

a) bez okretanja stranica
 zvezdanu kartu i
 rešenje primjera
 ovom Novom
 seš-

COMPASS ERROR BY CALCULATOR:

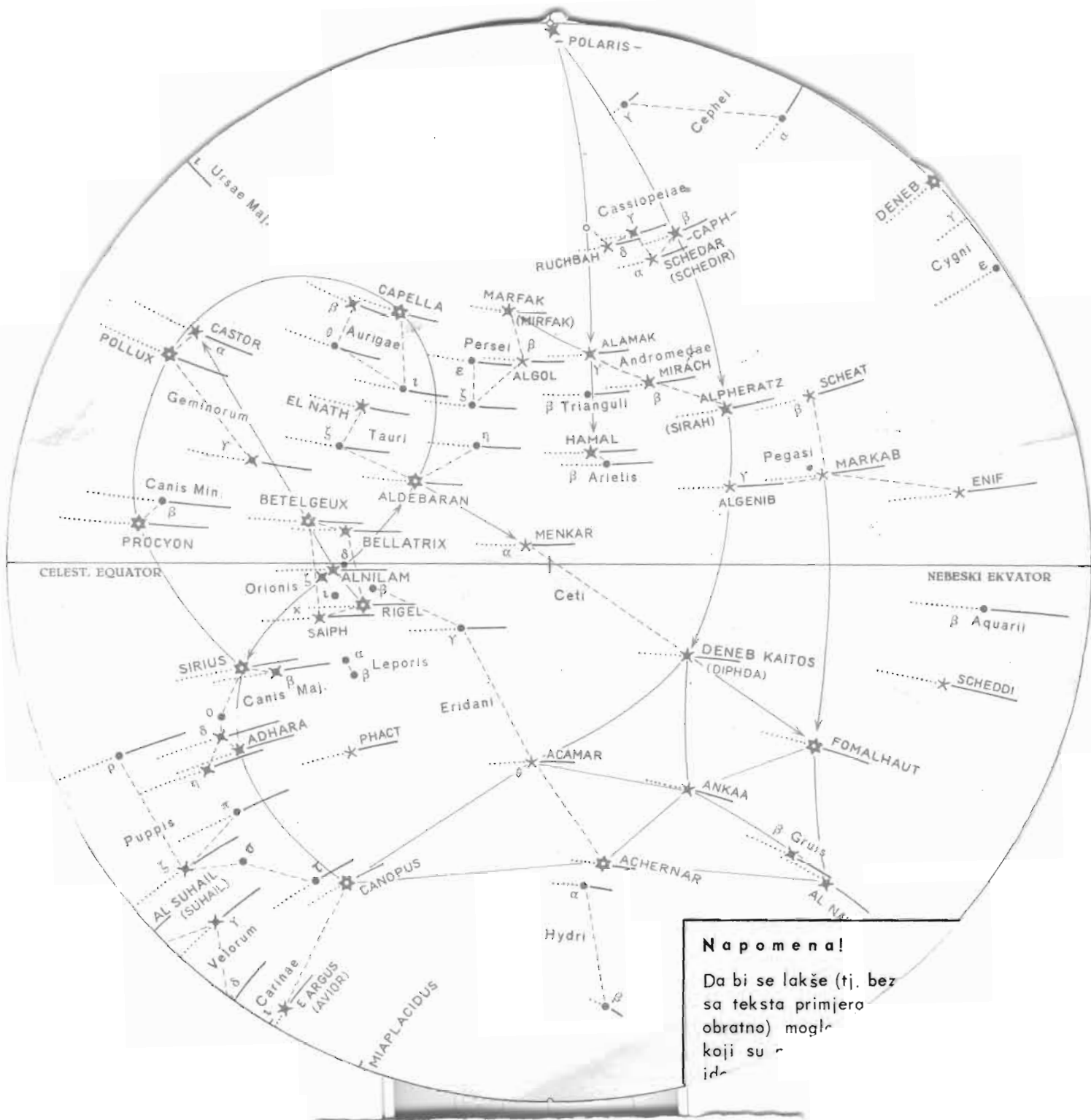
$$LHA \text{ (TAN)} \text{ (INV)} \left(\frac{1}{X}\right) \text{ (X)} \text{ LAT (TAN)} = A$$

$$LHA \text{ (SIN)} \text{ (INV)} \left(\frac{1}{X}\right) \text{ (X)} \text{ DEC (TAN)} = B$$

