sumner's Method.
1865 — Method of finding the Latitude by the simultaneous Altitudes of Two Stars, and also their True Bearings or Azimuths at that Time.

1853 — **Hoëne Wronski** — Mémoire pour servir de complément aux deux Opuscules concernant la véritable science nautique des marées. - Paris.

1854 — **Capt. C.F.A. Shadwell** — Tables for facilitating the determination of Latitude and Time at Sea by observations of the Stars — J.D. Potter, London — edition 1869 (cf. 1847).

1854 — **Lieussou,** hydrographic engineer, compiled his formula for chronometer rates.

1855 — **J. Thomas Towson** — The principle of great circle and composite sailing. - London. (cf. 1849).

1855 — **Rev. P. Robertson** — The theory and practice of Great circle sailing under one general rule (Naval Pamphlet, Vol. 32). Bell and Dally, London.

1855 — American Ephemeris and Nautical Almanach - Washington (1st edition).
(the first issue of the British Nautical Almanac dates from 1767).

1855 — **W.C. Alexander** — Great Circular Navigation (Naval Pamphlet, Vol. 36).
A ship's position by one Altitude, two assumed Latitudes, and the chronometer (Naval Pamphlet, Vol. 36).

(T) 1856 — **Capt. Charles F. Shadwell** — Formulae of Navigation and Nautical Astronomy as an "Aide Mémoire" for Naval Officers. — J.D. Potter - London.
revised edition 1862, 1869.

1856 — **James Greenwood** — Rudimentary Treatise on Navigation.

1856 — **A.H. Deichmann** — Neue Tafeln zur Erleichterung der Praxis des Segelns im grösstenkreise... etc. - Hannover.
New Tables to facilitate the practice of Great Circle Sailing — Hanover, London, 1857.

(L) 1856 — **G.E. Tuxen** — Nautiske Astronomiske af Logarithmiske Tabellen - Kjöbenhavn.

(I) 1856 — **S.M. Saxby** — The Spherograph, or Captains and Calculation - Liverpool (cf. 1861).

1857 — **A.H. Deichmann** — Spherical Tables and Diagrams - London.

1857 — **Wm. Culberg Bergen** — Spherical Tables and Diagrams, with their application to Great Circle Sailing and various problems in Nautical Astronomy — Simpkin and Marschall - London.

(T) 1857 — **Carl Rümker** — Handbuch der Schiffahrtskunde - Hamburg.

1857 — **James Gordon** — Sumner Method of finding a ship's Position at Sea; also a method of finding both Latitude and Longitude by Double Altitudes, etc.

(T) 1857 — **John Riddle** — Navigation and Nautical Astronomy — Simpkin and Marshall - London.

1857 — **P.A. Hansen** — Tables de la Lune construites d'après le principe Newtonien de la Gravitation universelle.

(Q) 1858 — **Hugh Godfrey** — Great Circle Sailing Chart of the South Latitudes on the Gnomonic Polar projection — J.D. Potter, London.
— Time Azimuth Diagram.

1858 — **Robert Fitzroy** — Great Circle Sailing - London.

1858 — **Ducom** — Cours complet d'observations nautiques. — Gauthier-Villars, Paris.

1858 — **F.J. Evans** — Variation Chart of the World.

1858 — **A.W. Price** — On the Longitude, with the easiest methods of ascertaining the same by celestial observations at Sea or on Land, independent of Lunars or Chronometers.

(Az.) 1858 — **John Burdwood** — Tables of Bearings of the Sun between the Parallels of 14° and 20° South at intervals of Twenty Minutes from April to August — Admiralty - London.
cf. 1852 — (suite in 1862, 1864, completed in 1866).

1858 — **Comdᵉʳ P.F. Shortland, R.N.** — Practical observations on Surveying, on the determination of the position of a vessel when sounding.

(L) 1859 — **L. Schrön** — Tables de logarithmes à 7 décimales pour les nombres depuis 1 jusqu'à 108 000 et pour les fonctions trigonométriques de 10" en 10" (édition française: J. Houël, Paris — Gauthier, Villars — tirage 1899).

1859-1887 — **Service Hydrographique de la Marine** — Publication des "Cahiers de Recherches Chronométriques" - Paris.

(I) 1860 — **Philips** — Etude du Spiral du Chronomètre.

(T) 1860 — **Brünnow** — Spherical Astronomy — transl. Rev. Rob. Main — Cambridge. (cf. 1869, 1881).

(T) 1860 — **W.C. Alexander** — Reckoning and Calculation; with examplifications of the Astronomical Day as it ought to be understood, treated, and used by Mariners; also a new set of Solar Tables.

1860 — **Charles F.A. Shadwell** — Tables for facilitating the reduction of Lunar Observations, mathematical and practical. — J.D. Potter, London (editions 1881, 1894).

1861 — **Charles F.A. Shadwell** — Notes on the management of chronometers and the measurement of meridian distances — new edition — London.

1861 — **S.W. Blunt** — Kubik Tabellen — Hamburg.

(I) 1861 — **S.M. Saxby** — The Projection and Calculation of the Sphere, being a complete initiation into Nautical Astronomy. (Sphérographe Saxby) analogue à celui de Keller (1850).

1862 — **Hansen** — Tables de la Lune.

1862 — **W. Freeden** und **T. Köster** — Nautische Hülfstafeln — Oldenburg.

(G) 1862 — **John Burdwood** — (cf. 1852). Diagram to facilitate the obtaining of a Ship's Position by Sumner's Method.

(I) 1862 — **Yvon Villarceau** — Mémoire sur le mouvement et la compensation des chronomètres.

1862 — **Estignard,** hydrographic engineer, studied the image of altitude circles on Mercator's projection chart (IIIrd pamphlet of chronometric researches 1877-1885).

1863 — **Louis Pagel** — Formule générale pour trouver la Latitude et la Longitude par les hauteurs hors du méridien. - Paris. (voir aussi: 1847) 2nd Edition. — Pagel's coefficient is represented by $\frac{dG}{dh}$

(Long.) 1863 — **Louis Hommey** — "Table d'angles horaires";
containing over 40 000 hour angles calculated for all latitudes - 2 volumes - Paris. (Improvement on Cassini's and de Lalande's tables (1793). (See Davis Chronometers Tables, 1902) (see also Thomas Lynn, 1827).

1863 — **Rev. John B. Harbord** — Glossary of Navigation.

(T) 1864 — **J.A. Norie** — A complete epitome of Practical Navigation - London. (origine 1803, éditions jusqu'à 1920).

(T) 1864 — **William Chauvenet** — A manual of Spherical and Practical Astronomy — 2 vols. — J.B. Lippincott Cy. - Philadelphia.
(gives methods evolved by Gauss, Cagnoli, Caillet, Hansen, Bessel, and that of the least squares).
(cf. 1850, éditions en 1885, 1890, 1896, 1906 (5th).

(T) 1864 — **A. Breusing** — Steuermannskunst — 2° Aufl. Bremen — 1890 - 5° Aufl. — 1902-1909 - 6°, 7°, 8° Aufl.

1864 — **A.L. Crelle** — Tables de Calculs où se trouvent les Multiplications et les Divisions toutes faites de tous les Nombres au-dessus de Mille et qui facilitent et assurent le Calcul. — Berlin (cf. 1820, 1919).

(I) 1864 — **Hue** — Triédromètre de M.J. Zescevich et Planisphère pour les Distances Lunaires. — E. Garnault, Brest.

— **E. Garnault** — Règle Rhumbée et Secteur Dromoscopique de M.J. Zescevich et E. Garnault. — Brest.
(Recherches sur les Chronomètres et les Instruments Nautiques — 7° cahier — Paris 1864, p. 16).

(L) 1865 — **Theodor Wittstein** — Fünfstellige logarithmisch-trigonometrische Tafeln. — Hannover.
(avec les Logarithmes de Gauss à 7 décimales pour la somme ou la différence de deux nombres).
1865 - 2° Aufl. — 1890 - 14° Aufl.

**(L)** 1865 — **L. Schroën** — Table des fonctions trigonométriques. — 1868 édition à 7 décimales.

1865 — **John Burdwood** — Method of finding the Latitude by the simultaneous Altitudes of Two Stars, and also their True Bearings or Azimuths at that time. (cf. 1852, 1862). Reprint 1896.

1865 — **Dr. F. Paugger** — Einfache Lösung der Probleme der Schiffahrt im grössten Kreise — Trieste.

1866 — **Rossel,** in the Mercantile Marine Magazine works out Pagel's method with a view to finding the Latitude, Longitude and Azimuth.

1866 — **Henry Raper** — Practice of Navigation and Nautical Astronomy — J.D. Potter, London. (cf. 1840, 1850, 1857, 1891 revision par Th. A. Hull). (edition 1898, 1920).

**(Az.)** 1866 — **John Burdwood,** Staff-Comd$^{er}$ R.N., Naval Assistant, Hydrographic Department — Sun's true bearing or Azimuth Tables. —

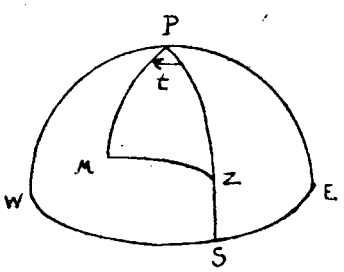
1st complete edition allowing the determination of the compass variation (see 1852 above) etc.

1873 — 3rd edition... computed for Intervals of 4 Minutes between the Parallels of Latitude 30° and 60° incl. London.

1898 — edition (Reprinted 1912). H.M. Stationery Office — & J.D. Potter - London.

1918 — Brown's Completed Burdwood — Full Tables for Bearing from Horizon to Meridian. Lat 30° to 60° N or S — D $<$ 23° — Glasgow.

Size of the tables 16 $\times$ 24 cm.
314 pages for the zone of Latitude 30° to 60°.
Burdwood's tables were calculated from the following formulae :—




the $\frac{1}{2}$ sum and $\frac{1}{2}$ difference of the colatitude and given polar distance are formed :—

$$a = \frac{PZ + PM}{2} \qquad b = \frac{PZ \sim PM}{2}$$

$$\left\{ \begin{array}{l} \tan \frac{Z + A}{2} = \sec a \cos b \operatorname{cotg} \frac{t}{2} \\ \tan \frac{Z \sim A}{2} = \operatorname{cosec} a \sin b \operatorname{cotg} \frac{t}{2} \end{array} \right.$$

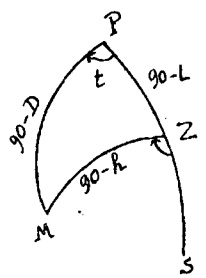
$$\left\{ \begin{array}{ll} \text{When PM is greater than PZ} & Z = \frac{Z + A}{2} + \frac{Z \sim A}{2} \\ \text{When PM is smaller than PZ} & Z = \frac{Z + A}{2} - \frac{Z \sim A}{2} \end{array} \right.$$

These tables were continued for the zone of Latitudes 30° N to 60° S by Captain J.E. Davis (cf. 1875) of the Hydrographic Department, then supplementary azimuth Tables were extended to Latitude 64° N and S by P.L.H. Davis of the Nautical Almanac Office (cf. 1904).

1868 — **Calliet** — Traité de Navigation. — Paris (4$^{e}$ édition).

**(Az.)** 1868 — **F. Labrosse** — Table des Azimuts du Soleil correspondant à l'heure vraie du bord entre les parallèles de 61° S et 61° N et pour les Déclinaisons de 0° à ± 30°.

édition anglaise 1868 - Londres.
11$^{e}$ édition 1902, 15$^{e}$ édition 1920 — A. Challamel, Paris.




These tables containing 275 pages of 18 $\times$ 28 cm. size furnish t as a function of Z for L and D from degrees to degrees.

formula $-\operatorname{cotg} Z = \frac{\operatorname{tg} D \cos L}{\sin t} - \sin L \operatorname{cotg} t.$

— **F. Labrosse** — Tables Nautiques pour abréger et simplifier les calculs journaliers à la mer.

4° édition — A. Challamel, Paris avant 1902.

1868 — **André Fasci** — Nouvelles méthodes pour la détermination simultanée de la Latitude... etc., et nouveaux types de Calculs nautiques. — Nice.

(I) 1868 — **Alm. Joao Capelo** — Cronogoniometro — Lisboa — (cf. W. Araujo — Jornal de Sciencias Mathematicas, Lisboa 1919).

(I) 1869 — Planispherio Azimutal.

1868 — **Henri Evers** and **John Merrifield** — Navigation and Nautical Astronomy. — London.

1868 — **Karl von Littrow** — Andeutungen für Seeleute über den Gebrauch und die Genaukeit der Methoden, Länge und Missweisung durch Circum-Meridianhöhen zu bestimmen. — Wien.

(T) 1869 — **Brunnow** — Traité d'astronomie sphérique et d'astronomie pratique, traduction française Lucas et André. — Gauthier-Villars, Paris.

(Az.) 1869 — **Capt. Robert Shortrede** — Azimuth and Hour Angle for Latitude and Declination. (cf. 1845).

(Az.) 1869 — **Gen. Robert Shortrede** — Tables for finding Azimuth at Sea, together with a Great Circle Sailing Table. - London (Pantaspheric Table).

(Az.) 1869 — **Hue** — Table générale des Azimuts. - Brest.

1869 — **J.C. Arnaud** — Le guide du calculateur de nuit pour déterminer la position du bâtiment à la mer. - Cherbourg.

1869 — **C. Brent** — Ex-Meridian Altitude Tables. - London.

(L) 1869 — **C. Bremiker** — Logarithmisch-trigonometrische Tafeln mit Sechs Decimalstellen. - Berlin.

2. Aufl. 1883. (autres éditions de 1873 à 1900 etc.).

1870 — **Fasci**, professeur d'hydrographie — Méthode des lieux géométriques rectilignes. — (cf. 1872).

1875 — Courbes sur l'Ellipsoïde.

1870 — **E. Dubois** — Cours de Navigation et d'Hydrographie. - Paris. — 2me édition. - (3e édition 1876).

1871 — **G.D.E. Weyer** — Vorlesungen über nautische Astronomie. - Kiel. (cf. 1890).

1871 — **A. Breusing** — Nautische Hülfstafeln. 3e Aufl. — Bremen.

1885 : 5e Aufl. 1897 : 6e Aufl. 1902 : 7e Aufl.

(M) 1871 — **William Thomson** — On the determination of a Ship's Place from observations of Altitude. (Proceedings Royal Society - London, 6th feb. 1871)

with examples of "Tables for facilitating Sumner's method at sea".
These tables were published later in November 1876 — (see also 1880).

(L) 1871 — **Houël** — Tables de logarithmes des fonctions trigonométriques.

édition 1899.

1872 — **Comder T.A. Hull, R.N.** — Practical Nautical Surveying and the Handicraft of Navigation.

1872 — **Fasci** — (Etude théorique des Courbes de hauteur et des droites de position).

(I) 1872 — **Saunier** — Traité d'Horlogerie. - Paris.

(Alt.) 1873 — **A. Blond de Marcq St. Hilaire** — Calcul du Point observé, méthode des hauteurs estimées.

aussi 1875.

**(Long.)** 1873 — **Martelli** — Tables of Logarithms Lightning Printing Office. - New-Orléans. (Méthode de la longitude estimée).

20 × 13 cm. tables: Table I: 7 pages, Table II: 9 pages, Table III: 9 pages, Table IV: 17 pages, Table V: 7 pages; Total: 49 pages.

Application of the D.R. longitude method, these tables entail a modification of the general longitude formula

$$\text{hav } t = \frac{\sin z - (L - D)}{2} \times \frac{\sin z + (L - D)}{2} \sec L \sec D$$

Table I: log cos L and log cos D
Table II: log (L — D)
Table III: log sin z
Table IV: log Numerator
Table V: log hav t

The graph is made from the dead reckoning.

1873 — **Miguel Lobo** — Traduction française de l'explication de la Théorie des Tables de Mendoza. - Madrid.

1873 — **Denham** — Tables of Position in the Pacific Ocean 1852-1860.

1873 — **Antonio Terry y Rivas** — Manual del navegante, redactado con presencia de los mejores autores modernos. - Barcelona.

**(T)** 1874 — **Henry Raper** — The practice of navigation and nautical astronomy complete with Nautical Tables. - London (11th edition).

1891 - 19th edition. — 1920 - 21th edition. — (cf. 1840).

**(T)** 1874 — **Nathaniel Bowditch** — The new American Practical Navigator; being an Epitome of Navigation; with Tables. - Washington.

(cf. original 1773 etc..., editions: 1880, 1903, 1914, 1925, 1938).

1874 — **Hilleret** — Etude sur les Courbes de Hauteur.

1874 — **F. Domke** — Nautische, astronomische und Logarithmische Tafeln. — 6. Aufl. - Berlin (cf. 1852).

1879: 7e Aufl.

1875 — **Henri Evers** — Navigation in Theory and Practice. - London & Glasgow.

**(T)** 1875 — **Oliver Byrne** — Treatise on Navigation and Nautical Astronomy — Tables — Gauthier-Villars - Paris.

(cf. 1877).

1875 — **Antonio Terry y Rivas** — El companero del navegante a la vista de las tierras. - Madrid.

**(Alt.)** 1875 — **A. Blond de Marcq de St. Hilaire** — Calcul du Point observé par la méthode des hauteurs estimées — Méthode du point rapproché.

(Revue Maritime et Coloniale — Vol. XLVI, Août-Sept, 1875, p. 341 & 714. - Paris 1875).

**(Az.)** 1875 — **Capt. John E. Davis** of the Hydrographic Department & **L.H. Percy Davis** — Sun's True Bearing or Azimuth Tables, computed for intervals of 4 minutes, between the Parallels of Lat. 30 N and 30 S inclusive. - London.

called "Time-Azimuth tables".
Burdwood died shortly before 1900. Cap. J.E. Davis, of the Hydrographic Department and P.L.H. Davis of the Nautical Almanac Office continued to improve the Azimuth tables.
Editions: 1897, 1899, 1900, 1902, 1904, 1913, 1916, 1918, 1921 - J.D. Potter - London.
See continuation of Davis in 1897, 1900, 1904, etc...

1875 — **G.B. Magnaghi** — Gli strumenti a riflessione per mesurare angoli. - Napoli.

**(Az.)** 1875 — **Giacinto Albini** — Gli azimut del Sole — Istituto Idrografico - Genova (tirage en 1922).

**(L)** 1875 — **Georg Freiherr von Vega,** bombardier à l'armée du Rhin en 1794 — Logarithmisch-trigonometrisches Handbuch.
Bearbeitet von Dr. Bremiker — 59 Aufl. Berlin (edition 1889).

**(L)** 1875 — **J. Dupuis** — Tables de Logarithmes à 7 décimales, d'après Bremiker, Callet, Vega — 5e tirage, Hachette et Cie, Paris.

**(Az.)** 1876 — **E. Perrin,** enseigne de vaisseau — Nouvelles Tables destinées à abréger les Calculs nautiques — 1re édition, Paris.

2e édition 1892. — 4e édition 1906 — 5e édition ante 1920.

