

A long-exposure photograph of the night sky showing concentric star trails around a central point, with a crescent moon visible near the center. The foreground features the dark silhouettes of trees against the starry background.

William Millar

**The Amateur Astronomer's
Introduction to the
Celestial Sphere**

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For Larry Oppliger, Jerry Hardie, Michitoshi Soga, and Leo Parpart
My teachers and my friends

Preface

This is the first of a series of five introductory astronomy books written specifically for amateur astronomers. They are the result of many years of teaching college-level introductory astronomy courses and working with amateur astronomers. Amateur astronomers have a wide variety of backgrounds and levels of current knowledge. As a group, this description also fits the students attending a typical community college.

There are many introductory texts on the market geared for one-semester courses with plenty of full-color photos and drawings. All of them are well-written books covering the many aspects of astronomy. However, I have found that amateur astronomers have a natural desire for a deeper understanding of the sky than the majority of the students for whom these books are written. Therefore I chose to write this series of introductory books with the depth and detail that my interactions with amateurs have led me to believe they desire.

All five volumes in this series use a minimum of mathematics. There is a set of appendices giving greater mathematical details for those readers wishing to learn them, but ignoring the mathematics should not detract from your understanding of the material. The text is written in a conversational style without side-bars, footnotes, or end notes, which, in my opinion, only act to distract the reader. The pages are not a collage of pictures and text boxes. You can start at page one and simply read straight through the story.

The Amateur Astronomer's Introduction to the Celestial Sphere describes the general characteristics of the sky for both northern and southern hemisphere observers. It covers stars and constellations (Chapter 3), and the motion of the sky (Chapter 4). As part of understanding this motion the reader is introduced to the terrestrial and celestial coordinate systems used by astronomers (Chapter 2). The sky maps included with this volume are used for examples of simple conversions between the coordinate systems: larger,

printable copies are available from the book's website, which may be visited at <http://www.cambridge.org/9780521671231>. This volume then goes on to discuss the motion of the Sun and the measure of time (Chapter 4). The cause of the seasons is covered in Chapter 5. The motions and phases of the Moon are discussed in Chapter 6. Solar and lunar eclipses are covered in Chapter 7. Chapter 8 contains a set of sky observation projects to get you started on the types of observations emphasizing the topics discussed in the book.

There are some paragraphs set-off from the text by a little extra space and a line along the left side of the paragraph. I call these, "concept paragraphs."

| *This is a concept paragraph.*

Their purpose is to make sure you see the major points of the discussion. There are also some places where I want to make sure you understand the arithmetic in the discussion and so I've included examples. They look like this:

Example: This is an example of an example.

Each chapter has a set of review questions and short review problems to reinforce your understanding of the material. Make sure you can answer these questions and problems before moving on to the next chapter. The answers are available as a .pdf type file on the book's associated website.

The main difficulty in writing astronomy books is the deep connections between the topics. These connections make hard work out of deciding on the order of topics and deciding how deeply to cover each topic. The deeper you go, the more connections there are to be seen. In certain places within this volume I was forced to drop the discussion of a topic in further detail and leave it to a later volume in the series. This was necessary in part because there is material needed for that detail which is not discussed until the later volume and in part because I needed to keep the number of pages in this volume reasonable.

Most of us are aware that astronomy grew out of astrology. The history of astrology is discussed in the context of the roots of modern astronomy in *The Amateur Astronomer's Introduction to the History of Astronomy* – the next volume of this series. In that discussion, I present the basic ideas of astrology and present both astrologers' and astronomers' points of view in the discussion of its validity. The second volume also covers archaeoastronomy, pre-telescope discoveries, and the work of the major Renaissance astronomers in far greater detail than the astronomy textbooks. It discusses astronomical discovery through the twentieth century.