Bez predznaka

$$A + B = C$$

$$C \text{ (X)} \text{ LAT (COS)} = \text{(INV)} \text{ (TAN)} - 90^\circ = W$$



COMPASS ERROR BY CALCULATOR:

$$\begin{aligned}
 &LHA \text{ (TAN)} \text{ (INV)} \left(\frac{1}{x}\right) \text{ (X)} LAT \text{ (TAN)} \equiv A \\
 &LHA \text{ (SIN)} \text{ (INV)} \left(\frac{1}{x}\right) \text{ (X)} DEC \text{ (TAN)} \equiv B \\
 &A + B = C \\
 &C \text{ (X)} LAT \text{ (COS)} \equiv \text{ (INV)} \text{ (TAN)} - 90^\circ \equiv W
 \end{aligned}$$

Bez prethodna

THE TWELVE SIGNS OF THE ZODIAC

The Ram, the Bull, the Heavenly Twins.
And next the Crab the Lion shines,
The Virgin and the Scales ;
The Scorpion, Archer and He-Goat,
The Man that bears the Watering Pot,
The Fish with glittering tails.

DISTANCES OF STARS

THE distances of stars from Earth, or even from the Solar System, are so enormous that it would be impossible to use miles as units of distance when considering them. When we wish to denote these tremendous distances we generally express them in "light-years." Light travels—in round numbers—about eleven million miles a minute: in a year it travels 5,878,310,400,000 miles. Even with this staggering unit, the nearest star, Proxima Centauri, is more than four light-years distant: the more remote stars being a thousand times this distance. Einstein has suggested that our apprehended creation is a definite and limited sphere with a minimum diameter of 300,000,000 light-years.

Another unit of stellar distance is the "parsec." This is the distance that a star would have to be to exhibit a parallax of one second of arc when viewed from the two extreme points of Earth's orbit. As this distance is equivalent to about 3.26 light-years all stars are more than one parsec distant.

NOTES ON THE SOLAR SYSTEM

THE Solar System consists of the Sun—which is a smallish star—and a group of planets that revolve round it at various distances. The Sun is infinitely larger than the whole mass of the combined planets. Each planet revolves round the Sun in an elliptical orbit, with the Sun at one focus of the ellipse—which is also the centre of gravity of the System. The outermost planet is billions of miles away from the nearest star and, in consequence, the planets appear to move in an epicyclic path against the background of the fixed stars. Planets emit no light, but reflect some of the light they receive from the Sun. They phase in very much the same way that the Moon does, and this causes their “magnitudes” to vary. Only four planets are used in practical navigation—Venus, Mars, Saturn, Jupiter. The others are either too far away to be visible to the naked eye (Uranus, Neptune, Pluto) or are too close to the Sun to be distinguished (Mercury). The following are the chief facts concerning the Sun and planets:

Sun is at a mean distance of 92,900,000 miles from the Earth. This distance is known as “the astronomical unit of planetary distance.” The Sun’s diameter is about 865,000 miles, and his angular diameter varies from 31’ 32” (in July) to 32’ 36” (in January).

Mercury is 36 million miles from the Sun. Its diameter is 3000 miles. It rotates on its axis in 24 hours 5 minutes, and it revolves round the sun in 88 days. As it is never more than 29° from the Sun it can only be seen on very rare occasions.

Venus is 67 million miles from the Sun. Its diameter is 7600 miles. It rotates on its axis in 23 hours 21 minutes, and it revolves round the Sun in 225 days. Its apparent diameter may exceed 1’.

Earth is 92·9 million miles from the Sun. Its equatorial diameter is 7926½ miles, and its polar diameter is 7899¼ miles. It rotates on its axis in 23 hours 56 minutes 4 seconds of Mean Time, and revolves round the Sun in 365·2422 Mean Solar days.

Moon is a satellite of Earth, and she therefore traces a somewhat complicated pattern in the heavens. Her diameter is 2159 miles. She rotates on her axis in 27 days 7½ hours (approx.) and revolves round Earth in the same time. Her apparent diameter varies between 29’ 22” and 33’ 31”. *Note.*—Moon is the proper name of our satellite and it is incorrect to refer to the satellites of other planets as “moons.”

Mars is 141·4 million miles from the Sun. Its diameter is 4620 miles. It rotates on its axis in 24 hours 37 minutes, and it revolves round the Sun in 687 days. It has two satellites.

Jupiter is 483 million miles from the Sun. Its diameter is about 88,250 miles. It rotates on its axis in 10 hours, and revolves round the Sun in about 11¾ years. It has 11 satellites, 7 of which are very small: the other 4 were formerly used for determining longitude.