17 × 24 cm. size. — Table I: 9 pages, Table II: 7 pages, Table III: 6 pages.
These tables result from an adjustment of the formula:

$$\text{cotg } Z = \frac{\cos L \text{ tg } D}{\sin t} - \frac{\sin L}{\text{tg } t} = \cos L \left( \frac{\text{tg } D}{\sin t} - \frac{\text{tg } L}{\text{tg } t} \right)$$

Table I = p' Table II = p''

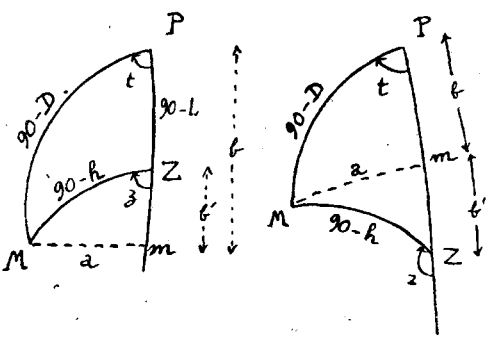
Table III cotg Z = p. cos L. p (Pagel's coefficient) = p' + p''

that is the variation of the angle at the pole when the latitude increases by 1'.

**(M)** 1876 — **Sir William Thomson** — Tables for facilitating Sumner's Method at Sea — J.D. Potter, London (cf. 1871 - 2nd edition in 1886).

German translation. Berlin 1877.
(employs the "auxiliary position" different from the dead reckoning position (assumed position ≠ dead reckoning position).

Sir William Thomson divides the triangle like Towson does (1849).




The 34 × 25 cm. table contains only 9 pages.
It gives values for $t$ and $Z$ as functions of the height of declination and of $\frac{1}{2}$ colatitude.

formulae :

$$\sin a = \cos D \sin t$$
$$\sin b = \sin D \sec a$$
$$\sin h = \cos a \cos b'$$
$$\sin Z = \sin a \sec h$$

Enter the table with the $\frac{1}{2}$ colatitude in col. b. The cohypothenus col. opposite is investigated with a spread of compass legs so as to find the values of h above and of a quantity equal to that which D shows underneath. Z is found in col. A opposite the value of h and the value of t opposite D.
After interpolation, the line of altitude is shifted for the difference hc — ho between the altitude hc found in the table and the altitude observed ho.

This table specially intended for the calculation of the angle at the pole and of the azimuth was modified in 1880 by the Russian astronomer Kortazzi. A French edition of the latter's work was published by Collet in 1891.

**(L)** 1876 — **Jérôme Lalande** — Tafeln der fünfstelligen Logarithmen — 3 Aufl. Leipzig.

**(L)** 1876 — **Gen. Harrington** — Haversines Natural and Logarithmic — Eyre & Spottiswoode, London.

1877 — **Eduardo Salviati** — Elementi di Astronomia nautica, ad uso delle scuole nautiche e degli istituti di marina mercantile. - Genova.

1877 — **Oliver Byrne** — Navigation and Nautical astronomy. - London. — cf. 1876.

1877 — **A. Ledieu** — Les Nouvelles méthodes de navigation. — Ed. Dunod, Paris.
(théorie générale des fausses positions).

(I) 1877 — **A. Ledieu** et **H. Rodanet** — Les montres marines — Description, théorie et perturbations (extrait des "Nouvelles méthodes de Navigation" - Paris).

1877 — **G. Chabirand** — Traité d'Astronomie et de Météorologie appliquées à la Navigation. — Bertrand, Paris.

1877 — **Yvon Villarceau,** membre de l'Institut et **Aved de Magnac,** lieut. de vaisseau. — Nouvelle Navigation Astronomique. — Gauthier-Villars, Paris.

1877 — **Caspari** — 11me Cahier des Recherches Chronométriques. — Service hydrographique, Paris.

1877 — **Magnaghi** — Tavole e formule nautiche. - Genova.

1877 — **G.E. Tuxen** — Nautiske, Astronomiske og Logarithmiske Tabeller. - Kjobenhavn.

1877 — **N. Zinger** — Die Zeit bestimmung aus correspondierenden Höhen verschiedener Sterne. - Leipzig.

(I) 1877 — **Hydrogr. Amt des Admiralität** — Handbuch der nautischen Instrumente. - Berlin.

Aufl. 1882 — 2e Aufl. 1890.

1878 — **Louis Pagel** — Cours de Navigation. - Paris.

(T) 1878 — **J.R. Young** — Navigation and Nautical Astronomy.
— Tables.

1878 — **F. Schaub** — Nautische Astronomie — 3. Aufl. bearbeit von Eugen Gelcich. - Wien.

1878 — **Preus d'Esfleth** — Le point par projection stéréographique des cercles de hauteur.

(Q) 1878 — **Hilleret,** lieut. de vaisseau — Instruction sur les Cartes pour la Navigation par l'Arc de Grand Cercle, publication S.H. N° 592. — Service hydrographique, Paris.

(I) 1878 — **Sir William Thomson** — Instructions for the use of Sir William Thomson's Navigational Sounding machine. - Glasgow.

(T) 1879 — **Hydrographisches Bureau der Kais. Admiralität** — Handbuch der Navigation — Kompas-chronometer, sowie der neuesten Methode der astronomischen Orts-bestimmung. - Berlin.

1e Aufl. 1879 — 2e Aufl. 1881 — 3e Aufl. 1891.

(I) 1879 — **Gustave Herrle** — Circular Protractor, for measuring and plotting great circle distances on gnomonic Charts. - Washington.

(L) 1879 — **D'A. Jackson** — Accented five figure logarithms. - London.

1880 — **E. Dubois** — Cours de Navigation et d'Hydrographie. — 2e édition, Paris.

1880 — **H. Faye** — Cours d'Astronomie Nautique. — Gauthier-Villars, Paris.

1881 — H. Faye — Cours d'Astronomie de l'Ecole Polytechnique.

1880 — **C. Berry,** lieut. de vaisseau — Théorie complète des occultations à l'usage spécial des Officiers de marine et des Astronomes. - Paris.

1880 — **F. Fernandez Fontecha** — Curso de astronomia nautica y navegacion. — 2 vol. — Cadiz.

(T) 1880 — **Nathaniel Bowditch** — American Practical Navigator, revised edition, with usefull Tables. Bureau of Navigation. — Hydrographic Office. - Washington.

(Original edition 1773, etc...). Revised 1903, 1914, 1917. Editions: 1920, 1927, 1938. H.O. Publication N° 9.).

(Az.) 1880 — **Kortazzi** — Modification des Tables d'Azimut de Thomson (1876) reproduite par Collet en 1891.

1880 — **A. Bretel** — Tables pratiques pour la navigation courante en mer ou près des côtes pour tous les astres et pour toutes les latitudes — Constructions, applications. - Paris.

1881 — **H. Faye** — Cours d'Astronomie de l'Ecole Polytechnique. — Paris.

1881 — **F. Brünnow** — Lehrbuch der sphärischen Astronomie. — 4. Aufl. — Berlin.

(cf. 1860, 1869).

1881 — **R. Adm. Charles Shadwell** — Notes on the Reduction of Lunar Observations. — Mathematical and Practical. — J.D. Potter, London.

1881 — **S.T.S. Lecky** — " Wrinkles " in practical navigation, George Philip & Son, Ltd. - London.

1894 : 9th edition.
1908 : 15th edition revised by William Allingham.

(L) 1881 — **J. Houël** — Tables de logarithmes à 5 décimales et logarithmes d'addition et de soustraction de Gauss. — Paris.

(Az.) 1882 — **E. Decante,** lieut. de vaisseau — Table du Cadran Solaire Azimutal pour tous les points situés entre les cercles polaires. — Gauthier-Villars - Paris. — édition 1904.

1882 — **Hydrographisches Amt.** — Nautische Tafeln der K.K. Kriegsmarine. — Pola. — édition 1885.

(Az.) 1882 — **S. Schroeder** and **W.H. Southerland** — Azimut Tables giving the true Bearings of the Sun at intervals of 10 minutes between sunrise and sunset for Parallels of Latitude between 61° N. and 61° S. inclusive. Washington.

1882 — **Nathaniel Bowditch** — Useful tables from the American Practical Navigator. - Washington.

Reprint H.O. N° 9 — II — U.S. Hydrographic Office 1917, 1920... etc.

(T) 1882 — **Rossel** — Stellar Navigation.

C Azimuth tables, Nautical Magazine 1846 and 1873 are arranged in their present form (Tables XXVII and XXVIII of Norie's).

1882 — **P.F. Harrington,** U.S.N. — Notes on Navigation and the Determination of Meridian Distances. - Washington.

1882 — **F.M. Pereira de Souza** — Novas methodos de Navegaçao.

(Revista Maritima Brasileira — Decemb. 1882).

1882 — **Eugen Gelcich** — Stüdien über die Entwicklungs — Geschichte der Schiffahrt. - Laïbach.

1882 — **F.C. Beuf** et **E. Perrin** — Les occultations des étoiles par la Lune, prédiction du phénomène et détermination de la longitude. — Berger Levrault. - Paris.

(T) 1882 — **A. Germain** — Traité d'Hydrographie — Levé et Construction des Cartes marines — Accompagné de Tables. — Service Hydrographique. Publication N° 641. - Paris.

(L) 1882 — **Henrich Bruhns** — Tables de logarithmes à 14 décimales. — Leipzig. (édition 1903).

1883 — **J.A. Normand** — Navigation Stellaire. — Gauthier-Villars, Paris.

Formules 1888. (cf. Annales Hydrographiques, Paris 1888, page 267)..

1883 — **H. Faye** — Cours d'Astronomie de l'Ecole Polytechnique — (Navigation) — Gauthier-Villars - Paris.

(cf. 1881).

1883 — **Souchon** — Traité d'Astronomie pratique — Calcul des Ephémérides Nautiques. — Gauthier-Villars, Paris.
(en 1891 : Traité d'Astronomie théorique).

**(L)** 1883 — **Callet** — Tables de Logarithmes de Callet à 7 décimales, suivies d'un recueil de Tables Nautiques. — Firmin Didot - Paris. (cf. 1783, 1798).

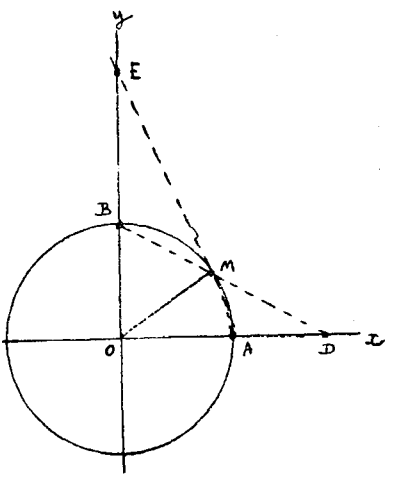
**(Az.)** 1883 — **H.S. Blackburne** — A and B Tables for correcting the longitude and facilitating Sumner's Method on the Chart. To be used also as Azimuth Tables to every 4 minute in time; also a short, simple, and accurate Method of double altitudes with other practically useful tables.
(A companion to the "Epitome of Navigation") — London. (cf. 1905, 1908, 1911, 1916). (cf. aussi Rosser 1889).

1884 — **A.C. Johnson,** R.N. — Brief and simple methods of finding the Latitude and Longitude. - London.
(cf.: 1889, 1891, etc.).

1884 — **E. Guyou** — Cours d'Astronomie et de Navigation de l'Ecole Navale (édition en 1901).

1884 — **E. Guyou** — Etude théorique des Courbes de Hauteur (aussi 1901).

1884 — **E. Guyou,** professeur de navigation à l'Ecole Navale. — Tables de poche donnant le point observé et les droites de hauteur. — Paris. — Berger, Levrault et Cie, 1884.
These 9 × 14 cm. pocket tables containing 52 pages are compiled in a special way so as to determine some fundamental elements of the altitude curve on the chart which are necessary for fixing the position. They contain the meridional parts of the arcs (lambda) with, opposite, the meridional parts of the complements (colambda).




The lambda of arc AM = OD.

The colambda of arc AM = OE.

The table, in the system the basis of which is $e^{\frac{\pi}{10.800}}$ that is $e^{\text{arc } 1'}$ gives on the one side.
$\log \lambda (L) = \log \tan (45° + \frac{L}{2})$

and on the other side $\log \text{co}\lambda (L) = \log \tan (45° + \frac{90° - L}{2}) = \log \text{cotan} \frac{L}{2}$

And as $\lambda_{(L)} = \frac{\text{co}\lambda_{(L)} + 1}{\text{co}\lambda_{(L)} - 1}$ and $\text{co}\lambda_{(L)} = \frac{\lambda_{(L)} + 1}{\lambda_{(L)} - 1}$,

the tables being arranged so that the lambda and colambda of the arc (L) are placed opposite each other, the two mutually corresponding logarithms in the table are those of the two quantities m and m' connected together by the relation $m' = \frac{m+1}{m-1}$.

According to Borda's formulae, by laying down $\begin{cases} 2S = h + L + P \\ \text{with } P = 90° \pm D \end{cases}$

we obtain for the time and azimuth in terms of altitude :

$$\begin{cases} \text{cotan}^2 \frac{t}{2} = \frac{\cos (S - P)}{\sin (S - h)} \times \frac{\sin (S - L)}{\cos S} \\ \text{cotan}^2 \frac{Z}{2} = \frac{\cos (S - P)}{\sin (S - h)} : \frac{\sin (S - L)}{\cos S} \end{cases}$$

E. Guyou's pocket tables for the solution of the following group :—

$$\begin{cases} \lambda(m) = co\,\lambda(h + D) + \lambda_{(L)} \\ \lambda(m') = co\,\lambda(h - D) - \lambda_{(L)} \end{cases}$$

$$\begin{cases} 2\,co\,\lambda\,t = co\,\lambda\,m + co\,\lambda\,m' \\ 2\,co\,\lambda\,Z = co\,\lambda\,m - co\,\lambda\,m' \end{cases}$$

(see details in the "Annales Hydrographiques", Paris 1888, page 542).
see also: G. Simeon — Considerazioni su alcuni metodi e formule del Guyou — Annali del R. Istituto Superiore Navale — Napoli, 1936, p. 260).

1884 — **Edouard Perrin** — Détermination du point par les hauteurs circumzénithales correspondantes. — Berger-Levrault, Paris.

**(I)** 1884 — **E. Lartigue** — Nouveau Calculateur nautique pour effectuer rapidement tous les problèmes de la navigation. — Paris.

1884 — **de Carfort** — Exposé de la Méthode de conduite des chronomètres par isotemps et isotherme.

1884 — **F. Jessen** und **Th. Lüning** — Hülfstafeln zur Schnellen Berechnung von Deviations-Tabellen für den Regelkompass eiserner Schiffe. — Flensburg.

**(L)** 1884 — **Callet** — Tables de logarithmes et cologarithmes à 6 décimales avec Recueil de Tables astronomiques et nautiques. — Lamarzelle, Vannes.

**(L)** 1884 — **P.H.** — Tables d'anti-logarithmes à huit décimales — Kopenhagen.

1886 — **W. Jordan** — Grundzüge der astronomischen Zeit-und Ortbestimmung. — Berlin.

1885 — **G. Pouvreau** — Nouvelles Tables de mer pour le calcul de la hauteur, de l'heure et de l'azimut. — Gauthier-Villars, Paris.

**(I)** 1885 — **Sigsbee** — Great circle Protractor; perfectionnement de celui de Chauvenet.

**(I)** 1886 — **N.** — On the Station Pointer and the manner of Fixing a Ship's Position by its aid. — London.

1886 — **P. Pizzetti** — La Determinazione degli Azimut. — Ed. Loescher, Torino.

1886 — **Luis Pastor** — Curso completo de astronomia y navegacion y IV ano. (E. Naval Militar) 2 vols. — Buenos-Aires.

1887 — **Ecole Navale** — Types de Calculs Nautiques. — Gauthier-Villars, Paris.

1888 — **E. Caspari,** ingénieur hydrographe — Cours d'Astronomie pratique — application à la Géographie et à la Navigation. — 2 vols. — Paris.
(Table III des Circumméridiennes, empruntées au traité de Brünnow).

1888 — **E. Perrin** — Détermination exacte de la latitude et du temps du lieu à l'aide d'observations au sextant par la méthode des hauteurs égales d'étoiles. — Gauthier-Villars, Paris.

**(L)** 1888 — **J. Houël** — Tables de Logarithmes à 7 décimales de L. Schrön. — Gauthier-Villars, Paris.

1888 — **Inman** — Revision des Inman's Nautical Tables 1821 (by the Rev. William Hall in 1904, 1913).

1888 — **Richard A. Proctor** — Great Circle Sailing; indicating the shortest sea route and describing maps for finding them in a few seconds. — Longmans, Green & Co., London.

1889 — **G.W. Littlehales,** hydrographic engineer — The Development of Great Circle Sailing. — Publication N° 90. — U.S. Hydrographic Office, Washington.

(Towson, Deichman, Brevoorts, Bergen, Godfray, Knorr, Hilleret, Jenzen, Heerle, Airy, Fisher, Chauvenet, Sigsbee, Proctor, Asmus, Zescevich Methods).

2nd edition 1899.

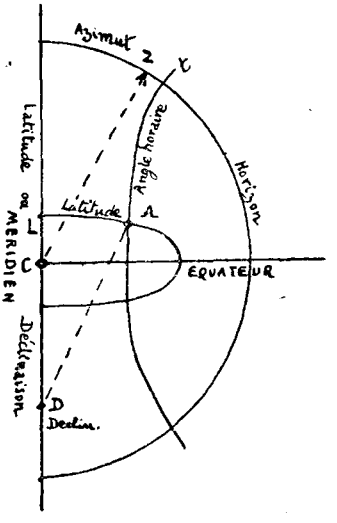
1899 — **W.H. Rosser** — makes a complete revision of John Norie's work (1803) and publishes A.B.C. Azimuth tables, similar to H.S. Blackburne's (1883).

1889 — **A.C. Johnson** — How to find the Time at Sea in less than a Minute; being a new and accurate Method, with specially adapted Tables. — London. cf. 1884, 1891, etc.

1889 — **Ossian Bonnet** — Astronomie Sphérique. — Gauthier-Villars, Paris.

**(Az.)** 1890 — **G. D. E. Weyer** — Kurze Azimut-Tafeln für alle Deklinationen, stundenwinkel und Höhen der Gestirne. — Hamburg. (cf. 1871).

**(G)** 1890 — **Captain Weir's** — Azimuth Diagram. — J.D. Potter, London, may 1890. Republished September 1914.




In order to find the azimuth, the intersection A of the ellipse of Latitude L with the hyperbola of hour angle t is marked on the diagram.

Figurative point D of the declination is marked on the meridian.

Direction D.A. is traced.

By means of a parallel rule, direction DA is transferred to centre C of the diagram.

Parallel CZ gives Z, the azimuth, on the outer horizon circle.

**(G)** 1891 — ... — Time Azimuth Diagram. — Washington.

1891 — **A.C. Johnson** — Hour angles of the Sun, Moon, and Stars for Latitude and Declination 0°-80° and altitude 5°-64°. — London. (cf. 1884, 1889, 1894, etc.).

1891 — **W.R. Martin** — Navigation and Nautical Astronomy, Royal Naval College. — Greenwich.

1891 — **Capt. Th. A. Hull** — Revision de l'Epitome of Navigation de Raper, London.

1891 — **William Chauvenet** — A manual of spherical and practical astronomy; embracing the general problems of spherical astronomy, the special applications to nautical astronomy, and the theory and use of fixed and portable astronomical instruments; with an appendix on the method of least squares. — 2 vols. University Edition. — Philadelphia. (origine 1850, 1864, 1896, 1906).

