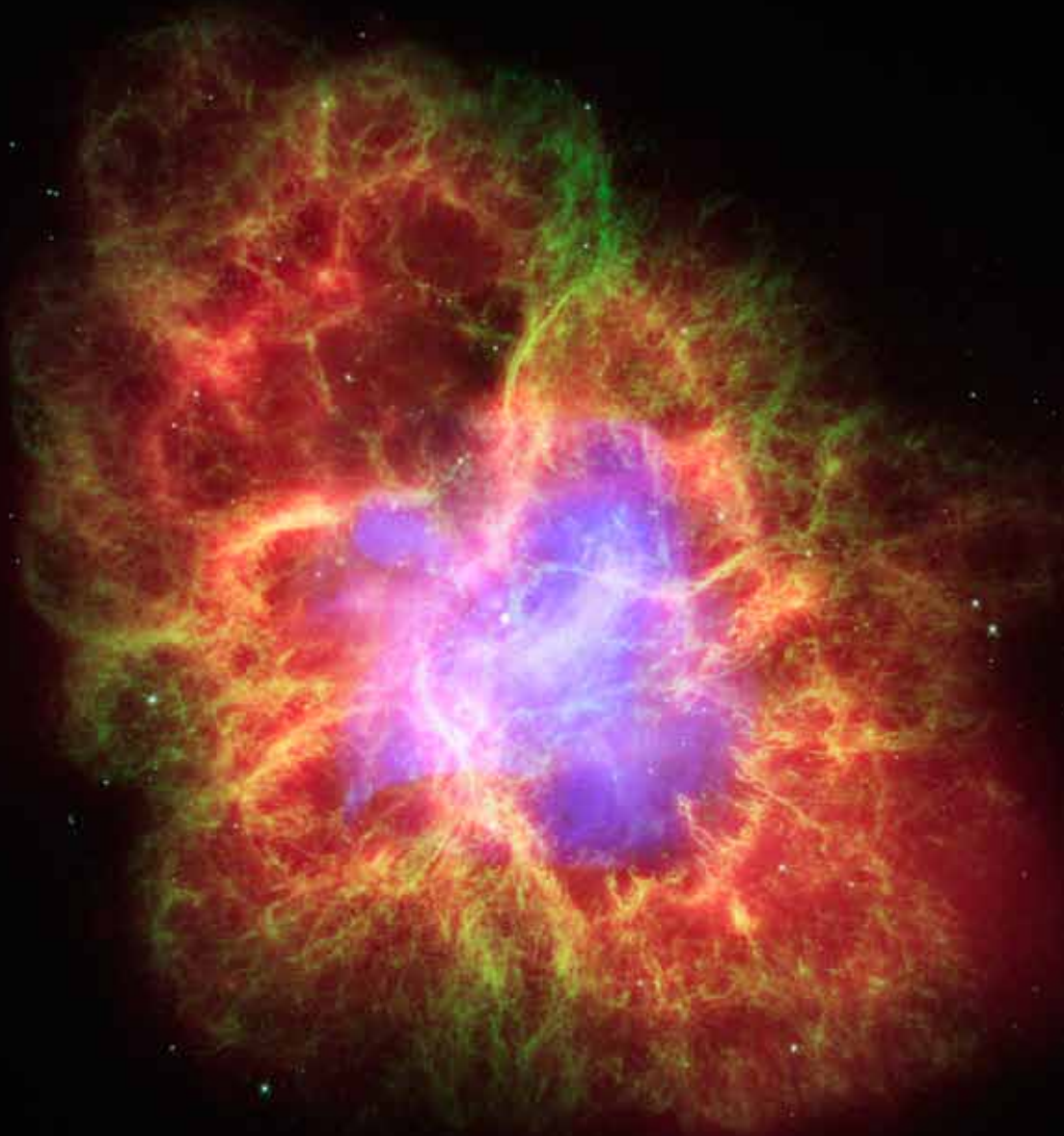




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Deep Sky Field Guide
Cragin, Bonanno

\$59.95

About *Uranometria 2000.0 Deep Sky Atlas*

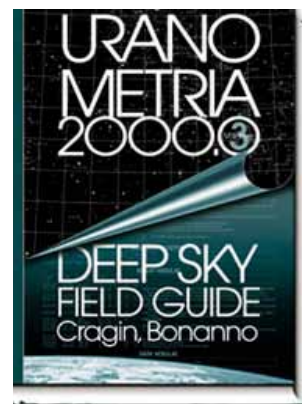
- Over 30,000 non-stellar objects, more than three times the number of any other atlas.
 - ◆ 25,895 galaxies
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- 280,035 stars to 9.75 magnitude which is about what you will see in a 50mm finder scope. Stars are continuously tapered to create a more realistic perspective.
- 220 double page, (18 x 12 inches) charts equally divided (with a generous overlap) between Volume 1 and 2 at a scale of 1.85 cm per degree of declination.
- In 26 areas of heavy congestion, close-up charts are provided at 2 or 3 times normal scale with a stellar limiting magnitude approximating 11
- 22 page magnitude 6.5 star maps keyed to Uranometria 2000.0's charts.

- Objects are indexed by Common Names, Star Names, Bayer Stars, Messier Objects, and NGC/IC Objects in Volumes 1 and 2 and all 30,000+ non-stellar objects are indexed in Volume 3. Know the name but not the position? No problem, these indexes make it a snap to find.
- Acetate overlays, including field-of-view and Telrad finder (Volume 2 only). This by itself is a \$20.00 value — and they securely tuck into a special inside back cover pocket.

The Deep Sky Field Guide answers these questions

- Just what kind of galaxy am I looking at?
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- What is the opacity of that dark nebula?
- Is that bright nebula emission or reflective?
- and, much, much more.

Uranometria 2000.0 Deep Sky Field Guide expands and enhances the Uranometria 2000.0 charts by providing precise data as to location, size, orientation, magnitude, type and much more on non-stellar objects, making your time out under the stars more productive.



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Celestial Atlases

Bright Star Atlas

An Affordable, Go Anywhere Atlas

by Wil Tirion & Brian Skiff

9.00" by 10.00", 32 pages,
softbound, 14 Ozs. ship wt.

\$9.95

This affordable 10 map atlas of the night sky is drawn by Wil Tirion and is based upon the best visual star catalog data available — Hipparcos and Tycho Catalogs with a stellar limiting magnitude of 6.5. Opposite each full page map Brian Skiff of the Lowell Observatory has prepared a tabular listing of interesting objects visible in binoculars or small telescopes. These include galaxies, open clusters, diffuse nebulae, bright nebulae, planetary nebulae, double stars, and variable stars. It also includes a set of seasonal star maps to help orient the user to the night sky throughout practically the entire populated world. Objects in Skiff's catalog are also listed in cross referenced tables. Ideal companion atlas to the larger *Uranometria 2000.0*



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Men, Monsters and the Modern Universe

by George Lovi & Wil Tirion
9.00" by 12.00", 112 pages
hardbound.

\$24.95

...*Men, Monsters and the Modern Universe* lures amateurs into the intricacies of locating stars, clusters, and nebulae through appealing and concise stories once told about the constellations. This approach can be counted on to turn innocent bystanders into committed stargazers...



Sky & Telescope Magazine

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The Arp Atlas of Peculiar Galaxies

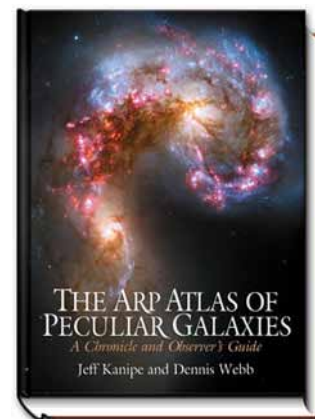
A Chronicle and Observer's Guide

by Jeff Kanipe and Dennis Webb

8.5 by 11 inches, 400 pages,
Hardbound, 4 lb. 2 oz. ship. wt.

\$39.95

This work is both a chronicle of Halton Arp's career and an observing guide to Peculiar Galaxies. Whatever size telescope you have, the point is not to just look for an Arp galaxy, but to observe the unusual structures produced by galactic interactions, gravitational tidal forces, and inherent dynamics. To help you identify these structures, the guide provides detailed diagrams of each Arp field. What can you see? Counter-tails, rings, jets, "wind" effects, plumes, galaxy chains, single- and multi-armed galaxies, and other oddities. Such features may task your imaging and observing skills, but they are what make the Arp galaxies so intriguing. Observers seeking new challenges, a good story, and an important piece of astronomy history need look no further than The Arp Atlas of Peculiar Galaxies: A Chronicle and Observer's Guide.



THE CHRONICLE SECTION IN THIS BOOK INCLUDES

- The processes that make galaxies peculiar
- Halton Arp's early life
- His initial work at Mount Wilson and Palomar
- How and why he constructed the Atlas
- Why he left the Carnegie Institute
- The breakup between Carnegie and Caltech
- His controversial work on galaxy-quasar associations
- Profiles of some of Arp's most prominent discordant redshifts cases

THE OBSERVER'S GUIDE SECTION IN THIS BOOK INCLUDES

- A detailed guide to observing the Arp peculiar galaxies
- 26 sky charts showing the locations of the Arp galaxies by region
- Detailed tables for each sky chart to help you locate them
- Amateur images of all 338 Arp galaxies plus a full set of the original *Atlas of Peculiar Galaxies*
- Annotated schematic diagrams of each galaxy field
- Galaxy characteristics and visual observation narratives
- Arp's explanatory notes from the *Atlas*

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MegaStar is written by a deep sky observer for deep sky observers. It is not a "planetarium" program designed to amuse and while the hours away watching the "dance of the planets." It is for people who spend their time planning their observing sessions and then actually get out under the stars and observe!

MegaStar is not "bloated" software- you do not need the latest protable computer to take it out into the field. It will easily load and run on a Windows 98 portable computer up to the latest Windows 7 computer.

MegaStar will control most commercial telescopes that have a computer interface. It also interfaces with most stand-alone encoders (Tangent, MicroGuider III, BBox, etc) on the market today.

MegaStar is built around an intergrated database that provides extensive cross-references and much else useful information about an object.

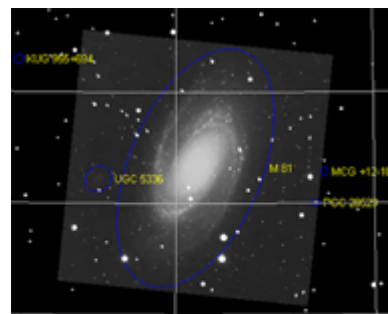


MegaStar allows you to load custom databases of your choosing.

MegaStar allows you to export data in user friendly tables.

MegaStar has the best night vision display in the business.

MegaStar comes with 78,800 Digital Sky Atlas images of non-stellar objects. An optional CDROM can increase this to 208,000 objects. It can also load Real Sky and Digital Sky Survery images that are downloaded from the Space Telescope Science Institute.



Screen shot of a typical MegaStar supplemental image (M81).

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Supplemental Non-Stellar Image Files CDROM

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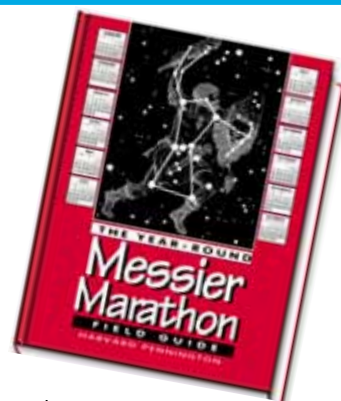
Download the user manual here

Observing Handbooks

The Year-Round Messier Marathon Field Guide

by Pennington,
Hardbound, 8.75" by 11.25", 196 pages, (2 Lbs. 12 Ozs. ship wt.).

\$24.95



This book was written for the person who wants to become deeply familiar with the most famous list of 110 deep-sky wonders, the Messier objects. Using bright "guidepost stars" and detailed sky charts, the novice soon learns how to find the nebulae, star clusters, and galaxies that every amateur astronomer should know.

The observing techniques taught in this book are both easy to learn and powerful, suitable not only for the novice but also for the experienced amateur. By following the sequence of charts presented in the second half of the book, a beginner using Harvard Pennington's methods should be able to locate and identify 25 to 30 Messier objects at any time of year before midnight. Beyond midnight the list expands into the high 80s or low 90s! By working systematically against time, by running the "Messier Marathon", the observer quickly hones crucial observing skills and soon gains a deep familiarity with the night sky. Then, once each year, on a moonless night during late March or early April, observers test their skills by trying to observe all 110 objects that make up the Messier catalog in just one night! It is not an easy achievement, but those who have done the dusk-to-dawn Messier Marathon run it again and again!

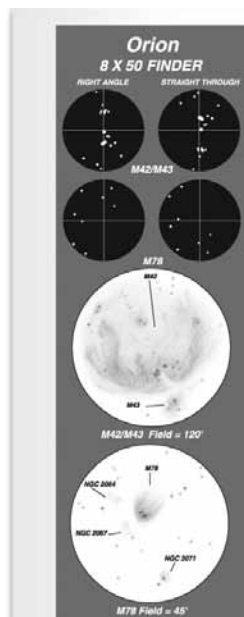
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**BOOK
REVIEW**

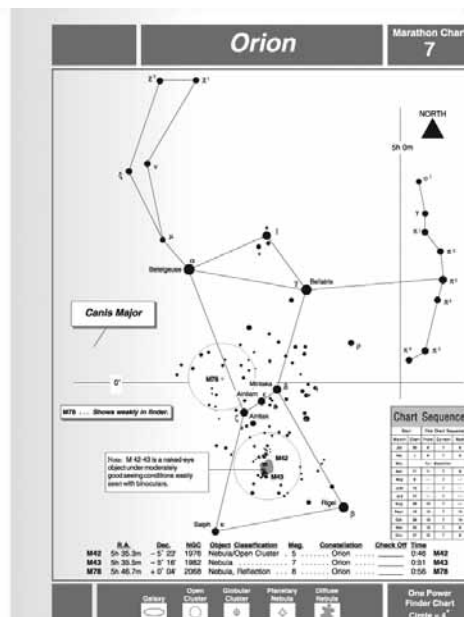
This "guide" is really much more than the title might suggest. It is part star atlas, part descriptive text, part telescope primer, and part strategy session, all held together with the infectious enthusiasm of its author. The whole first third of the book is chock full of practical information on telescopes and observing. Here Pennington does an admirable job of anticipating the difficulties beginners face using a telescope under the night sky for the first time—a perspective that is all too easy for experienced observers to lose sight of. The wealth of helpful pointers and the useful information presented in the opening chapters alone justify the book's price. . . . Here at last is a series of drawings that accurately portray the telescopic appearance of all 110 objects. These drawings are a wonderful resource for the beginning Messier hunter and provide a far better representation of the eyepiece view than the color photographs that dominate astronomical literature. . . . Pennington has provided the next best thing to having an experienced observer at your side guiding you personally through the Messier list. And that's where this book really belongs—at one's side in the field, collecting dew right along with the telescope, red flashlight, and eyepieces.

Sky & Telescope Magazine

The Year-Round Messier Marathon Field Guide is designed around pages like those shown here which take the guess work out of locating Messier Objects. The circles shown on the map of Orion are Telrad finder views. Just place the Telrad as shown and you are very close. Then check (if necessary) the 8x50 finder views shown on the opposite page to zero in on the object. The sketches and accompanying text take the guess work out of any final identification. This technique works year-round so you do not have to limit your fun to a single night in the Spring.



M42 Visual Magnitude: 5
Visual Index: 1
Angular Size: 85"
Nebula in Orion
"Messier certainly did not 'discover' this prominent naked-eye object, but he did determine its exact position in March of 1781 along with that of M43, M44, and M45. Messier's reason for cataloging these objects had to be to bring his list to a round number of 43 objects as these three are naked-eye objects known from antiquity. My question is why did he not include the Double Cluster in Perseus which he saw at 971?"
M42 is possibly the most rewarding deep sky object for a telescope of any size. It has a wealth of eye detail and shows some color in telescopes of moderate aperture. It is famous from its myriad photographs plastered across countless pages of books, magazines and newspapers of every description. One look through an eyepiece will cause you to go back again and again to study this incredible object. A notable feature of the nebula is the Trapezium, a tight compact cluster of four stars arranged in a trapezoidal shape within the nebula just below the "head" of the bird."
Together with M43 (see below), this nebula almost completely occupies an eyepiece of 1" true field. The overall shape of M42 and M43 has always reminded me of a figure from a geology text showing the localized remains of Archeopteryx—the earliest known bird of the Late Jurassic age—as embedded in the graphic simulation from Solenhofen, Germany. I see the "head of the bird" in M42, and the "wings and chest" are M43. The loose cluster M42 M78 and the nebulae M42 M78 to the north make up the "tail of the bird" (outside the field of the sketch).
M43 Visual Magnitude: 7
Visual Index: 2
Angular Size: 15"
Nebula in Orion
Messier cataloged this object along with M42 (see above). See sketch (left) for positive identification and relationship to M42.
M78 Visual Magnitude: 8
Visual Index: 3
Angular Size: 4' x 6'
Reflection Nebula in Orion
There are two 10th magnitude stars (53 seconds separation) in the small 10 minutes by 6 minutes nebula. This patch of luminosity is actually one of the brighter portions of the huge nebula which covers much of Orion and becomes visible in the possibility of hot early type stars embedded within the nebula. It is easy to locate by virtue of its proximity to Betelgeuse—C Orion—and is easily seen in small telescopes and binoculars, although I do not show much detail. This nebula was discovered by Méchain in 1780 and described by Messier later the same year.
It is about 1,000 light-years distant and roughly 4 light-years in diameter.



Observing Handbooks

The Night Sky Observers Guide

"A subtitle to the two-volume *Night Sky Observer's Guide* could have been *Burnham's Celestial Handbook: The Next Generation*"

... Sky & Telescope magazine



BOOK REVIEW

A subtitle to the two-volume *Night Sky Observer's Guide* could have been *Burnham's Celestial Handbook: The Next Generation*. ... (it is) a bible of very deep-sky observing, taking objects constellation by constellation with full page charts and numerous smaller finder charts and drawings. Tables list variable and double stars, and a few individual stars are highlighted. But the meat of the volumes is the descriptions of galaxies, nebulae, and star clusters as they appear through a variety of apertures. If you're looking for targets to keep you busy and challenge your observing skills, *The Night Sky Observer's Guide* has come to your rescue.

