

A Field Guide to the Stars and Planets

Including the moon, satellites, comets, and
other features of the universe

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COLLINS

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III

Pathways in the Sky

TO FIND your way among the stars, choose some familiar pattern as a starting point and gradually work your way from one star group to another. The endpaper on the inside front cover illustrates useful ways of tracking from one constellation to another. The green arrows direct the eye to significant features of various constellations. Miscellaneous triangles of bright stars, indicated by dash lines, help you to check your findings and extend your knowledge of the sky.

The Big Dipper (Ursa Major)' is perhaps the best place to begin, because it is easily recognized and also because it lies above the horizon for so large a portion of the globe. The Pointers, the two stars in the front of the Dipper, are the most dependable guides to start with. In the northerly direction they indicate the all-important Pole Star. In the opposite direction they point toward the constellation of Leo, with its conspicuous asterism, the Sickle. From the Pointers proceed directly to the Pole Star and then turn a sharp right angle toward the right and you will encounter the prominent 1st-magnitude star Capella, in the constellation of Auriga. At Capella, angle across the constellation of Gemini toward Procyon, in Canis Minor

Now return to the Big Dipper, to the star that lies between the bowl and the bend in the Dipper handle. Proceed again to Polaris and continue straight on for an equal distance on the opposite side. There you will encounter the W-shaped figure, Cassiopeia. Along a curved line, as indicated, lie the "four C's" (Camelopardalis, Cassiopeia, Cepheus, and Cygnus), in alphabetical order. Deneb and Vega form the base of an isosceles triangle, with Altair in the vertex.

Return again to Polaris and draw a line from that star through Caph (β Cassiopeiae) and extend it south to Alpheratz (α Andromedae) and the eastern edge of the Great Square of Pegasus. The rear feet of the Winged Horse rest on Aquarius. Just south of the Square lies an asterism, the Circlet, a delicate ring of stars marking the head of the western fish in Pisces. To the east of Andromeda lies the associated constellation Perseus, the hero rushing to save the lady chained to the rock. A line drawn southeastward from the legs of Andromeda encounters, in turn, Triangulum, Aries, and the Head of Cetus. The Knot of Pisces lies just west of the Neck of Cetus.

Again return to Polaris and note the Guards, the bright pair of stars at the end of the bowl of the Little Dipper. Draw a line from Polaris near the eastern Guard star and extend it southward. It will indicate another delicate circle of stars, the well-known constellation Corona Borealis, the Northern Crown. Note how the body of Draco seems to hold the Little Dipper, Ursa Minor in its folds, its head well marked by the asterism, the Lozenge. Just to the south of the head of Draco lies the constellation Hercules, with its distinctive asterism, the Keystone. Note how the head of Hercules and the head of the other giant, Ophiuchus, are essentially touching. Hercules, holding a bow in his outstretched hand, has just launched an arrow, Sagitta, toward the two birds, Cygnus and Aquila, both of whom seem to have escaped. Lyra, on old sky maps, also appears as a bird - Vultur, the Vulture.

Sagittarius, with its conspicuous asterism, the Milk Dipper, lies south of Aquila. Directly south of Ophiuchus lies Scorpius, with its bright red star Antares and the sharp sting beneath this giant's right foot. To the west of Scorpius lies Libra, designated by the ancients as the Claws of the Scorpion.

Return again to the north and from the Big Dipper extend the handle along an *arc* to Arcturus and continue this line in a *spike* to Spica. Note that Spica and Arcturus form the base of an isosceles triangle with its vertex at Denebola (β Leonis). Regulus, Procyon, and Alphard (α Hydrae) form a right-angle triangle. Procyon, Sirius, and Betelgeuse form another. And, as indicated in Table 6, "Asterisms," the stars Aldebaran, Capella, Castor, Pollux, Procyon, Sirius, Rigel, Bellatrix, and Betelgeuse make up a large and conspicuous asterism sometimes called the Heavenly G.