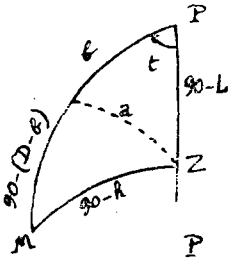
**(T)** 1891 — **Aved de Magnac** — Traité de navigation précise et Tables simplifiant la navigation à la mer. — Gauthier-Villars, Paris.

1891 — **A. Collet** — Navigation astronomique simplifiée. — Gauthier-Villars, Paris — d'après Kortazzi 1880 et W. Thomson.

**(Z)** 1891 — **F. Souillagouet,** professeur d'hydrographie — Tables du "Point Auxiliaire" pour trouver rapidement la hauteur et l'azimut estimés. — Douladoure-Privat, Toulouse.
2me édition, 1900. — A. Challamel, Paris.

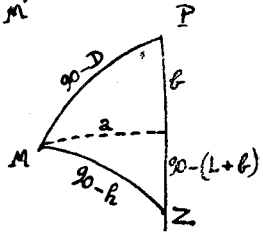
the "auxiliary position" indicated originally by Thomson (1876) facilitated tabulation in connection with or in place of the "dead reckoning".

Size of tables 27 × 19 cm.
Table I: 192 pages, Table II: 60 pages, Table III: 106 pages, Table IV: 48 pages; Total: 408 pages.




formulae for h

$$\begin{cases} \text{tg } b = \text{cotg } L \cos t \\ \sin a = \cos L \sin t \\ \sin h = \cos a \sin (D \sim b) \\ \log \sin h = \log \cos \varphi + \log \cos (90 + D - \varphi) \end{cases}$$




formulae for Z

$$\begin{cases} \text{tang } b = \cos t \text{ cotg } D \\ \sin a = \sin t \cos D \\ \text{cotg } Z = \cos (L + b) \text{ cotg } a \\ \text{tang } A = \cos (L - \varphi) \text{ cotg } \varphi' \end{cases}$$

$$Z = 90 - A$$

An approximate latitude within 15' is assumed.
The longitude is assumed so that $t$ is approximately right to 2 minutes.
With $L$ and $t$ thus assumed, tables I and II are entered with $\varphi$ and $\varphi' = \log \cos \varphi$
$90 + D - \varphi$ is formed
To the log cos of this angle in edded log cos $\varphi$ from which sinus hc is substracted.
Table III is entered in function of declination to the 1/2 degree and of $t$ in order to obtain $\varphi$ and $\varphi'$
Finally table III is entered with $\varphi$ and $L - \varphi$ to obtain A,
hence $Z = 90 - A$.

1891 — **E. Serres** — Tables condensées pour le calcul rapide du point observé. — Gauthier-Villars, Paris.

**(L)** 1891 — **Service Géographique de l'Armée** — Tables de logarithmes à 8 décimales des nombres de 1 à 120.000 et des tangentes de 10 secondes en 10 secondes d'arc dans la division centésimale du quadrant. - Paris.

**(G)** 1892 — **Favé** et **Rollet de l'Isle** — Abaque pour la détermination du point à la mer. (Annales hydrographiques, Paris, 1892 et Revue Maritime, Paris, janvier 1893).

1892 — **M.F. Albrecht** und **C.S. Vierow** — Lehrbuch der Navigation und ihrer mathematischen Hilfswissenschaften. — Berlin, 7 Aufl.
8. Aufl. 1900. 10. Aufl. 1913. 11. Aufl. 1925.

1892 — **Dr. Th. Wittram** — Tables auxiliaires pour la détermination de l'heure par des hauteurs correspondantes de différentes étoiles. — St. Pétersbourg.

**(Az.)** 1893 — **Dollen** — Tables de hauteurs et d'azimuts. (cf. Fuss, 1901).

1893 — **Direktion des Bildungswesen der Marine** — Leitfaden für den Unterricht in der Navigation 1. u 2. Teil mit Anhang. — Berlin.

1893 — **Le Blanc** — Méthode de Calcul de la hauteur et de l'azimut. — (Revue Maritime, Paris 1873).

**(Z)** 1893 — **R. Delafont,** lieut. de vaisseau — Méthode rapide pour déterminer les droites et les courbes de hauteur et faire le point. — Berger-Levrault — Paris, Nancy.

These are the first tables intended especially for the determination of altitude and azimuth. Their defective production has since given rise to tables compiled by Bertin (1918-1919) and Newton and Pinto (1924).

(Q) 1894 — **M. E. Pereire** — Détermination graphique du point à la mer — Méthode Favé et Rollet de l'Isle. — Atlas, Paris.

1894 — **Th. Albrecht** — Formulen und Hülfstafeln für geographische Ortsbestimmung. — 3. Aufl. — Leipzig. — 4. Aufl. 1908.

1894 — **M. A. Goodwin** — The Ex-Meridian.

1894 y 1895 — **Luis Pastor,** Astronomia nautica y navegacion — Curso de Astronomia y Navegacion dictato en el III y IV ano de estudio de la Escuela Naval. — 2 vols. — Buenos-Aires.

1894 — **S.T.S. Lecky** — "Wrinkles" in practical navigation. — 9th edition — London.

1894 — **A.C. Johnson,** R.N. — Time Altitudes for expediting the calculation of apparent time. — Dartmouth. — J.D. Potter, London.

Table I = log secants of Lat. and Decl. Table III = log Versines of Time.
Table II = *log of Time-Altitude* { L ~ D 0° — 83° Table IV = correction in Longitude
Alt 5° — 53°

(cf. 1884, 1889, 1891, 1895, 1898, 1900, etc.).
(See in 1903: complete list of works by A.C. Johnson, R.N.).
(cf. in 1904 for translation into various languages).

1895 — **A.C. Johnson,** R.N. — The Bearings of the Principal Bright Stars of greater declination than 23° North and 23° South, also those of the Moon and Planets when similarily situated. — J.D. Potter, London.

(Q) 1895 — **J. White** — Diagram for obtaining the reduction in ex-meridian altitude observations. — Publ. N° 5005, Hydrographic Department, London.

1896 — **G. Lapointe** — Essai sur la Navigation aérienne, aérostation, aviation. — Berger-Levrault, Paris.

1896 — **H.M. Taylor** — On a method of plotting out on a chart the Great Circle Route between any two points. — Trinity College. — University Press. - Cambridge.

1896 — **von Braunmülh** — "Beitrag zur Gesichte der prósthasphärischen Methode". — Bibliotheca Mathematica, 1896, p. 105-108.

(Az.) 1896 — **Julius Ebsen** — "Azimuth-Tabellen" enthaltend die wahren Richtungen der Sonne, des Mondes und anderen Gestirne deren Declination 29° Nord oder Süd nicht überschreitet, für Intervalle von 10 Zeitminuten zwischen den Breitenparallelen von 72° Nord bis 72° Sud. — Eckardt & Messtorff — Hamburg.

1erste Aufl. 1896. 2. Aufl. 1899. 3. Aufl. 1903.

Format 19 × 27 cm. : 292 pages.
The table is entered with latitude and declination rounded off to an integral degree.
The table furnishes Z in terms of the true time from 10 to 10 minutes.

formula $\quad -\operatorname{cotg} Z = \dfrac{\operatorname{tg} D \cos L}{\sin t} - \sin L \operatorname{cotg} t.$

1896 — **F.C. Stebbing,** chaplain & naval instructor R.N. College, Greenwich — Navigation and Nautical Astronomy. — Mac-Millan and Co. — London. (2nd edition 1903).

1896 — **Wm. Chauvenet.** — (cf. 1850 etc.).

1896 — **Logan, George Wood** — Sunrise and Sunset Tables. — U.S. Hydrographic Office, Washington.

(Q) 1896 — **C.D. Sigsbee** — Graphical Method for Navigators for Star-identification, great circle sailing, etc. — Washington.

1896 — **André Chauchard** — La Navigation en vue des côtes, connaissances indispensables pour conduire un yacht; tables pour faire le point. - Paris.

(Az.) 1897 — **Seaton Schroeder & W.H. Southerland,** U.S.N. — Azimuth Tables for parallels of Latitude between 61° N and 61° S and for Declination between 23° N and 23° S. — Hydrographic Office publication N° 71. — Washington.

1897 — **H.S. Blackburne** — A and B Tables for correcting the Longitude for errors in Latitude. — Adams, Southampton. (cf. 1905, 1916).

1897 — **E. Guyou** — Les Problèmes de Navigation et la Carte marine. — Types de Calculs et Tables complètes. — Berger-Levrault, Paris.

1897 — **G. Lecointe** — La navigation astronomique et la navigation estimée, Paris et Nancy.

1897 — **J.B. Guilhaumon** — Eléments de Cosmographie et de Navigation, précédés de notions de trigonométrie sphérique. — 2me édition. — Paris, Nancy.

1897 — **Administration d'Hydrographie** — Tables Nautiques, 7e édition. — St. Pétersbourg.

1897 — **Antonio Terry y Rivas** — Manual del navegante, IV edicion. — Madrid.

1897 — **J. White** — A method of finding Latitude and Longitude from observations that are not suitable for the Chronometer Method. — J. Griffin and Co. — Portsmouth.

(Q) 1897 — **E. Purey Cust** — Star Chart for facilitating the selection of pairs of stars for observations for Latitude (with movable frame). — Publication N° 5016, Hydrographic Department, London.

(Long.) 1897 — **Percy L.H. Davis,** of the Nautical Almanach Office — Davis's "Chronometer" Tables, or Hour angles for selected Altitudes between Latitude 0° and 50° with variation for 1' in all elements providing means for adjusting the H.A. for the intermediate minutes of each element to which it may be desired to give effect.

previous tables: Lalande (1793), Lynn (1827), Hommey (1863).
See above 1875 Davis, etc.
See above 1897, 1899, 1902.
édition in 1904.
Inspection tables — on the line of those compiled by Thomas Lynn (1827) and Blackburne (1916).

These 25 × 19 cm. tables comprise 204 pages.
They supply t in terms of the altitude.
They are based, like Lynn's Horary Tables (1827) on the general Longitude formula :

$$\begin{cases} 2\,S = 90^\circ - L + D + h \\ \text{hav } t = \sin^2 \frac{1}{2} t = \cos S \sin (S - h) \sec L \sec D \end{cases}$$

The tables for t are analogous to those of Lynn's but, in addition comprise tables for the variation in Latitude, Declination and Altitude.
The table is entered with L°, D° and h° to find t
Interpolation is made for L, D, h.

1898 — **A.C. Johnson,** R.N. — A Handbook for Star Double Altitudes with directions for selecting the Stars. — J.D. Potter, London.

(Az.) 1898 — **J. Burdwood** — Sun Azimuth Tables. — (cf. 1852, 1862, 1866, 1896, 1898, 1902, 1912).

1898 — **Börgen** — Uber die Auflösung nautisch-astronomischer Aufgaben mit Hilfe der Tabelle der Meridionalteile. — Archiv. Deuts. Seewarte. — Hamburg.

(I) 1898 — **A. de Wilkitsky** — Notice sur l'emploi du "Calculateur de Latitude" proposé par le Général des officiers pilotes.

1898 — **E. Legrand** — Prismes réitérateurs appliqués au Sextant. — Montevideo.

(L) 1898 — **Luis Pastor** — Tablas logarithmicas, Buenos-Aires.

1899 — **Bolte** — Neues Handbuch der Schiffahrtskunde. — Hamburg.

1899 — **Radler de Aquino** — O methodo de Marcq St. Hilaire para determinar posiçao no mar, com taboas para a sua applicaçao. — Rio-de-Janeiro.

1899 — **G.W. Littlehales** — The development of great circle Sailing. — Hydrographic Office, Washington. — 2nd edition.

**(L)** 1899 — **G. Friocourt,** lieut. de vaisseau. — Tables de logarithmes à 6 décimales et Tables de navigation. — 5$^{me}$ tirage 1907. — A. Challamel, Paris.

**(L)** 1899 — **Houël** — Tables de logarithmes à 8 décimales pour les nombres et les lignes trigonométriques. — Gauthier-Villars, Paris.

**(Az.)** 1899 — **J. Ebsen** — Azimuth-Tabellen... etc. — Hamburg. — 2. Aufl. (cf. 1896. 1. Aufl. — 3. Aufl. 1903).

## THIRD PART.

# AFTER 1900.

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(Az.) 1900 — **A.C. Johnson** — Combined Time and Altitude Azimuth Tables. — London.

1900 — **Rouget** — Théorie des observations circumzénithales. — Gauthier-Villars, Paris.

(Az.) 1900 — **M. Zhdanko** — Tabellen der wahren Azimute der Sonne. — Petersburg.
supply ready calculated azimuths for latitudes between 61° and 75°.
(See 1935: A. Yustchenko).

1900 — **G. de Lannoy** — Précis de Cosmographie et de Navigation (2me édition). — A, Challamel, Paris.

(L) 1900 — **Ligowski** — Table des fonctions trigonométriques. — Sammlung fünfstelliger Logarithmischer Trigonometrischen und Nautischen Tafeln. — 4° Aufl. — Kiel.

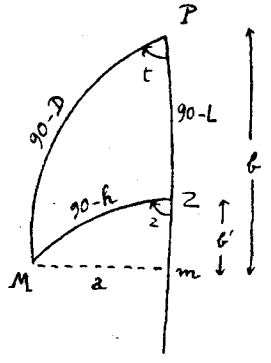
1900 — **F. Domke** — Nautische, Astronomische und Logarithmische Tafeln, für die Königlich Preusischen Navigationsschulen (10 und 11 Aufl.). — Berlin, 1910.
(cf. 1852).

1900 — **Holzmuller** — Stereometrie. — Göschen, Leipzig.

(Az.) 1900 — Davis's Star True Bearing or Azimuth Tables.
computed by P.L.H. Davis, Chief Assistant in H.M. Nautical Almanac Office.
from ± 0° to 30°
from ± 30° to 60°
for $(\mathfrak{f}) < 64°$. — at 10 minutes intervals.
with special Table for the Azimuth of the Pole Star.
(edition in 1902 for Lat. 60° N. to 60° S. at 5 m. and 10 m. interval).
(edition in 1914) (see also 1897, 1902 and 1904).

1900 — **P. Thomson** — Navigation simplified. — J.D. Potter, London.

(M) 1901 — **B. Fuss** — Tablitsi dlia Nakhojdniia Visotti Azimutoff. — Tables to find Altitudes and Azimuths.
Académie Impériale des Sciences et Service hydrographique. — St. Petersbourg.




28 × 20 cm. tables, 144 pages.

formulae
$$\sin a = \cos D \sin t$$
$$\tan b = \operatorname{cotg} D \cos t$$
$$\sin h = \cos a \cos b'$$
$$\operatorname{cotg} Z = \operatorname{cotg} a \sin b'$$

A longitude approximated to 30 minutes is assumed.
The table is entered with $t$ and $D$ to obtain $a$ and $b$ with interpolation for the declination.
Then with 90° — b' and $a$ to obtain hc and Z with interpolation for a; then the difference hc — ho is obtained in the usual way and the diagram made by dead reckoning.

(M) 1901 — **Hydrographiski Upravlenia** — Tabellen zur Berechnung der Höhen und Azimute. — Petersburg.

1901 — **Mac Hattie** — Ex-meridian Tables for Sun or Stars. — London.

1901 — **M. Knudsen** — Hydrographische Tabellen. — Kopenhagen u. Hamburg.

1901 — **Ramon Estrada y Eugenio Agacino** — Tratado de Navegacion teorica y practica. — Nociones de trigonometria y astronomia. — 2 vols. — La Coruna y Madrid.

**(Q)** 1901 — **Molfino** — Nomograma degli Azimut del Sole.

**(L)** 1901 — **G. Friocourt** — Tables de Logarithmes et de Navigation. — A. Challamel, Paris.

1901 — **J.R. Walter,** naval instructor — Explanation of the "New Navigation" Method. — J. Giffin & Co — Portsmouth.

1901 — **Reichs Marine Amt.** — Lehrbuch der Navigation. — 1. Aufl., Berlin. — 2. Aufl. 1906.

**(Az.)** 1901 — **E. Perrin** — Tables destinées à abréger les Calculs Nautiques, Correction Pagel, azimuts, angles de route pour l'Arc de Grand Cercle. — 3me édition. — A. Challamel, Paris.

(cf. 1876, 1884, 1888, 1892, 1906, 1920).

1901 — **G.F. Martelli** — Short easy and improved method of finding the apparent time at ship, rapid calculation, with explanation and examples in English, French, German, Italian and Spnish. — 1 vol. — Glasgow.

**(M)** 1901 — **Capt. Ch. Brent** — Ex-meridian Altitude Tables. — $\varphi$ 0° - 70° — 4th edition, London & Liverpool.

Format 16 × 25 cm. — 91 pages.
Table II — Limits of Extra-meridian observations.
Table III — Values of C = change in altitude during the minute preceeding or succeeding the meridian transit.
Table V — Approximate apparent time of the Merd. Pass. of the Principal fixed Stars for each day of the 12 months.

**(Long.)** 1902 — Davis's "Chronometer Tables" or Hour angles for selected altitudes between Lat. 0° and 50° with variation for 1' in all elements by Percy L. H. Davis of the Nautical Almanach Office — providing means for adjusting the H.A. for the intermediate minutes of each element to which it may be desired to give effect.

(after Lalande 1793, Th. Lynn 1827, Hommey 1863).
previous edition 1897-1899.
edition in 1904.
(See above 1897).

**(Az.)** 1902 — **U.S. Hydrographic Office** — Publication H.O. N° 120 — The Azimuths of Celestial Bodies. — Déc. 24° to 70° — Lat. 0° to 70°. — 2nd edition 1907; 3rd edition 1912; 4th edition 1916 — reprint 1920 — Washington.

**(Az.)** 1902 — **J. Burdwood** — Star Azimuth Tables for declinations 23° to 64°. (cf. 1866, 1912).

1902 — **E. Guyou** — Les Distances Lunaires (Revue Maritime, Paris).

**(T)** 1902 — **J.A.D. Jensen** — Laerbog i navigation — Nautiske Tabellen — Kopenhagen.

1902 — **Radler de Aquino** — Taboas para achar alturas e azimuths, etc... (Revista Maritima Brasileira — Rio-de-Janeiro, october 1902). — (cf.: 1903).

**(M)** 1902 — **Borgen** — Tables de hauteur et d'azimut. (Annalen der Hydrogr. u. Mar. Meteor.).

derived from Thompson's tables and modified by Prof. Pesci, 1909.

(Az.) 1902 — **F. Labrosse** — Table des Azimuts du Soleil et de la Lune et de tous les Astres. $\omega$° 30° S — 30° N. — Lat. 61° S — 61° N.
11me édition. — A. Challamel, Paris. — (cf. aussi: 1868).

(I) 1903 — **Segré** — Azimutometro.

1903 — **Pesci** — formules de Pesci (Rivista Marittima).

1903 — **A. Wedemeyer** — Zur Höhenberechnung.
(Annalen der Hydrogr. u. Mar. Meteor. 1903. p. 366).

1903 — **Radler de Aquino** — Estudo elementar de Trigonometria Espherica e algunes das suas applicaçoes à Astronomia Espherica, Navegaçao e Geographica. — H. Garnier, Paris.

(T) 1903 — **Nathaniel Bowditch** — The American practical Navigator, with usefull Tables (1904-1911).
2nd edition 1904. — Publication N° 9 — U.S. Hydrographic Office, Washington.
Revised by Lieut. G.W. Logan, U.S.N.

