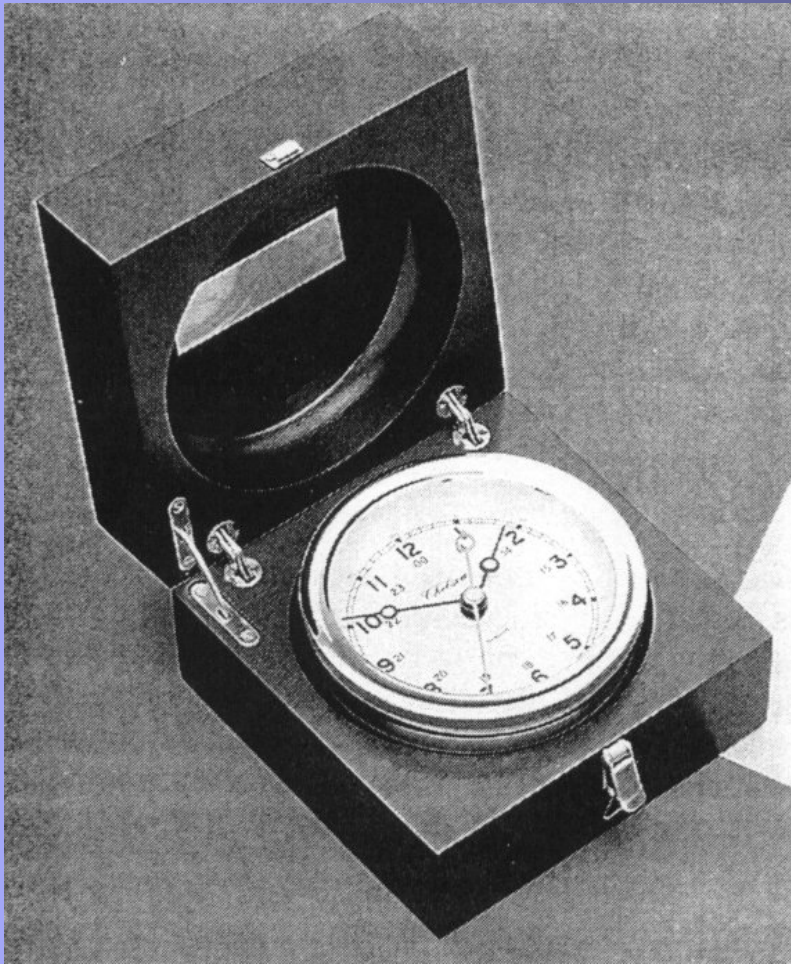


# Celestial Navigation TOOLS



# TOOLS of the 'TRADE'

- There are four Special Tools that the Celestial Navigator uses
- We will explore each of these Tools
  - What they are
  - How they work
  - How they are used

This will be an Overview

# What are the 4 Special TOOLS

- Sextant
- Watch or Timekeeping Device
- Nautical Almanac
- Workform

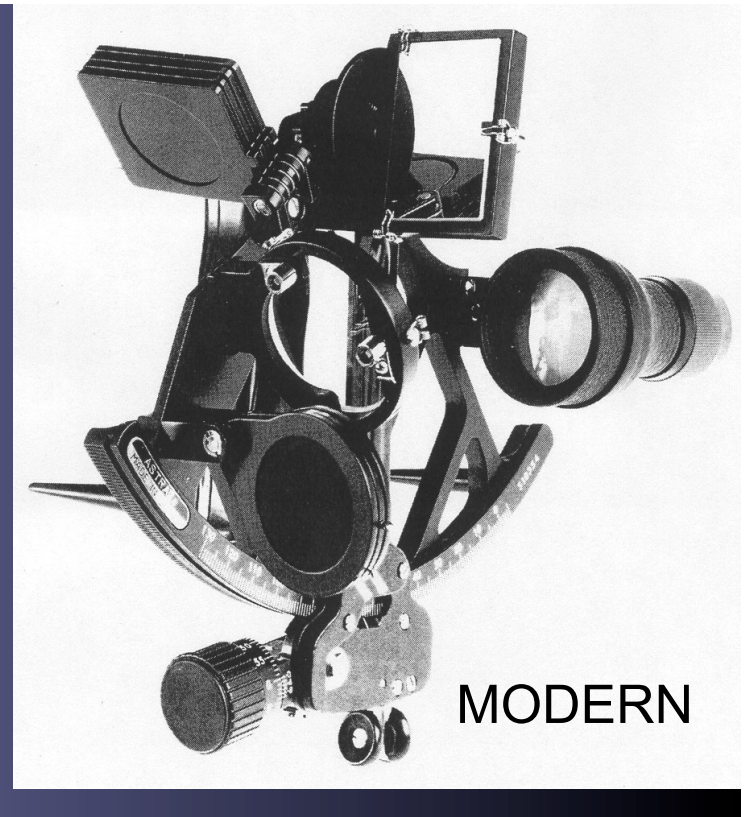
# Overview

- Each of the Tools described are **Essential to the Celestial Navigator**
- The first – the **SEXTANT** will be described in great detail in a later Lesson