Orion continually fights Taurus, the Bull. Lepus, the Hare, lies just beneath Orion's foot.

To continue the pathways into the southern half of the sky, turn to the endpaper on the inside back cover. The Belt stars of Orion point toward the brightest star in the sky, Sirius. The River, Eridanus, rises near Rigel in the foot of Orion and wends its tortuous way south via the 1st-magnitude star Achernar. Canopus, in Carina, lies directly south of Sirius. Rigel, Sirius, and Canopus form a distinct right-angled triangle.

Canopus, Achernar, and Rigel Kent form another triangle that encloses a smaller triangle, formed by the Large Magellanic Cloud, the Small Magellanic Cloud, and the south celestial pole. As previously noted, there is no South Star analogous to Polaris.

On the other side of the pole, a line from the foot of Sagittarius through Pavo also points directly to the south celestial pole. Note the closeness of the four birds, Pavo, Tucana, Phoenix, and Grus. From the north, water flows from Aquarius into the mouth of Piscis Austrinus, the Southern Fish.

A somewhat irregular line drawn southward from the tail of Scorpius crosses Ara, Triangulum Australe, and eventually leads to the South Pole. Ara lies east of Lupus. Note also, that Centaurus lies just south of Corvus and the Southern Triangle slightly east of Centaurus. The conspicuous pair of 1st-magnitude stars, α and β Centauri, point toward the nearby Southern Cross. This will help distinguish the true cross from the somewhat larger "False Cross" formed by ι and ε Carinae and δ and κ Velorum. The False Cross also lies in the Milky Way and its arms roughly parallel those of Crux.

When you have become familiar with the pathways just described, you will easily find a number of constellations, sufficient to provide sky marks for recognizing the positions of others. There is no royal road to learning the sky. To master each new area, you must continually check and recheck your path, especially from season to season, as the stars slowly change their places relative to the sun.

A resume of the sky paths and additional helpful hints appear in Chapters IV and VI.

IV

Order and System of the Constellations

THE SKY was man's first picture book. Primitive races the world over have whiled away the hours of night looking at the slowly moving heavenly pageant. The stars suggested to them vague outlines of familiar animals and men. Gradually, as man's intellect grew, he expanded his relationship with the universe through an intricate legendry of the constellations. The myths we have inherited from the ancients enrich our appreciation for the starry patterns associated with them.

Rarely does the constellation resemble its supposed terrestrial prototype so clearly that recognition is immediate and beyond question. Orion, a major exception, does suggest a giant figure. But the Big Dipper, though a remarkable replica, is a modern asterism, part of Ursa Major, which more nearly resembles a long-tailed mouse than a lumbering bear.

How, then, can one expect to learn the sky as a whole, with its 88 distinct constellations, if each individual star group is independent of all the others? Fortunately, the sky is not quite as disorderly as a casual inspection would indicate. Indeed, all 88 constellations fall into only 8 separate and distinctive families, with a small amount of overlapping. We shall consider each family in turn, giving a brief commentary on each constellation. Chapter III provided a geometrical association between the groups; this chapter indicates a logical association based on mythology or other factors.

A. The Ursa Major Family

1. Ursa Major (the Great Bear) and its familiar asterism, the Big Dipper (known to the British as the Plow, the Wain, or Wagon), is the best skymark for starting constellation study. In the latitude of the United States, the Dipper never sets. Ursa Major rides highest in the early evenings of spring and lowest in the fall; legends of North American Indians imply that the animal is looking for a place to lie down, preparatory to winter hibernation.

The 7 stars are lettered α , β , γ , δ , ϵ , ζ , η from bowl to handle. Their respective names are: Dubhe, Merak, Phecda, Megrez, Alioth, Mizar, and Alkaid. Dubhe and Merak, at the fore of the bowl, are often called the Pointers, because they point to the Pole Star (Polaris), the star at the end of the tail of

2. Ursa Minor (the Little Bear). This group is sometimes termed the Little Dipper because of a resemblance to an old fashioned cream ladle or gravy spoon. The two brightest stars in the bowl of the dipper are often called the Guardians of the Pole or, more simply, the Guards.