1903 — **P. Güssfeldt** — Grundzüge der Astronomisch-geographischen Ortsbestimmung Braunschweig.

1903 — **H. Harvey** — What star is it ? — Tables for identifying unknown Stars. — London.
Another edition 1909.

1903 — **Ecole Navale,** Brest — Types de Calculs Nautiques. — Berger-Levrault, Paris.
Edition 1908.

(M) 1903 — **Radler de Aquino** — A Navegaçao sem Logarithmos, Imprensa Nacional, Rio de Janeiro.
(méthode Thomson et Borgen).

1903 — **A.C. Johnson,** R.N. — On finding the Latitude and Longitude in cloudy weather and at other times — 26th edition — with new Time-Azimuth and Ex-Meridian Tables.
Part II: The Longitude by chronometer — J.D. Potter, London (32e edition, 1909). (cf.: 1894).

— Brief and simple Methods of finding the Latitude and Longitude by Sun or Stars together with new Extra-meridian, Double extra-meridian and Chronometer Tables.
4th edition. — George Philip & Son, Ltd. — London.

— How to find the Time at Sea in less than a minute with specially adapted Tables.
4th edition. — J.D. Potter, London.

— Short Tables and Rules for finding the Latitude and Longitude by single and double altitude Pole Star, Lunars, etc.
2nd edition. — J.D. Potter, London.

— Hour Angles of the Sun, Moon and Stars, adapted to short methods of finding the Latitude and Longitude by Projection on the Chart. (Lat. Decl. 0° - 80°. Alt. 5° - 64°).

— Nautical Astronomy made easy. — J.D. Potter, London.

(Az.) — A combined Time and Altitude — Azimuth Table for all Latitudes and for all heavenly bodies within the limits of 80° Declination or Altitude.
3rd edition — J.D. Potter, London. (edition 1900).

(Az.) — Short, accurate, and comprehensive Altitude-Azimuth Tables; to show the true bearing of the Sun, Moon, and Planets for each degree of Latitude and Altitude from 0° to 75°, and Declination 30° North to 30° South. — J.D. Potter, London.

2nd edition 1902 { Table I = f. Lat. Alt. / Table II = f. Polar distance & (Lat. + Alt.) / Table III = Z.

— Time-Altitudes for expediting the Calculation of apparent Time, etc. (cf.: 1894).

— The bearings of the Principal Bright Stars of greater declination than 23° North and 23° South, also those of the Moon and Planets when similarily situated. (cf.: 1895).

— A Handbook for Star Double-Altitudes, with directions for selecting the Stars... etc. (cf.: 1898).

1904 — **A.C. Johnson,** R.N. — Méthode pour trouver la Latitude et la Longitude par temps nuageux et par tous les temps — traduit et annoté par O.V. de Jassaud — 1 vol., A. Challamel, Paris.

traduction allemande par Theodor Luning — Flensburg (Mittler & Sohn, Berlin).
traduction espagnole par Don Garcia Nuñez — Santander.
traduction italienne par Capt. Guarianti — Genova.

1903-1904 — **P. Constan** — Cours élémentaire d'Astronomie et de Navigation. — 2 vols. — Gauthier-Villars, Paris.

**(G)** 1904 — **Hydrographic Department** — Diagram to facilitate obtaining a ship's position by Sumner's Method — Publication N° H.D. 5015 — London.

**(G)** 1904-1905 — **Perret** — Notes sur quelques applications de la Nomographie à l'Astronomie Nautique (Annales hydrographiques, Paris, 1904) et aux Principales Tables Nautiques (Revue Maritime, Paris, 1905). — Nomogramme de l'Azimut.

1904 — **A. Cousin** — Résumé pratique de navigation. Long-cours, Plaisance, Cabotage. — A. Challamel, Paris.

**(I)** 1904-1907 — **J.A. de Rey-Pailhade** — Ephémérides décimales et montre décimale à l'usage des astronomes et des navigateurs. — Gauthier-Villars, Paris.

1904 — **W.V. Merrifield** — Text-book on Navigation and Nautical Astronomy by J. Gill rearranged — new edition 1913, Longmann, Green & Co. — London, New-York, Calcutta.

1904 — **G.W. Littlehales** — Modern Nautical Astronomy. — Ed. Manders, Publishing Co. — Washington.

1904 — **William Hall,** chaplain and Naval instructor — Modern Navigation — text-book for cadets of the R.N. edition 1912 — W.B. Clive, London.

1904 — **Bossen & D. Mars** — Zeevaartkundige Tafeln voor circummeridiaan-waarnemingen met toepassing op de plaatsbepaling door hoogteliijnen. — Amsterdam.

**(Az.)** 1904 — **Decante** — Tables d'azimut pour tous les points situés entre les cercles polaires et les astres dont la déclinaison est comprise entre 0° et 48° — Variation automatique... etc. — 8 volumes, 3me édition. (1re édition 1882).

| | | | | | |
|---|---|---|---|---|---|
| Tome | I | Lat. 1° à 7° | Tome | V | Lat. 35° à 42° |
| | II | 8° à 16° | | VI | 43° à 50° |
| | III | 17° à 25° | | VII | 51° à 58° |
| | IV | 26° à 34° | | VIII | 59° à 66° |

**(M)** 1904 — **Davis** — Ex-meridian Tables for Latitude up to 64° and declination up to 34° giving the reduction to the meridian. — J.D. Potter, London.

**(Az.)** 1904 — **Davis** — Supplementary Azimuth Tables for various intervals of Hour Angle between Lat. 64° N. & S. and Azimuth for altitudes greater than 60° and others suitable for use with ex-meridian observations. — 19 × 26 cm. — 92 pages. — J.D. Potter, London.

There tables are an extension of Burdwood's original azimuth tables.
(See: 1900).

1904-1907 — **W. Jordan** — Handbuch der Vermessungskunde. — 5. Aufl. — Stuttgart.

**(L)** 1905 — **G. Friocourt** — Tables de Logarithmes et Tables de Navigation. — A. Challamel, Paris.

**(I)** 1905 — **J. Vallerey** — Rapporteur azimutal.

**(Q)** 1905 — **E. Perret** — Note sur la construction d'un nomogramme à points alignés pour le calcul de l'équation des hauteurs correspondantes du Soleil.
(Revue Maritime, Chapelot, Paris, avril 1905).

1905 — **Luis Ribera y Uruburu** — Tratado elemental de astronomia; cronometro y sextante. — Astronomia Nautica — Ferrol.

1905 — Suppression in the nautical almanac of tables relative to lunar distances (as dead as Julius Ceasar!).

**(Alt.)** 1905 — **Percy L.H. Davis** — Requisite Tables (Logarithmic) with natural and logarithmic haversines sine, tang and secant. — (Nautical Almanac Office) — J.D. Potter, London.

1905 — Davis's Requisite Tables.
These 31 × 18 cm. tables combine in a single one the log haversine and natural haversines comprising 105 pages for the haversines, 18 pages for the log cosines; total 123 pages.

laying down $\begin{cases} \text{hav } \theta = \cos L \cos D \text{ hav } t \\ hc = 90 - z \end{cases}$

formula $\text{hav } z = \text{hav } (L \sim D) + \cos L \cos D \text{ hav } t$
$= \text{hav } (L \sim D) + \text{hav } \theta$

The natural haversine of $(L \sim D)$ is added to the natural haversine of $\theta$ to obtain the natural haversine of z. From z one goes to $hc = 90 - z$.
On the other hand, the azimuth is determined by any appropriate method.

1905 — **E. Kohlschütter** — Messkarte zur Auflösung sphärischer Dreiecke nach Chauvenet, Berlin.

**(Az.)** 1905 — **H.S. Blackburne,** extra Master P & O and nautical adviser to the New Zealand Government — Tables for Azimuth, Great circle sailing and Reduction to the Meridian.
Lat. & Decl. ± 0° — 85° (A. B. and C. Azimuth Tables).
(Original tables A and B for time-azimths published in 1883)
2nd edition 1908 (Tables A, B, C and D).
4th edition 1916 — Lat. & Decl. ± 0° — 90° — Wellington N.Z.
cf.: 1883, 1887, 1897, 1908, 1914.

These 15 × 24 cm. tables, containing 177 pages, were published originally in the New Zealand Nautical Almanac (1883) A & B Tables.

formulae $\begin{cases} \text{Table A} = \tan L \text{ cotg } t \\ \text{Table B} = \tan D \text{ cosec } t \\ \text{Table C} = \text{cotang } Z = (A \sim B) \cos L. \text{ (after W.H. Rosser, 1889).} \\ \text{Table D} = \dfrac{dt}{dh} \end{cases}$

**(Az.)** 1906 — **E. Perrin,** capit. de vaisseau — Nouvelles Tables destinées à abréger les Calculs nautiques, Correction Pagel, etc.
4me édition — A. Challamel, Paris. — (voir: 1876).

1906 — **Prof. Pesci** — Sull'uso e sulle tavole dei valori naturali delle funzioni trigonometriche. (Periodico di Matematica, Vol. XXI, fasc. V-VI, 1906).

1906 — **A. Stupar** — Lehrbuch der terrestrichen und astronomischen navigation. — Fiume.

1906 — **José Nunez da Matta** — Taboa Polytelica. — Lisboa.

(G) 1906 — **G.W. Littlehales** — Altitude-Azimuth and geographical position, comprising graphical tables for finding the altitude and azimuth, the position line etc. — Philadelphia.
— A New Altitude-Azimuth-Hour-Angle Chart. — J.D. Potter, London.

by means of this diagram representing a square with the sides divided according to the values of the Natural Haversine, the Altitude Azimuth is solved by drawing a straight-line — Again, with the same data, latitude, declination and altitude, an approximate value may be found for Hour Angle.

1906 — **H.B. Goodwin** — Position-line Star Tables: for fixing ship's position by reduction to meridian and prime vertical without logarithmic calculation. — J.D. Potter, London.

1906 — **J.B. Guilhaumon** — Eléments de Cosmographie et de Navigation. 4me édition — Berger-Levrault, Paris.

(G) 1906 — **P. Constan** — Tables graphiques d'azimut. — Gauthier-Villars, Paris.

(c'est une réduction de l'abaque de Favé et Rollet de l'Isle 1892).

(G) 1907 — **Dr. G. Pesci** — Resoluçâo nomografica do Triangulo de Posiçâo. (transl. Revista Maritima Brasileira — Nov..Dec. 1907 & Feb. 1908).

(Δ) 1907 — **Rev. Frederick Ball**, M.A., chaplain and naval instructor in H.M.F. — Altitude Tables or Position-Line Tables, computed for intervals of Four minutes lat. 31° to 60° N. or S. & D 0° - 24° without logarithmic computations, 3 vols.

calculated by the computers at the Royal Observatory, Greenwich, Superint. A.C.D. Crommelin, Esq. — Sir William H.M. Christie, Astronomer Royal, Prof. J.A. Ewing, Director of Naval Education. — J.D. Potter, London.

— d° — between Lat. 0° — 30° and Decl. 0° — 24°
— d° — — 24° — 60°. (1907-1911).

27 × 19 cm. Tables — 2 volumes 244 and 240 pages.

formula $\begin{cases} \sin h = (\sin L \sin D) + (\cos L \cos D) \cos t \\ \dfrac{\cos D}{\sin Z} = \dfrac{\cos h}{\sin t} \end{cases}$

A rounded degree of Latitude and Longitude is assumed as an approximate position, so that *t* is approximated to intervals of four minutes.
The tables are entered with L°, D° and t to intervals of four minutes.
Appproximate $h_c$ is found there and interpolated for declination.
The azimuth can be found by entering the same table, but with L°, h° in the same declination column, *d* in the altitude column and Z in *t* column.

(G) 1907 — **d'Ocagne** — Calcul graphique et Nomographie. — Paris.

1907 — **Luis de Ribera y Uruburu** — Tratado de Navegacion costera y astronomica. — Ferrol.

1907 — **G.W. Littlehales** —
U.S. Naval Institute Proceedings. — Vol. 43, N° 11, Nov.

1907 — **E.B. Simpson-Baikie** — New Navigation Tables, being tables to facilitate the solution of combined altitudes when worked by Marcq Saint-Hilaire's Method. — London.

1907 — **Fontoura da Costa** e **Azevedo Coutinho** — Tabuas Nauticas. — 1 vol. — Lisboa.

1907 — **José de Mendoza y Los Rios** — Coleccion de tablas para los usos de la navegacion y astronmia nautica.

autres éditions antérieures: cf. 1792, 1795, 1800, 1805, 1809, 1850.

(T) 1908 — **G. Mansilla** — Metodo rapido para calcular el Punto astronomico con Tablas de 0° a 60° de Latitud. — Buenos-Aires.

1908 — **T. Fragoso** — Determinaçâo da latitude por alturas iguaes de duas estrellas. — Rio-de-Janeiro.

1908 — **A. Rust** — Ex-meridian, Altitude, Azimuth and Starfinding Tables. — New-York.

1908 — **L. de V. E. Perret** — Navigation, instruments, observations, calculs. — Octave Doin, Paris.

1908 — **F. Imperato** — Trattado elementare di navigazione stimata. — Mailand.

**(L)** 1908 — **C. Börgen** — Logarithmisch-trigonometrische Tafel auf 11 Stellen. — Leipzig.

**(G)** 1908 — **A. Alessio** — Diagrammi altazimutali. — Genova.

1908 — **A. Alessio** — Sulla teoria e la pratica della nuova navigazione astronomica. — 1 vol., Roma (Rivista Marittima, Juill. Aug. 1908 e March 1909).

**(L)** 1908 — **C. Bremiker** — Logaritmisch-trigonometriches handbuch — Georg's Freiherrn von Vega. — Berlin.

1908 — The Nautical Almanac ceases the publication of its lunar distance tables.

1908 — **Cdt. W.C.P. Muir,** U.S.N. — Navigation and Compass deviations. — 2nd edition — U.S. Naval Institute. — Annapolis.

1908 — **Blackburne** & **Westland** — Ex-Meridian and Azimuth inspection Tables. — (cf.: 1911).

1908 — **Radler de Aquino** — Altitude and Azimuth Tables for facilitating the determination of Lines of position and geographical position at sea — The simplest and readiest in solution (U.S. Naval Institute Proceedings. Vol. 34, N° 4).

1st edition in 1910. — J.D. Potter, London.
2nd edition in 1912. — J.D. Potter, London.
3rd edition in 1924. — J.D. Potter, London.
cf.: 1927.

**(G)** 1908 — **Radler de Aquino** — Nomograms para achar alturas e azimuth... etc.

(Revista Maritima Brasileira — July 1908 — traduc. anglaise U.S. Naval Institute Proceedings, June 1908).

**(G)** 1908-1909 — Las Tablas graficas de Luyando. (Annales de la Faculté des Sciences de Saragosse).

1909 — **Dr. Alberto Alessio,** R.I.N. — Sulla Teoria e la Pratica della nuova navigazione astronomica. (Rivista Marittima, Roma, Juil.-Aug. 1908 et March 1909).

**(M)** 1909 — **Radler de Aquino** — Sea and Air Navigation Tables for solving all problems by inspection. — U.S. Naval Institute, Annapolis.

edition in 1927. (The preface contains explanations concerning Delafon's method (1893) and Bertin's (1914) given by Benjamin Dutton).

These tables with 23 × 15 cm., 90 pages, determine simultaneously the altitude and azimuth by means of 2 tables.
The first gives Z and the tabular altitude with arguments from degree to degree.
The second supplies the correction to be made in the tabulated altitude to obtain the dead reckoning altitude.

The method is similar to that of Fuss (1901)
Formulae :—

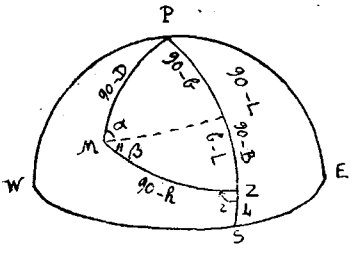



*Table of the Spheric Triangle*

$$\begin{cases} \sin a = \cos D \sin t \\ \sin D = \cos a \sin b \\ \operatorname{cotg} t = \operatorname{cotg} a \cos b \\ \operatorname{cotg} \alpha = \sin a \operatorname{tg} b \end{cases} \quad \begin{matrix} C = b - L \\ = 90 - B \end{matrix}$$

$$\begin{cases} \sin h = \cos a \cos C \\ \operatorname{cotg} Z = \operatorname{cotg} a \sin C \\ \operatorname{cotg} \beta = \sin a \operatorname{cotg} C \end{cases} \quad M = \alpha + \beta$$

Ready Reckoner $\begin{cases} he = h_{tab.} + (\Delta h)_D \\ (\Delta h)_D = (D - D_{tab.}) \cos M. \end{cases}$

The Latitude and Longitude are assumed so as to simplify interpolation.
The table is entered with $t$ and $D$ approximated to the integral degree, in order to obtain approximate values of $a$ and $b$.
Then, with these values for $a$, $b$ and $D$ enter the table in order to obtain $b$ and $t$ by interpolation.

1909 — **Dr. G. Pesci** — Studio critiso sulle "Tables for facilitating Sumner's Method at Sea" di Lord Kelvin. (Rivista Marittima, Roma, Jan. 1909, p. 43).

1909 — **Prof. Pesci** — Cenni sulla risoluzione del triangolo di posizione... etc. (Rivista Marittima, Roma, Sept. 1909).

1909 — **Adm. Sir. E. Purey-Cust** — Sumner's Method. — London. 2nd edition in 1928.

(L) 1909 — **B. Cohn** — Tafeln der Additions — und Subtraktions — Logarithmen auf Sechs Dezimalen. — Leipzig.

1909 — **L. Ambronn** und **J. Domke** — Astronomisch-geodätische Hilfstafeln zum Gebrauche bei geographischen Ortsbestimmungen und geodätischen übertragungen. — Berlin.

1909 — **A.P.W. Williamson** — Texbook of navigation and nautical astronomy. — London. (2nd edition in 1915).

1909 — **Hydrographic Office** — Publication **H.O. 127** — Star identification Tables, giving simultaneous values of declination and hour angle for values of latitude, altitude and azimuth. — Lat. 0° - 88°. Azimuth 0° - 180°. — Washington.

1909 — **H. Meldau** — Nautik. — Leipzig.

1909 — **Marcuse** — Astronomische Ortsbestimmung im Ballon.

1909 — **Alberto Alessio** — Istruzioni e tavole nautiche. — Genova.

1909 — **Smithsonian Institution** — Smithsonian Mathematical — Hyperbolis functions. — Becker & Van Ostrand. — Washington.

1909 — **H.W. Harvey** — "What Star is it?" — Tables for identifying unknown stars. — London.

1910 — **Manuel J. Garcia Mansilla** — Método ortogonopolar para la determinacion del punto en el mar. — Rio Santiago.

(L) 1910 — **J.W. Atherton** — Table of meridional parts of the terrestrial spheroïd. — London.

1910 — **F. Marguet** — Le Point à la mer (Revue générale des Sciences, Paris 1910, 1912, 1917, 1918).

(I) 1910 — **Claude** et **Driencourt** — Description et usage de l'Astrolabe à prisme. — Gauthier-Villars, Paris.

(I) 1910 — **A. Brill** — Instrument for fixing position by astronomical observations. (Annalen der Hydrogr. u. Mar. Meteor. Vol. 38, p. 614-622, 674-686).

