NEW TYPE OF STAR FINDER

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This article deals with a new type of star finder developed by the Author of the article. It consists of eighteen star charts and a transparent diagram (template) representing the visible hemisphere. Each star chart comprehends the interval of 20° of local hour angle of the First Point of Aries. Equatorial stereographic projection is used for construction of both the star charts and the template. The circle passing through the poles on the star chart represents the observer's celestial meridian.

The identification of a star by this star finder is carried out by plotting the position of the star (azimuth and altitude) on the template carrying the horizon system of coordinates, superimposing this template on one of the star charts shown therein, which corresponds to the local hour angle of the First Point of Aries (LHA γ), and reading out the corresponding name of the star.

The way of showing positions and names of stars on the star charts is demonstrated by the following example. On the star chart No. 7 the positions of stars, for 180° of local hour angle of the First Point of Aries (LHA γ), are plotted by a small red five-pointed star or large black dot, depending on the azimuth, and one part of the star's path for the interval of LHA γ from 120° to 130° is plotted by a dotted line, and from 130° to 130° of LHA γ, by a firm line. For better differentiation of stars on the E and W half of the celestial sphere, different types of letters and different colours are used to indicate their names (see figure attached showing star chart No. 7 and template superimposed on this chart for the observer's latitude 42.3°N).

By placing the template over the star chart in such a way that their centres coincide and the zenith is placed above the celestial equator (on the positive scale of the star chart) for the degrees of Northern latitude, or below the celestial equator (on the negative scale) for the degrees of Southern latitude, we have arranged this star finder so that positions of stars from the star chart can be read in the coordinates of the horizon system and vice versa, i.e. with the altitude and azimuth we can determine which star is situated in that position.

USE OF THE STAR FINDER AND EXAMPLES

Identification of stars.

1. From the Nautical Almanac with the Greenwich Mean Time (GMT) of observation, take out the Greenwich hour angle of the First Point of Aries (GHA γ) and add the longitude (Long.) if East or subtract if West so as to get the local hour angle of the First Point of Aries (LHA γ).

2. With the LHA γ choose the appropriate star to be used.

3. On the transparent diagram (template) plot the position of the observed star by means of the true azimuth and true altitude (scale for azimuth is shown on the line of celestial horizon (NS) or in the vicinity of zenith, and scale for altitude on the vertical circles).

4. Set the template over the star chart so that their centres coincide and place the zenith on the positive (+) scale of the right edge of the star chart for the amount of degrees of Northern latitude, or on the negative (—) scale for the degrees of Southern latitude.

5. If the LHA γ amounts exactly to odd tens of degrees, the symbol of the identified star accompanied by its name will be found on the star chart below the star's position plotted on the template. The star's symbol will be shown either as a large black dot if the azimuth figures used to plot the star's position on the template are shown in black, i.e. if the azimuth is eastward (0° — 180°), or as a small red five-pointed star if the azimuth figures used on the template are shown in red, i.e. if the azimuth is westward (180° — 360°).

If the LHA γ does not amount exactly to odd tens of degrees, the position of identified star will be somewhere on the star's path; on the path's firm line if the LHA γ is greater, or on the path's dotted line if the LHA γ is smaller than exact odd tens of degrees of LHA γ. For instance, on star chart No. 7, the position of the identified star will be on the path's firm line if the LHA γ is 135°, but for LHA γ 125°, the star's position will be on the path's dotted line, and in this case exactly half way, because star symbol is plotted for LHA γ 130° and the firm line contains a spherical distance of 10° as well as the dotted line. Also in this case the same rule regarding black and red is applied and reads as follows: if the azimuth figures used on the template are shown in black the star's position will be on the black path of a star, but if the azimuth figures are red the position of the identified star will be on the red path of a star.

6. After the identification of a star the plotted position on the template has to be canceled.

Note: Having solved a few examples of work by this star finder the navigator will be familiarized with it and it will not be necessary for him to plot the star's position on the template, but only to superimpose the template on the corresponding star chart in a proper way and by means of the azimuth and altitude to find the name of the identified star.

It is not necessary to keep in mind the above mentioned rules, as they are shown schematically on each star chart. Only the following is to be pointed out: black azimuth figures (0° — 180°) *on the template refer to the black star symbol or black path of a star, and red azimuth figures* (180° — 360°) *refer to the red star symbol or red path of a star.*

Example 1. At $19^h36^m42^s$ GMT on 26th March, 1955, in dead reckoning position Lat. = 42°20' N, Long. = 16°50' E, the altitude and azimuth of an unknown star have been taken and converted into true altitude Alt. = 45° 01', and true azimuth Az. = 270°. Identify the star.