3. Draco (the Dragon) is one of the few constellations that resemble the objects for which they are named. The tail starts north of the Big Dipper handle. The body turns northward enveloping Ursa Minor in a fold and then deviates abruptly south to a conspicuous lozenge-shaped head, near Hercules. Mizar, the star at the bend of the Dipper handle, Polaris, and the head of Draco form an approximate equilateral triangle.

4. Canes Venatici (the Hunting Dogs) consists of two bright stars south of, but still within, the bend of the Dipper handle. These dogs, yapping at the heels of Ursa Major, are a modern formulation by the astronomer Hevelius.

5. Bootes; (the Bear Driver, sometimes called the Herdsman) lies south and east of Ursa Major. (Pronounce both o's of Bootes, as in "coordinate.")

6. Coma Berenices (Berenice's Hair) imaginatively depicts the shorn locks of beautiful Berenice, an Egyptian queen. A line from Polaris extended through Alioth points toward this group, which lies just south of Canes Venatici. Actually, Coma is an open star cluster, more beautiful when seen with field glasses than with the naked eye.

7. Corona Borealis (the Northern Crown), a delicate circlet of stars, lies between Bootes and Hercules.

8. Camelopardalis (the Giraffe) is situated in a region where stars are few, between Polaris and Auriga.

9. Lynx (the Lynx), likewise in a barren region, forms a sort of fence in front of Ursa Major, whose Pointer stars, extended in the direction opposite to Polaris, indicate Leo, a zodiacal constellation.

10. Leo Minor (the Smaller Lion) lies just north of Leo. Leo Minor, Lynx, and Camelopardalis are modern astronomical images providing identification for a few faint stars unattached to the older groups.

B. The Zodiacal Family

Twelve constellations, one for each month of the year, make up the Zodiac. Memorize them in order if you can. The following rhyme may help:

*The Ram, the Bull, the Heavenly Twins,
And next the Crab, the Lion shines,
The Virgin and the Scales,
The Scorpion; Archer, and the Goat,
The man who holds the watering pot
And Fish with glittering tails.*

11. Leo (the Lion), whose asterism, the Sickle, forms an arched mane, really looks like the king of beasts.

12. Virgo (the Virgin) lies south of Coma Berenices.

13. Libra (the Scales) was once regarded as the claws of

14. Scorpius (the Scorpion), whose curving back and poised sting form a realistic group on the edge of the Milky Way. Antares, the red luminary of the group, signifies "rival of Mars."

15. Sagittarius (the Archer), represents a Centaur. Its characteristic asterism, the Milk Dipper, appears in the beautiful star clouds of the southern Milky Way.

16. Capricornus (the Sea Goat),

17. Aquarius (the Water Carrier), and

18. Pisces (the Fish) lie in a region of the sky devoted largely to water and denizens of the sea. Most maps picture the Fish tied together with a ribbon and bowknot; I suggest that the ribbons indicate streams of water pouring from the mouths of live fish and that the bow denotes the splash against the body of Cetus. (For further information, refer to F below, "The Heavenly Waters.")

19. Aries (the Ram) represents the animal famous for its golden fleece, the goal of the Argonautic expedition. The asterism, the Northern Fly, hovers appropriately over the rump of Aries.

20. Taurus (the Bull), with long curving horns and fiery Aldebaran for an eye, is a magnificent constellation. The V-shaped cluster, the Hyades, marks the head of Taurus and the Pleiades cluster lies in the shoulder. Both clusters are beautiful objects seen either with field glasses or a small telescope. The Bull continuously backs away from the advancing Orion.

21. Gemini (the Twins) is the constellation of the mythological Castor and Pollux. It occurs in a densely populated region of the northern Milky Way.

22. Cancer (the Crab) is associated with the Hercules family. Astronomically, Cancer is significant for its delicate cluster Praesepe or the Beehive.