The third volume, *The Amateur Astronomer's Introduction to the Solar System*, discusses the Sun and the planets. It covers observations of the Sun, the planets' and moons' orbital motions, naked-eye and telescopic appearance, geology and environments – all of which are based on our observations and explorations of the planets. The fourth volume is *The Amateur Astronomer's Introduction to Deep Space*, covering the characteristics of the stars and the galaxies they inhabit. This includes the stellar and galactic classification schemes based on spectroscopy

and observation. The fifth volume is *The Amateur Astronomer's Introduction to Cosmology*, which discusses galactic redshift and its implications for cosmology, and the various cosmological models developed through the ages.

I hope that you find these books both useful and interesting. Please enjoy and learn!

Acknowledgments

Any book project requires the work of many people to complete. I must first thank Dr. Larry Oppliger and Leo Parpart of Western Michigan University for changing a flame of interest in astronomy into a bonfire. Thanks to Dr. Kirk Korista also of Western for encouragement and gently nudging me into doing this project after reviewing an ancient version of the manuscript.

James R. Henningsen provided important aid with some of the photographs. Kevin S. Jung of the Grand Rapids Amateur Astronomical Association (GRAAA) provided important photographs and proof-read the entire manuscript, offering valuable suggestions. Kevin Kozarski of the GRAAA also proof-read the text. I also want to thank the members of the GRAAA and the Kalamazoo Astronomical Society (Kalamazoo, Michigan) for their support.

The Linda Hall Library of Science and Technology provided the photograph from Bayer's *Uranometria* and the United States Naval Observatory provided the clock photos. I had a rather eventful trip to Bolivia with Herb and Shirley DeVries to see the November 1994 total solar eclipse. Thanks go to Herb for allowing me to use his photo of the Diamond Ring in this and other of my publications. The three of us also witnessed the May 1994 annular solar eclipse.

Thanks to my friends and colleagues at Grand Rapids Community College for their help and support – especially Dr. Tom Neils, Bob Cebelak, and Elaine Kampmueller. Tom read the entire manuscript offering many helpful suggestions for clarity and readability. Bob checked my physics and Elaine helped with geology.

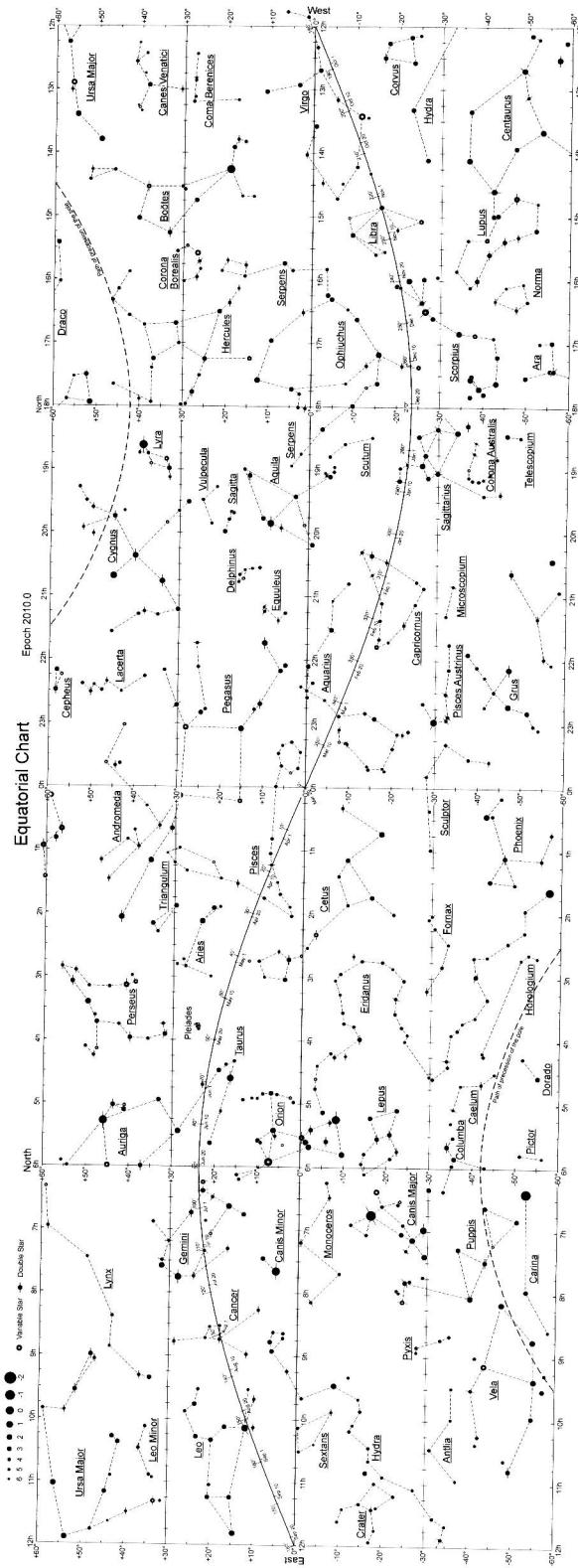
Many thanks go to all the people at Cambridge University Press, particularly to Jacqueline Garget for believing the project to be worth the effort and putting in the work to get it approved by the CUP Syndicate. I believe her patience with