1910 — **Giuseppe Fesci** — Studio comparativo sulle ordinarie tavole trigonometriche naturale. (Rivista Marittima, Roma, Oct. 1910).

1910 — **J. Rigal** — Navigation en temps de brume. — Toulon.

(I) 1910 — **Mansilla** — Altazimetro. — Buenos-Aires.

1910 — **A. Cureau** — Détermination des positions géographiques — Manuel d'astronomie pratique et de topographie à l'usage des voyageurs et des explorateurs. — Paris.

1910 — **Dr. Giuseppe Pesci** — Sul Calculo delle rette Saint-Hilaire. — (Rivista Marittima, Roma, feb. 1910).

1910 — **Radler de Aquino** — Altitude and Azimuth Tables for facilitating the determination of lines of position and geographical position at Sea. — J.D. Potter, London.

— Taboas para achar alturas e azimuths facilitando a determinaçâo de rechas de posiçâo .e o ponto observado no mar. — Imprensa Nacional — Rio-de-Janeiro. — Reproduites dans H.O. 200 - U.S. Hydrographic Office, 1913.

1910 — Types réglementaires des Calculs Nautiques des Ecoles d'Hydrographie de la Marine Marchande. — Paris.

1910 — **H.L.D. Craven** — Short Tables for use at Sea. — London.

1910 — **H.B. Goodwin** — The Haversine in Nautical Astronomy. (U. S. Naval Institute Proceedings, Vol. 36 - Annapolis, 1910).

1910 — **von Kobbe** — Astronomische Ortsbestimmung nach Horizontalwinkeln. (Annalen der Hydrogr. usw. — July, 1910).

1910 — **Wedemeyer** — Die Azimutgleichen und der Pothenosche Problem auf des Kugel. (Annalen der Hydrogr. usw. — August, 1910).

(L) 1910-1911 — **J. Bauschinger** und **J. Peters** — Logarithmisch-trigonometrische Tafeln mit ach Dezimalstellen. — 2 vols. — Leipzig. (Tables logarithmiques à 8 décimales).

1911 — **G. Pes** — Nuova Navigazione astronomica — Le rette di posizione. Teoria, applicazioni. — Genova.

(2nd edition 1922).

1911 — **E. Guyou** — Nouvelles Tables de Navigation. 2 vols.
Tome I. — Réduction à l'Equateur.
Tome II. — Calcul de la Hauteur et de l'Azimut. — Berger-Levrault, Paris, Nancy.

1911 — **W.C.P. Muir** — A Treatise on Navigation and Nautical Astronomy. — Annapolis.

(4th edition 1918).

1911 — **Kühtmann's**-Rechentafeln (Multiplikations— und Divisionstafeln). Dresden.

(Az.) 1911 — **H.S. Blackburne** — Tables for azimuths, great circle sailing and reduction to the meridian with a new and improved "Sumner" method. Latitudes and Declinations 90° N. to 90° S. — Wellington N.Z.

cf.: 1908, 1914, 1916.

1911 — **M. Worsley Blackden** — New rules for the Selection of Pairs of fixed stars to determine the centring or arc errors of the sextant at sea or land. — Southampton.

(T) 1911 — **S. Dorgueil** — Table nautique — Azimut et hauteur approchée d'un astre quelconque. — A. Challamel, Paris.

(Az.) 1912 — **W.P. Symonds,** Survey Commissioner, Bombay — Nautical Astronomy, with New Tables. — J.D. Potter, London.

1912 — **J. Towson** & **J.W. Atherton** — Tables to facilitate the practice of great circle sailing and the determination of azimuths and their application to the construction of gnomonic charts. — 6th edition. — London (1re édition 1847).

(Az.) 1912 — **J. Burdwood** — Sun's true bearings or azimuth Tables, between the parallels of latitude 30° and 60° incl. — London.

cf.: 1852, 1858, 1862, 1864, 1866, 1873, 1896, 1898, 1902.

(L) 1912 — **J. Peters** — Fünfstellige Logarithmentafel der trigonometrischen Funktionen für jede Zeitsekunde des quadranten. — Berlin.

1912 — **L. de Ball** — Lehrbuch der sphärischen Astronomie. — Leipzig.

1912 — **R. Peaux** — Zeewaartkundige Tafeln. — Rotterdam.

1912 — **Cdr. Isaias A. Newton** — Novo processo rapido para a Determinação de rectas de altura; applicavel as Taboas de Radler de Aquino e de Souillagouet.
(Anais do Club Militar Naval, Lisboa, N° 3, 1912, etc.).

**(Alt.)** 1912 — **Radler de Aquino** — New Log and Versine Altitude Table (The "Newest" Navigation altitude and Azimuth Tables. — 2nd edition 1912. — J.D. Potter, London.

16 × 25 cm. tables. — Table I: 8 pages; Table II: 18 pages; Table III: 9 pages. Total: 35 pages.

By laying down versine $\theta = 2 \sin^2 \frac{\theta}{2} = 2 \cos L \cos D \sin^2 \frac{t}{2}$

is obtained : versine $(90 - h) =$ versine $(L - D) +$ versine $\theta$

$$\sec L \sec D \operatorname{cosec}^2 \frac{t}{2} = \operatorname{cosec}^2 \frac{\theta}{2}$$

formula : $\frac{1}{2} \log \sec L + \frac{1}{2} \log \sec D + \log \operatorname{cosec} \frac{t}{2} = \log \operatorname{cosec} \frac{\theta}{2}$

The first table gives $\frac{1}{2}$ log sec L or $\frac{1}{2}$ log sec D.

The second table gives log cosec $\frac{t}{2}$ or log cos $\frac{\theta}{2}$ in terms of t or $\theta$.

The third table gives log cosec $\frac{t}{2}$ when t is comprised between 90° and 270°.

All sines verses or logarithms have been multiplied by $10^6$ to reduce them to integral numbers.

1912 — **H.B. Goodwin** — A new form of Table for calculating Altitude, interpolation being reduced to the odd minutes of declination.
(Nautical Magazine. — Glasgow, feb. 1912).

1912 — **J.B. Guilhaumon** — Astronomie et Navigation, suivies de la compensation des compas. — Paris, Nancy.

1912-1913 — **Newton** — Tabuas esfericas do ponto. (Anais do Club Militar Naval. — Lisboa).

1913 — **F. Marguet** — Cours de Navigation et de Compas de l'Ecole Navale. — A. Challamel, Paris.

1913 — **G. Massenet** et **J. Vallerey** — Cosmographie et Navigation — Manuel à l'usage des capitaines au cabotage et des officiers de la marine marchande. — Paris.

1913 — **A. Breusing** — Steuermannskunst. 9. Aufl.
(Neubearbeitet vom O. Fulst, H. Meldau, und C. Schilling). Leipzig.
edition 1932.

**(L)** 1913 — **Istituto Idrografico R. Marina** — Tavole logaritmiche a cinque cifre decimali. — Genoa.

1913 — **Capt. Jordan** — Tables de Claude et Driencourt pour déterminer la distance au point approché. — Service Géographique de l'Armée. — Paris.

1913 — **Rev. William Hall** — Appendix to Raper's Practice of Navigation. — London.

1913 — **P. Thomson** — Navigation. A new method of finding a ship's position at Sea by one observation only. — London.

1913 — **George R. Maxwell** — A study of the Development of the Method of finding a Line of Position. (U.S. Naval Institute Proceedings. — Vol. 39, N° 1. Annapolis, March 1913).

**(I)** 1913 — Fontura's T. Square. (U.S. Naval Institute Proceedings, N° 147. Sept. 1913, p. 1042).

**(I)** 1913 — Aquino's graduated Triangle and Protractor Diagram. (U.S. Naval Institute Proceedings. N° 147, p. 1035).

**(T)** 1913 — **A. Thore** — Lärobok i enklare navigation m. m. jämte nautiska tabeller. — Göteborg.

**(Az.)** 1913 — **P.L.H. Davis** — Sun's true bearing or azimuth tables, computed for intervals of four minutes between the parallels of latitude 30° N. and 30° S., incl. — London.

**(Alt.)** 1913 — **U.S. Hydrographic Office,** Publication **H.O. 200** — Altitude, Azimuth and Line of position, Marcq St. Hilaire cosine-haversine formula and also Aquino's altitude and azimuth Tables. — Washington.

(4th reprint in 1918) (voir aussi: 1918).

Altitude, Azimuth, and Line of position comprising Tables for working sight of heavenly body for line of position by the cosine-haversine formula, Marcq Saint Hilaire Method and also Aquino's Altitude and Azimuth Tables for line of position, Marcq Saint Hilaire method.

19 × 26 cm., 320 pages. Recueil de diverses Tables parmi lesquelles :—
Table IV — Logarithmic Haversines and Natural Haversines : 106 pages.
Table V — The finding of Azimuths : 33 pages.
Table VI — Aquino's Spherical Traverse Table : 117 pages.
Table VII — Change of Altitude per minute of arc of Hour Angle : 1 page.
Table VIII — Change of Azimuth per minute of Altitude : 1 page.

formules : $\begin{cases} \text{hav } z = \text{hav } (L \sim D) + \text{hav } \theta \\ \text{hav } \theta = \cos L \cos D \text{ hav } t. \\ z = 90 - h \end{cases}$

Table IV giving the logarithm of the 1/2 sine verse along with the 1/2 natural sine verse, the latter can be deduced from the logarith of the 1/2 sine verse without going through the value of the corresponding angle.
Table V is accompanied by a diagram for the determination of time of transit at the prime vertical.

1913-1916 — **Reichs. Marine Amt.** — Höhen und Azimute der Gestirne, deren Abweichung zwischen 30° S und 30° N liegt, für 55° Breite und für 50° Breite. — Berlin. (cf.: 1916-1920, 10 volumes).

1914 — **B. Soeken** — Höhentafeln. — Hamburg.

1914 — **J. v. Roon** — Zeevaartkundige Tafelen voor waarnemingen nabij den Meridian. — Helder.

**(T)** 1914 — **Nathaniel Bowditch** — American practical navigator. An epitome of navigaton and nautical astronomy — with Tables. (U.S. Hydrographic Office, Washington).

(original publication in 1773).

1914 — **E. Aylmer** & **J. White** — Admiralty Manual of Navigation 1914. H.M. Stationery Office, London.

(other editions in 1922, 1928).

1914 — **J. Morgan, T.P. Merchant, A.L. Wood,** navigation masters. — The "Conway" school ship Manual of Navigation and Nautical Astronomy. — J.D. Potter, London.

1914 — **H.S. Blackburne** — Modern up to date Navigation, position finding by Sumner's and Marcq St. Hilaire Methods. Star reduction and azimuth Tables. — John Mackay, Wellington. — New Zealand.

**(Long.)** 1914 — **H.S. Blackburne** — Tables of calculated Hour-Angles and Altitude-Azimuth Tables 30° N. to 30° S. — Ex-meridian Tables and calculated Reductions and Azimuths of Bright Stars 60° N. to 60° S. from 1 to 3 hours from the Meridian. — Wellington, N.Z.

17 × 24 cm. tables, 242 pages + 127 auxiliaries, Total: 372 pages.

formula: haversine $t = \cos S \sin (S - h) \sec L \sec D$

$2\,S = h + L + 90 \sim D$

2nd edition in 1916 entitled : The Excelsior Azimuth and Position finding Table. — Wellington, N.Z.

24 × 17 cm. tables: Table I (t) 242 pages, Table IV (Az) 10 pages, total: 252 pages. They employ the general Longitude formula like Lynn's horary tables (1827) and Davis Chronometer tables (1902).
Table V is entered with L°, D°, h° in terms of integral degrees to obtain t.
An interpolation is made for L, D and h by using variations $\frac{dt}{dL}$, $\frac{dt}{dD}$ and $\frac{dt}{dh}$. These are the first tables giving these variations in column form, with two places of decimals for a change of 1' in declination, latitude and altitude.
Table IV is entered for azimuth, with L° and the variation of t for 1' of latitude.

1914 — **Bertin** — expose dans la "Revue Maritime", **Paris**, un projet de Table sphérique du point. (Voir: 1918 et 1919).

1915 — **Raja Gabaglia** — Tables Trigonométriques.

1915 — **Joseph Bate** — Zur Gesichte der Meridionalteile.
(Annalen der Hydrog. u. Mar. Meteor., Berlin 1915, p. 425).

1915 — **U.S. Hydrographic Office** — Publication **H.O. N° 171** — Line of Position Tables, for working sight of heavenly bodies for line of position by the cosine-haversine formula, Marcq St. Hilaire method. — Washington.
This table supplies the log sin and cos, as well as the natural haversine and logarithmic haversine of the arcs for the application of the formula hav $\theta$ = cos L cos D havt and of the formula hav (90 — h) = hav (L ~ D) + hav $\theta$.
(See 1913 — H.O. Publication N° 200).

1915 — **Luis A. Imperiale** — Curso de Astronomia Nautica; texto de la Escuela Naval. — Buenos-Aires.

1916 — **F. Marguet** — Cours d'Astronomie de l'Ecole Navale. — A. Challamel, Paris.

1916 — **Seychal** — Guide de Navigation. — A. Challamel, Paris.

1916 — **A. Wedemeyer** — Die Tafeln der Meridionalteile.
(Annalen der Hydrog. u. Mar. Meteor., Berlin, feb. 1916).

1916 — **S.F. Card**, naval instructor — Navigation Notes and Examples, Royal Naval College, Greenwich. — Edw. Arnold, London.

**(Az.)** 1916 — Davis High Latitude Azimuths 61° to 78° (for Sun and Planets, calculated in 1901 for the Scott Antarctic Expedition). — J.D. Potter, London.

1916 — **Blackburne & Westland** — Ex-Meridian and Azimuth inspection Tables. — 4th edition — for Lat. & Decl. ± 0° to 90°.
previous editions 1908, 1911.
— Tables of calculated Hour Angles and Altitude Azimuth — Wellington, New-Zealand.

1916 — **Reichs-Marine Amt.** — Höhen und Azimute der Gestirne, deren Abweichung zwischen 30° S. und 30° N. liegt, für 45° Breite. — Berlin.
für 45° Breite (1915)
für 50° Breite (1916)
für 70° Breite (1917)
für 35° Breite (1918)
für 25° Breite (1920) etc. 10 vols.
& Stereographischen Kartennetz, für die zone zwischen 30° und 44° Breite.

1916 — **Reichs-Marine Amt.** — Höhen und Azimute der hellen Fixsterne bis zur 3. Grösse, deren Abweichung grössen als 30° N. ist, für 45° Breite, und für 55° Breite. — Berlin.
für 35° Breite (1918)
für 25° Breite (1920)

1917 — **Reichs-Marine Amt.** — Lehrbuch für den Unterricht in der Navigation an der Kaiserl. Marineschule. — Berlin.

1917 — **W. Immler** — Die linien gleicher Azimutdifferenz und das Pothenotsche Problem auf der Kugel.
— Die Azimutgleiche als Standlinie. — (cf. Annalen der Hydrogr. u. Mar. Meteor. — 1917).

1917-1919 — **Reichs-Marine Amt.** — Nautische Tafeln 4 u. 5. Aufl. — Kiel.

1917 — **Jacoby** — Tables Trigonométriques.

1917 — **Capt. H.C. Grant** — Pocket book of Practical Navigation — Gieves Cy, Portsmouth, John Hogg, London.

1917 — **Bigourdan** — L'Astronomie. — Paris.

1917 — **A. Cousin** — Résumé pratique de Navigation, Long Cours, Plaisance, Cabotage. — 2me édition. — Paris.

1917 — F. Marguet — Histoire de la Longitude à la Mer, au XVIIIme siècle, en France. — Paris.

**(Q)** 1917 — **U.S. Hydrographic Office** — Altitude - Azimuth - Hour Angle. — Publication **N° 2776.** — Washington, June 1917.

The value of L ~ D on the left hand scale of this rectangular diagram and that of L + D on the right hand scale are both marked. These two marks are joined by a straight line whose intersection with the vertical corresponding to the horary angle t furnishes the value of the zenith distance z — hence h = 90° — z.

In order to obtain azimuth Z, the same construction is made with L — h and L + h whose intersection with the horizontal of the polar distance 90 ~ D read off the left hand scale is then taken. The ordinate of this intersection furnishes the values of Z in abscisse.

1917 — **Anfindsen's** Altitude Correction Tables and Ex-Meridian Tables, Lat. & Decl. 0° to 60° — The Rudder publishing Cy., New-York.

1917 — **Fr. Gagelmann** und **Fr. Lieck** — Navigation und Kompasskunde (Die Fliegerschule, Bd. 4.) — Berlin.

1918 — **W.C.P. Muir** — A treatise on Navigation and Nautical Astronomy including the theory of compass deviations, prepared for use as a text-book at the U.S. Naval Academy.
4th edition — Annapolis, Md. (previous edition 1911).

**(Alt.)** 1918 — **U.S. Hydrographic Office** — Publication **H.O. 200.**
4th reprint — Washington.
(Voir édition antérieure en 1913).

**(Long.) - (Az.) - (G)** - 1918 — **Rust** — Practical Tables for Navigators and Aviators. — Rust Azimuth Diagram.
(modified in 1927 Weems).

24 × 15 cm. size. Table A: 1 page, Table B: 35 pages, lbTae C: 1 page; total: 37 pages.

formula for t :

$$\log \text{hav } t = \log \sec L + \log \sec D + \log \frac{1}{2}\left[\cos (L + D) - \sin h\right]$$

Enter Table A in terms of longitude and declination.
Enter Table B in terms of L ~ D and h'
Table C furnishes t as a function of the sum total of the above values.
In order to determine the azimuth, Rust's diagram based on the formula sin Z = sin t cos D sec h is employed; the diagram furnishes Z as a function of t according to the declination and altitudes curves.

1918 — **F. Marguet** — Une histoire de la Navigation. — Paris.

**(Z)** 1918 — **Bertin** — Table de point sphérique. Pour calculer à la mer vite et sans erreur, essai d'une navigation sans logarithmes. — Oberthur, Rennes.
(voir aussi: Revue Maritime, Paris, Juillet 1913 et Janvier 1914).
cf.: 1919 — Tablette de point sphérique.

1918 — **E.** & **M. de Catalano** — Table zonique à l'usage des navigateurs. Bordeaux 1918 et Paris 1926.

**(Δ)** 1918 — **Percy L.H. Davis,** chief assistant in H.M. Nautical Almanach Office. — Alt.-Azimuth Tables. Lat. 30° to 64° - Decl. 0° to 24° — H.M. Stationery Office — to replace Burdwood's Azimuth Tables. — 2 vols.
(editions in 1921 & 1922) (voir détails en 1921).

**(M)** 1918 — **Dr. A. Obrecht** — Nuevas Tablas Nauticas. — Observatoire Santiago de Chile.
(méthode Souillagouet, 1891).

1918 — **Reichs-Marine Amt.** — Nautische Tafeln für den täglichen Gebrauch auf See. — zusammengestelet von O. Fulst. — Berlin.

1918 — **Reichs-Marine Amt.** — Lehrbuch für den Unterricht in der Navigation an den Deckoffizierschulen der Kaiserl. Marine — 2 Aufl. — Berlin.

1918 — **Reichs-Marine Amt.** — Höhen und Azimut der Gestirnes. — Berlin. (10 vols.). (cf.: 1913, 1916).

1918-1920 — **U.S. Hydrographic Office** — Publication **H.O. 202** — Noon interval Tables. — 1st edition. — Washington.