C. The Perseus Family

We turn northward to consider the numerous constellations associated with Perseus.

23. Cassiopeia (the Lady of the Chair) is a W-shaped (or M-shaped, depending on your Latitude) group lying on a line drawn from Alioth through Polaris and extended an equal distance on the opposite side of the pole.

24. Cepheus (royal consort of Cassiopeia) lies to the north and west of the Queen, whose boast that she was fairer than Juno evoked the wrath of the sea nymphs. They sent a sea monster (Cetus) to ravage the coast and banished Cassiopeia to the sky, where she hangs head downward half of the time, learning humility. Neptune demanded that her daughter, Andromeda, be chained to a rock as a sacrifice to Cetus. Perseus, flying in on Pegasus the winged horse, rescued the maiden,

25. Andromeda.

26. Perseus is a clearly delineated figure. His body extends approximately parallel to the Milky Way. The right leg, indicated by a number of bright stars, stretches almost to the Pleiades. The left leg is not quite so noticeable.

27. Pegasus (see also Eridanus).

28. Cetus (the Whale or Sea Monster) also belongs to the family I call "Heavenly Waters."

29. Auriga (the Charioteer), in my opinion, represents Neptune, the sea god often shown driving his chariot drawn by sea horses.

30. Lacerta (the Lizard) is an inconspicuous modern group lying between Cepheus on the north and Pegasus on the south.

31. Triangulum (the Triangle) contains some interesting star fields

D. The Hercules Family

Again we turn north, where we find a number of star groups related to the legends of Hercules.

32. Hercules. Historians have frequently wondered why Hercules appears to be kneeling. I think the answer is simple: he holds a bow in his outstretched arm; one foot rests on the head of Draco. Many ancient carvings and paintings show him thus.

33. Sagitta (the Arrow) flies from the bow, directed toward Aquila, Lyra, and Cygnus, which seems to me to represent the Stymphalian Birds of one of Hercules' labors.

34. Aquila (the Eagle).

35. Lyra (the Lyre) often appears in early descriptions as a vulture and sometimes as a tortoise. Mercury invented the lyre by placing strings across the back of a tortoise shell. Lyra has a distinctive geometrical pattern consisting of a parallelogram and an equilateral triangle with the bright star Vega at one vertex.

36. Cygnus (the Swan) is also known as the Northern Cross. The arrow has also narrowly missed another creature,

37. Vulpecula (the Fox), which lies just south of Cygnus.

38. Hydra (the Sea Serpent) probably represents the Lernean Hydra that Hercules encountered on one of his labors. The head is an asterism. The body straggles almost interminably south and eastward across the sky, below Virgo. With Regulus and Procyon, Alphard (Solitary One in the Sea Serpent), forms a right triangle. At least two zodiacal constellations - Leo (the Nemean Lion) and Cancer - also figure in the labors of Hercules. And Eridanus may be the river that the giant used to flush out the Augean stables.

39. Sextans (the Sextant), a modern group,

40. Crater (the Cup [of Bacchus]), and

41. Corvus (the Crow) appear to stand on the body of Hydra lying between the Sea Serpent and the zodiacal groups Leo and Virgo.

42. Ophiuchus (the Serpent Holder), wrestling with

43. Serpens (the Serpent), is a fitting associate for Hercules.

The two giants lie with their heads almost in contact, their bodies' extending in opposite directions. Ophiuchus appears to tread on the Scorpion; whose sting is striking toward the giant's right leg. The Milky Way, running southward from Ophiuchus through Scorpius,

44. Scutum (the Shield), Sagittarius, and Centaurus, is spectacular.

45. Centaurus (the Centaur) also figured in the legends of Hercules. Sagittarius is also a Centaur, remember.

46. Lupus (the Wolf) has undergone many transformations in history. In my opinion, the original figure represented the Erymanthian boar, which Hercules hunted in company with the Centaurs.