Sky & Telescope magazine

...Birders have their bible in the form of Roger Tory Peterson's Field Guide. Bird illustrations, descriptive text, and maps comprise a guide used by birders for decades. Now apply that strategy to observational astronomy and you'll have *The Night Sky Observer's Guide*....the Observer's Guide's generous use of maps, drawings, and photos places it squarely in the realm of a bona fide field guide....an exemplary guide to the deep sky.

Astronomy magazine

The Night Sky Observer's Guide Volume 1: Autumn and Winter

Hardbound, 8.5" by 11", 476 pages, 4 Lbs. 4 Ozs, **\$34.95**

Covers the following constellations: Andromeda, Aquarius, Aries, Auriga, Camelopardalis, Cancer, Canis Major, Canis Minor, Cessiopeia, Cepheus, Cetus, Columba, Eradinus, Fornax, Gemini, Lacerta, Lepus, Lynx, Monoceros, Orion, Pegasus, Perseus, Pisces, Piscis Austrinus, Puppis, Pyxis, Sculptor, Taurus, and Triangulum.

The Night Sky Observer's Guide Volume 2: Spring and Summer

Hardbound, 8.5" by 11", 516 pages, 3 Lbs. 12 Ozs, **\$34.95**

Covers the following constellations: Antlia, Aquila, Bootes, Canes Venatici, Capricornus, Centaurus, Coma Berenices, Corona Australis, Corona Borealis, Corvus, Crater, Cygnus, Delphinus, Draco, Equuleus, Hercules, Hydra, Leo, Leo Minor, Libra, Lupus, Lyra, Microscopium, Ophiuchus, Sagitta, Sagittarius, Scorpion, Scutum, Serpens Caput, Serpens Cauda, Sextans, Ursa Major, Ursa Minor, Virgo, and Vulpecula.

The Night Sky Observer's Guide Volume 3: The Southern Skies

Hardbound, 8.5" by 11", 434 pages, 3 Lbs. 9 Ozs, **\$34.95**

Covers the following constellations: Apus, Ara, Caelum, Carina, Centaurus (expanded coverage beyond that found in Volume 2), Chamaeleon, Circinus, Crux, Dorado, Grus, Horologium, Hydrus, Indus, Mensa, Musca, Norma, Octans, Pavo, Phoenix, Pictor, Reticulum, Telescopium, Triangulum Australe, Tucana, Vela, Volans plus extensive coverage of The Large Magellanic and Small Magellanic Clouds.

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Observing Handbooks

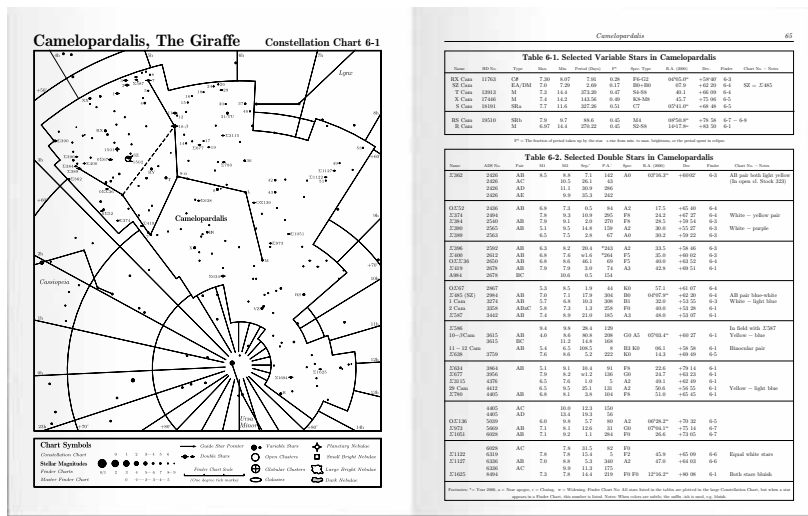
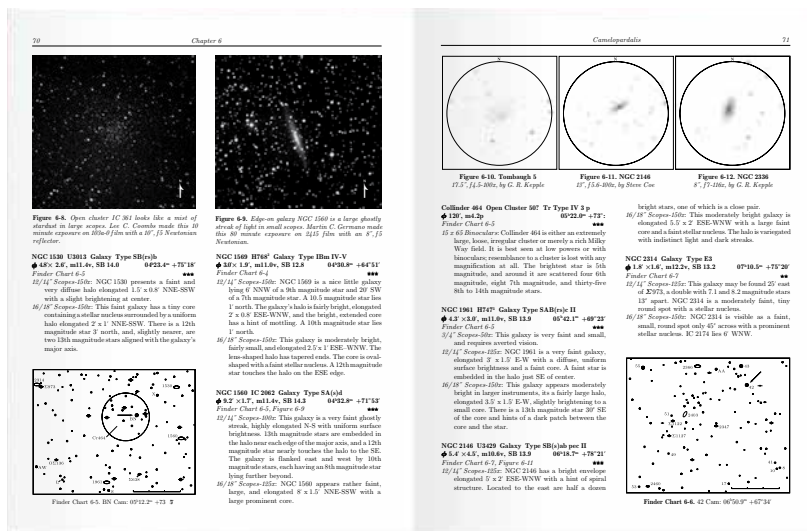
About The Night Sky Observer's Guide

The Night Sky Observer's Guide endeavors to assist the observer in the act of observing—in truly seeing what there is to see in each of the objects described in these pages—because the first step in astronomy is to actually look with attention at what is in the night sky. It began in 1987 when George Kepple and Glen Sanner founded *The Observers Guide*, a bi-monthly magazine that set out to describe, with their readers as active participants, what could be seen with telescopes 8-inches and larger from mid-northern latitudes. Unlike an ordinary magazine it would have a finite life because each issue was devoted to one-or occasionally several smaller constellations. When completed in the early 1990s 64 constellations had been covered.

Though both *The Observer's Guide* and now **The Night Sky Observer's Guide** were aimed at amateurs especially interested in observing galaxies, nebulae and clusters, neither the magazine nor these volumes have neglected double and variable stars. Data tables for doubles and variables within a constellation are provided near its beginning, and these stars are labeled on maps and finder charts. Moreover, the most famous or visually impressive doubles and variables are given written descriptions similar to those for other deep-sky objects.

All 3 Volumes Combined Have:

- 698 Photographs
- 935 Drawings (Eyepiece Impressions)
- 609 Star Charts
- 197 Tables



Object Counts For All 3 Volumes

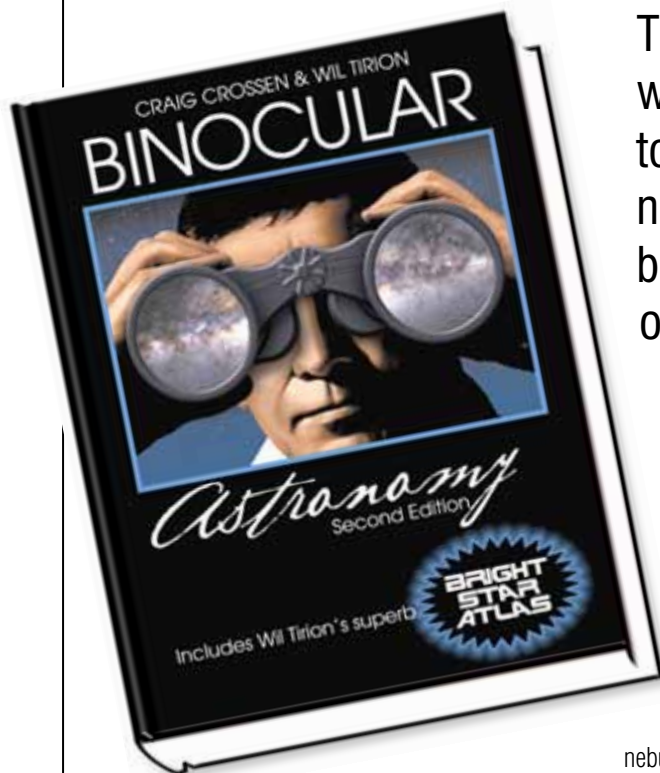
Double Stars 2,749
Variable Stars 556
Galaxies 2,878
Planetary Nebulae 175
Bright Nebulae 259
Dark Nebulae 73
Open Clusters 1,077
Globular Clusters 153
QSOs, Asterisms 14

Total Objects 7,935

A QUICK TOUR OF THE NIGHT SKY OBSERVER'S GUIDE

The four pages shown above illustrate the many features you will find throughout the 1,426 pages of the 3 volumes of NSOG. A constellation map (top left page) and numerous "close-up" maps (bottom left and right pages) make it easy to locate each object discussed in the text. For plotted variable and double stars data are provided in tables near the beginning of each chapter (top right page). A wide range of objects are photographically reproduced (bottom left page) or presented as sketches (bottom right page) making identification much easier. Each object is described as it appears through the eyepiece of various sized telescopes.

Observing Handbooks



There is no better way to learn how to get around the night sky than this book and a pair of ordinary binoculars



BINOCULAR ASTRONOMY

Second Edition

by Craig Crossen and Wil Tirion

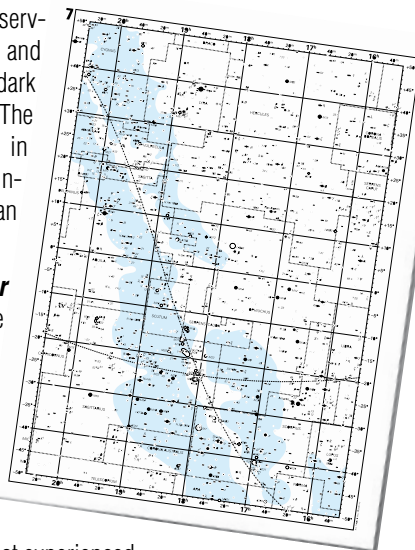
Hardbound, 8.5" by 11.00", 224 pages, hardbound, (2 Lbs. 12 Ozs. ship wt.)

This book and a pair of binoculars are all you need to begin observing the night sky—stars, open and globular clusters, bright and dark nebulae, galaxies, and much more. The

binoculars need not be expensive! Everything described in *Binocular Astronomy* was viewed by the author using a pair of \$40 binoculars he purchased from Sears Roebuck in 1978. The chances are good that you now have or can borrow a pair of binoculars that will do very nicely. You don't have to buy an atlas.

Binocular Astronomy includes a specially adapted version of Wil Tirion's 10-map *Bright Star Atlas 2000.0* (a \$9.95 value!). This atlas plots practically every star visible with the naked eye plus hundreds of deep-sky objects. Tirion has also created 24 detailed finder charts plus a set of seasonal finder charts.

Not only does *Binocular Astronomy* help you locate objects but it explains what they are and how they fit into our understanding of the universe. While there is great aesthetic beauty in the night sky, there is also the Science of Astronomy. You can easily skip over the technical jargon, but you will probably soon find yourself recognizing a star's age by its color, understanding its place in our Galaxy by its distance and much else. *Binocular Astronomy* will show you why most experienced amateur astronomers think that binoculars should be the first optical instrument for the beginner and why they are of value to even seasoned observers.



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BOOK REVIEW

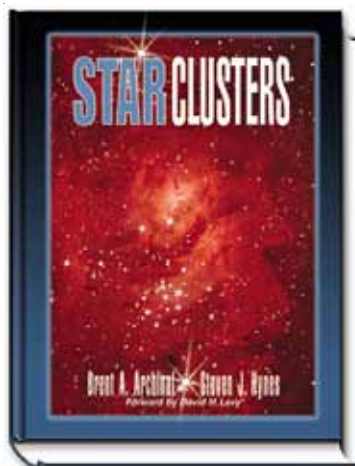
The attention to detail in the observing information bears the hallmark of one who really knows his way around the sky. I would recommend it not so much as a general guide to binocular observing, but as a first-class deep-sky atlas both for observers with binoculars and those with small telescopes.

Journal of British Astronomical Association

Binocular Astronomy is a glorious travelogue of the deep sky as surveyed by Craig Crossen with a pair of cheap Sears 10x50s—the sort of instrument anyone can afford and many households already have in the back of a closet. Crossen describes about 250 interesting objects at some length, weaving in not just their visual appearance but often their astrophysical significance and observational history, including a lot of constellation lore. In these respects the book shines. Unlike many popular authors who copy each other's mistakes, Crossen has done graduate work in modern astrophysics and has researched the ancient constellations from original sources in Syria and Jordan.

Sky & Telescope Magazine

Observing Handbooks



Star Clusters

by Brent Archinal and Steven Hynes
Hardbound, 498 pages, 8.5" by 11", 4 lb. 4 oz. ship wt.

\$34.95

This book covers, in just under 500 pages, star clusters, globular clusters, asterisms and other objects that have been misidentified as such in the Milky Way, Large and Small Magellanic Clouds, Andromeda galaxy, and the Fornax Dwarf galaxy.

It is both a descriptive text of the historical study and astrophysics of some of the youngest (open clusters) and oldest (globular clusters) objects that populate the Universe along with the most up-to-date catalog of these objects in existence—an effort that has taken more than a decade to complete.

Over the last few hundred years many of these objects have been repeatedly rediscovered and subsequently renamed, misidentified as to their true nature, or given incorrect celestial coordinates.

This work catalogs 2,017 clusters in the Milky Way or previously misidentified as Milky Way clusters, including 151 globular clusters or possible globular clusters, and 1,547 open clusters or possible open clusters. Also cataloged are clusters or objects misidentified as such in several of the Local Group galaxies. This includes 2,025 objects in the Large Magellanic Cloud, 419 objects in the Small Magellanic Cloud, 578 objects in the Andromeda (M 31) galaxy and 6 objects in the Fornax Dwarf galaxy.

An extensive Appendix explains the origin of all object names and abbreviations and provides detailed references to the original source material for all object discoveries. In total there are 197 illustrations and 119 pages of extended notes on objects that are either astrophysically or observationally of interest, or have been especially troublesome to catalogers. The approach to developing this catalog has involved a comprehensive survey of discovery documents, visual reports from telescopic observers and personal inspection of the great photographic surveys of the past century. Particular care has been exercised to determine accurate positions across the entire catalog. Finally, in addition to the chapters on the history and astrophysics of globular and open clusters a chapter is devoted to the observation of these objects.

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BOOK REVIEW

You know you have a keeper of a reference book when upon first paging through it you think: "If only I had owned this book when. . . ." That happened to me three times with *Star Clusters*. When I wrote about the dark nebula Barnard 353 in *Cygnus* for *Sky & Telescope* (August 2003, page 118), I sent a lengthy note to my editor about the discordant treatment of the supposed nearby open cluster NGC 6996 by my various atlases. If I had owned this fine book then, I would have needed its single reference, which agrees with my logbook that NGC 6996 is merely a bright patch of the Milky Way.

. . . It's a tribute to the authors and their editors that the book is this mistake-free. More important, hours of spot checks of data in the tables revealed no errors. I will use this reference frequently, with confidence in the quality of its data.

Alan Whitman, Sky and Telescope Magazine

SOLAR ASTRONOMY HANDBOOK \$29.95

Ed. by Beck, Hilbrecht, Reinsch and Völker
Hardbound, 9.00" by 6.00", 515 pages, 2 Lbs. 13 Ozs. ship wt.



Compared with other areas of astronomy observing the Sun has a number of advantages.

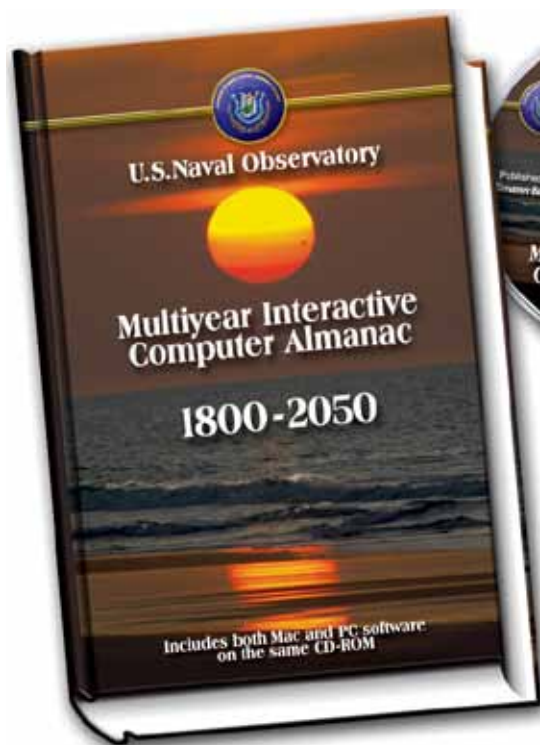
- You can be do it during the day. No sleepless nights!
- There is an abundance of light. Unlike "Deep Sky" astronomy you actually have to discard much of the light reaching your telescope.
- You can set up your observatory in your own backyard—even in the city—here is no need to escape light pollution at remote locations.
- Observations can be made practically every clear day and some simple programs like sunspot counts can be done in just a few minutes.
- You do not need a monster telescope, even a small telescope will show an amazing amount of detail.
- The view is constantly changing, the Sun's appearance has never been, nor will it ever be exactly, the same as today.

The book is divided into four major parts. Part A, describes instruments used in solar astronomy, offers help in making decisions with regard to buying, and provides instructions for building instruments oneself. Part B deals with the many different amateur observation opportunities, while Part C gives encouragement and help in planning and carrying out expeditions to observe solar eclipses and gives details on observation. Part D is an extensive bibliography especially tailored for the amateur solar astronomer.

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Astronomical Almanacs



Includes CD-ROM
with PC (Windows)
and Macintosh
Software

\$29.95

Multiyear Interactive Computer Almanac 1800-2050

by U.S. Naval Observatory
Astronomical Applications
Department

Hardbound, 124+ Page Manual, Includes CD-ROM with
PC (Windows) and Macintosh Software. 1 Lb 4 Oz ship
Wt.

About This Almanac

The Multiyear Interactive Computer Almanac (MICA Version 2.2) is a software system for Windows and Mac OS X created by the U.S. Naval Observatory's Astronomical Applications Department, especially for astronomers, surveyors, meteorologists, navigators and others who regularly need accurate information on the positions, motions, and phenomena of celestial objects.