**(Δ)** 1919 — **U.S. Hydrographic Office** — Publication **H.O. 201** — Simultaneous Altitude and Azimuth of Celestial Bodies. — Washington.
26 × 18 cm. tables — 605 pages.
Declination of 0° to 24° — Latitude of ± 0° to 60°.
These tables furnish hc and Z jointly in terms of L°, D° and t with intervals of 10 minutes.
hc and Z are interpolated for declination, etc.

1918 — **W. Immler** — Flugzeugkompasswesen und Flugsteuerkunde. — Berlin-Charlottenburg.

1918 — **Th. E. Sönnichsen** — Navigation und Seemannschaft im Seeflugzeug. Ein Handbuch für Marineflieger. — Berlin.

1918 — **H. Rauschelbach** — Divisionstafel, enthaltend drei-order vierziffrige Quotienten aller ein-bis dreiziffrigen Dividenden und aller zweiziffrigen Divisonen. — Göttingen.

**(L)** 1919 — **C. Bremiker** — Logarithmische-trigonometrische Tafeln mit fünf Dezimalstellen. (Hunderstel Grade) 14 Aufl. — Berlin.

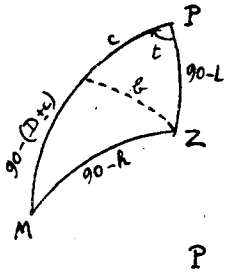
1919 — **A.L. Crelle** — Rechentafeln, welche alles Multiplizieren und Dividieren mit Zahlen unter 1000 ganz ersparn usw. — Berlin, Leipzig. (cf. 1820, 1864).

1919 — **J. Möller** — Nautik. 2 Aufl. — Leipzig.

1919 — **Luigi Tonta** — Elementi di Navigazione astronomica. Testo per la R. Accademia Navale; con 186 figure. — 1 vol. — Livorno.
(2ª edizione 1922).

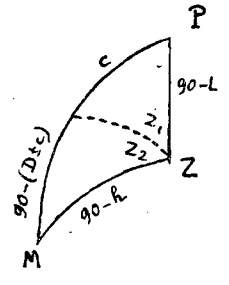
**(Z)** 1919 — **Bertin,** professeur d'hydrographie — Tablette de Point Sphérique, sans logarithmes. — Gauthier-Villars et C^ie^, Paris.
(édition en 1929).

28 × 19 cm. tables: 324 pages.




formulae for h

$$\tan c = \cot L \cos t$$
$$\sin b = \cos L \sin t$$
$$\sin h = \cos b \sin (c + D)$$




formulae for Z

$$\sin Z_1 = \sin c \sec L$$
$$\cot g\ Z_2 = \sin b \tan (c + D)$$
$$Z = Z_1 + Z_2$$

A longitude and a latitude approximated to 20° are.

Assumed enter the table in terms of t end L then assumed so as to deduce c, b and Z.

With (c ~ D) approximated to 10' and b rounded off to an integral degree, enter the table to obtain h and Z2 by interpolation for the exact value of c ~ D and for b.

**(L)** 1919 — **Le Mée** — Tables de Logarithmes à 4 décimales.

**(G)** 1919 — **Le Mée** — Nomogramme de la Hauteur.

**(L)** 1919 — **Teege** — Vierstellige logarithmische Tafel zur Berechnung der Höhe eines Gestirns. — Reichs-Marine Amt. — Berlin.

1919 — **J.P. Ault & J.H. Flemings** — Navigation of Aircraft by Astronomical Methods. Publication N° 175. Vol. V. — Carnegie Institution — Washington.

1919 — **Dr. W.A. Smart** — "Sine Method" in the Monthly Notices of the Royal Astronomical Society. Vol. LXXIX — May 1919.

1919 — **Baker & Filon** — Position fixing in Aircraft during long distance flights over the Sea.
Part II - Position by time-azimuth observations.
(Transactions Royal Aeronautical Society, London, March 1920).

1919 — **E. Modena** — Traciamento della Retta d'Azimut.
(Rivista Marittima, Roma, feb. 1919, pp. 169-173).

1920 — **J.W. Norie** — A complete set of Nautical Tables. — London.
(original publication in 1803).

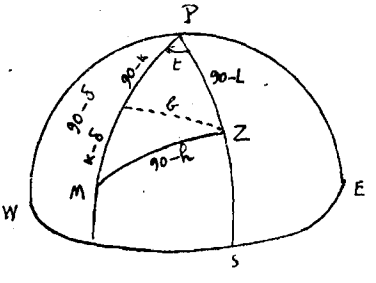
1920 — **Alberto Alessio** — The standard determination of the ship's position at sea by astronomical observations. — (Nautical Magazine - Glasgow - feb. 1920).

**(Az.)** 1920 — **F. Labrosse** — Table des Azimuts du Soleil, etc... Lat. 0° à 60°, Décli. 0° à 30°.
Edition nouvelle Augustin Challamel, Paris (1re édition en 1868).

**(Z)** 1920 — **Sinkiti Ogura**, hydrographic engineer — "Sin Kôdo Hôikaku Hyô" "New Altitude and Azimuth Tables", between Lat. 65° N. and 65° S. for determination of the Position line at Sea. — Hydrographic Department, Tôkyo.
including Yonemura's-Tables for calculating Altitude and Azimuth of Celestial Bodies.

English edition — Hydrographic Department, Tokyo, 1924.
(cf. A. Alessio — Rivista Marittima — Roma, Aug. Sept. 1921).
une application de la méthode de Souillagouet (1891).

25 × 16 size. Table A: 18 pages, Table B + C: 9 pages, Table D: 8 pages, Table E: 8 pages, Table F: 13 pages; Total = 56 pages.
The altitude is furnished by two tables A and BC for the latitude comprised between 0° and 65° and the angles at the pole between 0° and 180°.
The azimuth is determined by 3 tables D, E, F (similar to Perrin's) for latitudes and declinations comprised between 0° and 65° and angles at the pole from 0° to 180°.




formulae :

$$\text{tg } K = \text{tg } L \sec t$$
$$\sec b = \sec L \sec t \cos K$$
$$\text{cosec } h = \sec b \sec (\delta - K)$$
$$\text{cotg } Z = (-\text{tg } L \text{ cotg } t + \text{tg } \delta \text{ cosec } t) \cos L$$

Assume Longitude, so that t is to nearest degree. Assume latitude to nearest degree.

With $t_A$ and $L_A$ enter Table A for K and A.
Combine $\delta$ — K to deduce B from table B.
Table C furnishes hc for A and B.
Table D furnishes D for t; table E likewise.
With D + E enter Table F for Z.

Table A
(K) $\text{tg } K = \text{tg } L \sec t$
(A) $10^5 \log \sec b = (10^5 \log \sec L) + (10^5 \log \sec t) + (10^5 \log \cos K)$
A

Tab. B C. $\begin{cases} (h)\ \underbrace{10^5 \log \operatorname{cosec} h}_{C} = \underbrace{10^5 \log \sec b}_{A} + \underbrace{10^5 \log \sec (\delta - K)}_{B} \end{cases}$

Tab. Azm $\begin{cases} (Z)\ \operatorname{cotg} Z = \Big[\underbrace{(-\operatorname{tg} L \operatorname{cotg} t)}_{D} + \underbrace{(\operatorname{tg} \delta \operatorname{cosec} t)}_{E}\Big] \cos L \\ \operatorname{cotg} Z = \underbrace{(D + E) \cos L}_{F} \end{cases}$

**(Alt.)** 1920 — **Yonemura** — Tables for calculating Altitudes and Azimuths of Celestial Bodies. — Nippon Yusen Kaisha, Tôkyo.
(English edition in 1924) (Souillagouet's method 1891).

Tables containing 39 pages, size: 25 × 16 cm.

Lays down $\operatorname{hav} \theta = \cos L \cos D \operatorname{hav} t$
$= \operatorname{hav} (90 - h) - \operatorname{hav} (L \sim D)$

formulae :

$\log 1 \operatorname{hav} \theta - (\log \sec L + \log \sec D) = \log 1 \operatorname{hav} t$, for t and
$\log \operatorname{cosec} Z = \log \operatorname{cosec} t + \log \sec D - \log \sec h$, for Z.

Enter table with t, D and L for A1, A2, A3 and Z1 and Z2.
Combine A4 = A1 + A2 + A3, substract A5.
With L ~ D enter table for A6 — Combine A7 = A5 + A6.
The table gives hc and Z3 for A7.
Combine on the one hand hc — ho for intercept; and on the other hand the difference (Z1 + Z2) — Z3 from which the table gives result for Z.

**(Q)** 1920 — Ing. hydr. **L. Favé** — Planisphère pour la détermination des Routes orthodromiques.
Publications N°s 5603 et 5603 bis, 2 A, 2 B, 2 C et graphique 2 Bis du Service Hydrographique de la Marine, Paris, 1920.
(cf.: Annales Hydrographiques, Paris, 1892).

**(I)** 1920 — **Pino** — Sferoscopio.

1920 — **U.S. Hydrographic Office** — Publication **H.O. N° 202** — Noon-Interval Tables. (1st edition). — Washington.

**(T)** 1920 — **Henry Raper** — The practice of Navigation and Nautical Astronomy, with Nautical and Traverse Tables — 21st edition. — J.D. Potter, London. (cf.: 1840, 1866, 1874, 1890).
Appendix by William Hall, chaplain and Naval Instructor. (cf.: 1904, 1906, 1913).

**(Az.)** 1921 — **Seaton Schroeder, H. Southerland, G.W. Littlehales** — Azimuths of the Sun, for latitudes extending to 70° from the Equator. — Publication **N° H.O. 71** — U.S. Hydrographic Office — 10th edition enlarged) — Washington.

Δ 1921 — **Percy L.H. Davis** — Altitude Azimuth Tables.
J.D. Potter, London. (cf. 1re edition in 1918).

*a)* — Latitude limits 0° to 30° — Declination limit 0° to 24°.
*b)* — Latitude limits 30° to 64° — Declination limit 23° to 64° published by Imray, Laurie, Norie & Wilson, Ltd. (1922).

25 × 16 cm. Tables — 248 pages.

formulae : $\begin{cases} \sin h = \sin L \sin D + \cos L \cos D \cos t \\ \operatorname{cosec} Z = \cos h \sec D \operatorname{cosec} t. \end{cases}$

Enter table with L° and D° and with t to 4 minutes.
Table gives juxtaposition of values of hc and Z, the latter to 1/10 degree.
Interpolation required for declination.

1921 — **Edw. J. Willis** — The Mathematics of Navigation. - Richmond (Va.)

(Long.) 1921 — **H.B. Goodwin** — The "Alpha, Beta, Gamma" Navigation Tables. — J.D. Potter, London.
(other edition 1926) (See details in 1926).

(Az.) 1921 — **H.B. Goodwin** — An Equatorial Azimuth-Table.

1921 — **Prof. G. Pes** — Retta d'altezza, la retta di posizione - Tavole Nautiche.
(2ª edizione).

1921 — **C.F. Alberto Alessio** — Tavole Goodwin (alpha, beta, gamma Navigation Tables) e Tavole Pes (la Retta di posizione - Teoria, applicazioni, tavole) 2e édition. (Rivista Marittima, Roma, juillet 1921).

1921 — **C.F. Alberto Alessio** — Nuove Tavole Nautiche di S. Ogura (Rivista Marittima, Roma, Aug.-Sept. 1921).

1921 — **Marguet** — Cours de Navigation et de Compas. — A. Challamel, Paris.

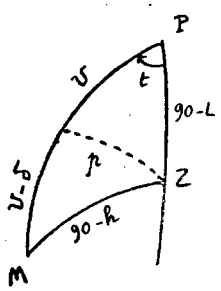
1922 — Admiralty Manual of Navigation. — 2 vols.
H.M. Stationery Office — London (previous edition 1914).

(Az.) 1922 — **Giacinto Albini** — Gli azimut del Sole. — Istituto Idrografico, Genova.
(1re édition en 1875).

1922 — **F. Marguet** — Tracé d'un relèvement radiogoniométrique, tracé du segment capable sphérique. (Radio-Electricité, Paris — Mars et Août 1922).

(I) 1922 — **Bygrave** — A Position line slide rule (The Engineer, London, 3 March 1922). (cf.: 1924).

(Z) 1922 — **Smart** and **Shearne** — Position Line Tables (Sine method).
J.D. Potter, London, 1924.
Tables de 34 pages, 24 × 15 cm.




formulae
$$\begin{cases} \text{tang } U = \cos t \cot g L \\ \sin p = \sin t \cos L \\ \sin h = \cos p \cos (U \sim \delta) \\ V = \log \cos p \\ \sin h = V \cos (U \sim \delta) \end{cases}$$

Assume Longitude, so that t is to nearest 4 minutes. Assume latitude to nearest degree. The table gives U and V for $t_A$ and $L_A$.
Combine $U \sim \delta$, then pass on to sin hc.

(L) 1922 — **V.A. - M.G. Giavotto** — Tavole Logaritmiche a 5 cifre decimali (3a edizione). — Istituto Idrografico della R. Marinia. — Genova.

1922 — **R. Karbiner** — Hilfstafeln zur terrestrichen Ortsbestimung. — Berlin.

(L) 1922 — **C. Bremiker** — Logaritmische-trigonometrische Tafeln mit fünf Dezimalstellen. — Berlin.

(L) 1922 — **H. Andoyer** — Tables logarithmiques à 13 décimales et nouvelles tables trigonométriques fondamentales (1915-1918). — J. Hermann, Paris.
(1re édition en 1911, à 14 décimales).

1923 — **F. Cedee** — Nautische Tafeln. — Helder.

**(Long.)** 1923-1924 — **G.W. Littlehales** — Publication H.O. **203** - **204** — The Sumner Line of Position, furnished ready to lay down upon the chart by means of Tables of Simultaneous Hour-Angle and Azimuth of Celestial Bodies. — (2 vols.).

Lat. 60° N. - 60° S. — Decl. 27° N. - 27° S. (H.O. 203, edition in 1930). H.O. 204 carrying the Declinations from 27° to 63° N. and 63° S. for Navigator's Stars.

U.S. Hydrographic Office, Washington. (H.O. 204, edition in 1933).

These very voluminous tables contain respectively 847 and 675 pages of 24 × 30 cm. size. They are an improvement on publication H.O. 201 "Simultaneous Altitudes and Azimuths of Celestial Bodies" (1919) giving "by inspection" (inspection tables) or by very simple interpolation, the result of the calculation of the altitude line.

In these two works, the horary angle t and azimuth Z corresponding to each true altitude expressed from degree to degree, are given for latitudes from degree to degree and for declination from degree to degree.

t was calculated by the general Longitude formula, as in Lynn's tables (1829).

Z by the general azimuth formula for altitude, as in Lynn's tables (1829).

These tables have been carried up to the value of 64° for Star declinations. Enter the table with assumed latitude, the declination and altitude to nearest degree. Note t and Z interpolate values of t and Z thus found for the variation of declination only.

**(I)** 1923 — **Rupert T. Gould,** member of the Horological Institute. — The Marine Chronometer. Its History and Development. — J.D. Potter, London.

**(Q)** 1924 — **K. Takeda** — Charts for calculations in Navigation.

(Suiro-Yoho [Hydrographic Bulletin] Vol. 3, 1924, pp. 493-499; Vol. 4, 1925, pp. 543-553. — Tokyo (in japanese) 6 plates).

Δ 1924 — **Romeo Braga** — Taboas de Alturas para Calculo do Recta Marcq de Saint-Hilaire.

Société d'Editions A. Challamel, Paris.

These tables are in conformity with the Austrian Professor Vital's scheme, expounded in the Pola Maritime Review in 1902.

27 × 18 cm. tables. Table I: 108 pages, Table II: 9 pages; total: 117 pages.

formulae

$$\text{hav } z = \text{hav } (L - D) + \text{hav } t \cos L \cos D$$

$$= \text{hav } (L - D) + \text{hav } t \, [1 - \text{hav } (L + D) - \text{hav } (L - D)]$$

$$= \underbrace{[\text{hav } t - \text{hav } (L + D) \text{ hav } t]}_{A} + \underbrace{[\text{hav } (L - D) - \text{hav } (L - D) \text{ hav } t]}_{B}$$

$$\text{hav } (90 - z) = A + B$$

Assume Latitude so that (L + D) is to nearest degree.
Assume longitude so that t is to nearest degree.
With (L + D) and t thus assumed enter Table I for A.
With (L — D) and t assumed find on the same page B and Δ B.
Add A and B and correct for minutes of (L — D).
Enter Table II with A + B and find hc.
These tables do not include azimuth tables.

**(M)** 1924 — **Radler de Aquino** — The "Newest" Sea and Air Altitude and Azimuth Tables for facilitating the determination of Lines of Position at Sea and in the Air.
(3rd edition) — New-York & J.D. Potter, London.

(Voir aussi ci-dessous 1924, cf. aussi 1927, 1938).

1924 — **Arthur Breusing's** Steuermannskunst (Dr. H. Meldau) 10e édition. — Berlin.

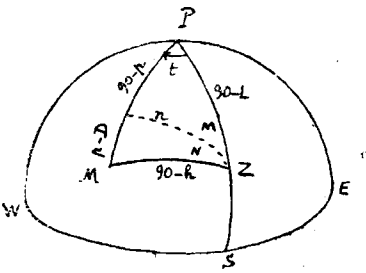
(1re édition 1852).

1924 — **P. Andersen** — Die Geschichte der Monddistanzen mit bezonderer Berücksichtigung ihrer theoretischen und praktischen Grundlagen. — Hamburg.

1924 — **Smart** & **Shearne** — Position Line Tables (Sine Method). — J.D. Potter, London.

**(Z)** 1924 — **J.A. Newton** & **J.C. Pinto** — Navegaçâo Moderna, Tabuas esfericas do Ponto, Impressa da Silva, Lisboa

in accordance with the ideas expounded by Commander Newton in 1912-1913.
cf. spanish version by Dagnino and Menacho 1927.
These 26 × 18 cm. tables, containing 122 pages, determine simultaneously the altitude and azimuth by means of two tables.
The first gives Z and the tabulated altitude for arguments from 30' to 30'.
The second gives the correction to be made to the tabulated altitude to find the dead reckoning altitude.




Spheric Triangle Table.

formulae for h:
$$\sin n = \cos L \sin t$$
$$\operatorname{cotg} p = \operatorname{cotg} L \cos t$$
$$b = p - D$$
$$\sin h = \cos n \cos b$$

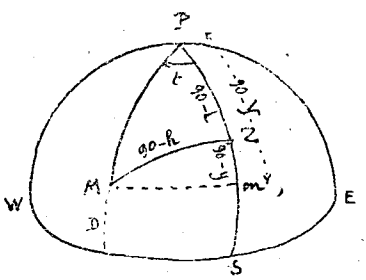
formulae for Z:
$$\operatorname{cotg} M = \sin L \operatorname{tang} t$$
$$\operatorname{cotg} N = \sin n \operatorname{cotang} b$$
$$\operatorname{cotg} B = \operatorname{cotg} n \sin b$$
$$Z = M + N$$

Correction Table:
$$h_c = h_{tab.} + (\Delta_a)_n + (\Delta_a)_b$$
$$(\Delta_a)_n = -(n - n_{tab.}) \cos N$$
$$(\Delta_a)_b = -(b - b_{tab.}) \cos B$$

Assume Longitude so that t is to nearest 30' and Latitude to nearest half degree
With $t_A$ and $L_A$, (assumed values) enter Table for p, n and M.
With n and b to nearest 30' enter table for a, B and N.
Enter declination Table with b and B for first correction; then with n and N for second correction.
Combine hc — ho for intercept, M + N gives azimuth.

