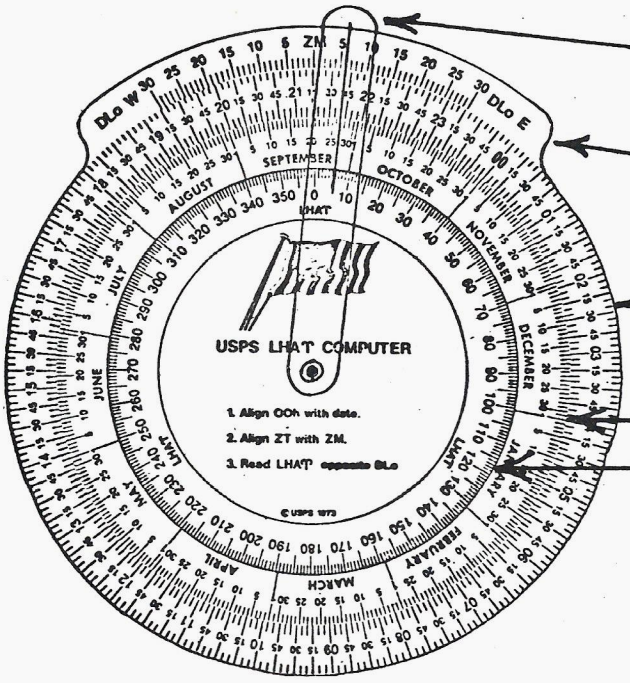
UNITED STATES POWER SQUADRONS
EDUCATIONAL DEPARTMENT

THE USPS LHA ARIES COMPUTER



Cursor

BASE DISC

Meridian Scale

MIDDLE DISC (Light Blue)

Hour or Time Scale

TOP DISC

Calendar or Date Scale

LHAϒ Scale

This illustration has been reduced in size. The middle disc is six inches in diameter.

PURPOSE

~~JN and N students and practicing navigators will find the Computer particu-~~larly useful to set the USPS Star Finder (HO 2102 D) as LHAϒ is much more easily and quickly found than by arithmetical computation. It is also useful for pre-set star sights in combination with Volume I of HO 249. The Computer is quite accurate enough for these applications as it has a maximum error of about ±1°. For those with interests in astronomy, an added step will give local sidereal time, LST, to comparable accuracy.

DESIGN

The Computer is an all-plastic circular slide rule with three concentric discs and a transparent cursor. It is waterproof and durable and can be stored in the same case with the Star Finder. Each disc adds a fraction of 360° of LHAϒ equivalent to a fraction of a year plus a fraction of a day plus (or minus) a fraction of 360° of longitude; the sum of these is LHAϒ.

HOW TO USE

If the time, date, and observer's longitude are known, the three steps required to find LHAϒ, briefly noted on the face of the instrument, are: (1) The date (calendar scale) is set opposite OOh (hour scale), (2) the time, ST or ZT, of the sextant observation (hour scale) is then set opposite the reference meridian, ZM (meridian scale), for the time zone, and, finally, (3) the value for LHAϒ (LHAϒ scale) is read opposite the DLo value (meridian scale) for the DR or the known position. Only the last step requires the use of the cursor.

LHAϒ at Twilight: To locate the star positions for twilight sights, LHAϒ is needed for the time of civil twilight that is listed in the Nautical Almanac. The listed time is the GMT of the event at Greenwich, but, to sufficient

accuracy, it is also the LMT of the event at the observer's meridian. So, DLo is not needed and step 2 in setting the Computer may be omitted: LHA♈ is read opposite the time of listed civil twilight (interpolated for latitude) without reference to the meridian scale. (If the ZT of the event is wanted as well, set LMT opposite DLo and ZT will be opposite ZM.)

Time Used: Standard Time may be used just as well as Zone Time as the meridian scale will encompass the large DLo values sometimes required in the more irregular Standard Time Zones.

Accuracy: The Computer should be read only to the nearest degree of LHA♈ as there is an inherent instrument error of about this magnitude. The error is irregular so that no attempt should be made to interpolate for the time of day on the calendar scale: Just set 00h opposite the line representing the date, no matter the time of day.

Local Sidereal Time: After finding LHA♈, 00h on the hour scale is placed opposite 0° LHA♈ and LST read on the hour scale opposite LHA♈. As the two quantities are identical except for the units involved, the instrument's scales are used to make the conversion.

INSTRUMENT ERROR

This instrument is an analog computer and equates: 360° of hour angle of Aries = 24 hours of mean time = 365 mean solar days. But these relations are not entirely correct due to (1) the "additional" sidereal day in the calendar year and (2) the difference in the length of the calendar (365 mean solar days) and tropical year (equinox to equinox).

The "diurnal" error results from the fact that LHA♈ increases very nearly 361° during a 24-hour period, rather than 360°, due to the "additional" sidereal day each year. Consequently, the computer will have essentially no error on this account at 00h, but it will steadily approach -1° at 2400.

The "calendar" error results from the difference in length of the calendar and tropical year which approaches -1° in four years when it is largely corrected by the addition of an extra (intercalary) day in leap years.

4-year increase of mean value of ♈	-0°57.2936'
Addition of intercalary day	+0°59.1388'
Residual 4-year discrepancy	+0°01.8452'

By choosing 21.0 September as the point at which LHA♈ is 0° on the Computer, the calendar error will vary from approximately 0° to +1°. Thus the combined effect of diurnal and calendar errors will not exceed about ±1° at any given time and, as the two errors are of opposite sign, they will tend to be compensatory so that the error will generally be less than 1°.

The residual 4-year discrepancy which appears in the above computation is small, but, as the Gregorian calendar compensates for this remaining discrepancy by omitting the intercalary day every 100 years except those centurial years divisible by 400 (the residual error after this maneuver amounts to one day in 3300 years), the Computer will develop a gradually increasing error on this account which will amount to 0.2° in the year 2000 and will reach 0.5° about the year 2050.

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The USPS LHA♈ COMPUTER may be ordered from USPS Headquarters for $1.50

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