47. Corona Australis (the Southern Crown),

48. Ara (the Altar), and

49. Triangulum Australe (the Southern Triangle) lie on the southern fringe of the Milky Way.

50. Crux (the Southern Cross) consists of four stars, two of the 1st magnitude. It lies in the Milky Way, on the southern border of Centaurus. A dark starless patch of cosmic dust, known as the Coalsack, is silhouetted against the Milky Way.

E. The Orion Family

51. The giant Orion, battling Taurus (the Bull) and followed by his two dogs, is one of the most striking figures of the sky.

Betelgeuse (pronounced *Bet-el-gerz*) is the red star in his right shoulder. Rigel is the bright blue star in the left leg. The central star of the belt is Alnilam (String of Pearls). From Orion's belt hangs a well-defined dagger, sometimes regarded as the handle of Venus' Mirror, an asterism formed in conjunction with the belt and the star in the left hip. The mirror is diamond-shaped. Scorpius, on the opposite side of the sky, is sometimes credited with stinging Orion to death. The Belt stars point toward Sirius, the brightest star in the sky, in

52. Canis Major (the Larger Dog).

53. Canis Minor (the Smaller Dog), having one 1st-magnitude star, Procyon, forms an equilateral triangle with Sirius and Betelgeuse. The dog appears to stand on the back of

54. Monoceros (the Unicorn), which gallops behind Orion in a brilliant region of the winter Milky Way. Orion appears to be standing on

55. Lepus (the Hare).

F. The Heavenly Waters

A large portion of the heavens consists of watery wastes, a sort of celestial aquarium inhabited by creatures natural to that medium. The zodiacal constellations Pisces, Aquarius, and Capricornus lie near the northern border of the celestial sea.

56. Delphinus (the Dolphin) and

57. Equuleus (the Little Horse, which I interpret to be a small sea horse) lie between Pegasus and Aquila. The delicate diamond of Delphinus forms the asterism known as Job's Coffin. Cetus (the Whale or Sea Monster) lies just south of Pisces and Aries. The latter group, portraying the Golden Fleece, took part in a well-known aquatic adventure, the Argonautic expedition.

58. Eridanus (the River) rises near Rigel and meanders southward to its terminus at the bright star Achernar. The rear hoofs of Pegasus strike over the water jar in Aquarius, thus giving an astronomical basis for the association of Pegasus with the mythical spring Hippocrene, supposed to have burst forth at a blow of the horse's hoofs. The stream from Aquarius flows southward to be engulfed by

59. Piscis Austrinus (the Southern Fish). On the edge of the sea, as if wrecked upon the shore, rests the great ship Argo, subdivided into four constellations:

- 60. Carina (the Keel),
- 61. Puppis (the Stern),
- 62. Vela (the Sails), and
- 63. Pyxis (the Mariner's Compass).
- 64. Columba (the Dove) flies near the stern of the Ship.

G. The Bayer Group

The foregoing constellations were known to the ancients. When the astronomer Johann Bayer early in the 17th century delineated the star groups near the South Pole of the sky, he continued the concept of sea and land, suitably introducing sea creatures in the southern extension of the waters:

- 65. Hydrus (the Water Snake),
- 66. Dorado (the Goldfish), with the Large Magellanic Cloud within the constellation borders, and
- 67. Volans (the Flying Fish), on the southern edge of Carina.

On the shore we encounter five Bayer Birds and an Indian:

- 68. Apus (the Bird of Paradise),
- 69. Pavo (the Peacock),
- 70. Crux (the Crane; appropriately just south of Piscis Austrinus) ,
- 71. Phoenix (the Phoenix),
- 72. Tucana (the Toucan), with the Small Magellanic Cloud, and
- 73. Indus (the Indian). Although the name is masculine, Flamsteed drew a female figure. Perhaps the group refers to the Amazonian queen Hippolyta, whose golden girdle was the objective of one of the labors of Hercules. Might not Corona Australis be the girdle itself?