**(I)** 1924 — **Bygrave** — Slide rule for navigation. — London (A.M.L. Slide Rule).

This cylindrical slide rule permits the determination of the azimuth and observed altitude.




formulae :
$$\operatorname{tg} y = \frac{\operatorname{tg} D}{\cos t}$$
$$\operatorname{tg} Z = \frac{\operatorname{tg} t \cos y}{\cos Y}$$
$$\operatorname{tg} h = \cos Z \operatorname{tg} Y$$

Azimuth Z and altitude h are determined by three settings of the rule arising from the application of the proportion $\frac{\operatorname{tg} p}{\operatorname{tg} q} = \frac{\cos m}{\cos n}$ that is :

$$\log \tan p - \log \tan q = \log \cos m - \log \cos n.$$

the fixed scale being graduated with log cos and the sliding scale with log tan.
The expansion of the scale would correspond to 3 meters 50.
(See detailed explanation in Hydrographic Review, Vol. XII, N° 2, Monaco 1935, page 122).

1924 — **H. Andoyer** — Cours d'Astronomie de la Faculté des Sciences de Paris. — 2 vols. — J. Hermann, Paris.

1924 — **H. Hughes & Son.** — The Husun Star Globe 1920, London.

1924 — **Cavic** — Tavole Nautiche — Cattaro.

**(M)** 1924 — **Radler de Aquino** — The "Newest" Navigation and Aviation Altitude and Azimuth Tables for facilitating the determination of Lines of position and geographical position at sea and in the air. — The simplest and readiest in solution — Plane and Spherical traverse Tables for solving all problems of Navigation (3rd edition) J.D. Potter, London (1st edition, 1909).

**(Z)** 1924 — **U.S. Hydrographic Office** — Publication **H.O. N° 66** — Arctic Azimuth Tables for parallels of Latitude between 70° and 88°. — Washington.

1925 — **Albrecht** und **Vierow** — Lehrbuch der Navigation und ihrer mathematischen Hilfwissenschaften — 11. Aufl. — Berlin.

**(R)** 1925 — **A. Wedemeyer** — Tafeln zür Funkortung. — München und Berlin.

1925 — **S. Luensee** — Praktische Winke zur Ortsbestimmung auf See durch astronomische Beobachtungen. — Hamburg.

1925 — **Edw. G. Willis** — The Methods of Modern Navigation. D. van Nostrand — Richmond (U.S.A.). — edition in 1935.

**(R)** 1925 — **Prof W. Immler** — Azimutafeln für Funkortung. — Hamburg. — Die Azimutgleiche langstrahliger Wellen und ihre Konstruktion in der Merkatorkarte (Annalen der Hydrog. 1925).

1925 — **J.F. Ruthven** — Great Circle Sailing Lat. by Alt. and Hour Angle. — J.D. Potter, London.

**(T)** 1925 — **Bowditch** — American practical navigator — An epitome of navigation and nautical astronomy. Publication N° 9. U.S. Hydrographic Office, Washington.

1926 — **E. Modena** — Osservazioni di astri in uno stesso verticale per determinare la posizione dell'osservatore. (Rivista Marittima, Roma, Mai 1926, p. 1-14).

**(M)** 1926 — **E.** et **M. de Catalano** — Table Zonique, tables nautiques à l'usage des navigateurs. — Paris.

**(Long.)** 1926 — **H.B. Goodwin** — The Alpha, Beta, Gamma Navigation Tables. — J.D. Potter, London.

(édition en 1921).

Size of tables: 24 × 15 cm.

Table I ($\alpha$ and $\beta$): 18 pages; Table II ($\gamma$): 16 pages. Total: 34 pages.

formula : $\text{versine } t = (\cos (L - D) - \cos z) \sec L \sec D.$

Enter Table I ($\alpha$) with L — D and $z = 90 - h$.

With the difference of these values in Tab. I ($\alpha$) find corresponding value in Tab. I ($\beta$).

Add log lat and log dec found in Tab. I ($\beta$).

With this sum enter Tab. II ($\gamma$) for t.

**(R)** 1926 — **Prof. W. Immler** — Azimuttafeln zur Bestimmung der Azimutgleichen für Funkortung. — Eckard & Meestorf — Hamburg.

1926 — **Leib** und **Nitzche** — Funkpeilungen, Berlin.

1926 — **Böhm von Böhmerscheim** — Zum Begriff und zum Verlauf der Loxodrome. — Wien.

1927 — **A. Fontoura da Costa** — Navegaçâo radiogoniometrica — Curvas e rectas do azimute. — Lisboa.

1927 — **A. Fontoura da Costa** — Traçado das curvas de altura. — Lisboa.

1927 — **H. Roeder** — Flugzeug-Navigation und Luftverkehr. — Dresden.

1927 — **W. Immler** — Messkarten

1927 — **Radler de Aquino** — Aquino's "Newest" Sea and Air Navigation Tables, for solving all problems by inspection. — U.S. Naval Institute. — Annapolis. — J.D. Potter, London (edition 1938) — Modern Methods in Sea and Air Navigation (U.S. Naval Institute Proceeding. - Jan. 1927).

1927 — **J.M. Luteroti** — Terrestricka Navigacija. — Dubrovnik.

(G) 1927 — **E. Hamanke** — Nomogramme für die Höhenmethode. (Annalen der Hydrogr. u. Mar. Meteor. — Heft IX, 1927, p. 293).

1927 — **Giuseppe Simeon** — A proposito d'idee sull'impiego delle curve di azimut. (Rivista Marittima, Roma, Dec. 1927).

1927 — **Edw. G. Willis** — The Line of Azimuth (an appendix to the Methods of Modern Navigation). — D. van Nostrand — New-York 1925. R. Massie Nolting, Richmond, V.A. (U.S.A.).

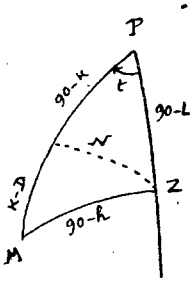
1927 — **Dagnino** e **Menacho** — Version espagnole des Tables de Newton and Pinto. 1924.

1927 — **Am. E. Burzagli** — Manuale dell'Ufficiale di Rotta. — Genova.

(G) 1927 — **P.V.H. Weems** — Rust's modified azimuth diagram & Line of position Book. — Annapolis.

(G) 1927 — **Cornet** — Graphique d'Azimut.

(Z) 1927 — **P.V.H. Weems** — Line of Position Book.
U.S. Naval Institute — Annapolis.
24 × 15 cm. volume; Table A: 18 pages; Table B: 9 pages; azimuth diagram: 4 pages. Total: 31 pages.
Method derived from Ogura's for altitude and from Rust's for Azimuth.




formulae :

$\text{cosec } N = \sec L \text{ cosec } t \qquad A = \log \sec N$

$\text{cotg } K = \text{cotg } L \cos t \qquad B = \log \sec (K \sim D)$

$\text{cosec } h = \sec N \sec (K \sim D)$

---

$\sin Z = \sin L \cos D \sec h$

Assume Longitude so that t is to nearest degree.
Assume Latitude to nearest degree.
With $t_A$ and $L_A$ enter table for A and K.
Table B gives B in terms of $(K \sim D)$.

With (A + B) enter body of Table B to find hc.
Z is found in diagram (similar to Rust's) for t, D, h.

1928 — **Admiralty** Manual of Navigation — 2 vols.
H.M. Navigation School, Portsmouth & R.N. Naval College, Greenwich.
H.M. Stationery Office, London.

1928 — Nauticke Tablice za uporabu u Kraljevskoj Mornarici — Beograd.

(Z) 1928 — **P.V.H. Weems** — Extended Tables for the Line of Position Book, Polar edition for Lat. 60° to 90°. — Rodney Stokes — San Diego, Calif.

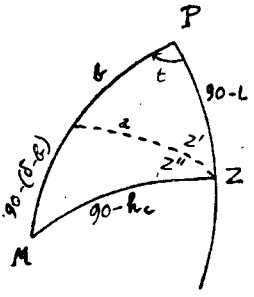
(G) 1928 — **P.V.H. Weems** — Star-Altitude Curves — Lat. 30° to 41° North. — Rodney Stokes Cy — San Diego, Calif.

(I) 1928 — **Le Sort** — La Machine à faire le point.
cf.: Rev. Hydrogr., Monaco.

(I) 1928 — **Rust** — Cylindrical Slide Rule.

(Z) 1928 — **J.Y. Dreisonstok,** Naval Examinator. — Navigation Tables for Mariners and Aviators for all Latitudes. — Publication H.O. **208** — U.S. Hydrographic Office. — Washington.
3rd edition 1931 — reprint 1936 — 5th edition 1935.

These tables (24 × 15 cm.) are good for latitudes between 0° and 65° and angles at the pole from 0° to 90°. They make use of Souillagouet's and Bertin's formulae for h though inverting them to obtain tables more accurate in sec and cosec. (Ogura's system slightly modified).




formulae sec a = sec L sec t sin b

for h cosec a = sec L cosec t  A = log sec a

tang b = cotg L cos t  B = log cosec (δ ~ b)

cotang b = tang a sec t

cosec h = sec a cosec (δ ~ b)

formulae for Z :  C = log cosec a

cotang Z' = sin L tang t  D = log cotg (δ ~ b)

tang Z'' = cosec a cotang (δ ~ b)  Z = Z' + Z''

Table I: 45 pages; Table I$_A$: 23 pages; Table II: 18 pages. — Total: 86 pages.
The altitude and azimuth are given simultaneously by both tables I and II.

Tab. I

cotg b = tg a sec t

$10^5 \log \sec a = 10^5 \log \sec L + 10^5 \log \sec t + 10^5 \log \sin b$ (A)

$10^3 \log \operatorname{cosec} a = 10^3 \log \sec L + 10^3 \log \operatorname{cosec} t$ (C)

cotg Z' = sin t tg t.

Tab. II

$10^5 \log \operatorname{cosec} h = 10^5 \log \sec a + 10^5 \log \operatorname{cosec} (\delta \sim b)$ (A + B)

$10^3 \log tg\ Z'' = 10^3 \log \operatorname{cosec} a + 10^3 \log \operatorname{cotg} (\delta \sim b)$ (C + D)

Z = Z' + Z''

Assume Longitude and Latitude to nearest degree.
With $t_A$ and $L_A$ enter Table I for b, A, C and Z'.
Enter Table II with (δ ~ b) to obtain B and D.
Table II gives hc in terms of (A + B) and Z'' in terms of (C + D).

1928 — **F. Bolte** — Nautische Tafelsammlung. — 3 Aufl. - Berlin. — 4 Aufl. - Hamburg.

(L) 1928 — **International Hydrographic Bureau** — Table of meridional parts to 5 places of decimals for the International Ellipsoid. — Special Publication N° 21, Monaco.

1928 — **Benjamin Dutton** — Navigation and Nautical Astronomy (2nd edition 1928). — U.S. Naval Academy, Annapolis.
(5th edition 1934) (6th edition 1936).

1928 — **Sinkiti Ogura** — A.B.C. Tables for short methods of astronomical observations (for fishing boats) (" Suiro Yoho ", Hydrographic Bulletin, Vol. 7, pp. 357-368 — Hydrographic Department, Tôkyo).

1928 — **H.E. Purey-Cust** — Sumner's Method — 2me édition — J.D. Potter, London.
(1st edition 1909-1914).

1929 — **Evangelis, G. Floka** — Enkeiridion Nautilias, 2 vols. — Athenai.

1929 — **Ecole Navale** — Recueil de Types de Calculs. — Paris.

(I) 1929 — **G.W. Littlehales,** hydrographic engineer — Mechanical means for finding geographical position in Navigation. (Journal of the American Society).

1929 — Tafeln zur Bestimmung der Breite und des Azimuts, wenn das Gestirn in der Nähe des Meridians Steht. — Hamburg.

1929 — Nautische Tafeln, 14 Aufl. — Bremen.

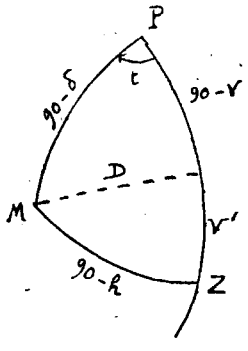
1929 — **J. Peters** — Sechsstellige Tafel der trigonometrischen Funktionen. — Berlin.

1929 — **W.E. Sommerville** — The St. Hilaire Method in Practice. Brown & Fergusson, Glasgow.

(G) 1929 — **Lieut. Alun Jones** — Diagrams for preparation of Star programmes for 45° Astrolabe. — Publication N° 5170, Hydrographic Department, London.

(I) 1929 — **G. Simeon** — Apparato mecanico per il calcolo dell'altezza e dell'azimut. — Notiziario Tecnico di Aeronautica.

(M) 1930 — **Pierce** — Publication H.O. **209** — Position Tables for Aerial and Surface Navigation an adaptation of Towson's Great Circle Sailing tables - for all Latitudes. — U.S. Hydrographic Office, Washington.
Table containing 206 pages. 24 × 16 cm. Table I: 146 pages; Table Ia: 24 pages; Table II: 36 pages.




formulae : $\sin D = \cos \delta \sin t$

$\cos V = \text{cotg } t \text{ tang } D \qquad v' = V \sim L$

$\sin h = \cos D \cos V'$

$\cos Z = \cos V' \sin D$

With dec to nearest tenth of a degree and approx. t, enter Table I for D, t' and V.
t + GHA gives assumed Long.

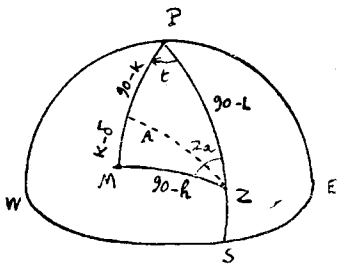
Assume Lat so that V' = V ∼ L will be to even degree.
With V' enter Table II for hc and Z.

1930 — **A. Fontoura da Costa** — O actual e o futuro Ponto no mar. — Lisboa.
Contains important historical data and a methodical analysis of most of the modern methods of finding position.

(G) 1930 — **Harms** — Graphish Rechentafeln für die Praxis der Navigation. (Annalen der Hydrogr. u. Mar. Meteor., Berlin, 1930).

1930-31 — **G. Simeone** — Lezioni di Navigazione. — GUF. Napoli.

(Z) 1931 — **John E. Gingrich** — Aerial and Marine Navigation Tables. Mac Grau Hill — New-York & London.




27× 18 cm. Tables. Table A: 31 pages, Table B: 7 pages; Table Az: 13 pages. Total: 51 pages.

The altitude and azimuth are given by Tables A, B and Az for the latitude and declination between 0° and 65° and for angles at the pole between 0° and 180°.

Similar to Ogura's formulae and tables for altitude and Perrin's for azimuth.

formulae for h

$$\text{tang } K = \text{tang } L \sec t \qquad A = \log \sec A$$
$$\sec A = \text{cosec } L \sin K \qquad B = \log \sec (K \sim \delta)$$
$$\text{cosec } h = \sec A \sec (K \sim \delta)$$

formulae for Z

$$\text{cotg } Z = \cos L \,(\text{tang } \delta \text{ cosec } t - \text{tang } L \text{ cotg } t)$$
$$= \cos L \,(Y + X)$$

Tab. A

$$\text{tg } K = \text{tg } L \sec t$$

$$\underbrace{10^5 \log \sec A}_{A} = 10^5 \log \text{cosec } L + 10^5 \log \sin K$$

$$\text{cotg } Z_a = (\underbrace{-\text{tg } L \text{ cotg } t}_{X} + \underbrace{\text{tg } \delta \text{ cosec } t}_{Y}) \cos L$$

Tab. B

$$10^5 \log \text{cosec } h = \underbrace{10^5 \log \sec A}_{A} + \underbrace{10^5 \log \sec (K \sim \delta)}_{B}$$

Tab. Az

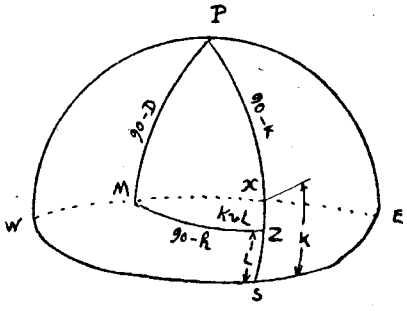
$$\text{cotg } Z_a = (X + Y) \cos L$$

Assume Long. so that t is to nearest integral degree and latitude to nearest integral degree.
Table A gives K, A and X in terms of $t_A$ and $L_A$.
It gives Y in terms of $t_A$ and declination.
Table B gives B in terms of $(K \sim \delta)$ and hc in terms of (A + B).
Table Az gives Z in terms of (X + Y) and L.

**(Alt.)** 1931 — **A. Ageton** — Publication H.O. **211** — Dead Reckoning Altitudes and Azimuths Tables first edition — en fonction des secantes et cosécantes — U.S. Hydrographic Office, Washington. — (autre édition 1934). (cf.: U.S. Naval Institute Proceedings — Vol. 57 — Annapolis — Oct. 1931, pp. 1375-1385).

24 × 15 cm. Tables: 36 pages.

Uses formulae similar to R. de Aquino's (Souillagouet 1891) for t but inverting them to get cosec. values. For Azimuth uses Sir William Thomson's formula also inverted in order to obtain cosec. value.




formulae :

(1) $\text{cosec } R = \sec D \text{ cosec } t$

(2) $\text{cosec } K = \dfrac{\text{cosec } D}{\sec R}$

(3) $\text{cosec } h_e = \sec R \sec (K \sim L)$

(4) $\text{cosec } Z = \dfrac{\text{cosec } R}{\sec h_e}$

Enter table with t = GHA + $\lambda$ to find $A_1$

The Table gives $B_1$ and $B_2$ in terms of declination.

Combine $A_1 + B_1 = A_3$, in terms of which the table gives $B_2$.

With $A_4 = A_2 + B_2$ find K in table.

Combine K $\sim$ L and find $B_3$ etc... and substract hc and Z.

1931 — **H. Meldau - O. Steppes** — Lehrbuch der Navigation. — Bremen.

1931 — **T.L. Gatch** — The Complete Navigator — The Secant and Cosecant Method. — U.S. Naval Institute Proceedings — Annapolis, Octob. 1931.

1931 — **F. Marguet** — Histoire générale de la Navigation du XV$^e$ au XX$^e$ siècle. — A. Challamel, Paris.

1931 — **L. Tonta** — Détermination précise du Point en mer. (Revue Hydrogr., Vol. VIII, N° 2, Monaco, Novemb. 1931).

**(Long.)** 1932 — **Soule** & **Dreisonstok** (manuscript tables) — Annapolis.

24 × 15 cm. manuscript tables using the general longitude formula but inverting it.

for t : $$\frac{1}{\text{hav t}} = \frac{\text{sec S cosec (S — h)}}{\text{sec L cosec p}}$$

for Z : $$\frac{1}{\text{hav (180° — Z)}} = \frac{\text{sec S sec (S — p)}}{\text{sec L sec h}}$$

Enter Table $I_{(a}$ with L, h, s and (s — p).

Mark in Table $I_{(b)}$ elements corresponding to p and (S — h).