MICA produces high-precision astronomical data in tabular form, tailored for the times and locations specified by the user. Unlike traditional almanacs, MICA computes these data in real time, eliminating the need for table look-ups and additional hand calculations. MICA tables can be saved as standard text files, enabling their use in other applications. Several important new features have been added to this edition of MICA, including: extended date coverage from 1800 to 2050; a redesigned user interface; a graphical sky map; a phenomena calculator (eclipses, transits, equinoxes, solstices, conjunctions, oppositions, elongations), ephemerides of Jupiter's Galilean satellites and selected asteroids; the JPL DE405 lunar and planetary ephemerides; and updated catalogs of celestial objects, including a new astrometric catalog containing about 230,000 stars.

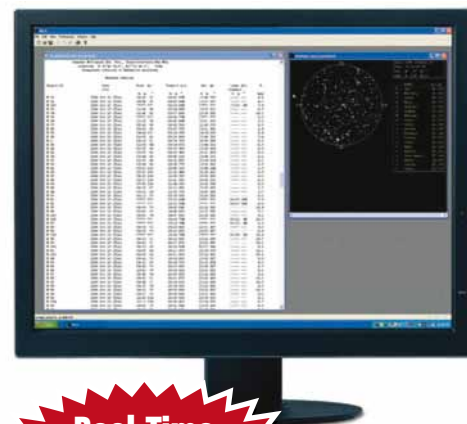
MICA Version 2.2 has been designed for modern computers running the Microsoft Windows® and Apple Mac OS® operating systems. The distribution CD-ROM contains both the PC and Mac editions of MICA.

Minimum System Requirements (PC edition):

- PC-compatible 200 MHz Pentium or higher
- Windows® 98, Millennium Edition, NT 4.0 (with Service Pack 4 or later), 2000, XP, Vista or Win7 operating system
- Internet Explorer version 4.0 (5.0 recommended)
- 64 MB of RAM
- 135 MB of hard disk space (1 MB on the C: drive)
- CD-ROM drive for installation
- VGA or higher-resolution monitor (with screen area set to at least 640 x 480 pixels and 256 colors)

Minimum System Requirements (Macintosh® edition):

- Any PowerPC-based Mac running Mac OS 9.2.2 or higher.
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- 200 MB of hard disk space

Astronomical Almanacs

Planetary and Lunar Coordinates 2001-2020

by Her Majesty's Nautical Almanac Office

Hardbound, 494 pages, 6" by 9", includes CD-ROM with ASCII tables, 2lbs 5 Ozs. ship wt.

\$29.95

This book provides essential information well into the future for those people who require low-precision astronomical positions of the Sun, Moon and planets for tasks such as the planning of observations and the computation of cometary orbits. It is prepared jointly by HM Nautical Almanac Office at Rutherford Appleton Laboratory and the Nautical Almanac Office of the United States Naval Observatory.

The companion CD-ROM to this book contains computer readable ASCII files of the planetary and lunar coordinates. The ASCII files are similar to the tabulated data but without column headings, gaps or pagination and Julian dates are given in full. A readme file giving the structure of these files is provided.



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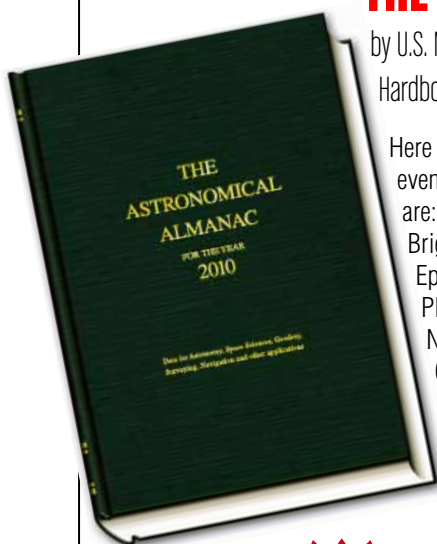
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by U.S. Naval Observatory Astronomical Applications Department and HMS Nautical Almanac Office
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by U.S. Naval Observatory Astronomical Applications Department and HMS Nautical Almanac Office
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This volume is a low precision, abbreviated version of the *Astronomical Almanac*. It is customarily printed several years in advance of the almanac and is intended to provide those with long-range data needs, a source of information.

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Computational Astronomy

Canon Of Lunar Eclipses 1500 B.C. – A.D. 3000

by Bao-Lin Liu and Alan D. Fiala

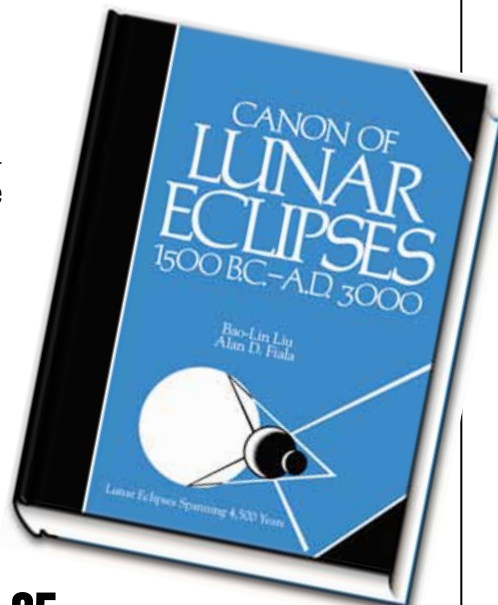
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Eclipses of the Moon are dramatic natural events which have been described in records going back for centuries in many civilizations. This canon of 10,990 lunar eclipses spans a time period exceeding four millennia (–1500 to 3015). Its uses include:

- Chronological dating for history,
- Studies of the Earth's rate of rotation,
- Statistical analysis for cyclical occurrence and frequency distribution, and
- Planning for observation.

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TRANSITS

by Jean Meeus

Softbound, 8.50" by 11.00", 75 pages 1 Lb. 1 Oz. ship wt

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Transits of Venus across the face of the Sun rank among the rarest astronomical phenomena—only 81 occur during the 6,000 year period spanning –2000 to +4000. The last transit of Venus took place over 100 years ago (1882) but 2 occur early in this century (2004 and 2012). Transits of Mercury are somewhat more frequent — 117 occur during the 700 year period +1600 to 2300. Four Mercury transits will take place between 1993 and 2006: 1993, 1999, 2003 and 2006. This book presents elements, geocentric data for all transits of Venus from –2000 to +4000 and Mercury from +1600 to +2300. These elements allow the calculation of local circumstances and Jean Meeus has provided all necessary formulae and worked examples to do this. Also presented is a discussion (without elements) of transits seen from other planets.

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Elements of Solar Eclipses 1951–2200

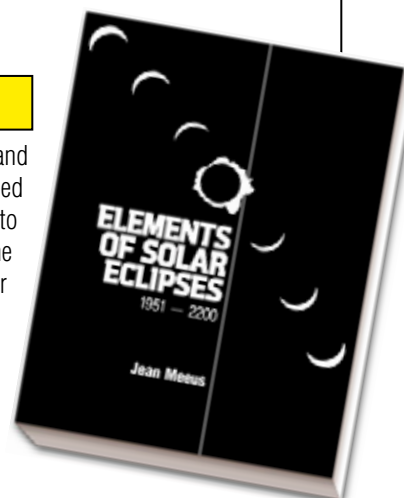
by Jean Meeus,

Softbound, 8.50" by 11.00", 112 pages

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This book contains Besselian elements for the 570 solare eclipses during the 250 years between 1951 and 2200. The elements were calculated using highly accurate modern theories of the Sun and Moon developed at the Bureau des Longitudes of Paris. This is the first readily available computation of Besselian elements to use these theories. Formulae are provided for the calculation of local circumstances, points of the central line or the northern and southern limits, etc. These algorithms can easily be programmed on a home computer and checked against numerical examples included in this book.



Magnetic media version of the Besselian elements from

Elements of Solar eclipses 1951–2200

SCII files on IBM-PC CDROM (6 Oz. ship wt.)

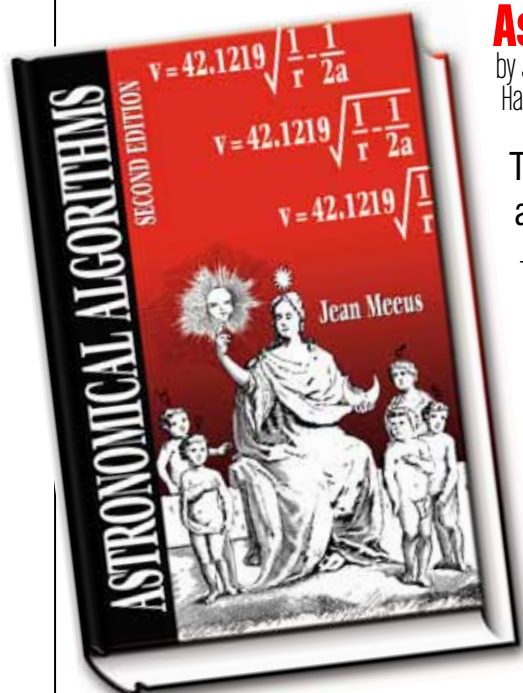
\$19.95

This is a "bare-bones" file — none of the explanatory material provided in the book is included. We assume that purchasers of this data will have purchased the book. There is no copy protection but the data is Copyrighted. A program to determine local circumstances provided by David Eagle is provided with this package.

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Computational Astronomy



Astronomical Algorithms, 2nd Edition

by Jean Meeus

Hardbound, 6.00" by 9.00", 429 pages, 2 Lbs. 3 Ozs. ship wt.

\$29.95

This is the essential reference for anyone who does astronomical computations

The Jet Propulsion Laboratory in California and the U.S. Naval Observatory in Washington, D.C., have perfected powerful new machine methods for modeling the motions and interactions of bodies within the solar system. At the same time in Paris, the Bureau des Longitudes has been a beehive of activity aimed at describing these motions analytically, in the form of explicit equations. Yet, until now the fruits of this exciting work have remained mostly out of reach of ordinary people. The details have existed mainly on reels of magnetic tape in a form comprehensible only to the largest brains, human or electronic. But *Astronomical Algorithms* changes all that. With his special knack for computations of all sorts, the author has made the essentials of these modern techniques available to us all.

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BOOK REVIEW

There are times when an amateur astronomer wants to perform the computations that support his or her observations. *Astronomical Algorithms* is the reference to have for this. Jean Meeus' concise volume collects most of the algorithms and computational techniques an observer might want—covering coordinate transformations, the apparent place of a star, the positions of solar system bodies, eclipse predictions, and much more. Discussions are complete enough to make the equations fully understandable to the novice, and virtually every algorithm includes a fully worked numerical example.... This is a very handy reference, well worth owning, even if you never have to perform a specific calculation. The text alone is helpful for understanding how the theories of celestial mechanics are applied in practice.

—Sky & Telescope magazine

SOLVING KEPLER'S EQUATION OVER THREE CENTURIES

by Peter Colwell

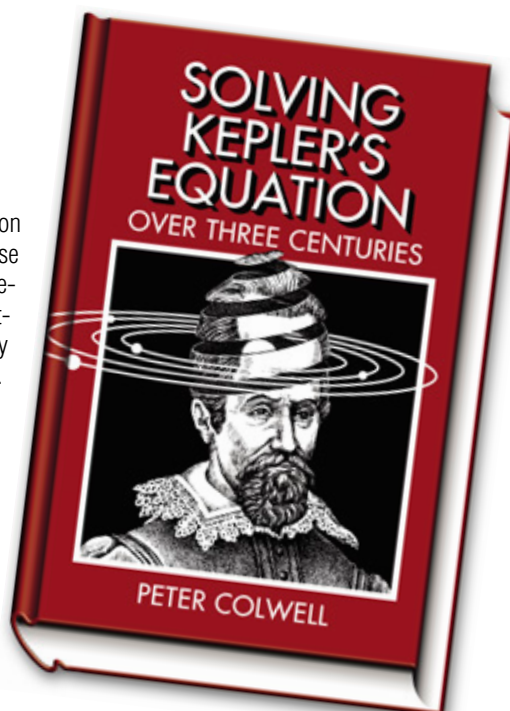
Hardbound, 6.00" by 9.00", 202 pages, 1 Lb. 10 Ozs. ship wt.

\$29.95

The sole subject of our work is Kepler's Equation (KE) $M = E - e \sin(E)$. In common with almost any scientific problem which achieves a certain longevity and whose literature exceeds a certain critical mass, the Kepler problem has acquired an undeniable luster and allure for the modern practitioner. Any new technique for the treatment of transcendental equations should be applied to this illustrious test case; any new insight, however slight, lets its conceiver join an eminent list of contributors. The idea to gather all the work on the Kepler problem is not new. Early work was surveyed in Melander [1767], Detmoldt [1798] and Brinkley [1803], and much of the recent work was described in Danby [1983], Burkhardt [1983] and Gooding [1985]. In addition, various partial bibliographies have appeared which contain extensive references to the Kepler problem. Perhaps the most cited has been Radau [1900]; others are Struve [1860], Houzeau [1882], Herglotz [1910], and Wood [1950a].

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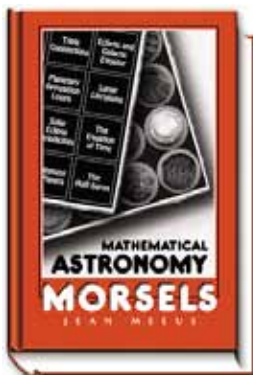
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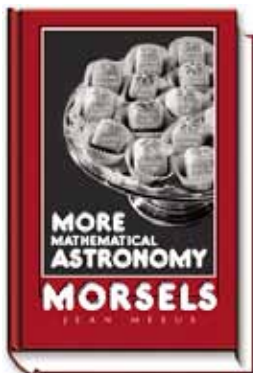
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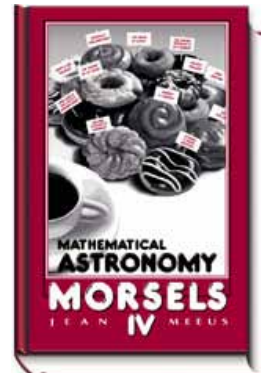
Jean Meeus' renowned **Mathematical Astronomy Morsels** series discusses a wide range of celestial configurations, cycles, and curiosity that Roger Sinnott observed in his Foreword to the first **Mathematical Astronomy Morsels** were "things almost impossible to find by paging through almanacs or scrolling through time with a computer's planetarium program." In the first Morsels Meeus explores 62 different subjects under 7 categories: The Moon, Eclipses and Occultations, Planetary Motions, Planetary Phenomena, On the Celestial Sphere, Statistics, etc., and Varia.

In **More Mathematical Astronomy Morsels** Meeus goes on to explore 75 more subjects, some of which were suggested by readers and friends, while others were inspired by actual (sometimes fictive) astronomical events, such as the so-called brightest Full Moon of December 1999, the recovering of asteroid Albert in May 2000, the long-duration lunar eclipse of July 2000, or the coming perihelic oppositions of Mars in August 2003. Morsels III continues with another 57 subjects dealing with the Moon, eclipses, planetary motions and phenomena, the Celestial Sphere and 5 varia.



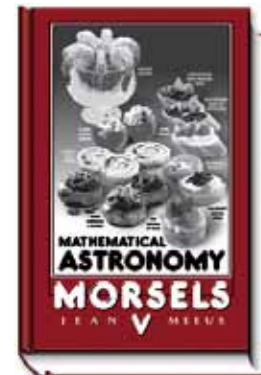
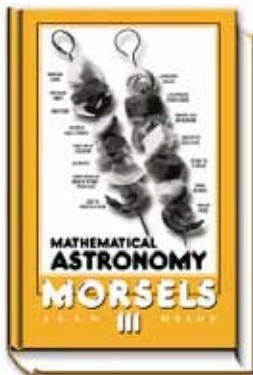
In **Mathematical Astronomy Morsels III**, Jean Meeus deals masterfully with a host of new questions about eclipses and planetary conjunctions — things that anyone from a curious child to a serious skywatcher might wonder about. The sky's rhythms are not strictly repetitive, as he proves time and again by finding entertaining quirks in the motions of the Moon and planets.

In his Preface the author hints that some readers might accuse him of practicing "old" astronomy. Don't let that fool you. The problems he tackles would have fascinated astronomers of the early 20th and prior centuries, but those poor souls faced a brick wall of computational difficulty. They had to work out all their answers laboriously, with a pencil and paper. Freed from that limitation, the author uses today's computers to address each topic with a rigor and finesse beyond the wildest dreams of any old-time practitioner.



Not too far into **Mathematical Astronomy Morsels IV** Meeus cites Maurice Ravel's *Une Barque sur l'Océan* (a boat at sea) piano piece as launching point into a study of when a horizon skimming Moon might look like a boat at sea. Interested? Here are 68 more subjects that have washed upon the beach of Jean Meeus' imagination.

In **Mathematical Astronomy Morsels V** Meeus introduces 69 new subject ranging from the size of the eclipsing Moon's shadow on the Earth's surface, the longest and shortest occultations, the motions of the celestial pole (nutation), duration of sunrise and sunset, stars that do not belong to "their" constellation and the French Republican Calendar and much, much, more.



Computational Astronomy

FUNDAMENTALS OF CELESTIAL MECHANICS

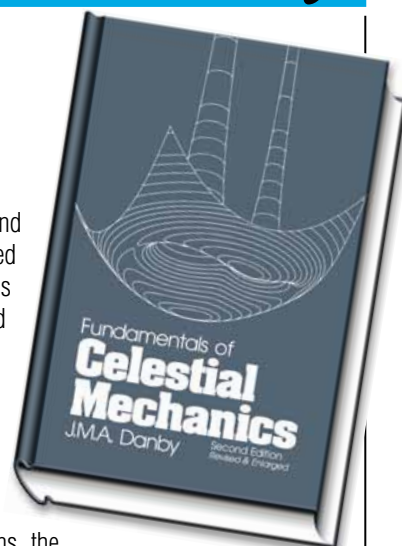
Second Edition, Revised and Enlarged

by J.M.A. Danby

Hardbound, 466 pages, 2 Lbs. 7 Ozs. ship wt.

\$29.95

This is an introductory text that should be accessible to a reader having a background in calculus and elementary differential equations. The original edition has been radically revised, and emphasis is placed on computation. The numerical analysis needed for the computations is derived, and sample programs (run on an IBM-PC) are included. There are introductory chapters on the astronomical background and on vectorial mechanics. Sections dealing with the problem of two bodies include the use of universal variables, several methods (including that of Laguerre) for solving Kepler's equation, and three methods for solving the two point boundary value problem. The chapter on the determination of orbits includes two versions of Gauss' method, the application of least squares and an introduction to recursive methods. The chapter on numerical methods has been expanded, and includes three methods for the numerical integration of differential equations, one of which has full stepsize control. There are also chapters on perturbations, the three- and n-body problems, the motion of the Moon and the rotations of the Earth and Moon. The appendix includes numerical tables and derivations of properties of conic sections that are used in the text. The text includes several hundred problems, and suggested computer projects. The computer listings found in the book are available separately, along with a selection of other programs, on IBM-PC CDROMS.