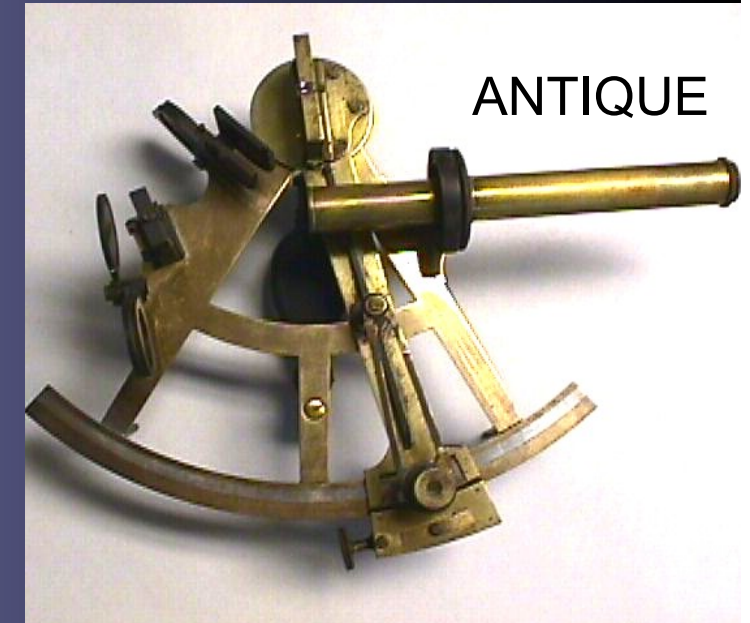


# SEXTANT

- Primary Measuring Instrument
- Measures Angles with great accuracy
- Precision Instrument
- Must be handled with CARE
- Arc Length  $\frac{1}{6}$  of a Circle, hence it's name.



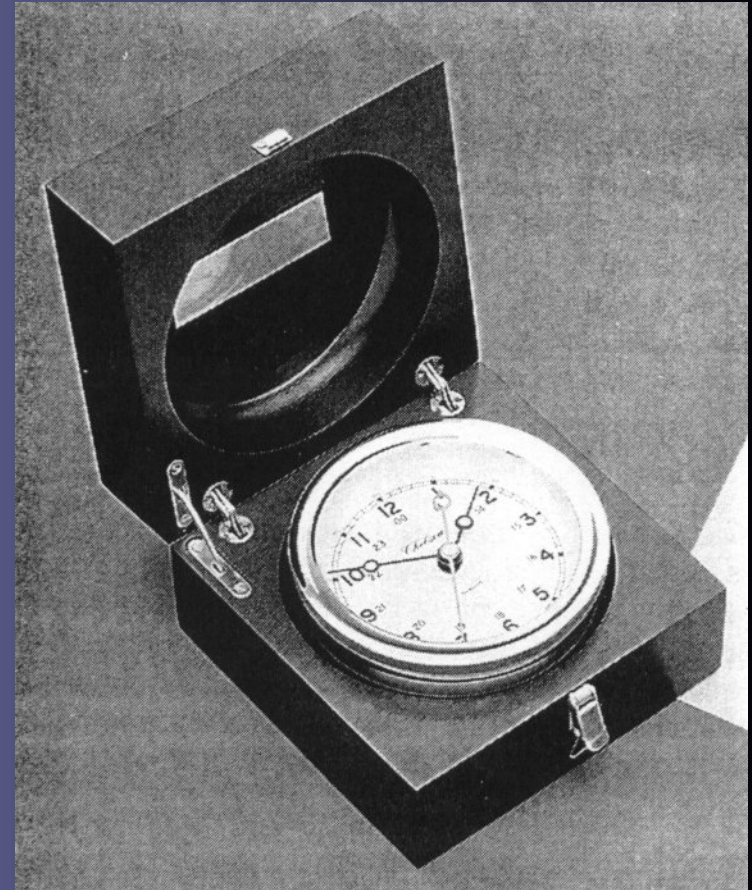
MODERN



ANTIQUE

# Watch or Timekeeping Device

- Precise Time is Essential
- Short-wave Radio – WWV or WWVH for Time Ticks
- Chronometers have a constant Error Rate
- Comparing Watches – Quartz Wrist Watch



Quartz Chronometer

# Nautical Almanac

- Essentially a Listing of the Geographic Position of ALL Heavenly Bodies for EVERY second of the Year.
- Published Yearly
  - Commercial Version  
Blue Cover
  - Government Version  
Orange Cover