Acknowledgments

my many questions to be inexhaustible. The CUP referees' suggestions made this a far better book than it started out to be.

I also thank my friends and family for putting up with me while I worked on "the book."

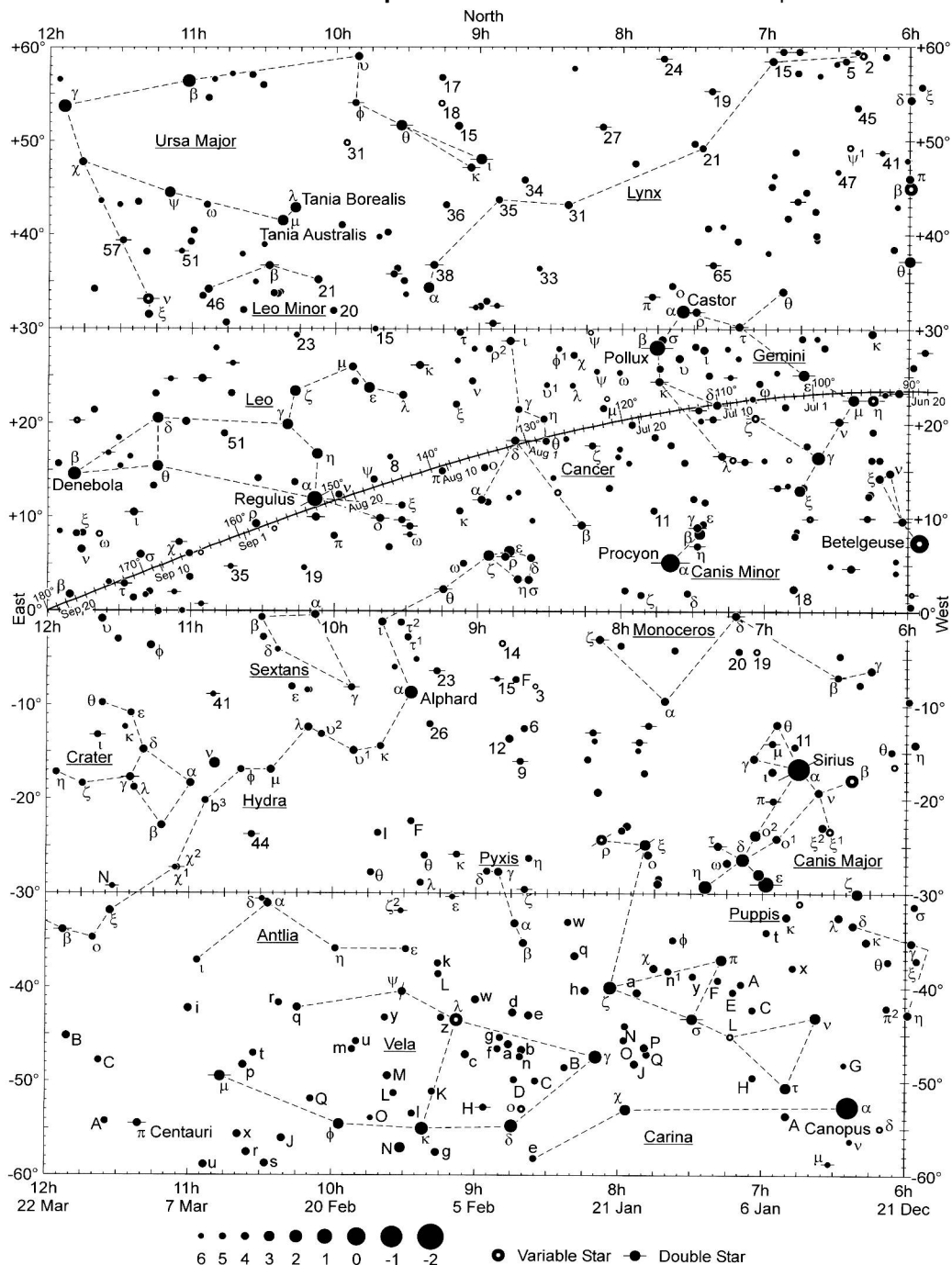
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Equatorial Chart (all)