BOOK REVIEW

...The select group of scientists and engineers who dedicate their career to celestial mechanics consider the author's book of fundamental importance. The original edition of 1962 appeared when the author worked at Yale University with several of the giants in our field (Brouwer, Clemence, Eckert, Hagihara, Herget, etc.). The considerable influence of the original edition on our field is surpassed by the present second, revised and significantly enlarged edition. The author often referred to his book as "Fun in celestial mechanics", and while this was certainly true for the original edition, it is even more applicable to the second edition.

Mathematical Reviews — American Mathematical Society

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Optional Source Code and demonstration programs in Borland BASIC **\$15.95**

Optional Source Code and demonstration programs in Borland Pascal **\$15.95**

METHODS OF ORBIT DETERMINATION FOR THE MICROCOMPUTER

by Dan Boulet

Hardbound, 6.00" by 9.00", 564 pages, 2 Lbs. 9 Ozs. ship wt.

\$29.95

This book describes how the principles of celestial mechanics may be applied to determine the orbits of planets, comets, and Earth satellites. More specifically, it shows how a dedicated novice can learn, by first-hand experience:

- How orbital motion conforms to Newtonian physics,
- How a set of orbital elements can be translated into quantities which can be compared with observations, and
- How a record of observed motion can be used to determine an orbit from scratch or improve a preliminary orbit.

Until recently, this exciting adventure with nature was beyond the reach of nearly all non-specialists. However the power of the microcomputer has swept away the drudgery of tedious calculations fraught with endless opportunities for careless error. With this book and a computer the enthusiast may have the satisfaction of conquering problems which preoccupied astronomy for hundreds of years, and, in the process, gain a fresh appreciation for the genius and industry of the great mathematicians of the seventeenth, eighteenth, and nineteenth centuries.

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Lunar Tables And Programs From 4000 B.C. TO A.D. 8000

by Chapront-Touze and Chapront

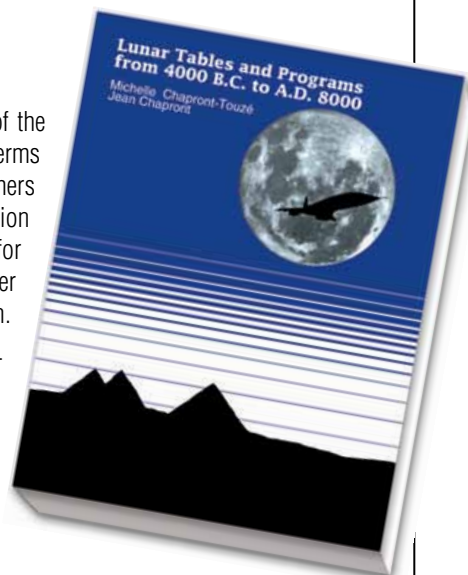
Softbound, 8.50" by 11.00", 164 pages, 1 Lb. 5 Ozs. ship wt.

\$19.95

This book contains two sets of tables for the geocentric motion of the Moon.

The first set provides time-dependent expansions of the longitude, latitude, and radius vector of the Moon, referred to the mean ecliptic and equinox of date. These tables include a large number of terms in order to ensure a sufficient precision in the present period for most users. For historians and others who do not need this full precision, procedures are given for computing middle- and low-precision coordinates that use a much smaller number of terms of the tables (with low-precision, 72 terms for the three coordinates inclusively). Included are formulae for computing coordinates referred to other reference frames, in particular the true equator and equinox of date, and for corrections of aberration.

The second set of tables provide expansions of the semimajor axis, eccentricity, sine of half the inclination, longitude of perigee, longitude of node, and mean longitude, referred to the mean ecliptic and equinox date. These tables are intended for the user who does not need high precision. For better precision, formulae for computing the osculating orbital elements from the full tables of the first set are given.



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Computer program listings in FORTRAN, BASIC and PASCAL are provided to implement the tables and formulae presented in the book. These programs display menus which allow easy computation of lunar coordinates in various reference frames and orbital elements.

\$19.95 each

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THE ORRERY: Models of Astronomical Systems

Includes IBM-PC compatible software in BASIC on CDROM

by Foster

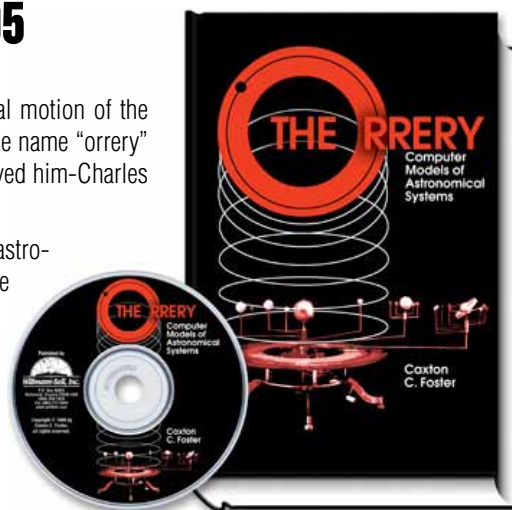
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An orrery is a mechanical device designed to demonstrate the rotation and orbital motion of the earth, and the orbital motion of the Moon and the planets. The device was given the name "orrery" by its inventor, John Rowley, as a gesture of gratitude to the nobleman who employed him—Charles Boyle, the fourth Earl of Orrery (1676-1731).

This book tells you how to exploit the power of the computer to model dozens of astronomical systems. BASIC software (on CDROM) includes both source and executable files.

A sampling of subjects covered include: Simple Harmonic Motion; The Doppler Effect; Non-Spherical Masses in Orbit; Trojan Stability; Orbital Resonances; Ovenden's Principle; Size Distributions of the Minor Planets; Global Positioning System; Gravitational Lenses; Harmonies Among the Stars; An Animated Anal-emma; Stability Zones; Solar Sailing; The Heliogyro; Build a Galaxy Moon Phase, plus much, much more.



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Planetary Programs And Tables From -4000 To +2800

Tables for the motion of the Sun and the Five Bright Planets from -4000 to +2800 and Tables for the motion of Uranus and Neptune from +1600 to +2800

by Bretagnon and Simon with Foreword by Meeus

Softbound, 8.50" by 11.00", approx. 165 pages, 1 Lb. 5 Ozs. ship wt.

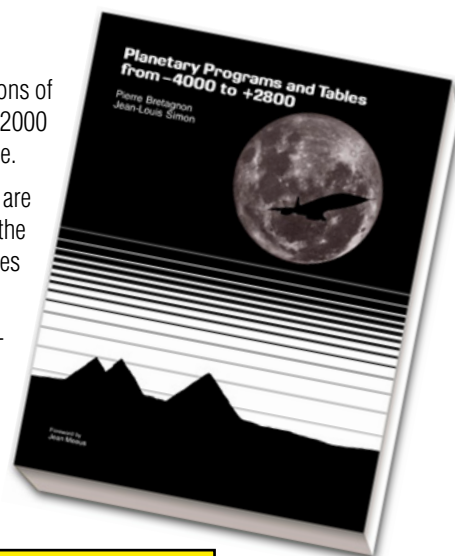
\$19.95

The tables and computer programs detailed in this book allow the computation of the positions of the Sun, and 7 planets with a precision better than 0.01 degree over the period -4000 to +2000 for Mercury, Venus, Mars, Jupiter and Saturn and +1600 to +2800 for Uranus and Neptune.

Compact tables and simple computations of the Sun and planets on a small computer are described in this book. Time-dependent expansions of the longitude and radius vector of the Sun as well as the heliocentric coordinates of the planets are provided. These coordinates refer to the mean equinox and ecliptic of date.

For the Sun, Mercury, Venus and Mars each coordinate is represented by only by one formula provided for the entire period -4000 to +2600. This formula includes between 5 and 60 terms depending on the coordinate and planet.

For Jupiter, Saturn, Uranus and Neptune the coordinates are expressed for time-spans of five years by power series with seven coefficients. The period -4000 to +2600 is then constituted by 1320 time-spans of five years. In addition to the tables, formulae for corrections of aberration and nutation which allow you to compute apparent geocentric coordinates are provided.



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Various computer programs in **FORTRAN (\$29.95)**, **BASIC (\$19.95)** and **Borland PASCAL (\$26.95)** are provided to implement the tables and formulae presented in the book. These programs display menus which allow easy computation of lunar coordinates in various reference frames and orbital elements. Also available are more robust programs **NEWCOMB (\$39.95)** and **BRESIM (\$39.95)**.

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Astronomical Formulae for Calculators

Fourth, Revised Edition

by Jean Meeus, Foreword Roger Sinnott

Softbound, 6.00" by 7.00", 201 pages, published 1988, 1 Lb. 2 Ozs. ship wt.

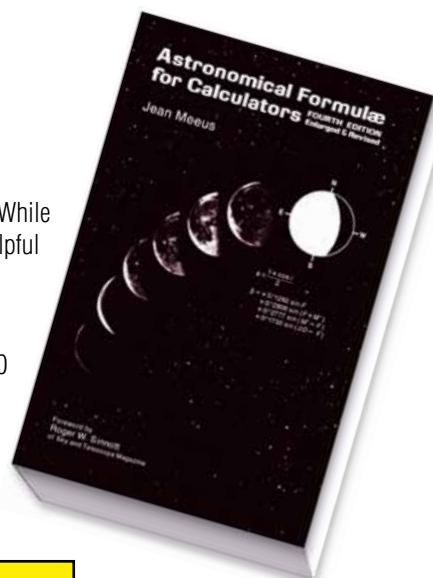
\$19.95

Since its first European printing in 1979 this book has met with world-wide acceptance. While originally written for the programmable scientific calculator, many persons have found it a helpful aid to writing programs for microcomputers.

From the reviews:

"No serious observer can afford to be without Jean Meeus' latest book. In just under 200 pages, he has covered most of the calculations that one is likely to encounter in practical, computational astronomy. The writing is crisp and clear throughout and well formatted."

—*Journal of the Royal Astronomical Society of Canada*



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Computational Astronomy

Everything You Need to Build a Fundamental Ephemeris

The how-to-do-it book: *Fundamental Ephemeris Computations* + The data: *JPL data on CDROM*

FUNDAMENTAL EPHEMERIS COMPUTATIONS

For use with JPL Data

Includes source code in Basic and C on CDROM

\$29.95

by Paul J. Heafner

Hardbound, 6.00" by 9.00", hardbound, 320 page, 2 Lbs, 3 Ozs. ship wt.

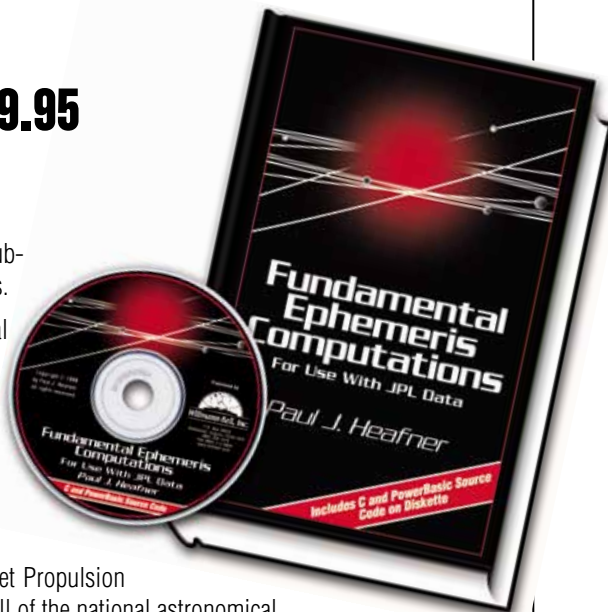
The primary goal of this book is to present a library of useful PowerBASIC and C sub-programs and functions that can be combined to make powerful application programs.

These routines cover both elementary and advanced topics in computational celestial mechanics and spherical astronomy such as time systems, precession, nutation, coordinate transformations, orbital elements and ephemerides, reduction to apparent place, rise/transit/set times for celestial objects, and use of the JPL ephemerides.

Care has been taken to present the results of computations in the same form as the corresponding data in the *Astronomical Almanac* and at least to the same precision.

This book is the only one describing how to obtain, process, and use the official Jet Propulsion Laboratory ephemeris data files. The JPL ephemerides form the basis of practically all of the national astronomical almanacs, including the *Astronomical Almanac*.

In addition, with this book a disk that includes enhanced PowerBASIC and C versions of the original JPL FORTRAN processing software that manipulates the data files. Today, these ephemerides are considered to be the final word on planetary ephemerides, and now the serious non-professional who wants to make use of them can do so.



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JPL PLANETARY AND LUNAR EPHEMERIDES ON CD-ROM

Standish et al.
14 Ozs. ship wt.

\$24.95

This CD contains three Jet Propulsion Laboratory Planetary and Lunar Ephemerides along with associated reading and interpolating routines. DE200, DE405, DE4061, and LE406 allow a competent programmer to obtain the rectangular coordinates of the Sun, Moon, and nine major planets by means of a subroutine written

in standard Fortran. When used with the routines described in *Fundamental Ephemeris Computations* (see above) it is possible to build a complete ephemeris.



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ASTROPHYSICS WITH A PC

An Introduction To Computational Astrophysics

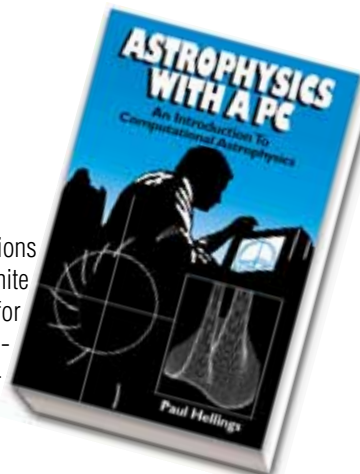
by Hellings

Softbound, 6.00" by 9.00", 260 pages, 1 Lb. 8 Ozs. ship wt.

\$19.95

Among the subjects covered are the morphology of comet tails, meteor dynamics, distance calculations of wide binary stars, polytropes, homogeneous stellar models, stellar atmospheres, the structure of white dwarfs, star formation in the galaxy, individual stellar orbits in the galaxy and cosmological models for the Universe. The relevant formulae and physical processes are discussed with qualitative physical arguments. The author provides numerical expressions, flowcharts and sample IBM-PC programs in Quick-Basic that demonstrate these processes.

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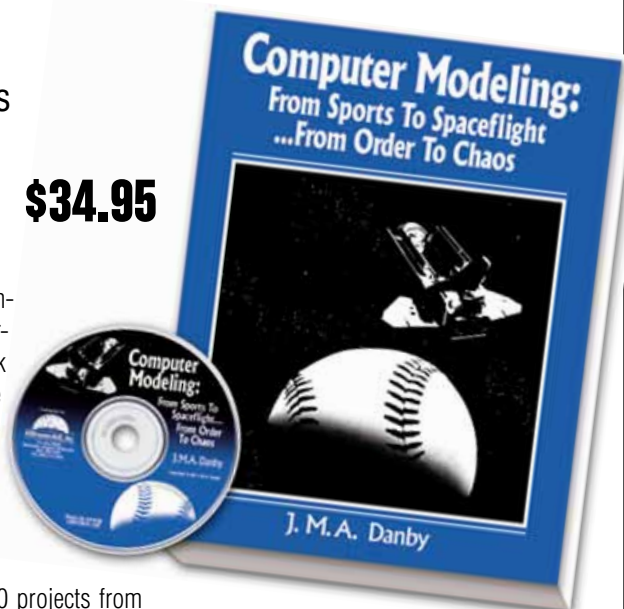
By J.M.A. Danby

Softbound, 422 Pages, 8.5 by 11 inches, 229 Illustrations, 2 Lbs. 13 Ozs. ship wt.,

\$34.95

Much of the material in this book has been used for over fifteen years in teaching an interdisciplinary one semester course in computer modeling to undergraduates, principally in engineering, physics and mathematics. The book is structured for those who do their own programming, but is also suitable for individuals using "packages" for solving systems of differential equations. The subjects covered are exceptionally diverse and include chaotic systems; population growth and ecology; sickness and health; competition and economics; sports; travel and recreation; space travel and astronomy; pendulums; springs; chemical and other reacting systems.

Accompanying each book is software on CD-ROM which includes over 50 projects from this book - denoted in the text by a CD-ROM symbol. The programs are menu driven with ample help files and make use of graphic and animation techniques to demonstrate the various phenomena being modeled. The programs are written to be run on MS-DOS platforms. The minimum hardware configuration is an IBM compatible 386-level machine with math coprocessor, mouse and VGA color monitor. The programs require 8.5 Mb of disk space and consists of executable files. Pascal code is also included for the user's information.



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INTRODUCTION TO BASIC ASTRONOMY WITH A PC

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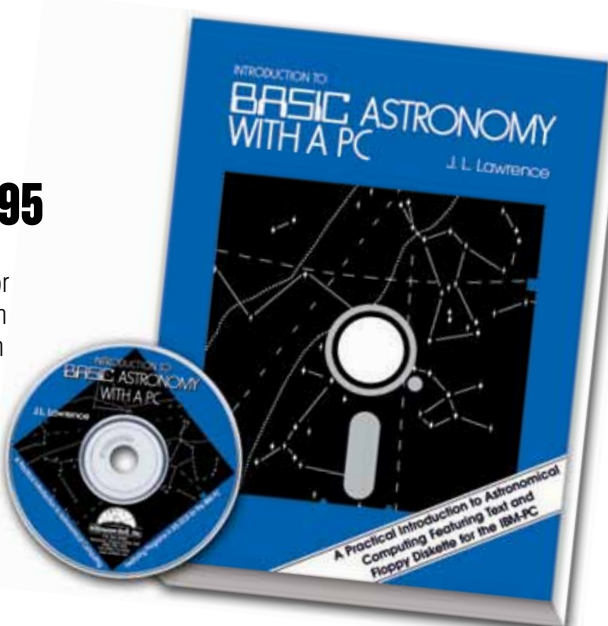
by Lawrence

Softbound, 8.50" by 11.00", about 120 pages, 1 Lb. 7 Ozs. ship wt.