Combine elements s + (s — h) — (L + p) and with this argument enter Table $I_{(c)}$ to get t.

Combine elements s + (S — p) — (h + L) and with this argument enter Table II to find Z.

1932 — **U.S. Naval Observatory** — The Air Almanac for the year 1933. — Washington.

(1$^{re}$ publication).

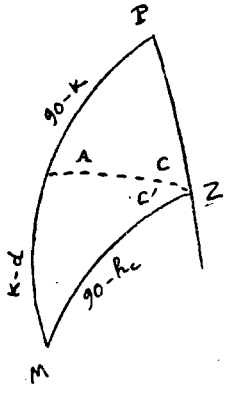
1932 — **A. Breusing** — Steuermannskunst (édition 1932) (cf. 1852 etc.).

**(I)** 1932 — **Robert T. Gunther** — The Astrolabes of the World. — 2 vols. — Oxford University Press.

1932 — **Fontoura da Costa** & **F. Penteado** — Instrucçoes para uso das principaes Tabuas de "Ponto Auxiliar" — Impresa de Armada. — Lisboa.

(Analyse des tables de Ogura, Dreisonstok, Gingrich, Aquino, Newton & Pinto, Littlehales H.O. 203-24).

**(Z)** 1932 — **Weems** — (manuscript tables) — Annapolis.




Tables containing 45 pages.

For altitude the formulae and arrangement are like Ogura's (1920) Table A being arranged with hour angles on one page.

For Azimuth Z is split into C + C'.

The table gives C in terms of t and L.

It gives C' in terms of hc and A.

Assume Long so that t is to nearest integral degree and Latitude to nearest degree.

Table A gives K, A and C in terms of $L°_A$ and $t°_A$.
Table A gives C' in t col., in terms of A and taking $h_o$ to the nearest degree in lat. col.
Table B gives B in terms of d ~ k.
Table B gives hc in terms of A + B.

1932 — **F. Marguet** — Cours de Navigation et de Compas de l'Ecole Navale (3me édition).

1933 — **Marineleitung** — Nachtrag zum Lehrbuch der Navigation. — Berlin.

1933 — **F. Conrad** — Astronomische Ortsbestimmung und Kimmtiefenmessung auf See, Wilhelmshaven Marine-Observatorium, Berlin.

1933 — **J. Carlos Pinto** — "Simplex" Taboas de Navigaçaon e Aviaçao — Faial (Açores).

1933 — **U.S. Naval Observatory** — The Air Almanac (1re publication, Washington).

1st publication in France in 1936, in Great Britain in 1937, in Germany in...

1933 — **G. Simeon** — Tavole di Navigazione aera. — R. Acc. Aeronautica. — Caserta.

1933 — **Tablice Nawigacyjne** — Instytut Wydawniczy Paustwowej Szkoly Morskiej — Gdynia (méthode de Dreisonstok).

1933 — New Astronomical Navigation Tables — Publication N° 228, Hydrographic Department, Tokyo.

1933 — **V.V. Akhmatov** — Morekhodnye Tablitzy — Administration d'Hydrographie — Leningrad.

170 pages — 17 × 26 cm. (2me édition en 1934).

(R) 1933 — **P. de Vanssay de Blavous** — The position at sea by radiogoniometric bearings taken on board (Hydrographic Review, Vol. X, N° 2, Monaco, November 1933). (cf.: 1935).

(Q) 1933 — Nomograms for use in navigation (16 Tableaux). Publication N° 227, Hydrographic Department, Tokyo.

1934 — **Deutsche Seewarte** — Aeronautische Hilfstafeln (Höhen - und Azimuttafel für die Luftfahrt) — Hamburg.

1934 — **H. Gadow** — Aeronautischen Tafeln zur Astronomischen Ortsbestimmung.

1934 — **Radler de Aquino** — "Universal Sea and Air and Radio Navigation Tables" — with and without logarithms and Versine — The simplest and readiest in solution — The safest and the most exact and the less expensive — 4 parts. — Annapolis, London & Rio de Janeiro.

1934 — **Giuseppe Severino** — Alcune considerazioni intorno al traciamento della retta d'azimut. (Rivista Marittima — Supplem. Jul.-Aug. 1934).

**1934** — **Soule & Collins** — Resume of Navigation Methods. (Supplem. to Pilot Chart of North Atlantic Ocean - 1 August 1934). U.S. Hydrographic Office, Washington.

1935 — **Radler de Aquino** — A Navegaçâo Hodierna com Logarithmos de 1633! — Impresa Naval, Rio de Janeiro (avec importante bibliographie).

1935 — **C.M. Meade** — Great Circle Diagram for use in Navigation, Aviation and Wireless Telegraphy — Publication N° H.D. 5029, Hydrographic Department, London.

1935 — **F. Marguet** — Le Point Azimutal (Revue Maritime, Paris. — Janvier 1935).

1935 — **F. Marguet** — Sur la courbe d'égal azimut et son emploi en navigation (C.R. Académie des Sciences, Paris, 1er Juillet 1935).

1035 — **Radler de Aquino** — A regua cylindrica de Bygrave e as minhas Altitude and Azimuth Tables, com una Exposição succinta da Nova Navegação Altazimuthal e Isoazimuthal pelas formulas e Tabuas em Tan ± Sec. (Revista Maritima Brasileira — Rio de Janeiro, Mars-Avril 1935).

1935 — **Deutsche Seewarte** — Aeronautische Tafel. — Hamburg.

1935 — **Domenico Spano** — Rette d'azimut e rette orthodromiche (Annalis del R. Istituto Superiore Navale, Vol. IV, fasc. II, Napoli 1935).

1935 — **W. Immler** — Loxodrome, orthodrome, stereodrome. (Annalen der Hydrog. u. Mar. Meteor., Heft VII — 15 Juillet 1935, pp. 275-281).

**(R)** 1935 — **P. de Vanssay de Bavous** — The position at sea by radiogoniometric bearings. (Hydrographic Review, Vol. XII, N° 2, Monaco, November 1935). (cf.: 1933).

**(Az.)** 1935 — **A. Yustchenko** — Azimuty Svetil — (Tables des Azimuts vrais en 9 volumes de 190 pages chacun) 17 × 26 cm. Administration d'Hydrographie. — Leningrad.

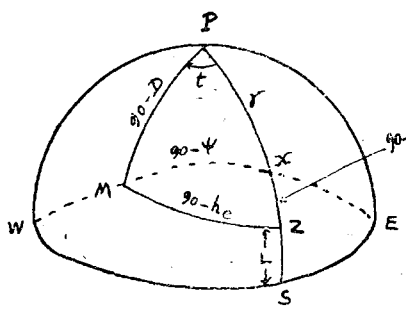
Compiled for 10° Latitude zones in terms of the declination given for each half degree and of the hour angle of the heavenly body given from minute to minute. Data supplied for the mean latitude of each zone, that is 5°, 15°, 25°... and 85°, an azimuth correcting factor corresponding to a variation of latitude of ± 1° allows the adjustment of the datum to any other latitude comprised in the zone.

1936 — **Istituto Idrografico R. Marina** — Publication N° 3099 — Tavole per la costruzione della Carta di Mercatore. — Genova.

**(M)** 1936 — **Fontoura da Costa** et **Penteado** — Tabuas de Altura e Azimute. — Lisboa

giving logarithms of secants and cosecants × 10⁵
(similar to Ageton's tables, with modification of the mode of splitting the spherical angle).
(cf.: Hydrographic Review, Vol. XIV, N° 1, Monaco, May 1937, page 147).

These 14 × 24 cm. tables, containing 26 pages, are especially suitable for aerial navigation. Being very concise and symmetrical they utilize the method of secants and cosecants (similar to Ageton's 1931) and do away with the use of voluminous logarithm tables.




formulae :

$$(1)\quad \sec \psi = \sec D \operatorname{cosec} t$$

$$(2)\quad \sec \gamma = \frac{\operatorname{cosec} D}{\operatorname{cosec} \psi}$$

$$(3)\quad \operatorname{cosec} h_e = \operatorname{cosec} \psi \operatorname{cosec} (L \sim \gamma)$$

$$(4)\quad \operatorname{cosec} Z = \frac{\sec \psi}{\sec h_e}$$

**(I)** 1936 — **Giuseppe Simeon** — "Polistaziografo Bresca" — (cf. Annali del R. Istituto Superiore Navale. — Napoli 1936, p. 271).

1936 — **Giuseppe Simeon** — Sulla retta radiogoniometrica considerata come retta d'azimut. (cf. Annali del R. Istituto Superiore Navale — Napoli 1936, p. 241).

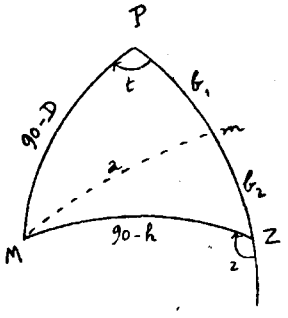
1936 — **Radler de Aquino** — Aquino's "Universal" Sea, Air, and Radio Navigation Tables.
Annapolis, London & Rio de Janeiro.

1936 — **Radler de Aquino** — O Ponto observado no Ar e no Mar com Taboas Nauticas ultra-simplificadas — Taboas de Azimuth. (Revista Maritima Brasileira, Rio de Janeiro, Sept.-Dec. 1935).

1936 — **Radler de Aquino** — A fix from Altitude and Azimuth at Sea and in the Air.
(U.S. Naval Institute Proceedings — Annapolis, Dec. 1936).

1936 — **Bureau des Longitudes** — Ephémérides Aéronautiques 1936 (1re année de publication). — Gauthier-Villars, Paris.

(M) 1936 — **E. Tillman** — Altitude Tables for Mariners and Aviators. — (Annales de l'Observatoire de Lund (Suède) 1936) — (Hydrographic Review, Vol. XIV, N° 2, Monaco, Nov. 1937, p. 273).




These tables are constructed in accordance with the system of splitting the astronomical triangle compiled by Sir William Thomson (1876).

They resolve the following group of formulae :—

(1) $\sin a = \cos D \sin t$

(2) $\sin a = \cos h \sin Z$

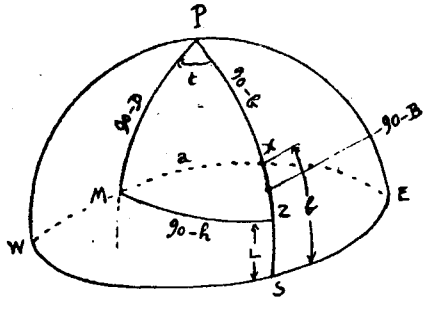
(3) $\cos b_1 = \sin D \sec a$

(4) $\cos b_2 = \sin h \sec a.$

(for further details: Hydrographic Review, Vol. XIV, N° 2, Monaco, November 1937).

1936 — **H. Dyèvre** — Le Point à l'Air. (Revue Maritime, Paris, Sept. 1936, p. 337-353).

(M) 1937 — **Radler de Aquino** — An all log Tangent ± log Secant Navigation Table.
U.S. Naval Institute Proceedings, Annapolis, May 1937. (edition en 1934 et 1935).
(cf.: Hydrographic Review, Vol. XIV, N° 2, Monaco, Nov. 1937, p. 272).




Tables containing 18 pages showing in a convenient form the log tangents and the log secants of the arcs:

formulae :

1) $\sin D = \cos a \sin b$
   $\sin h = \cos a \sin B$
2) $\sin a = \cos D \sin t$
   $\sin a = \cos h \sin Z$
3) $\operatorname{cotg} t = \operatorname{cotg} a \cos b$
   $\operatorname{cotg} Z = \operatorname{cotg} a \cos B$
4) $\operatorname{cotg} b = \operatorname{cotg} D \cos t$
   $\operatorname{cotg} B = \operatorname{cotg} h \cos Z$

$C = 90 - B = b \pm L$

by taking the inverses and passing to logarithms we obtain :

1) $\log \operatorname{cosec} a = \log \operatorname{cosec} t + \log \sec D$
2) $\log \operatorname{cosec} b = \log \operatorname{cosec} D - \log \sec a$
3) $\log \operatorname{cosec} h = \log \sec a + \log \sec C$
4) $\log \operatorname{cosec} Z = \log \operatorname{cosec} a - \log \sec h$
5) $\log \operatorname{tang} b = \log \operatorname{tang} D + \log \sec t$
6) $\log \operatorname{tang} a = \log \operatorname{tang} t - \log \sec b$
7) $\log \operatorname{tang} Z = \log \operatorname{tang} a + \log \sec B$
8) $\log \operatorname{tang} h = \log \operatorname{tang} B - \log \sec Z$

In this logarithmic form, the formulae show the sequence of operations to be made to pass on from the equatorial co-ordinates D and t to the auxiliary goniometric co-

ordinates, a, b and C; then, from the latter, to the horizontal co-ordinates h and Z, which it is desired to determine.
Enter table with declination and mark log tan D.
Enter table with t and mark log sec t and log tan t.
By adding the first two logarithms calculate b (Towson's augmented declination) whose log sec in also marked in the table.
From b pass on to C by formula C = b ± L, L being the assumed latitude.
The last two formulae in tan Z and tan h show the necessary operations to find the calculated altitude hc and the azimuth.
The use of tangents in these perfectly symmetrical tables gives better determination of arcs than if cosecants are used. Any logarithm table giving log tan and log sec may be used in the application of this method.

1937 — **Dr. Fritz Conrad** — Les derniers perfectionnements de la Navigation Moderne.
Der Seewart, Heft VIII, pp. 267-272 — Hamburg.

1937 — **Florian Laporte** — Du tracé des orthodromies sur les cartes de Mercator.
(Hydrographic Review, Vol. XIV, N° 1, Monaco, May 1937, pp. 21-31).

1937 — **Fontoura da Costa** — Astronomical fixes by Azimuth, Astronomical fixes by simultaneous altitude and azimuth of the sun, radiogoniometric fixes for distances nearer the station.
(Hydrographic Review, Vol. XIV, N° 2, Monaco, November 1937, pp. 29-52).

1937 — **H. Bencker** — New Nautical Tables (Analyses).
(Hydrographic Review, Vol. XIV, N° 1 & 2, Monaco, May, November 1937, pp. 147 and 272).

1937-1940 — **Richard H. Knight, Robert E. Japerson, John E. Gingrich, Elmer B. Collins.** — Tables of computed Altitude and Azimuth.

| | | | | | | |
|---|---|---|---|---|---|---|
| Vol. | I | Latitudes | 0° | to 9° | inclusive | (inspection tables) (tables à vue) |
| Vol. | II | — | 10° | — 19° | — | |
| Vol. | III | — | 20° | — 29° | — | |
| Vol. | IV | — | 30° | — 39° | — | |
| Vol. | V | — | 40° | — 49° | — | |
| Vol. | VI | — | 50° | — 59° | — | |
| Vol. | VII | — | 60° | — 69° | — | |
| Vol. | VIII | — | 70° | — 79° | — | |

Publication **H.O. 214** — U.S. Hydrographic Office, Washington.
(cf.: Hydrographic Review, Vol. XIV, N° 1, Monaco, May 1937, p. 149).

Each volume (24 × 30 cm.) contains about 265 pages.
The whole of the 6 volumes covers the range of latitude 0° and 79° N. and S., by zones of Latitude from 10° to 10°. — That is a total of 2120 pages.

These tables apply indifferently to any celestial body. They supply directly by inspection, (inspection tables) the fully calculated altitude and azimuth.

This work is an amplification of Publication H.O. 201 and H.O. 203-204 of the Hydrographic Office at Washington (1919 and 1923-24).

For each full degree of Latitude, the data are contained in a special chapter containing 24 pages, and two additional pages furnish convenient tables for star identification.

In each section the elements are furnished for the declination varying from 30' to 30'; the D.R. altitude is furnished to 1/10 of minute of arc and the azimuth to 1/10 of degree as functions of the hour angle, the letter being expressed in degrees and given for each degree. In the columns in addition to the computed altitude hc and the computed azimuth Zc, there are given two factors, one for the increase in the declination and the other for the increase in the hour angle, namely the change in altitude due to a change of one minute of arc in declination and the change in altitude due to a change of one minute of arc in the hour angle $\Delta d = \frac{dh}{d\Delta}$ et $\Delta t = \frac{dh}{dt}$

The interpolations are readily made by inspection by means of a table of proportional parts supplied at the end of each volume.

These tables also allow the solution of the great circle arc navigation between two given positions.

The tables are computed from the following formulae :—

$$\begin{cases} \sin h = (\sin L \sin D) + (\cos L \cos D) \cos t \\ \text{cotang } Z = \dfrac{1}{\sin t} (- \text{tg } D \cos L + \sin L \cos t) \end{cases}$$

1937 — ..... — British Air Almanac 1937 (1st year of publication).

1938 — **D. Razikotsikas** — Nautikoi Pinakis — Service Hydrographique — Athènes.

**(T)** 1938 — **U.S. Hydrographic Office** — Publication **H.O. N° 9.** — American Practical Navigator originally by Nathaniel Bowditch. — including the Usefull Tables. — Washington.
(original publication in 1773).

1938 — **U.S. Hydrographic Office** — Publication **H.O. N° 9 — II** — Usefull Tables from the American Practical Navigator. — Washington.

1938 — **L.J. Comrie** — Hughes' Tables for Sea and Air Navigation. Henry Hughes and Son, Ltd. — London.

1938 — **Radler de Aquino** — " Universal " Sea and Air Navigation Tables, for solving all problems by inspection, by logarithms or by a combination of both. The simplest and readiest in solution. The safest and the most exact.
U.S. Naval Institute, Annapolis — J.D. Potter, London.
(1st edition in 1927 — edition 1936).

1938 — **J.B. Grambow** — Die Genaukeit nautischer Tafeln und Ihre Eignung für Luftnavigatorische Zwecke — Deutsche Luftfahrtforschung F.B. N° 992.

1938-1939 — **J.B. Grambow** — Historical note on the latest improvements in modern navigation.
(Der Seewart, Hamburg).
(see: Hydrographic Review, Vol. XVII, N° 1, Monaco, May 1940, pp. 171-187).

1939 — **Radler de Aquino** — Isoazimuthal Lines of Position at Sea and in the Air. — uniform and universal solutions. — The genesis of a " Fix " from Altitude and Azimuth — The genesis of the " Isoal " and of the " Isoaz " — Longine's Sea and air chronometer of 1939. — Imprensa Naval, Rio de Janeiro.

1940 — **Alfredo Grillo** — Elementi di Navigazione Astronomica — Academia Navale, Livorno.

1941 — **U.S. Hydrographic Office** — Publication **H.O. N° 216** — Aircraft Navigational Manual. — Washington.

**(Q)** 1941 — **U.S. Hydrographic Office** — Time-Speed-Distance Nomograms. — Pilot Chart N° 1400, North Atlantic Ocean, Washington, Jan. 1941.

**(Q)** 1941 — **U.S. Hydrographic Office** — Radio bearing Conversion Diagram. Pilot Chart N° 3500, Central American Waters, Washington, November 1941.

1942 — **Capt. David Polowe** — Navigation for Mariners and Aviators — Cornell Maritime Press, New-York.
(méthodes Marcq St.-Hilaire et Dreisonstok).

# ALPHABETICAL INDEX OF AUTHORS OF VARIOUS TREATISES OR NAUTICAL TABLES.

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Sinkiti Ogura 1920, 1928.
Siria (Pedro de) 1602.
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