Equatorial Chart

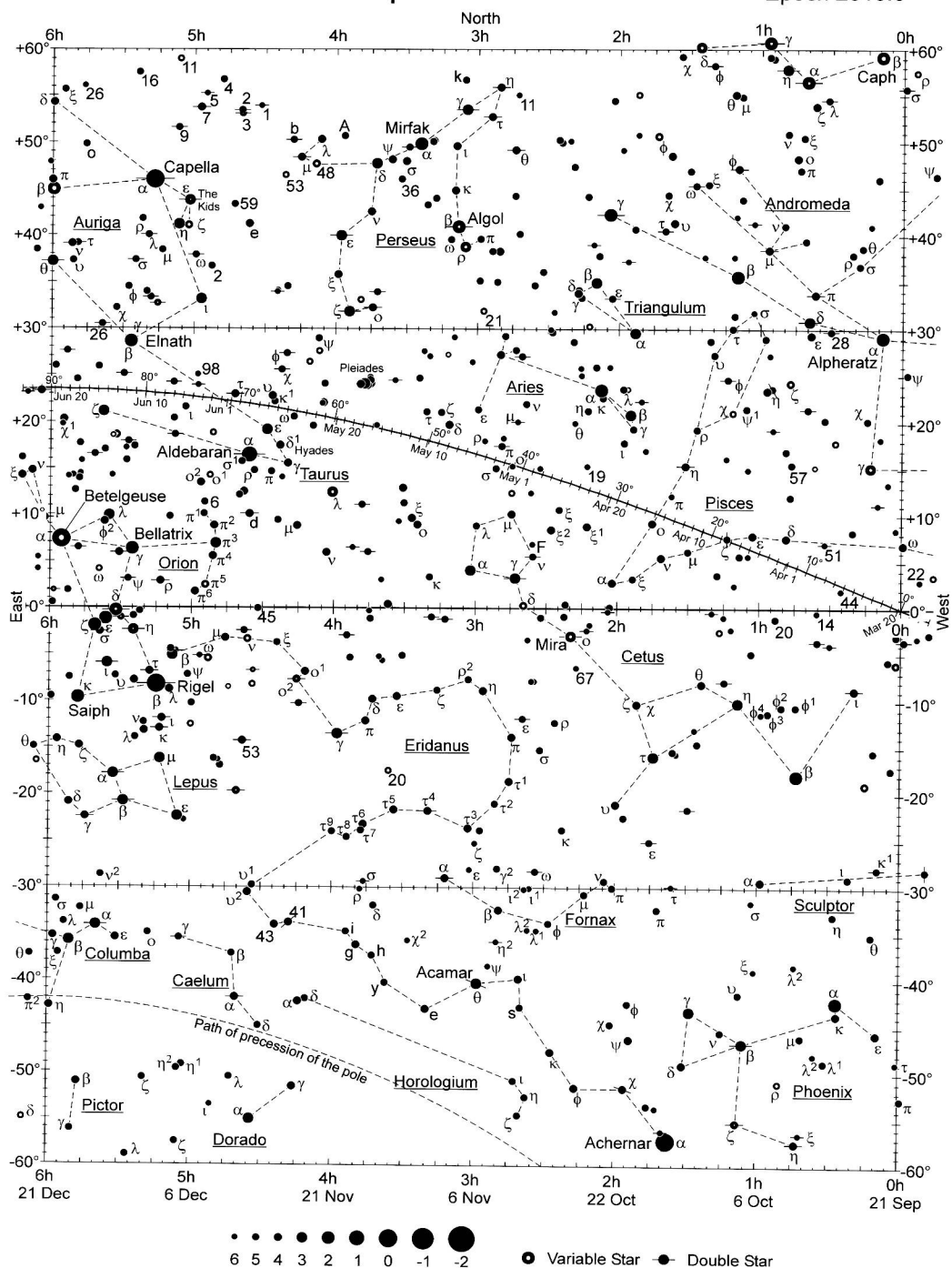
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Equatorial Chart 12–6 hours