2011

NAUTICAL ALMANAC  
2011 COMMERCIAL EDITION



# Workform 107

- NOON Sight
- Determines Latitude directly
- Special Type of Sight that does use the Nautical Almanac

| Step 1 Correct Hs to get Ho |  |                   |                  |
|-----------------------------|--|-------------------|------------------|
| 1-1                         | Record Maximum Sextant Height (Hs = peak height of the sun at noon), and mark limb   | Lower Hs<br>Upper | ° ' "            |
| 1-2                         | Record Index Correction (mark sign + if off, - if on)  | IC                | Off On + - ° ' " |
| 1-3                         | Record eye height (HE) and Look up Dip Correction on the right-hand side of Table A2, front of the Almanac (T-8 in notes)  | Dip               | - ° ' "          |
|                             |  | HE (ft)           | ° ' "            |
| 1-4                         | Sum the above three numbers to get Apparent Height   | Ha                | ° ' "            |
| 1-5                         | Look up altitude correction on lefthand side of Table A2, front of the Almanac (T-8 in notes) (correction depends on Ha, Limb, and month) (mark sign + for lower limb, - for upper limb) | Alt corr.         | + - ° ' "        |
| 1-6                         | Sum the above two numbers to get Observed Height   | Ho                | ° ' "            |

**Starpath Form 107**  
 for  
 Local Apparent Noon Sights

| Step 2 Determine the Zenith Distance |   | 89° | 60.0'   |
|--------------------------------------|---|-----|---------|
| 2-1                                  | Record Ho from Step 1, above, and then subtract it from 90° to get the zenith distance. | Ho  | - ° ' " |
| 2-2                                  | Zenith distance   | z   | ° ' "   |

| Step 3 Use the Almanac to Find Sun's Declination |   | GMT date =    |                    |
|--|---|---------------|--------------------|
| 3-1  | Record the date and GMT of the sight (the time the sun reached its peak height)   | GMT (hr) =    | GMT (min) =        |
| 3-2  | Turn to the daily page of the Almanac for the date of the sight, and find the sun's declination (dec) for the hour of the sight (line 3-1) and record it here.  | Dec (hr)      | N S ° ' "          |
| 3-3  | Record the d-value from the bottom of the dec column in the Almanac. Mark the signs of the d-value and d-corr + if the dec for the next hour is larger, or - if it is smaller.  | d-value = + - | d-corr = + - ° ' " |
| 3-4  | Turn to the Increments and Corrections pages at the back of the Almanac (T-9 to 12, in the notes) and find the minutes table for the GMT minutes (line 3-1). On the right-hand side of the double line in the table, find the d-corr corresponding to the d-value of line 3-3 | Declination = | N S ° ' "          |
| 3-5  | Apply the d-corr to the dec(hr) and record it above.  |               |                    |

| Step 4 Find Latitude from Zenith Distance and Declination   |       |
|---|-------|
| Record DR Latitude to use as a guide, and then take the sum or difference of zenith distance and declination to find your true Latitude at LAN. |       |
| Declination or Zenith distance  | ° ' " |
| Zenith distance or Declination  | ° ' " |
| Latitude =  | ° ' " |



# Workform 110

- Polaris Sight
- Determines Latitude directly
- Special Type of Sight that uses special tables in the Nautical Almanac

| Step 1 Correct Hs to get Ho   |   |                   |               |
|-------------------------------|---|-------------------|---------------|
| 1-1                           | Record Maximum Sextant Height   | Hs                | °             |
| 1-2                           | Record Index Correction<br>(mark sign + if off, - if on)  | IC                | Off +<br>On - |
| 1-3                           | Record eye height (HE) and look up Dip<br>Correction on the right-hand side of Table A2,<br>front of Almanac (T-8 in notes) | Dip               | -             |
|                               | HE (ft)   |                   |               |
| 1-4                           | Record Maximum Sextant Height   | Ha                | °             |
| 1-5                           | Look up the altitude correction in the center of<br>Table A2, front of the Almanac (T-8 in notes)                           | Alt corr.         | +<br>-        |
| 1-6                           | Sum the above two numbers to get<br>Observed Height   | Ho                | °             |
| Step 2 Find LHA Aries         |   | GMT date =        |               |
| 2-1                           | GMT Time in Hours, Minutes and Seconds  | GMT time =        |               |
| 2-2                           | Find GHA Aries on Left Hand Daily Page<br>of the Nautical Almanac (far left column)<br>for GMT Day and Hour                 | GHA Aries (Hr) =  |               |
| 2-3                           | Find GHA Aries minutes correction from<br>Increments and Corrections pages  | GHA Aries (Min) = |               |
| 2-4                           | GHA Aries - Sum the above two numbers   | GHA Aries =       |               |
| 2-5                           | DR Longitude (-W, +E)   | DR Long =         |               |
| 2-6                           | LHA Aries (Combine previous numbers)  | LHA Aries =       |               |
| Step 3 Latitude Determination |   |                   |               |
| 3-1                           | HO  | HO =              |               |
| 3-2                           | a0 from Polaris Table (using LHA Aries)   | a0 =              |               |
| 3-3                           | a1 from Polaris Table (using DR Latitude)   | a1 =              |               |
| 3-4                           | a2 from Polaris Table (using Month)   | a2 =              |               |
| 3-5                           | Subtract 1 Degree   | - 1 =             |               |
| 3-6                           | Sum the above five numbers to get LATITUDE  | LATITUDE =        |               |

Starpath Form 110  
for  
Polaris Sights

# Summary

- You have been introduced to the Tools of Celestial Navigation
- You will be using them during our hands on sessions