The two remaining Bayer animals lie south of Carina (the Keel [of Argo]). They are:

- 74. Chamaeleon (the Chameleon), a lizard with tongue extended toward the neighboring minor constellation,
- 75. Musca (the Fly, which Bayer originally designed as a bee). Someone, perhaps Halley of comet fame, later changed the designation.

H. The La Caille Family

I consider the 75 groups listed above as the major constellations. There are, however, 13 others, conceived by the astronomer La Caille to fill in the star-poor regions between the Bayer and other groups. With one exception (Mensa) they represent scientific equipment or instruments. They break up the pattern of related families. Nevertheless, since they are currently recognized groups, I must include them in the list of 88 constellations.

- 76. Norma (et Regula), the Level (and Ruler).
- 77. Circinus (the Compasses).
- 78. Telescopium (the Telescope).
- 79. Microscopium (the Microscope).
- 80. Sculptor (the Sculptor's Apparatus).
- 81. Fornax (the Furnace).
- 82. Caelum (the Graving Tool).
- 83. Horologium (the Clock).
- 84. Octans (the Octant), site of the south celestial pole.
- 85. Mensa (Table Mountain at Capetown, site of La Caille's observatory).

- 86. Reticulum (the Net).
- 87. Pictor (the Easel).
- 88. Antlia (the Air Pump).

I. The Milky Way

The Milky Way, neither a constellation nor an asterism, deserves special mention, if only because the luminous band with which it rings the entire heavens has always struck awe into the wondering mind of man. The diffused, hazy strip divides the sky into two hemispheres. Telescopes show that the glow comes from millions of stars, individually too faint to be seen with the naked eye but whose collective brightness is plainly visible.

The Milky Way system, more properly termed the Galaxy, contains about 100,000,000,000 stars, of which our sun is one. The stars are arranged in a flattened spiral, resembling the galaxy NGC 628. The diameter of our galaxy is 100,000 light-years and its thickness about 10,000 light-years. The center, which lies in the direction of Sagittarius, is some 30,000 light-years away. The thin, watch-shaped distribution of the stars accounts for the concentration of stars toward the long diameter. The Milky Way slowly revolves, one turn requiring about 200,000,000 years for a star at the distance of the sun from the galactic center. We do not see the separate spiral arms clearly because of our relatively poor location inside the Galaxy.

Even a small telescope resolves the Milky Way haze into swarms of stars. Many of the more interesting telescopic objects lie close to the Milky Way: the star clusters (both open and globular), the gaseous nebulae (both diffuse and planetary), and the great dU6t clouds that stand out in dark silhouette against the brighter Milky Way background. One of the most conspicuous of these dark patches is the Northern Coalsack, in Cygnus.

In Cepheus and Cassiopeia, the Milky Way comes closest to the north celestial pole. Perseus, Auriga, and Gemini display many interesting fields and beautiful clusters. Some dark obscurations occur between Gemini and the bright fields of Monoceros.

The Galaxy grows brighter through Puppis, Vela, and Carina. Crux, the Southern Cross, has the most pronounced sharp-edged black spot, the Coalsack, which the Bushmen of Africa call the Bag.

Taurus, Norma, Lupus, Scorpius, and Sagittarius are magnificent to the unaided eye as well as when seen through a telescope- This region, in the direction of the galactic center, abounds in nebulae and clusters. The small constellation Scutum is also spectacular. Through Ophiuchus and Aquila we see the Milky Way cut in two by a black rift of obscuring dust. The rift continues from the northern side of Sagitta on into Vulpecula and southern Cygnus.

The distribution of galaxies, sometimes called "external galaxies" (labeled "eg" on the Photographic Atlas Charts, Chap. VI) clearly shows the effect of the obscuring dust. Most of these objects lie quite far from the plane of the Milky Way, where the dust tends to thin out. The Large and Small Magellanic Clouds, which look like patches of Milky Way torn loose and set elsewhere in the sky, are also independent galaxies, the nearest to us of all such objects.