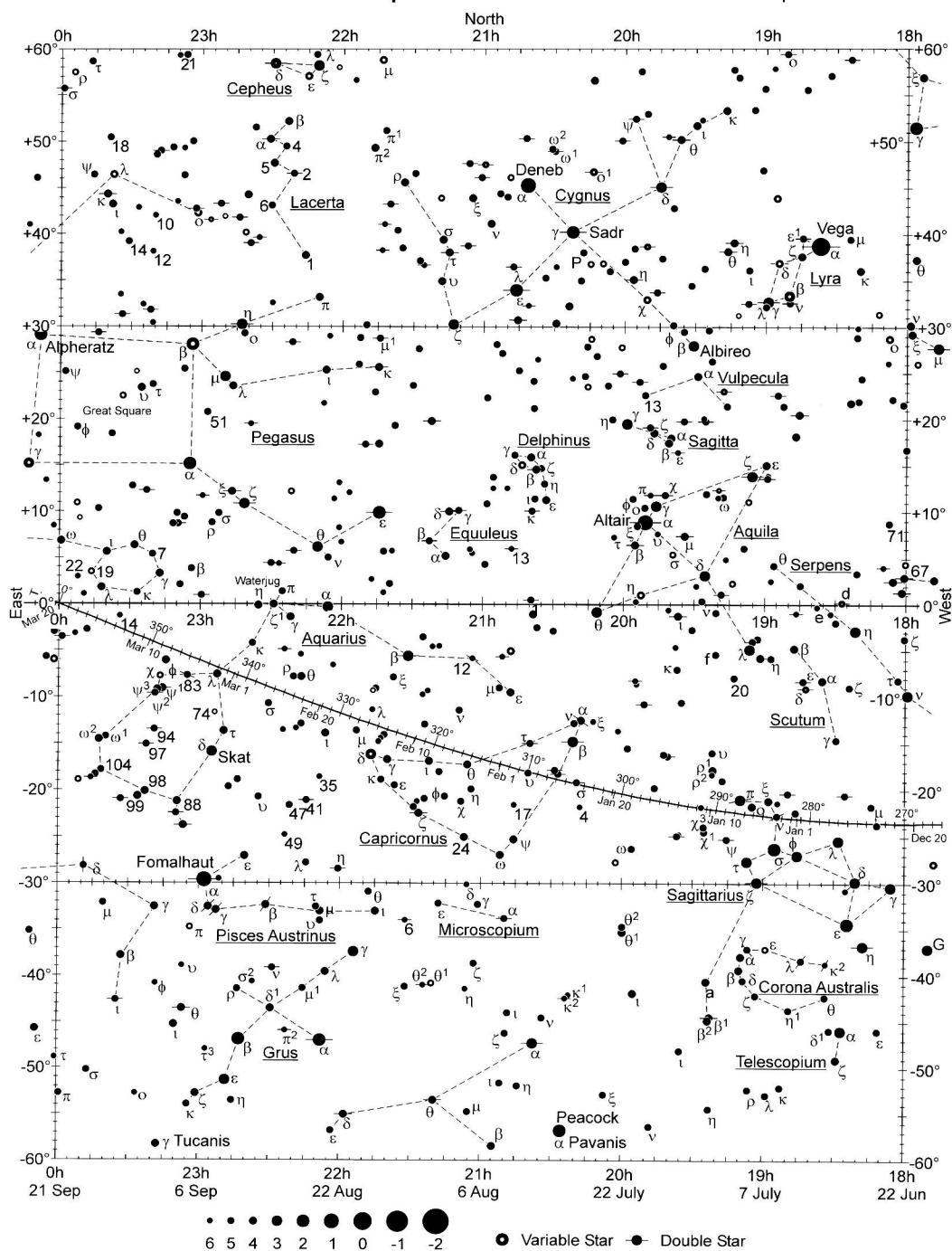
Equatorial Chart

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Equatorial Chart