\$19.95

Introductory astronomy books usually follow two broad paths: descriptive or mathematical. This book is fundamentally a mathematical approach but with a difference. Dr. Lawrence has written text and computer programs which emphasize concepts rather than derivation of formulas.

You do not have to be a mathematical wiz to read and learn from this book. In order that you can begin immediately to learn the how and why of astronomy, the programs are provided on a diskette along with this book. The tedium of keying a listing and debugging are avoided and there is nothing additional to buy.



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Prices subject to change with out notice

Photoelectric Photometry

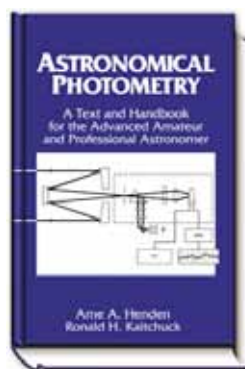
ASTRONOMICAL PHOTOMETRY

A Text and Handbook for the Advanced Amateur and Professional Astronomer

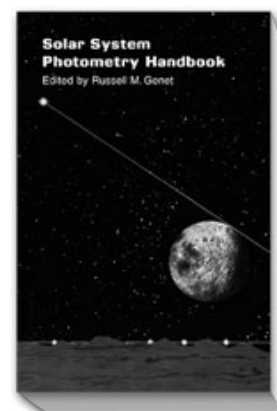
by Henden and Kaitchuck

Handbook, 9.50" by 6.00", 392 pages, 2 Lbs. 6 Ozs. ship wt., **\$29.95**

Photometry, the measurement of light flux, is one of the most fundamental and oldest research techniques employed in astronomy. It is also an area where valuable contributions can be made by amateur astronomers using small telescopes. Most people who do photometry have learned the hard way, because how-to books in this field are very few and often incomplete. This book is intended to fill this gap for both amateur and professional astronomers who wish to learn the techniques of photoelectric photometry. It begins with an overview of photometry and its history, followed by an explanation of photometric systems and how they are defined. There are three chapters dealing with statistics, required calculations and the processing of the observational data. These chapters, and their related appendices, contain many worked examples to aid the beginner. There are step-by-step instructions on the design and construction of the photometer head, and two chapters on the associated electronics. The book ends with outlines of some practical observing techniques, suggestions for research projects, and useful appendices of difficult to find information.



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SOLAR SYSTEM PHOTOMETRY HANDBOOK

Edited by Genet

Softbound, 9.00" by 6.00", 214 pages, 1 Lb. 4 Ozs. ship wt., **\$17.95**

This is the first "how-to" book for the advanced amateur and the smaller college observatory interested in solar system photometry. Ten chapters cover both high- and low-speed photometry of asteroids, planets and their satellites, comets, Moon and Sun. Written by professionals and advanced amateurs, the text is clear and to the point.

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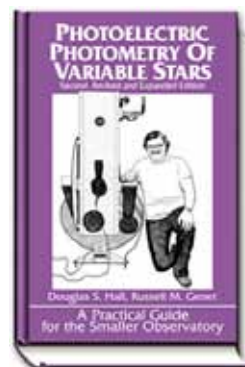
PHOTOELECTRIC PHOTOMETRY OF VARIABLE STARS

A Practical Guide for the Smaller Observatory

Ed. by Hall and Genet

Hardbound, 9.00" by 6.00", 240 pages, 2 Lbs. ship wt., **\$24.95**

Can amateur astronomers make significant contributions to the Science of Astronomy? In this book you learn how dedicated amateurs, using either homebuilt or commercial equipment, regularly produce data that is published in professional journals. This book, written and edited by both professional and amateur astronomers shows you how to design a program that is both personally satisfying and scientifically valuable.



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SOFTWARE FOR PHOTOMETRIC ASTRONOMY

by Ghedini

Softbound, 9.00" by 8.00", 220 pages, 1 Lb. 2 Ozs. ship wt. **\$19.95**

This book is one of the nicest presentations of theory and software we have ever seen. Indispensable for both the advanced amateur and professional working with data generated by photometric astronomy. The author has blended both theory (text and formulae) and actual computer programs (Hewlett-Packard BASIC). Included are: Julian Date and Decimals of Day Conversion; Greenwich Mean Sidereal Time at 0 Hour at UT (GMST); Local Mean and Apparent Sidereal Time; Hour Angle; Air Mass; Reduction For Precession; Standard Reduction to the U.B.V. Color System; First Order Atmospheric Extinction Coefficients; Second Order Atmospheric Extinction Coefficients; Photometric Scale Factors; Heliocentric Correction of Times; Eclipsing Binary Systems: Epoch of Minimum Light; Eclipsing Binary Systems: Contact Times; O-C Residuals Evaluation; Interpretation of the O-C Diagram; Time Phase Conversion; Ephemeris of Periodic Variable Stars; Periodic Phenomena in Variable Stars; Period Analysis; Fourier Waveform Analysis; Non-periodic Phenomena in Variable Stars; Determination of the Elements of Eclipsing Binary Stars and Spectra and Color Indices.



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ASTRONOMICAL PHOTOMETRY SOFTWARE FOR IBM-PC

by Kaitchuck and Henden

14 Ozs. ship wt., **\$69.95**

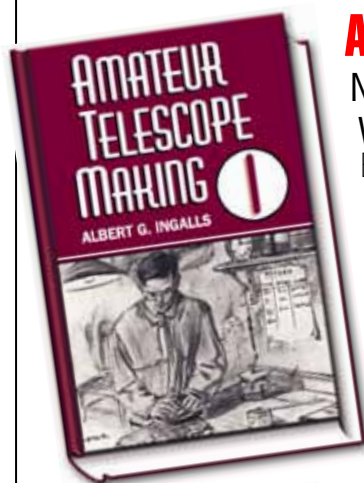
In addition to writing a book on the subject the authors have written a professional level computer program based upon the techniques described in their book. The software package is a fairly complete photoelectric photometry data reduction system. There are several programs, each of which handle a different aspect of the reduction process. This modularity allows the user the flexibility to adapt the reduction process to his specific needs.



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Telescope Making & Optics

The All-Time Amateur Telescope Making Classic



Amateur Telescope Making 1

Newtonian Telescope Mirror Making; Optical Testing; Workshop Wisdom; and Observatory Buildings

Edited by Albert G. Ingalls

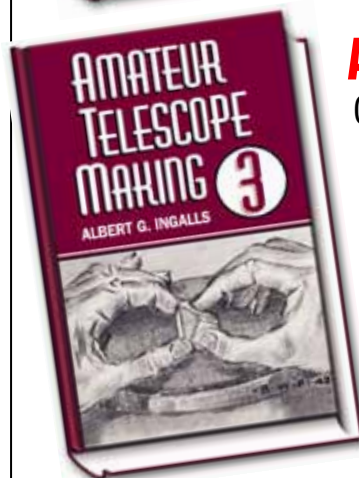
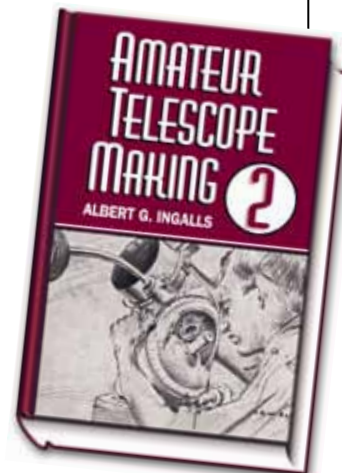
hardbound, 6.00" by 9.00", 590 pages, 2Lbs. 8 Ozs. Ship wt. **\$24.95**

Amateur Telescope Making 2

Refractor Telescopes; Telescope Mechanics; Telescope Adjustments; Binoculars; Schmidt Cameras; and Optical Flats

Edited by Albert G. Ingalls

Hardbound, 6.00" by 9.00", 590 pages, 2Lbs. 8 Ozs. Ship wt. **\$24.95**



Amateur Telescope Making 3

Optical Production Methods and Machinery; Eyepieces and Small Lenses; Optical Coatings and Coating Equipment; The Eye and Atmosphere; Other Optical Instruments; and Instrumentation for Solar Observations

Edited by Albert G. Ingalls

Hardbound, 6.00" by 9.00", 630 pages, 2Lbs. 8 Ozs. Ship wt. **\$24.95**

These books are a rearrangement of the original world-famous three-volume work published by Scientific American from the mid-1920s into the 1950s. They are a veritable storehouse of telescope making lore. Now, similar items are now grouped together. The objective was not to rewrite but to logically rearrange the text into a more user-accessible format. Spelling, hyphenation and usage have been standardized, and errors-in-fact corrected, but almost all the original text remains fundamentally unchanged (pendulum clocks and vacuum tube photo-electric photometry articles were cut) and now makes up over 1,800 pages of text and illustrations devoted to practical telescope making.

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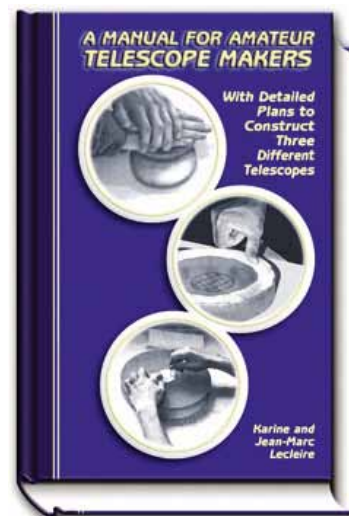
A Manual for Amateur Telescope Making

by Karine and Jean-Marc Leclaire

Hardbound, 6 by 9-inches, 320 pages, 1 Lb. 14 Ozs. Ship wt. **\$29.95**

This is the first new comprehensive mirror-making manual to appear in the English language in over 40 years. The theme of this book is the fabrication of both the optics and mechanical parts for three different telescopes. The first is a Newtonian with a 130-mm f/9.2 primary mirror. It is especially designed for beginners, being both inexpensive and easy to make. The second instrument is also a Newtonian reflector with a 250-mm f/4.3 primary mirror. This is an "all purpose telescope" which can provide a lifetime of viewing pleasure. The third instrument is a 300-mm f/12 Cassegrain-coudé (or Nasmyth). This is a project for the advanced telescope maker and features a long-focal-length mirror, a convex secondary, and a telescope window. Also featured is extensive coverage of local figuring and touch-up methods.

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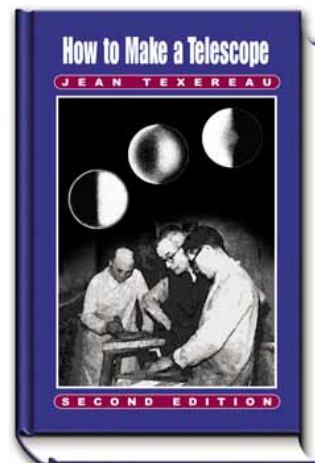


Telescope Making & Optics

How To Make A Telescope: 2nd Edition

by Jean Texereau
Hardbound, 9.38" by 6.00", 440 pages, 2 Lbs. 8 Ozs. ship wt., **\$24.95**

The first edition of *How to Make a Telescope* was universally acclaimed as the best book ever written for making a Newtonian telescope. This 2nd Edition is almost three times larger and adds to the original text new chapters on making a Cassegrainian telescope, optical windows, and equatorial mounts. Chapters on eyepieces and astronomical seeing have been expanded. Computer programs written in generic BASIC for reduction of Foucault test data. Included are indexes for the three principle magazines that carry telescope making information: *Sky and Telescope's* "Gleanings for ATM's" from November 1941 through June 1998, *Scientific American* magazine from 1925 through 1959 and the complete run of *Telescope Making* magazine. This book is the most complete single work available on making reflecting telescopes.



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BOOK REVIEW

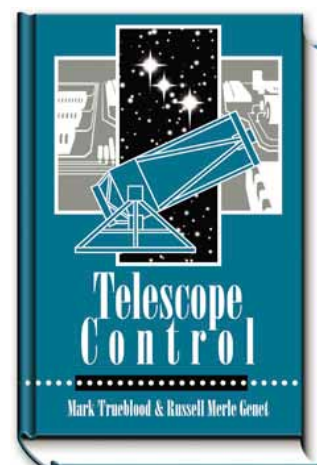
"... Borrowed from my high school library more than 20 years ago, the earlier book (the First Edition) was my introduction to an avocation that has occupied many evenings and weekends since. That fondly remembered volume forms the core of this new one, with many additions to complement and expand the older text. Reading the text in preparation for this review was like rediscovering an old friend. Key to the book's quality is Texereau's writing style, his workshop hints, diagrams and where appropriate, expansions into theory. The accent is upon the practical — details of just what it takes to fabricate an optical telescope . . . In the sections devoted to optics both novice and experienced "glass-pushers" will receive guidance that is as clear and in-depth as any that can be found in print . . . From the earlier edition he has retained complete instructions on the fabrication of a Newtonian telescope, including optics and mounting, and provides a well-written rationale for its choice as the novice's first telescope. For the new edition he has added detailed plans for the construction of a Cassegrain telescope, including both the primary and secondary optics. He even devotes a section — definitely not novice stuff — to fabrication of an optical window . . . I heartily recommend this new edition of *How to Make a Telescope*, both to the recently interested telescope maker and the seasoned "telescope nut." Novices will find the spicy, well-illustrated and detailed book that inspired me many years ago, while even old hands should find some new wrinkles within its greatly enlarged text.

Sky and Telescope Magazine

Telescope Control

by Trueblood and Genet
Hardbound, 6 by 9 inches, 562 pages, 183 figures, 2Lbs. 10 Ozs. ship wt. **\$29.95.**

This book fills a gap in the books that are available on using personal computers in astronomical applications like those that can be done at the leisure of both the hobbyist and the computer, and computing that uses only the basic computer and standard peripheral devices (disks, printers, etc.) as they come from the computer store. Image processing and orbit computing are examples of this type of computing. But this book is concerned with how to connect a non-standard computer peripheral device (a telescope) to a computer and how to program the computer to perform time-critical computations.



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BOOK REVIEW

Telescope Control contains a wealth of information for the reader with some knowledge of electronics and software who wants to build a computerised telescope, and I can thoroughly recommend it.

Journal of the British Astronomical Association.

Telescope Making & Optics

Making A Refractor Telescope

How to Design, Grind, Polish, Test, Correct and Mount a Doublet Lens
Includes Excel Spread Sheet Refractor Design Programs on CDROM

by Norman Remer

Hardbound, 6 by 9 inches, 408 pages, **\$34.95**



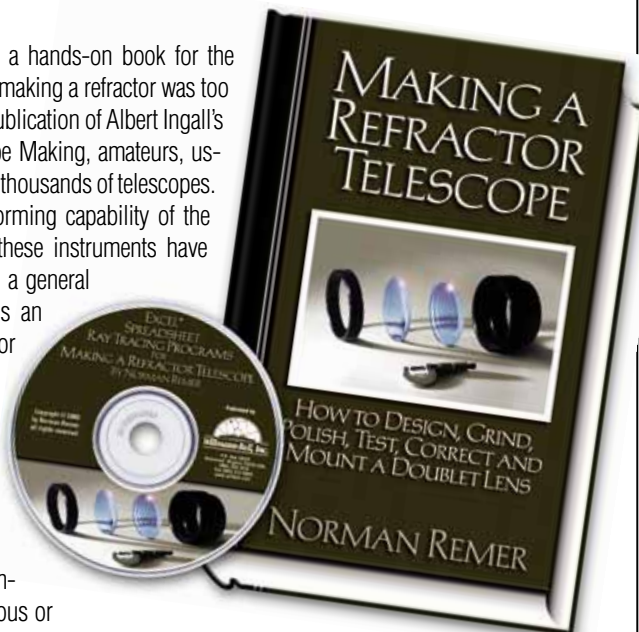
A 6-inch aperture lens made by author Norm Remer

Making a Refractor Telescope is a hands-on book for the amateur who has always thought making a refractor was too difficult to even consider. Since publication of Albert Ingall's first volume of Amateur Telescope Making, amateurs, using rudimentary tools, have made thousands of telescopes. In spite of the superior image forming capability of the unobstructed refractor, most of these instruments have used a parabolic mirror. There is a general perception that making a lens is an almost insurmountable task for an amateur. This is aided and abetted by the lack of literature on the subject of lens making for amateurs.

With this book, you will learn that making a lens involves the same simple practices and com-

mon tools involved in making a mirror. You will find there is nothing mysterious or unique. Yes, there are more surfaces to finish, but all are spherical. The author adopts the role of coach and guides the reader, step by step, through all aspects of making a doublet lens; from the characteristics of glass, abrasives, and pitch to methods for mounting the finished lens. Along the way you will learn how to grind the lens to shape, polish it, test and correct it. Not to be missed is a section covering the design of a two-element lens corrected for color, coma, and spherical aberration. The author's spreadsheet programs, included on CD-ROM, provide a direct approach to designing a well corrected lens. For those not interested in lens design, prescriptions are provided for several lenses ranging in aperture from 3 to 8 inches.

Do you know why a mirror surface must be figured four times as accurately as a lens? The author explains this, and much more, with discussions and demonstrations that explain the "why" along with the "how."



56 Chapter 5 Measuring Techniques



Fig. 5.2.1 Marking lens edge with pattern. Note reference mark on edge of lens blank.

Figure 5.1.1 illustrates this technique. Measure several diameters and measure from front to back (you might want to call it top to bottom) of the lens blank. Accuracy of 0.001 inch is adequate. Once you are satisfied with the diameter of your blanks, you will not have to measure their diameter again.

5.2 Measuring Edge Thickness

No matter what method you use to measure the thickness of the edge, it is important that you measure at the same points around the circumference every time. Put a reference mark on the edge of each lens blank with an indelible marker. Restate the mark if it starts to wear away. Make up a cardboard pattern as shown in Figure 5.2.1, with marks spaced 30° to 45° apart (depending on the diameter of your lens) around the cut out. Number these index marks as shown. With the lens blank centered in the pattern aperture, line up the #0 mark with the reference mark on the edge of the blank. Be sure you always have the same blank surface up when you make the measurements in the future. Otherwise, your interpretation of subsequent edge thickness measurements will get hopelessly confused. Use your marker to put index marks on the surface of the blank numbered to correspond with the marks on the pattern. They will get ground off eventually, and the pattern, along with the index mark on the edge of the blank, will allow you to replace them in exactly the same spot for future measurements. After you have marked the

Section 5.2: Measuring Edge Thickness 57

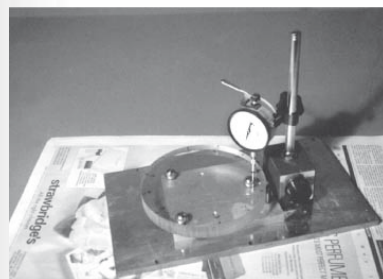


Fig. 5.2.2 Edge thickness measuring fixture. Measuring edge thickness using the fixture described in Figure 5.2.3. Ensure that the edge of the lens touches the two locating pins.

blank, measure its edge thickness at each of the marks. Record the thickness, along with the index number, in your notebook. The desired maximum difference in edge thickness around the lens is 0.0005" or less.