Saturn is 885·5 million miles from the Sun. Its diameter is about 74,240 miles. It rotates on its axis in 10½ hours, and it revolves round the Sun in 29½ years. It has 9 satellites (possibly 10) and a series of broad, flat rings; which are probably disintegrated satellites.

Uranus is 1781 million miles from the Sun. Its diameter is about 31,400 miles. It rotates on its axis in 9½ hours, and revolves round the Sun in about 84 years. It has 4 satellites.

Neptune is 2790 million miles from the Sun. Its diameter is about 33,000 miles. It revolves round the Sun in about 165 years. It has at least 1 satellite.

Pluto was first identified in 1930, and is the outermost known planet of the system. It is about $\frac{1}{15}$ th the size of Earth, and revolves round the Sun in about 248 years. The ellipticity of its orbit is great; the minor axis being only about 0·6 the length of the major axis.

Asteroids. Scattered between Earth and Jupiter are thousands of infinitely small planets whose centre of gravity is situated between Mars and Jupiter. Although some of them are hardly larger than a house they all obey the three fundamental laws of planetary motion.

BODE’S “LAW.”—There is a remarkable coincidence in planetary distances that comes in useful when requiring to know the distance of any planet from the Sun, and its period of revolution. If we write down 0, then 3, and double the previous number, we get 0, 3, 6, 12, 24, 48, 96, 192. We now add 4 to all these numbers and get 4, 7, 10, 16, 28, 52, 100, 196. *These are the relative*

distances of the planets from the Sun. The rule only holds good up to Uranus. Remembering that Earth's distance from the Sun is 92,900,000 miles, we can divide the numbers above by 10 (insert a decimal point) and we then find that the distances (approximately) of the planets are 92,900,000 miles multiplied by: Mercury 0.4, Venus 0.7, Earth 1.0, Mars 1.6, Asteroids (mean point) 2.8, Jupiter 5.2, Saturn 10.0, Uranus 19.6. These figures, used with Kepler's Third Law of Planetary Motion, will yield the orbital period of a planet.

KEPLER'S LAWS OF PLANETARY MOTION.

1. A planet moves in an elliptical orbit round the Sun—which is at one of the foci of the ellipse.
2. A line joining the Sun and a planet will sweep over equal areas in equal times.
3. The square of a planet's time of revolution round the Sun varies as the cube of its distance from it.

MAGNITUDES OF STARS.—The apparent brightness of stars, which has nothing to do with their nearness, is shown by a figure called their "magnitude." The brightest (about 60 of them) are termed "1st magnitude stars"; then 2nd magnitude stars, and so on. The stars in any magnitude are further graded by using a decimal point. Sirius is the brightest star, and its magnitude is -0.6 . The 6th and 7th magnitude stars are hardly visible to the naked eye even in clear weather. Navigational stars rarely go beyond the third magnitude. Strangely enough, there are approximately three times as many stars in any magnitude as there are in the magnitude below it.

SYMBOLS AND ABBREVIATIONS

EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED IN ASTRONOMY AND NAUTICAL SURVEYING.

♌ Conjunction. □ Quadrature. ♁ Opposition.
 ♊ Ascending Node. ♋ Descending Node.

h. Hours. s. Seconds of Time. ' Minutes of Arc.
 m. Minutes of Time. ° Degrees. " Seconds of Arc.

N. North.

E. East.

S. South.

W. West.

SIGNS OF THE ZODIAC.

I. ♈ Aries.
 II. ♉ Taurus.
 III. ♊ Gemini.
 IIII. ♋ Cancer.

IV. ♌ Leo.
 V. ♍ Virgo.
 VI. ♎ Libra.
 VII. ♏ Scorpio.

VIII. ♐ Sagittarius.
 IX. ♑ Capricornus.
 X. ♒ Aquarius.
 XI. ♓ Pisces.

Distance of sun (assumed horizon) ♄
 Distance of sun (right limb) ♄
 Sun's true altitude (right limb) ♄
 Sun's altitude of sun's lower limb
 Sun's altitude of sun's upper limb
 Sun's altitude of sun's lower limb
 Sun's altitude of sun's lower limb

Double altitude of sun's upper limb
 in artificial horizon ☉
 Sun's right limb ☉
 Sun's left limb ☉
 Sun's centre ☉ or ☉
 Right extreme, as of an island →
 Left extreme, as of an island ←
 Flood stream →
 Ebb stream ←

THE NAMES, and THEIR MEANINGS, OF THE PLANETS and SEVERAL OF THE CONSTELLATIONS and STARS

ASTRONOMY being an international science, the names it gives to planets, constellations and stars are generally Latin or Greek for the planets and constellations, and Latin, Greek or Arabic for the stars. All these names mean something. It is generally said that many of the constellations are named after the Greek myths; but there is a fair probability that the matter is the other way about, and that the fancied figures in the sky gave rise to the myths. The constellation of Cassiopeia, for instance, was known as "Casyapi" long before Greece was civilized. The subject is too long to be debated here, and we shall confine ourselves to the conventional explanations.