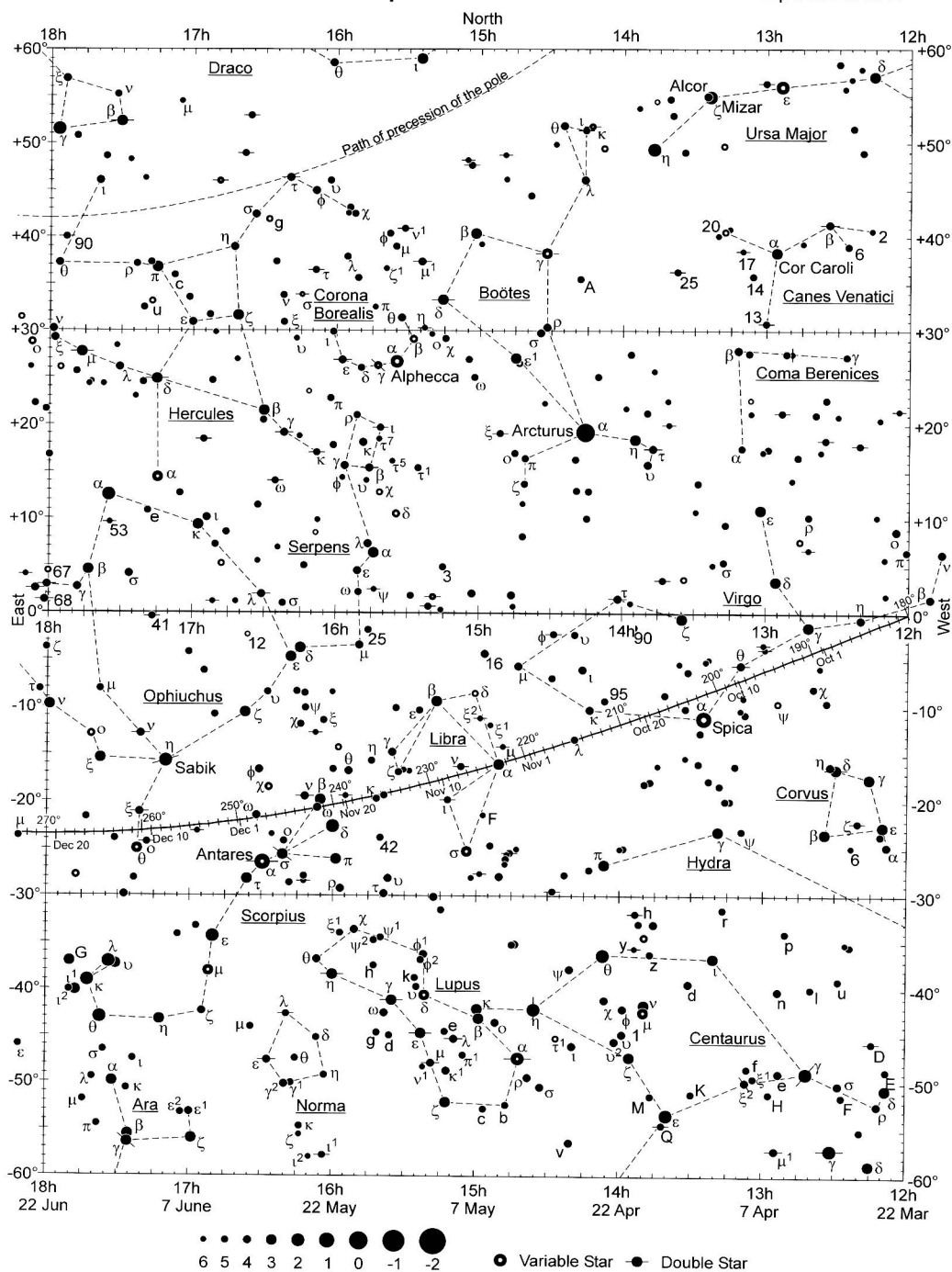
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Equatorial Chart 0-18 hours