5.2.1 Dial Indicator Method

The best way to measure edge thickness is with a dial indicator and kinematic locating fixture, as illustrated in Figure 5.2.2. A dial indicator is not very expensive and is extremely useful. It is strongly recommended that you acquire one. The three ball bearings (or rounded pins) in the base define the surface of a sphere or a plane (sphere with infinite radius). The two edge pins constrain the edge of the part and, with a circular lens, define (but don't locate) the center of the lens. The indicator contact point measures the top surface of the lens at a fixed distance from the edge and thus also at a fixed distance from the center of the lens. To be precise, we are not measuring the edge thickness of the lens. What we are measuring is the difference in edge thickness around the lens. A single measurement at any one point is meaningless by itself. To make a set of edge thickness measurements, set the lens on the measuring fixture with its edge touching the two pins. Set up the indicator with the contact point touching the surface of the lens far enough from the edge so it clears the bevel. The indicator should be set so it has some range below as well as above the initial measuring point. Measure the edge at each of the index marks. Measure, or estimate, to the nearest 0.0001". After measuring all the way around, double check at least the first point to insure that nothing has

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Telescope Making & Optics

The Schupmann Telescope

The Story, Design, Construction and Use of a Neglected Telescope Type

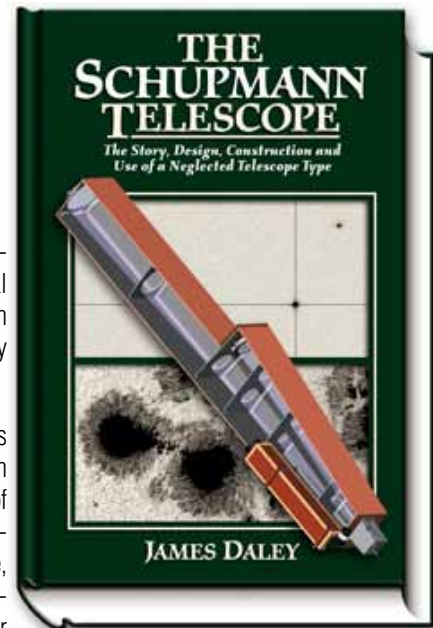
by James Daley

Hardbound, 6 by 9 inches, 200 pages **\$29.95**

Perfecting the refracting telescope has frustrated lens designers and glass makers since the invention of the telescope. This is because when using standard crown and flint glasses, residual longitudinal color (its dominant defect) cannot be reduced to an optically harmless value. Even today, the most expensive special glass apochromats show some noticeable color, especially at the limits of the visual spectrum.



Daley with a 14-inch objective of his own fabrication.



However, for over 106 years a refractor design has been available that is totally free of harmful color defects. Employing but one glass type, this design, called a Schupmann medial after its inventor Ludwig Schupmann, achieves

amazing performance. It is this neglected telescope, along with its close relative the brachymedial, that this book describes in detail, along with an historical account, a discussion of the Schupmann's role in modern amateur research, system principles and practical applications. Also included are design prescriptions and construction information giving the advanced telescope maker a new world to explore. Here for the first time is a comprehensive discussion of the design and fabrication of these high resolution instruments. Many successful medials are shown in a photo gallery, giving the builder a wealth of further ideas.

122 Chapter 10 Some Important "Standard Design" Details

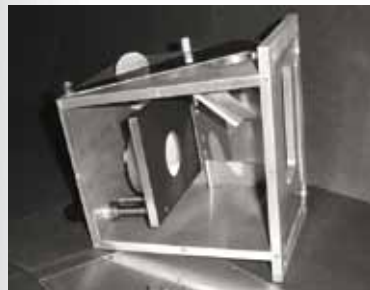


Fig. 10.1 The author's 9-inch medial with the field-mirror cover open (top)

Section 10.8: The Corrector 123



Fig. 10.2 Tailpiece of author's 9-inch medial

dii are proportional to the working distances and the *shorter* radius faces the objective. A plano-convex lens is about as good. Naturally the polish and focal length requirement are the same as for the field mirror and, of course, should have a similar cover arrangement. Remember that now the alignment cross faces the field lens! By making the cover of clear plastic, the cross is easily seen with the objective open to the daytime sky and will not require any sort of flashlight illumination during the alignment phase. By parking the scope pointing up it is only necessary to cover the field lens' skyward face. A long (2-inch) hood could provide dust protection on the lens' downward side. A very practical addition to the tailpiece is a heater to keep the temperature of the structure above the dew point when the scope is not being used. (The heater will go a long way toward keeping the telescope dry). This will prevent pinholes from forming in the field-mirror indefinitely. Small, 20-watt, bulbs located inside and out of the tailpiece. Just remember to turn them back on after an observing session. Pay special attention to these and all other details that your medial is capable of. No shortcuts allowed!

**Profusely
illustrated!**

provides lots of construction fun. The curves are adjustable as the objective when the corrector is used at once because the refraction is negative the color sign is reversed,

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Telescope Making & Optics

Advanced Telescope Making Techniques

Featuring Selected Articles from the Maksutov Circulars

Edited by Allan Mackintosh.

Over a period of 21 years Allan Mackintosh edited and distributed the Maksutov Circulars to Maksutov Club members. Ultimately, nearly 200 editions of the Circulars were distributed to members. From this mass of material two 300+ page books have emerged which describe a wide range of subjects of interest to the person who has made a telescope and wants to learn more about this fascinating hobby

VOLUME 1, OPTICS

Hardbound, 9.00" by 6.00", 320 pages, 2 Lbs. ship wt., **\$24.95.**

The subjects covered include figuring optical surfaces, testers and testing, optical theory, telescope designs and designing, spectrohelioscopes, interferometers, and calculator programs for telescope makers.

VOLUME 2, MECHANICAL

Hardbound, 9.00" by 6.00", 320 pages, 2 Lbs. ship wt., **\$24.95**

The subjects covered include grinding tools, curve generating, small lens work, accessories for glass working, grinding and polishing machines, making and testing flats, telescope construction, telescope accessories, photography and the telescope maker's workshop.

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BOOK
REVIEW

"... Within these two volumes the TN (Telescope Nut) will find a feast of goodies. "... overall Mackintosh has done a great service to amateur telescope making. And where will these volumes end up? When not open on the workbench, I predict they will be in the TN's library --- immediately to the right of ATM --- III!

Sky & Telescope magazine

The Best of Amateur Telescope Making Journal

Edited by William J. Cook

Volume 1

Hardbound, 6 by 9-inches 462 pages, 408 illustrations, 2 Lbs. 2 Ozs. Ship wt **\$29.95.**

Volume 2

Hardbound, 6 by 9-inches, 429 pages, 284 illustrations, 2 Lbs. Ship wt **\$29.95**

Over a period spanning nearly 10 years Amateur Telescope Making Journal published articles of interest to the telescope maker. These two volumes presents 150 the best of these articles, fully edited and where appropriate corrected by the original authors, in two volumes totaling nearly 900 pages with 692 illustrations. Volume 1 contains articles from ATMJ's issues 1 through 11 while Volume 2 covers issues 12 through 18. These are "How to Books" that cover a wide range of subjects of interest to people who design, build and use telescopes for astronomy.

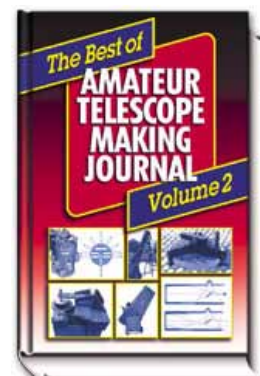
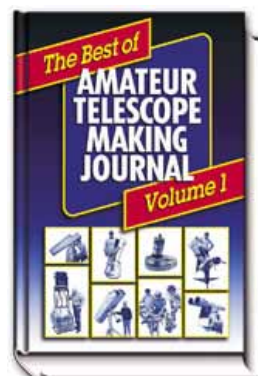
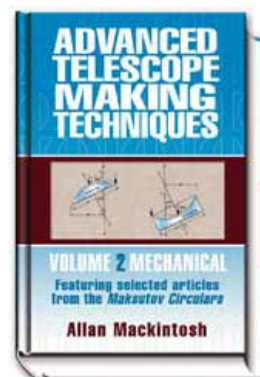
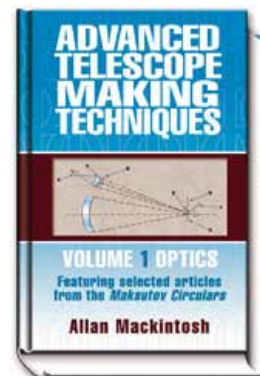
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BOOK
REVIEW

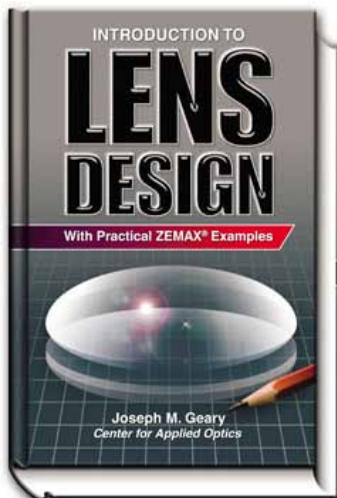
These books are jam-packed with all kinds of information on all kinds of telescope-making subjects. Volume 1 alone includes topics as diverse as the history of amateur telescope making in Australia, phase-contrast testing, and baffling a Newtonian reflector.

... it's a glorious mess of interesting and useful information that every active telescope maker should have on his or her bookshelf.

Sky & Telescope Magazine



Telescope Making & Optics

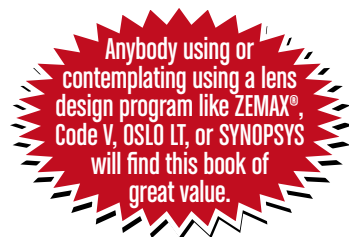


Introduction to Lens Design

With Practical ZEMAX— Examples

By Joseph M. Geary
Hardbound, 6" by 9", Smyth sewn to lay flat, 462 pages, 452
Illustrations, 45 Tables, 2 Lbs. 6 Ozs. Ship wt. **\$49.95**

This book is based on an introductory lens design course taught in the Optical Science & Engineering doctoral program at the University of Alabama in Huntsville. Its thirty-eight chapters follow Dr. Geary's classroom lecture syllabus suitably augmented and expanded for the person interested in self-study. Included are over 450 illustrations, numerous examples, problems and their solutions. While designed for self-study it is also suitable as a comprehensive introductory text. Although it is about lens design, the scope is general and will provide optical engineers and others with important tools and skills useful in a world which increasingly relies on optics in a wide variety of applications.



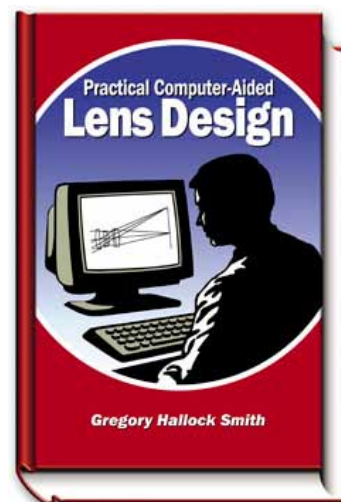
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Practical Computer-Aided Lens Design

by Gregory Hallock Smith

Hardbound, 6 by 9 inches, 428 pages, 2 Lbs. 10 Ozs. ship wt. **\$59.95**

The introduction of the computer revolutionized the way lenses (optical systems) are designed and evaluated. Gone is the drudgery of the past. Today the process of designing lenses is more direct, much faster, and infinitely easier. This book tells how to design and evaluate lenses using computers. The approach is general and fundamental, and is not limited to one specific software program. The approach is non-mathematical (the computer does this for you anyhow) and concentrates on the fundamental ideas and concepts that it takes to design optical systems. Anybody using or contemplate using a lens design program like ZEMAX®, Code V, OSLO LT, or SYNOPSYS will find this book of value.



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BOOK REVIEW

An engineering professor of mine once made a distinction between "computer-aided" design and "computer-ated" design. His point, of course, was that the computer can be used as a tool in the creative idea phase of a design, as well as to assist with the computational grunt work needed to bring a project to completion. Reflecting the author's years of industrial experience, Gregory H. Smith's *Practical Computer-Aided Lens Design* does an excellent job of covering both aspects of the lens design process. ...

... So if you are learning lens design as an undergraduate or graduate student, or don't yet have the years of experience which went into writing this book, you will find *Practical Computer-Aided Lens Design* a valuable investment.

Optical Society of America's *Optics & Photonics News*



SPECIAL OFFER!

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Introduction to Lens Design and
Practical Computer-Aided Lens Design
and you pay only **\$99.90**

Our customers tell us that these two books complement each other beautifully. **Introduction to Lens Design** relies heavily on the mathematics of lens design, while **Practical Computer-Aided Lens Design** has very little math and relies on extensive discussion text and worked examples. The perfect design for comprehensive knowledge!

Save
\$10.00!



Telescope Making & Optics

Telescope Optics

A Comprehensive Manual for Amateur Astronomers

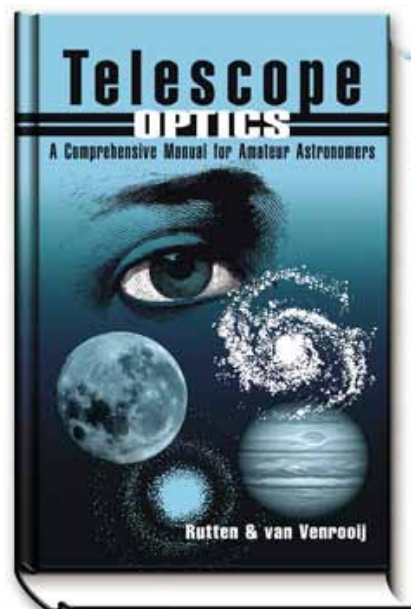
by Rutten and van Venrooij

6.00" by 9.00", 374 pages, hardbound, published 1988, 2 Lbs. 4 Ozs. ship wt. **\$24.95**

This book will both arouse your curiosity and answer your questions. Why are there so many different kinds of telescopes? What does each type have to offer? What makes one telescope better than another? Which are best? Why? What are the tradeoffs? As a telescope buyer, you will be better informed; as a telescope maker, you will be able to design custom optics.

Many readers will find the analyses of existing designs the most valuable part of the book. Newtonians, Cassegrains, Maksutovs, Schmidt cameras and more are described and analyzed so that you can easily compare them. What's your dream telescope? This book will help you choose it.

No longer must you, as an amateur astronomer, meekly accept someone else's opinion about a telescope design. You can scrutinize existing designs and improve them to meet your own standards. Is that new astrographic camera all it's cracked up to be?



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BOOK REVIEW

Telescope Optics provides a comprehensive analysis of practically any type of telescope an amateur would use for visual observation or photography. Coverage of the many types of catadioptric systems is outstanding. Taken in total, it is an optical design book, but written in such a way that amateur astronomers will find it of value whatever their level of interest, and the person seriously interested in design will find it a godsend. I recommend it highly for any serious amateur and for the professional who is going to work in these areas.

Sky & Telescope Magazine

Telescope Optics Optional Software for the IBM-PC \$24.95

In order to compare various telescope designs for *Telescope Optics*, Harrie Rutten wrote programs to run on his home computer. These programs were not "user friendly" since his main goal was only to secure data and spot diagrams. Diane Lucas has adapted these programs for the IBM-PC, \$24.95. If you are purchasing this software after you have purchased the book please provide us with the serial number in the space provided for comments in the shopping cart.

The result of this effort is three easy-to-use programs:

- TDESIGN, a powerful design program for Cassegrain or catadioptric telescopes, which produces a pre-design based on third-order aberration theory. These designs are preliminary and must be further optimized since they are computed on third order Seidel theory. In most cases, these pre-designs are quite accurate—within 5% of the final values—and often much better. Final optimization is done by skew ray tracing with RAYTRACE.
- LENSDES, a powerful design program for doublet and triplet lenses, which produces designs that are complete and require no further optimization.
- RAYTRACE, a fast and powerful raytracing program that can trace up to 2,800 rays through axially symmetric, tilted, or decentered systems with flat, spherical, conic, or aspherically deformed optical surfaces, with or without vignetting. The output of this program can be in graphical or tabular form.



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Telescope Making & Optics

The Dobsonian Telescope

A Practical Manual for Building Large Aperture Telescopes

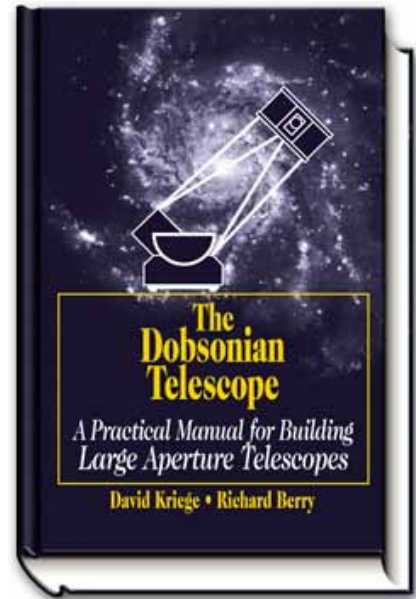
by David Kriege and Richard Berry
Hardbound, 6" by 9" inches, 496 pages, hardbound, 179 pictures,
88 drawings and 34 tables. **\$29.95**

This book tells how you can build a state-of-the-art Dobsonian telescope using readily available materials and supplies. Every step of construction is detailed in photographs and diagrams, and the underlying ideas are carefully explained. As a result of this three-year collaboration between authors David Kriege and Richard Berry, experienced and well-known telescope makers, you now have the opportunity to build a high performance telescope with a 14-inch to 40-inch aperture based on the thoroughly tested designs described in this book.