GMT = $19^h36^m42^s$
GHA γ = 117° 38,8'
Long. = 16 50,0 E
LHA γ = 134° 28,8'

For LHA γ = 134° 28,8' so computed, the star chart No. 7 is to be used (see picture attached). As the azimuth is 270° (red) and LHA γ approx. 135°, from the table at the top of star chart No. 7 we can find out beforehand that the star's position will be half way along the firm red line of a star's path. And so, by means of the template we find that the intersection of the vertical circle of red azimuth 270° with the 45° parallel of latitude lies half way along the firm lined red path of the star identified as El Nath.

Example 2. Four unknown stars were observed with the following data:
a) LHA γ = 123°, Lat. = 42°20'N, Az. = 305°, Alt. = 41°12';
b) LHA γ = 139°, Lat. = 42°20'N, Az. = 49'5°, Alt. = 49°00';
c) LHA γ = 130°, Lat. = 42°20'N, Az. = 49°, Alt. = 48°13';
d) LHA γ = 132°, Lat. = 42°20'N, Az. = 240°, Alt. = 37°33'.
Identify the stars.

From the star chart No. 7 by means of the template it is found that the observed stars are (see figure):

a) Marfak (not Alkaid which is shown nearby, because the red azimuth corresponds to the red path of a star);

b) Mizar (not neighbouring Alioth, because for LHA γ = 139° the position of a star is to be found approx. on the end of the path's firm line);

c) Alioth (not neighbouring Mizar, because for LHA γ = 130° the position of a star is to be found on the star symbol and not on the path of a star);

d) Betelgeux (not neighbouring Bellatrix, because for LHA γ = 132° the position of a star is to be found approx. on the beginning of the path's firm line).

Identification of planets.

Planets are not inserted in the star charts. From observation it is usually known which planet has been observed, and if is it necessary to identify a planet by this star finder, it can be done in the same way as already described for stars, with the following changes:

a) Under item 5 of the former procedure we shall not find the corresponding star on the star chart below the star's position plotted on the template. Therefore we shall bear in mind the point on the star chart where lies the projection of the plotted position. The distance between this point and the nearest red star if the azimuth is red, or black star if the azimuth is black, will be read in the difference of declination and difference of sideral hour angle. For easier reading of these differences we shall make the template coincide with the star chart so that the pole and zenith lie in the same point, and the altitude scale can be used for reading the difference of declination, and the azimuth scale for the difference of sideral hour angle.

b) Adding the difference of declination and sideral hour angle to the declination (d) and sideral hour angle (SHA) of that star, the d and SHA of the observed planet will be found, and with these data and the date of observation from the Nautical Almanac the name of the observed planet will be taken out.

Example 3. On 26th March, 1955, an unknown celestial body was observed with the following data : LHA γ = 125°, Lat. = 42°20'N, Az. = 276°, Alt. = 20°03'. Identify the body.

From the chart No. 7 we find that the position plotted on the template lies near the black path of the star Arcturus, approximately 2 millimetres below the first letter r in the word Arcturus. As the black path of a star does not correspond to the red azimuth we shall see if one of the planets was observed. Therefore from the star chart we read that the above mentioned position, lying below Arcturus, has a declination (d) approximately 2° greater than the red star Aldebaran and an approx. 22° greater sideral hour angle (SHA), measuring from Aldebaran's position for LHA γ 125.

	+2°	+ 22°	From the Nautical Almanac for 26th March, 1955, with d and SHA so obtained we find that the observed body is the planet Mars.
Aldebaran....	d = 16	SHA = 292	
	d = +18°	SHA = 314°	

Finding the stars for observations.