Equatorial Chart

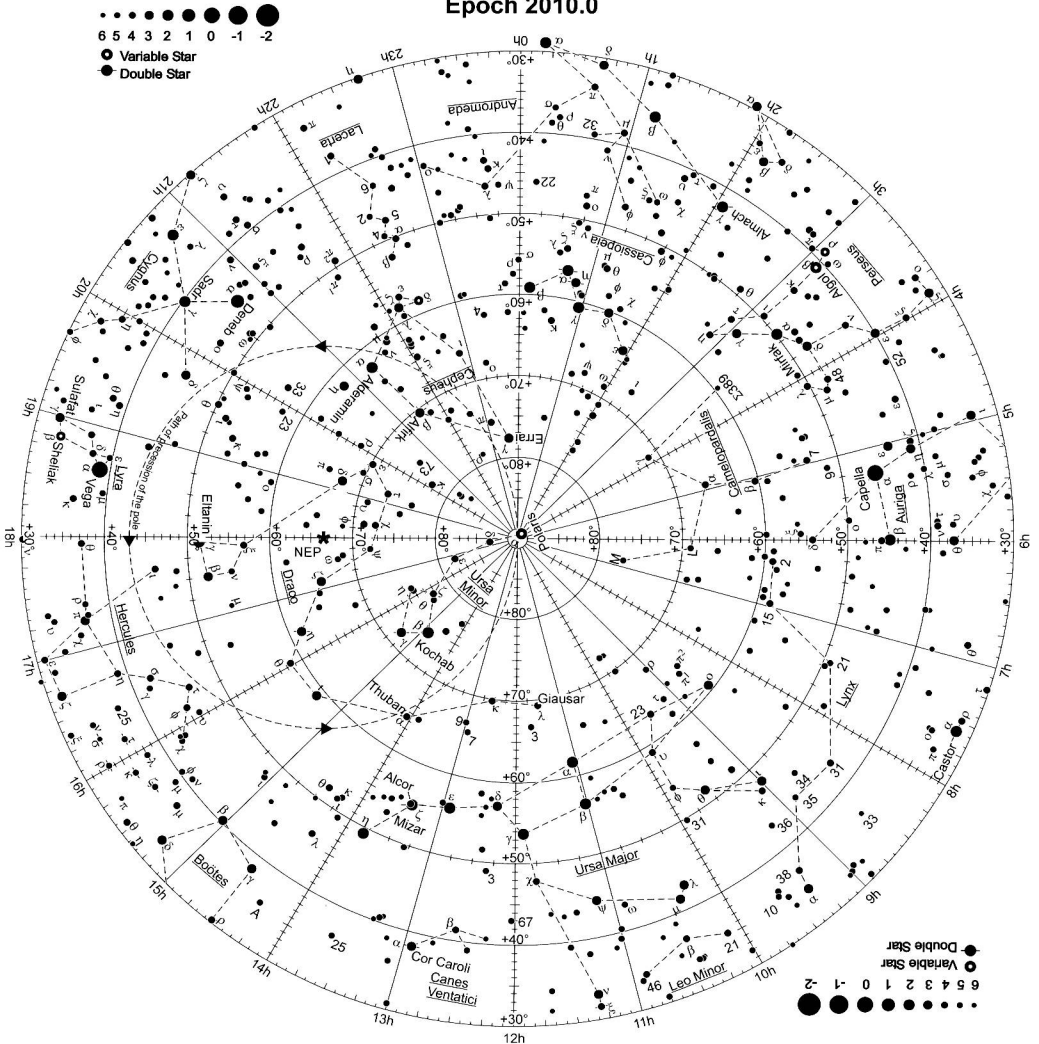
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Equatorial Chart 18–12 hours