The Dobsonian telescope takes its name from the astronomer/philosopher John Dobson, who introduced the concept of inexpensive, large-aperture telescopes to astronomy. Amateur astronomers at the time were so amazed that a telescope built from simple, inexpensive materials performed so well that they could hardly believe their eyes. As home-built Dobsonians started showing up at star parties across the nation and people saw what Dobsonians could do, the word spread. In just a few years, the Dobsonian revolution swept the world.

Since those early telescopes, Dobsonians have improved dramatically. An entire generation of amateur telescope makers contributed their best insights and refinements to Dobson's original design. Today's Dobsonians are larger, lighter, and more precise than ever before. For example, it is possible to build a telescope of 20-inch aperture that is compact enough to transport in a hatchback automobile, yet takes only ten minutes to set up at a remote, dark-sky observing site.

Deep-sky observers especially appreciate Dobsonian telescopes. With the 20-inch (50 centimeter) aperture that the authors recommend for first-time Dobsonian builders, hundreds of globular clusters, thousands of nebulae, and tens of thousands of galaxies are visible through the eyepiece. Planetary observers have discovered that from good observing sites, Dobsonians deliver breathtaking performance on the moon and planets. For the casual stargazer, familiar objects like the Hercules Cluster, the Great Nebula in Orion, the Lagoon Nebula, and the galaxies of the Virgo Cluster are an entirely new experience.



Here are some of the topics covered in this book

- Deciding what size telescope will suit your needs
- Ordering optics for a large Dobsonian
- Understanding plywood and how to use it properly
- Making a flotation cell to support the primary mirror
- Figuring how long to cut the poles for the truss tube
- Constructing precision truss tube sockets
- Performing torque analysis for first-time balance
- Installing precision digital setting circles
- Setting up and taking down the telescope
- Collimating your optics correctly

Whether you have never observed before or whether you have been an amateur astronomer all your life, you will benefit from the hands-on familiarity and experience in amateur astronomy and telescope making that the authors bring to this book.



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Telescope Making & Optics

Star Testing Astronomical Telescopes, 2nd Edition

A Manual for Optical Evaluation and Adjustment

by Harold Richard Suiter

Hardbound, 9.00" by 6.00", 376 pages, 2 Lbs., 9 Ozs. ship wt., **\$34.95**

What Star Testing Astronomical Telescopes Is All About

Simply stated, it is about telescopes that work properly and those that do not. If you have a new telescope that is not performing as well as other telescopes of equal aperture, the book gives you a no-nonsense technique of evaluating the optics doing exactly what they were designed to do — image the stars. No auxiliary equipment, no difficult data reductions, and no difficult setups are necessary. You just need a quality eyepiece and this book to do a sensitive at-site test of the entire optical train, from the top of the atmosphere to your eye.

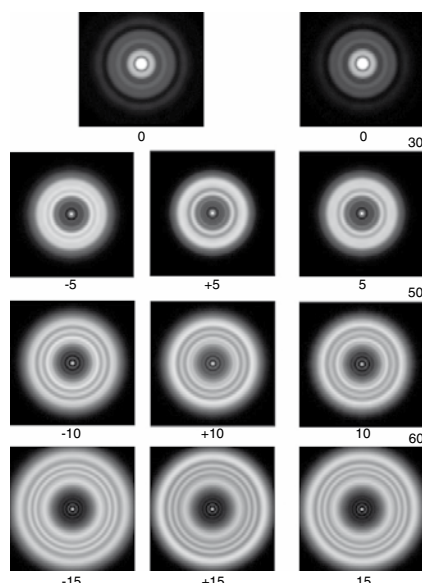
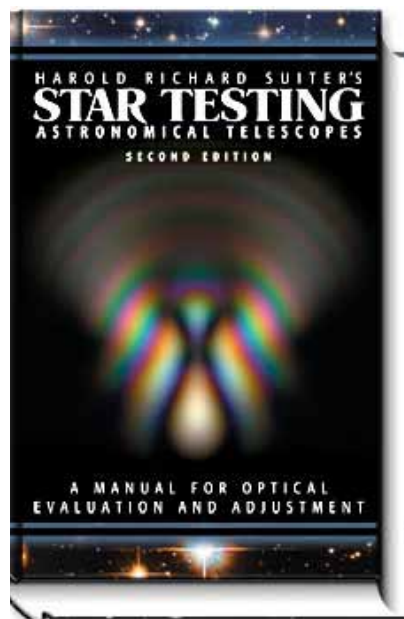


Fig. 11.4 Star-test pattern of 152-mm $f/12$ separated secondary Maksutov-Cassegrain. Differences between inner and outer defocused images are very slight. Grayscale polychromatic images.

What's New in the Second Edition

New images calculate the combined effect of many weighted wavelengths distributed through the spectrum. Real telescope designs are featured, including the popular commercial Maksutov-Cassegrain in a variety of implementations. An expanded treatment of chromatic aberration appears, with polychromatic grayscale star-test images calculated from real designs of achromatic and apochromatic refractors. The section discussing the important fabrication defect of low-order spherical aberration has been greatly expanded. In addition, there is an enlarged apodization section. Finally, tried and true, the old *Star Testing Astronomical Telescopes* is still there, rearranged and updated, with additions and changes to the main text and the optional appendices. Rediscover the book that *Sky & Telescope* said "is full of advice and experience from real-world amateurdom."



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BOOK REVIEW

"Computer-generated illustrations of defocused star images are so realistic that you can learn a great deal by just looking at the pictures... *Star Testing* is bound to have a big impact on our hobby. Harold Suiter wants to help buyers assess optical quality so that it plays a larger role in purchasing decisions. This, he feels, will give manufacturers added incentive to produce superior products. In my opinion Suiter will succeed — if enough of us buy this book and read it. Its cost is a small price to pay for becoming an informed consumer."

Astronomy

"Now, at last, Suiter has analyzed the star test in book-length thoroughness. He presents a bounty of information and instruction in a clear, practical manner never before available... The book displays with perfect clarity all the star test comparison images you'll ever need, illustrating all kinds of telescope aberrations in their pure forms... Those are just highlights of this long overdue book."

Sky & Telescope

A first casual inspection of the book indicates that it should reside on the applied optics book shelf of a Physics Department library. Nothing could be further from the truth. Suiter, who is an experimental physicist, has been very successful in using everyday analogies to explain the fundamentals of diffraction optics... For those with a more than casual approach to their telescopes, this book will become in the widest sense, a benchmark in astronomical telescope testing literature. Most importantly, it will give some weight to increasing the quality assurance standards of commercial telescopes, from the viewpoint of a better informed user.

Southern Stars

Telescope Making & Optics

Build Your Own Telescope

Complete Plans for Five High-quality Telescopes That Anyone Can Build

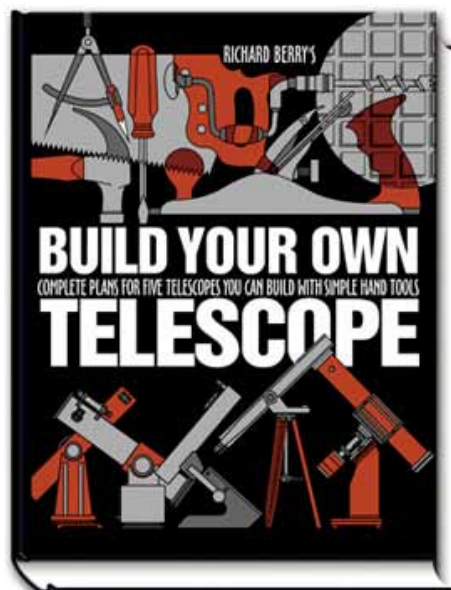
by Richard Berry

Hardbound, 8.50" by 11.00", 240 pages, 3rd Edition, 2 Lbs. 10 Ozs. ship wt., **\$24.95.**

For anyone who has ever dreamed of exploring the heavens with a telescope, **Build Your Own Telescope** can make that dream come true. In clear, step by step instructions, author Richard Berry tells how to build five telescopes, from a simple reflecting telescope suitable for a parent and child to build together to a "research-grade" 10 inch telescope capable of sustaining a lifetime's interest in astronomy. Detailed instructions include complete plans and photographs that show how anyone can construct a powerful telescope with ordinary household tools and materials.

Build Your Own Telescope includes complete plans, step by step instructions and 275 illustrations that show you how to build these five telescopes:

- ✓ 4" f/10 Reflector: A sturdy and easy to use telescope that is perfect for beginners or as a parent/child project.
- ✓ 6" f/8 Dobsonian Reflector: A light, compact telescope that is simple to build, but powerful enough to satisfy a backyard observer for many years.
- ✓ 6" f/8 Equatorial Reflector: A classic design for the amateur astronomer or craftsman who wants an elegant telescope and great performance.
- ✓ 10" f/6 Dobsonian Reflector: A powerful and versatile telescope suitable for casual stargazing or for a serious amateur's long term observing programs.
- ✓ 6" f/15 Refractor: A large refractor that outperforms commercial telescopes of considerably larger aperture.



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BOOK REVIEW

"Please send me plans for making a telescope." So write many enthusiasts eager to begin observing but unable to buy a commercial instrument. There are already several books on just this topic, usually giving an outline which you can then flesh out according to the materials available.

"This book takes a different approach. It gives very specific nut and bolt instructions for making five separate telescopes. If you want, you can build any of them precisely as instructed, or you can adapt the designs as you please..."

"The designs include many novel features, such as the use of silicone rubber cement to secure mirrors. The text is exemplary in its clarity and readability—praise that I don't bestow lightly. I recommend it without reservation."

— Robin Scagell, reviewed in the *Journal of the British Astronomical Association*

"Subtitled 'Complete Plans for Five Telescopes You Can Build with Simple Hand Tools,' this book is just that, with designs ranging from a simple but elegant 4.25 inch reflector (designed for an eight year old) to a beautiful 6 inch refractor. It assumes that you will buy commercial optics, but there is a section on homemade optics as well. Highly recommended!"

Geoff Chester, Smithsonian Institution, Washington, D.C.

"Richard Berry is to be congratulated for compiling this fine well-illustrated book. Most books about telescope making do not include telescope plans, and many assume that you have access to a machine shop in order to make a mounting. Richard shows ways to make mounts with common tools and hardware store materials. I only wish that this book had been available when I was a teenager building my first telescope."

Richard J. Wessling, reviewed in *The Strolling Astronomer*, Journal of the Association of Lunar and Planetary Observers

WHAT THE USERS SAY...

"Dear Mr. Berry/ Thank you for your book Build Your Own Telescope. If I had known building a telescope was so much fun I would never have bought one. I thought you might like a photo of a rich field version of your 4 inch design. Notice the peepsight built into the handle. I chose a 4 inch f/4 because I already have a 3-inch f/11 refractor. Next project: a 10 inch Dobsonian."

L.B.S., Clovis New Mexico

Dear Mr. Berry/ Thanks to your book I have achieved a 20 year goal and built a telescope with home brew optics. Enclosed is a picture of my 6 inch f/8 scope that I call 'Blue Skies.' As you can see it is based on the design in Build Your Own Telescope. The major difference is that I went with a smaller diagonal mirror for increased contrast on planetary views."

B.L., Melbourne, Florida

Epic Moon

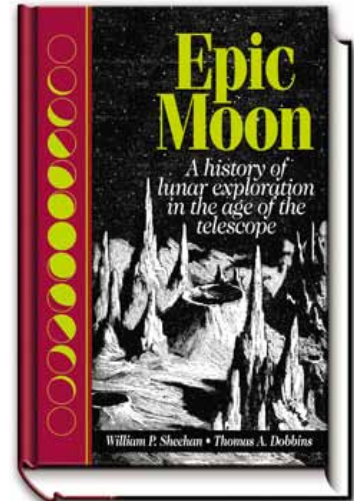
A history of lunar exploration in the age of the telescope

by William P. Sheehan and Thomas A. Dobbins

Hardbound, 6 by 9 inches, 364 pages, 186 illustrations, 2 Lbs. 7 Ozs. ship wt. **\$29.95**

The long era of pre-Apollo lunar studies is a fascinating subject that has never been told in detail. "No other book, recent or not-so recent, is devoted to the history of lunar studies with telescopes" (Clark R. Chapman). Though there was a lapse of interest in the Moon in the immediate post-Apollo era, there has been a recent "return to the Moon" with the successful Clementine and Lunar Prospector missions. There is also growing evidence of a return of amateur observers to the Moon as an object worthy of their attentions. This is understandable inasmuch as the Moon remains the most accessible planetary realm; it is, moreover, the only alien world open to geological prospecting from the eyepiece of the backyard telescope.

Many of the stories recounted for the first time here will still be recounted generations hence, when the Apollo explorations may seem a mere interlude in what has actually been a more sustained and more significant era of endeavour. It is possible that the names of Schroeter, Beer and Madler, Webb and Schmidt may prove to be as memorable as those of Armstrong, Aldrin, Cernan and Schmitt.



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BOOK REVIEW

How can I say more than perfect? Epitome, quintessence, nonpareil? Within my lifetime there have been only a handful of guys—one of them my former boss, Joseph Ashbrook—who could have pulled off such a brilliant, accurate synthesis of the history of lunar mapping and the concomitant search for change, something that would make the Moon worth watching. Here, with William Sheehan and Thomas Dobbins, we get two of the savants at once! From Galileo to Clementine, if you want to know how the Moon was unmasked, it's all here and delivered in captivating, beautiful prose.

.... Epic Moon is nicely produced, and it is illustrated with gobs of relevant illustrations, many of them new to me.

..... If a classic can be born as such, this is it.

Leif Robinson, former Editor-in-Chief of *Sky & Telescope*

Bibliography of Astronomers

Books and Pamphlets in English, Volume One, The Spirit of the Nineteenth Century

Compiled by Paul Luther

Hardbound, 8.5" by 11", 208 pages, 2Lbs. 4 Ozs. Ship wt. **\$34.95.**

This is a limited edition of 500 copies. Luther designed this bibliography to be useful to scholars, librarians, book collectors and antiquarian booksellers. He approached the subject with the bias of the bookseller and collector but it is also amply suitable for a wide variety of scholarly tasks. This volume covers: Airy, George Biddell, Ball, Robert Stawell, Bond, George Phillips, Clerk, Angles Mary, Hall, Asaph, Herschel, John Frederick William, Holden, Edward Singleton, Lockyer, Joseph Norman, Lowell, Percival, Mitchel, Ormsby MacKnight, Newcomb, Simon, Proctor, Richard Anthony, Somerville, Mary Fairfax Greig.



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The Bedford Catalogue

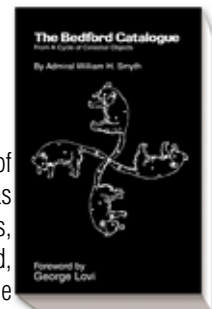
From Cycle of Celestial Objects

by Admiral William Smyth with Foreword by George Lovi

Softbound, 8.50" by 5.75", 600 pages, softbound, re-publication of the original 1844 edition, 2 Lbs. ship wt., **\$18.95.**

Admiral William Henry Smyth's Cycle of Celestial Objects has long been regarded as the patriarch of celestial observing guides, particularly the second volume, here offered, which was named The Bedford Catalogue after the site of Smyth's private observatory.

What makes it so special is that it is the first true celestial Baedeker and not just another "cold" catalogue of mere numbers and data. Like the original Baedeker travel guidebooks of the last century, this work is full of colorful commentary on the highlights of the heavenly scene and heavily influenced several subsequent works of its type, even to the present day.



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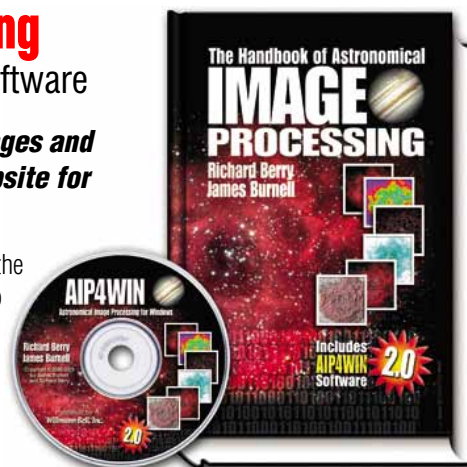
Astronomical Image Processing

Handbook of Astronomical Image Processing

and its integral AIP for Windows 2.0 image processing software

Now AIP4Win2.0 loads and processes both scientific grade ccd images and hundreds of different consumer digital camera RAW files. (see website for details)

Every astronomer interested in digital imaging and image processing needs a copy of the new revised and expanded Handbook of Astronomical Image Processing. Not only do you get the most complete reference on imaging and image processing, but you also get AIP4Win 2.0, a powerful, state-of-the-art full-featured, intuitive, easy to use image-processing software included on a CDROM in the back of book. The total cost of this 684-page book plus the AIP4Win 2.0 software is only **\$99.95**.



Richard Berry (left) and Jim Burnell

BOOK REVIEW

"... it's the finest book to date covering the entire gamut of digital astrophotography. It should be mandatory reading for those shooting digital pictures of the Moon, planets, or deep-sky objects regardless of what camera or software they use. And while it's certainly a book aimed at practitioners, *The Handbook for Astronomical Image Processing* is also for curious individuals who want an in-depth look at what's behind the stunning images being turned out by today's amateur astronomers - images that in many cases exceed the beauty and detail of the finest professional work done in the days of emulsion-based astrophotography.

Think of any cryptic term you've seen attached to a digital photograph, be it full-well capacity, wavelet filtering, or some alphabet-soup acronym, and you'll likely find a clearly written description in this book. Although there's no shortage of mathematical equations, in many cases you can bypass them and still understand the concepts more than well enough to use them to improve your imaging and image-processing techniques. Whether your interest is pretty pictures or scientific analysis, you'll find a wealth of useful information between the covers."

Sky and Telescope Magazine

Clearly structured, thoroughly documented, imaginatively presented . . .