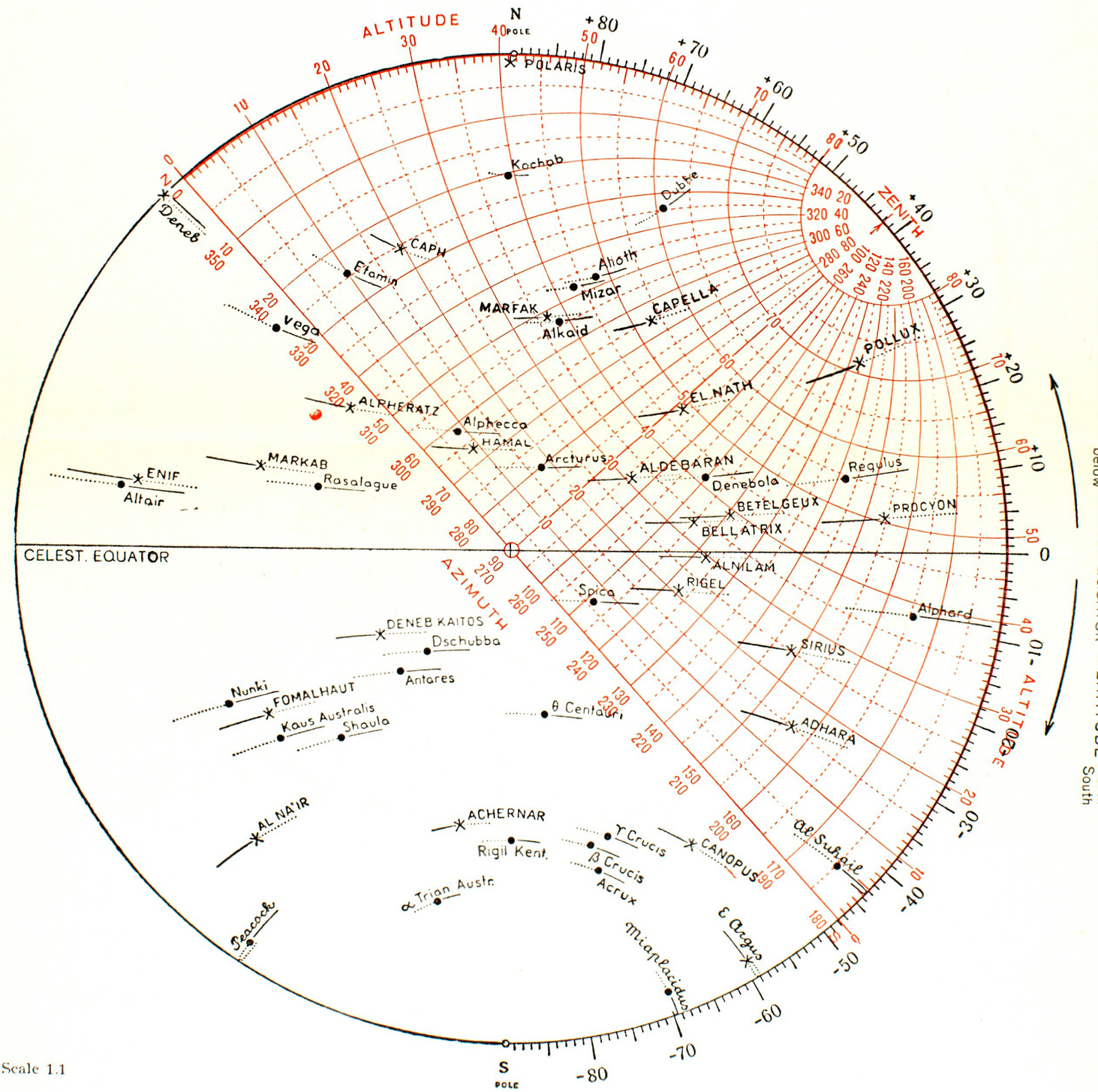
This star finder can also be usefully applied in the twilight to find the stars for observation while the horizon is still distinct but the stars scarcely visible. With the approx. GMT observation the LHA γ is to be determined and the appropriate star chart used. After the template is set for the observer's latitude the suitable stars for observation can be selected and their approx. altitudes and azimuths taken out so that they can be found more easily in the sky.

Note : Kotlaric's Star Finder, described in this article, was published in June, 1956, by the Hydrographic Institute of the Yugoslav Navy under the title « Identifikator zvijezda » (28 pages, hard cover, size over-all 9,4 by 11,8 inches). It contains also extensive directions for use in English and can be purchased from « Hidrografski institut JRM, Split, Yugoslavia ».

Star Chart № 7

FOR LOCAL HOUR ANGLE OF THE FIRST POINT OF ARIES (LHA ♈) 120° — 140°

	For AZIMUTH 0° — 180°	For AZIMUTH 180° — 360°	If the plotted part of a star's path is on E and W half of the celest. sphere
The name of star is written:	With lower case letters	With CAPITAL LETTERS	*In Italics*
Positions of star for **LHA** ♈ 120° – 140° are shown:	120° 130° 140°	140° 130° 120°	140° 130° 120° 130° 140°



Scale 1.1