Andromeda. The daughter of King Cepheus and Queen Cassiopeia. To appease a sea monster she was chained to a rock as a sacrifice; but was rescued by Perseus.

Argo (Navis) The ship Argo, in which Jason sailed, with a band of heroes, to find the Golden Fleece.

Bootes. Greek for "Ox Driver" or "Ploughman." A very ancient name; and suggests that Ursa Major was looked upon as a plough in remote times.

Cassiopeia. Sits in her chair, watching the sacrifice of her daughter Andromeda.

Centaurus. Latin for "Centaur." The Centaurs were a race of beings—half horse, half man—who were fabulously reported to dwell in Thessaly.

Gemini. Latin for "The Twins." The twins are Castor and Pollux. Castor was a famous horseman; Pollux was a renowned boxer. They sailed with Jason in search of the Golden Fleece.

Hercules. Greek "Herakles." The strong man of Greek mythology, and the most colourful of all the heroes. He performed twelve famous tasks and numerous wonderful exploits.

Luna. Latin for "Moon." Hence, "lunation," "lunar," etc.

Moon. Literally means "Measurer" (of time).

Pegasus. A mythical winged horse of the Greeks.

Perseus. A mythical hero of the Greeks. The slayer of Medusa and the rescuer of Andromeda—whom he married.

Phoenix. A mythical bird of the Egyptians. It was said to live for 500 years, make a nest of spices in Arabia, set fire to its nest and arise from the ashes to live another 500 years.

Piscis Australs. Latin for "Fish of the South."

Taurus. Latin for "Bull."

Uranus. Greek god of the overspreading vault of heaven, or celestial concave.

MEANINGS OF NAMES OF 80 STARS CONSTELLATIONS AND PLANETS

ALBIERO.	Beak of the Hen.	GALAXY.	Milky Way.
ALCYONE.	Kingfisher.	GEMINI.	Twins.
ALDEBARAN.	Eye of the Bull.	HERCULES.	Greek Hero famous for his strength.*
ALGOL.	The Demon.	HYDRA.	Water Snake.
ALKAID.	The Chieftain.	JUPITER.	Father of the Day. (Dies Pater.)
ALMAK.	Badger.	KOCHAB.	Star (Hebrew).
ALPHECCA.	The Dish.	LEO.	Lion.
ALPHERATZ.	Horse's Navel.	LEPUS.	Hare.
ANTARES.	Rivalling Mars (in redness).	LIBRA.	Balances. Scales.
AQUARIUS.	Water Bearer.	LUNA.	Moon.
AQUILA.	Eagle.	LUPUS.	Wolf.
ARCTURUS.	Bear Warden.	LYRA.	Lyre.
ARGO.	The Ship (of Jason).	MALUS.	Mast (of Argo).
AURIGA.	Charioteer.	MARS.	Roman God of War.*
BELLATRIX.	Warlike.	MERCURY.	Roman God of Com- merce. Messenger of the Gods.*
BENETNASCH.	Mourner.	MIRA.	Wonderful. (Variable star in Cetus).
BETELGEUSE.	Armpit.	NEPTUNE.	God of the Oceans.*
BOOTES.	Ploughman.	OPHIUCUS.	Serpent bearer.
CANCER.	Crab.	ORION.	Handsome Giant Hunter.*
CANES VENATECI.	Hunting Dogs.	PAVO.	Peacock.
CANIS MAJOR.	Greater Dog.	PERSEUS.	Rescuer of Andro- meda.
CANIS MINOR.	Lesser Dog.	PHOENIX.	Fabulous bird that was said to live for 500 years.*
CANOPUS.	Egyptian God of Water.*	PISCES.	Fishes.
COMA.	Hair.	PLUTO.	God of the dead.*
COR. CAROLI.	Heart of Charles I.	PROCYON.	Before the Dog (Sirius).
COR HYDRÆ.	Heart of the Hydra.	PUPPIS.	Poop (of Argo).
COR LEONIS.	Heart of the Lion.	SAGITTARIUS.	The Archer.
CORONA AUSTRALIS.	Southern Crown.	SATURN.	God of Time.*
CORONA BOREALIS.	Northern Crown.	SCORPIO.	Scorpion.
COR SERPENTIS.	Heart of the Serpent.	TAURUS.	Bull.
CORVUS.	Raven.	TRIANGULUM	
CROZIERS.	Cross.	AUSTRALE.	Southern Triangle.
CRUX AUSTRALIS.	Southern Cross.	URANUS.	God of the celestial concave.
CYGNUS.	Swan.	URSA MAJOR.	Greater Bear.
DENEK.	Tail.	URSA MINOR.	Lesser Bear.
DENEK ALGIEDI.	Tail of the Goat.	VENUS.	Roman Goddess of Love.*
DENEK KAITOS.	Tail of the Whale.	VIRGO.	The Virgin.
DENEKOLA.	Tail of the Lion.	ZODIAC.	Zone of the Animals.
DIPHDA.	Frog.		
ENIF.	Nose.		
ERIDANUS.	River Po.		
FOMALHAUT.	Mouth of the Big Fish.		
GACRUX.	Gamma Crucis.		