North-polar Chart

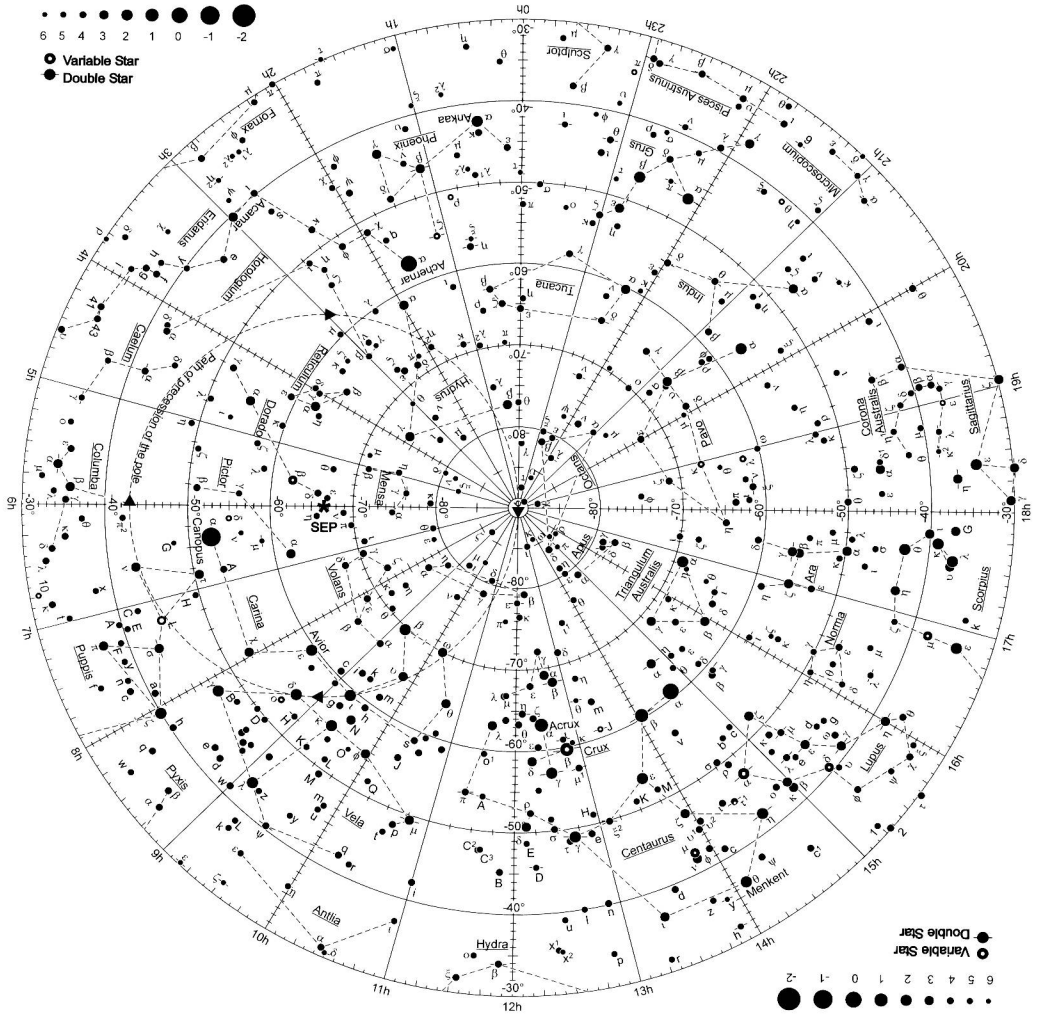
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North-polar Chart

South-polar Chart

Epoch 2010.0



South-polar Chart

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