*NOTE.—An asterisk applied to the meaning of a name indicates that meaning is a *definition* of the word concerned. In all other cases the meanings given are the *literal meanings* of the names considered.

HINTS FOR STAR OBSERVERS

THE first consideration should be to obtain a knowledge of the stars *at sight*. It will save a lot of time, and thus frequently enable you to obtain an observation when otherwise you might fail; for while you are hunting up books and charts the star may disappear behind the clouds, and, for a time at least, you will have to "watch and wait." It is therefore necessary to this end to study the books and chart at every possible opportunity. On a clear night have the chart out on deck, and then with the eyes glancing alternately from sky to chart, and *vice versa*, you will soon acquire a knowledge which in the future you will find to be of inestimable service to you in the navigation of your ship, and which will give you a feeling of independence and security to which the man who "*does not believe in the stars*"—and I have met many such—is an absolute stranger.

In beginning, I would advise tackling the stars around and about the Polar region—and there are few, I take it, who do not know the Great and Little Bears when they see them. The tail of the former, produced about twice its length, leads to Arcturus, the brightest fixed star in the Northern Hemisphere, and the Pointers in the body always direct the eye to the North Star in the Little Bear. Not far away you will see Deneb, Capella, Vega, and others. Deneb, well overhead in these latitudes, is a bright star in the constellation of Cygnus, and may be known by the Cross, of which it forms a part; Capella, in Auriga, is a bright star in a pentagon (five-sided figure); and Vega, in the Harp, is another bright star of about equal magnitude to Capella. These two are on opposite sides of the Pole, and almost equidistant, and may be distinguished from each other by the following little rule, viz.: when Capella is east a line drawn from it to Vega will pass *above the North Star*, and when Vega is in the east the *North Star* will be *above* the line. Two little words—"CELA" and "VEST"—may be found a good aid to memory, and may be translated thus—"Capella east, line above; Vega east, star top; it may be rather crude but will be found correct. Deneb, Vega, and Altair (in Aquila) farther south form nearly a right-angle triangle. The Square of Pegasus, formed by the stars Markab, Scheat, Algenib, and Alpherat, is a very prominent figure in the heavens, and may be easily recognized, as it, with the three bright stars leading from it, viz., Mirack, Alamak, and Mirfack (*a* Fersei), may be formed into a magnified Great Bear, the square being the body and the three stars named forming the tail. A line drawn through Scheat and Markab, forming the western side of the square, will lead to Fomalhaut (*a* Piscis Australis). The constellations of Orion and Leo are also very prominent figures, the former probably more so than the latter; it is near the meridian at midnight about the end of the year. Leo, whose principal stars are Regulus and Denebola, may be likened to a distorted or badly cut try-sail, four of the stars forming a figure of this form (*see* Chart); Arcturus, Spica (*a* Virginis), and Denebola form an equilateral triangle; Arcturus, Spica, and Regulus a right-angle triangle. Passing to other constellations, a line drawn from Polaris through the Pointers of the Great Bear, and continued rather more than the same distance, will pass between Regulus and Denebola, the former being on the west side of the line, the latter on the east.

Before concluding, there is just one other little wrinkle I would like to give to those not in the know, viz., how to obtain the latitude by the North Star while there is yet sufficient daylight to read off the altitude without the aid of a lamp. Compute the altitude of the star and set it on the sextant; screw up, fix the star telescope, and as the daylight wanes sweep the horizon under the star. It will need patience, which, however, will be rewarded by and by by the appearance of a bright little silver speck—the reflection of the North Star—*on or near* the horizon; bring it *dead on*, read off and in a few minutes you have your correct latitude.