In the book and on the included CDROM, the authors have provided 13 tutorials designed to introduce you to AIP4Win2.0. The tutorials provide concrete demonstrations of the subjects covered in the Handbooks, such as:

- ✓ **Image Enhancement** Discover how to extract detail from otherwise bland images. More than producing "pretty pictures," using the techniques will demonstrate to you enhanced details and show structures that, due to their low contrast, might otherwise be invisible.
- ✓ **Processing Multiple Images** Here is power at your fingertips! Calibrate an entire imaging session's worth of images at one time automatically. Align and enhance a set of images in preparation for creating a movie. Align and combine a group of images to create a single, "deeper" image. Process hundreds of planetary images.
- ✓ **Image Registration and Blinking** Registration and blinking are key tools in searching for asteroids and patrolling for supernovae.
- ✓ **Building Color Images** Learn how the "Join Color Tool" helps you to create stunning color images hassle-free from sets of red/green/blue filtered images.
- ✓ **Wavelet Noise Filtering** Experiment with one of the newest and hottest image-processing technologies. Wavelets are used by professional astronomers to analyze images from spacecraft.
- ✓ **Deep Sky Images** Learn the best ways to process a wide variety of deep-sky images, including the calibration and enhancement of a typical track-and-stacked deep-sky image.
- ✓ **Planetary Images** In this tutorial, you process an outstanding image of Jupiter using brightness scaling, unsharp masking, and deconvolution tools.

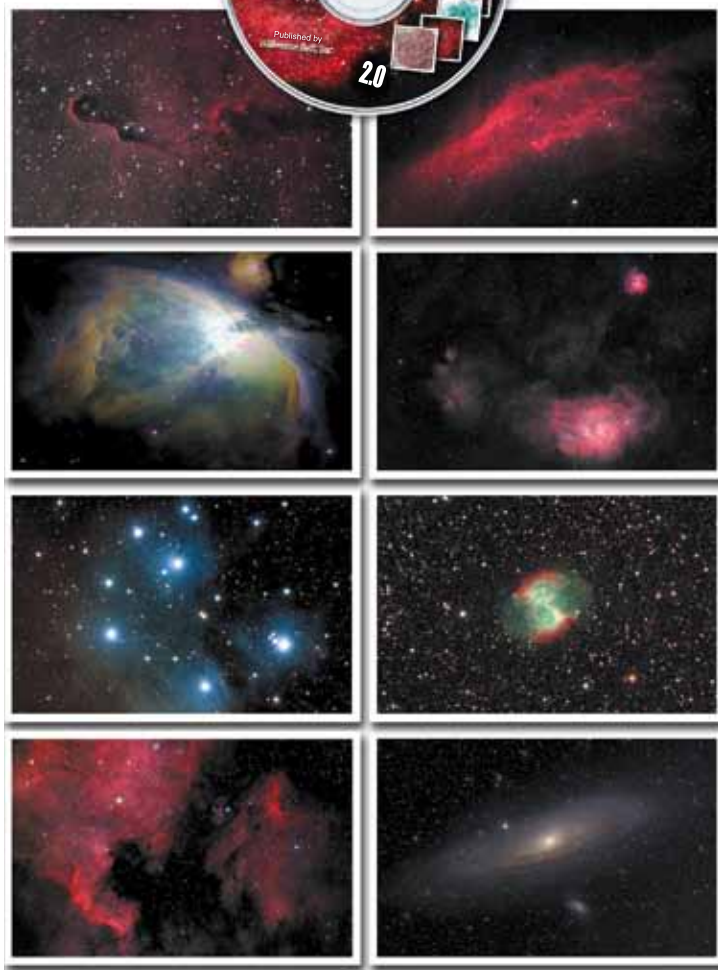
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Astronomical Image Processing

The book alone
is worth the
price ...



.. but when coupled with the unparalleled **AIP4Win2.0**,
you have a complete image processing tool
kit that is beyond price.



All of the images shown here were taken by Jim Burnell, processed and enhanced using the power of **AIP4Win2.0** the benchmark software for all astronomical images.

The features and capabilities were tailored to give astronomical imagers every tool they could possibly need for spectacular results, without the clutter and background noise of other more general focus imaging programs.

No need to commit to memory dozens of unnecessary tools, procedures and routines before you get to the good stuff. Here, crystallized for you, is everything that is the essence of night sky image processing.

For example, where else could you find out how to filter for specific gas emissions, assign the wavelengths to RGB channels in the HST palette, the way Hubble Space Telescope images are built, and in Jim Burnell's words, "show familiar objects in a new light." "All the tricks and techniques you need are here, clearly explained and demonstrated for you. there is no other software remotely comparable for the price."

If you're not using **AIP4Win**, don't you think it's time?

Here are just a few of the projects that you can accomplish with the **AIP4Win** software:

- ✓ Creating images of astonishing beauty...
- ✓ Tracking details of Jupiter's atmosphere...
- ✓ Hunting asteroids, comets, and supernovae...
- ✓ Picturing favorite deep-sky objects...
- ✓ Generating light curves of variable stars...
- ✓ Recording spectra of planetary nebulae...

Minimum Computer Configuration

AIP4Win 2.0 runs on any computer running Windows 95, 98, NT, 2000, XP, Vista and Win7. For your satisfaction, the authors recommend the following minimum specifications:

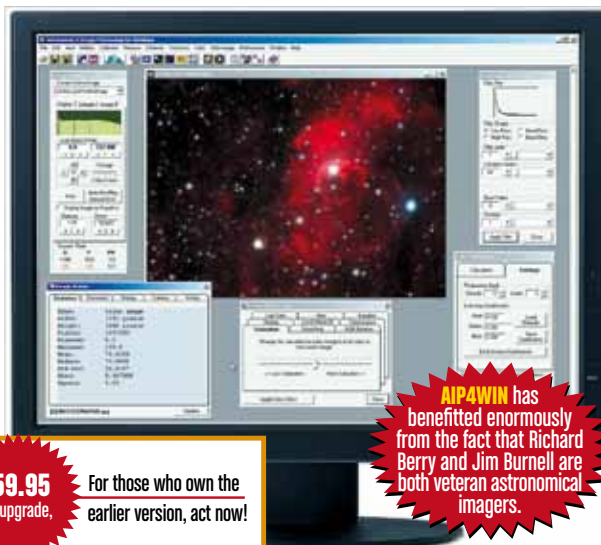
CPU: Pentium or Athlon 1 GHz or higher.

RAM: 256 megabytes minimum; however, more memory significantly improves speed.

Graphics: 1024 x 768 or better, 16-bit or 24-bit display

Hard Disk: 20 megabytes free space available.

CD-ROM: 16x or better



\$59.95
to upgrade.

For those who own the
earlier version, act now!

AIP4Win has
benefitted enormously
from the fact that Richard
Berry and Jim Burnell are
both veteran astronomical
imagers.

Astronomical Image Processing

Photoshop Astronomy, 2nd Edition

Includes DVD with full resolution images
used in this book's tutorials

by R. Scott Ireland

Softbound, 8.5 by 11 inches, 280 pages, Ship wt. 2 lbs. **\$39.95.**

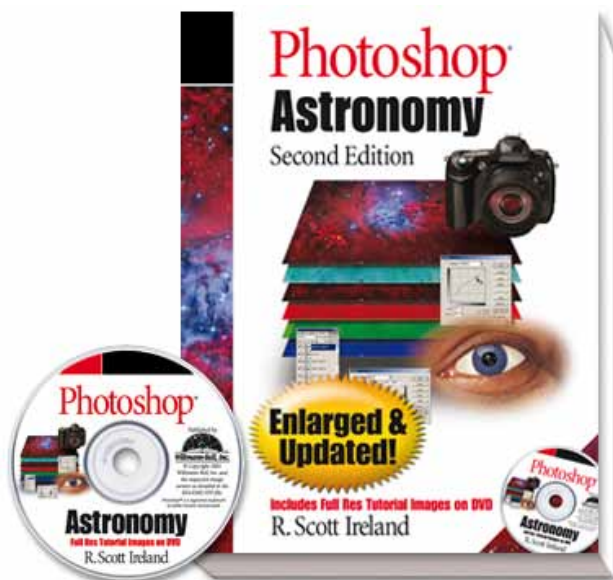
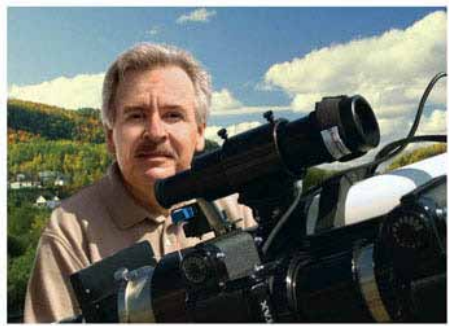
About this book in the Author's own words

I remember my first one-day class on how to use Photoshop in 1997. During the long drive home I was excited by the possibilities of what I had seen a Photoshop Master accomplish. However, as I began work on my own images I had great difficulty implementing what I had "learned." Even though I had diligently scribbled notes during the entire class, when faced with the power and complexity of the program, I hardly knew where to begin. Photoshop was speaking a language, indeed it was a language — one that I had not yet learned.

Over the years that followed I gradually learned Photoshop's language. In hindsight, what I really needed was a primer that outlined, step by step, exactly how to optimize my images and why I needed to do it in a particular way — a book that cut no corners or assumed that, as a beginner, I did not need to understand the big picture, complex techniques or why things worked.

I have written Photoshop Astronomy to do just that. It is packed with tutorial examples that are specific to astronomical imaging. Each Photoshop step is explained in great detail. A beginner will see results immediately. But make no mistake; this is not a "Photoshop for Dummies." I have not avoided complex material or procedures. Quite to the contrary, I have included difficult, extended image-processing tasks along with the simpler ones. Once you see how even the difficult procedures are worked with my step-by-step examples, their "difficulty" vanishes.

There are many things within this guide that even seasoned digital imagers will find challenging and useful. I have also included explanations of how and why things work. "Do this" and "Do that" are not sufficient. It is my firm belief that to speak the language of image processing you must understand the meaning of its "words" and their syntax. I have seen this method work during the many seminars I have conducted for amateur astronomers across the United States.



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For more info or to order over the web

BOOK REVIEW

Among the myriad computer programs used by astrophotographers, none is as popular or versatile as Adobe Photoshop. However, to take full advantage of the program's capabilities requires vast amounts of time. If a shortcut exists for mastering the tools and techniques needed to properly massage an astrophoto, R. Scott Ireland's new book Photoshop Astronomy is it.

Ireland, a Photoshop user since the mid-1990s, developed his book to help others understand and speak the Photoshop language. Everything you'll need to produce top-quality images is covered in intricate detail, from monitor calibration to complex layering and mosaicking techniques. Even better, the book includes a DVD with the image files used as examples throughout the book. Readers can walk through each step exactly as it is described.

Overall, it's hard to complain about anything in Photoshop Astronomy. Everything the author sets out to tackle is covered well, especially when the reader uses the images provided on the DVD to methodically follow each step. Ireland also freely admits (as does any good teacher) that he is still learning new tricks every day. Photoshop is such a powerful, evolving program that users always seems to be discovering new useful techniques that can further enhance their images.

While virtually all of Ireland's tips can be found or discovered on your own, it would take many months or even years to find and memorize all the information Ireland provides in this one-stop source. That makes Photoshop Astronomy worth its weight in gold ... or terabytes.

Sky & Telescope Magazine

Introduction to Digital Astrophotography

Imaging the Universe with a Digital Camera

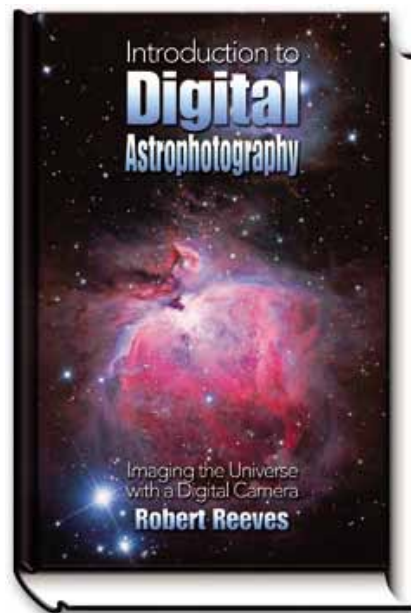
by Robert Reeves

Hardbound, 6 by 9-inches, 448 pages, Regular Retail Price **\$34.95**

This book is a comprehensive, nuts-and-bolts introduction to digital astro-imaging written by Robert Reeves, an accomplished author and film imager with nearly 50 years of experience who has enthusiastically made the transition to digital imaging. Robert describes how the family digital camera you probably already own can be used to take spectacular pictures of the night sky. This is especially true if you have purchased a digital camera within the past several years — even some entry level point-and-shoot digital cameras take pictures of the Moon and planets that rival or exceed the best film images. If you already own a digital camera, telescope, and computer you probably only require a camera adapter and image processing software—some of which is free—to begin your night sky imaging adventures and unlike film you see your results almost instantly!

Among the topics covered are:

- ✓ What digital cameras can do (and what they can't).
- ✓ How much resolution is enough?
- ✓ Web cams – spectacular immediate gratification on the cheap!
- ✓ Why is digital imaging often easier, much easier, than film?
- ✓ What are the special considerations for digital astrophotography?
- ✓ What are the various types of astrophotography and which is best for me and my equipment?
- ✓ How do I go about choosing a digital camera (or exploiting the strengths of the one I have now)?
- ✓ Which lenses are best for which targets and how do I go about testing them?
- ✓ How do I setup and align my telescope?
- ✓ What is image processing and how do I go about it?



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BOOK REVIEW

Robert Reeves explains everything you need to know about digital-camera Astrophotography.

Astrophotography is evolving — and fast. In the past few years alone digital cameras have super-seded film in popularity, sensitivity, and even availability. With such an evolution comes the need for tools to help newcomers overcome the challenges posed by the new equipment. Robert Reeves, who wrote *Wide-Field Astrophotography* (Willmann-Bell, 2000) — in my opinion, the last great book on film astrophotography — has taken up the challenge. In this new book he's compiled virtually every-thing there is to know about digital cameras.

Readers are safe in Reeves's competent hands. He tackles his subject with authority, presenting enough technical information to be interesting but not loading the text with so much jargon as to become tedious. From his introduction describing the differences between film and digital cameras, all the way through basic processing routines using popular computer programs such as Adobe Photoshop, ImagesPlus, and AIP4Win, Reeves demonstrates advanced knowledge and presents the material in an engaging format.

Reeves has spent nearly 50 years shooting the night sky, and his robust experience shows. I can't think of a single subject related to digital astro-photography (or even film photography) that was overlooked. Sensor size, pixel sensitivity, resolution, and storage media are all covered in depth. One particularly short but informative chapter deals with the history of lenses, from the first spectacles manufactured in AD 1285, to modern apochromatic objectives.

... Overall, Reeves has compiled yet another compendium of night-sky imaging that will be useful for many years to come.

SEAN WALKER

Assistant editor, Sky & Telescope magazine

Astronomical Imaging

Introduction to Webcam Astrophotography

Imaging the Universe with the amazing, affordable webcam

by Robert Reeves

Hardbound, 6 by 9-inches, 368 pages, 156 illustrations and 21 tables, 2 Lbs. 7 ozs. ship wt., **\$34.95**

In the last few years webcam astrophotography has exploded onto the astronomy scene. It has rapidly evolved from short exposure six-bit black-and-white imagery into long-exposure full-color 16-bit per channel imagery of such quality that it rivals "conventional" means of astrophotography. Indeed, webcams have become the method of choice for planetary imaging.

The message of this book is that you too can participate in this revolution without spending very much money. You do not need to invest \$10,000 in a CCD camera, telescope and software. A basic webcam costs about the same as a "so-so" eyepiece. Software to control the camera and process the images that will get you going is free. If you have the telescope (practically any telescope that will track)

and a computer you are ready. Since you see your results instantly the learning curve is much shorter.

Regardless of how you apply a webcam to astrophotography, you will derive a number of benefits. Working with them has been accurately described as interesting, challenging, and fulfilling. Webcams are capable of producing beautiful astrophotos that create a lasting record of your astronomical experience.

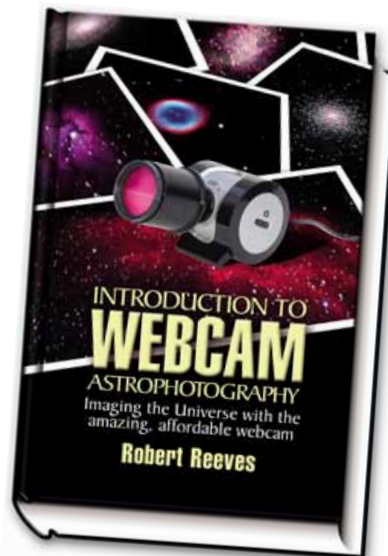
The book will guide you into this fascinating topic and allow you to

become a participant in this latest wave of astrophotography progress.

Here are some of the advantages of webcams

- ✓ Webcams are far cheaper than conventional cameras or astronomical CCDs.
- ✓ Webcams use USB plug-and-play technology, meaning they are easy to install on a computer and have fast image download times.
- ✓ Webcams provide real-time feedback. Focus and exposure are adjusted on the fly to insure best results.
- ✓ There are no film costs
- ✓ There is no need to wait for a full roll of images to be taken before developing them.
- ✓ You can create animated images and movies of changing events such as transits of Jovian moons or lunar occultations of bright stars and the planets.
- ✓ Your images are digital-friendly, meaning they can be printed, posted on the Internet, or emailed without the need for developing or scanning
- ✓ Plus much, much, more

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These simple webcams can do so much!



Astronomical Imaging

Wide-Field Astrophotography

Exposing the Universe Starting with a Common Camera

by Robert Reeves

Hardbound, 540+ Pages, 6 by 9 inches, 350 Illustrations, 53 Tables **\$29.95**

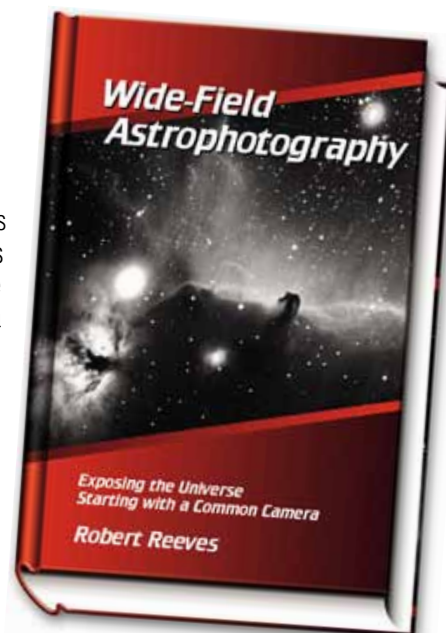
Wide-field astrophotography is an area where the beginner can bypass the complexities of prime focus telescopic astrophotography yet still excel and achieve good results quickly. Exquisite prime focus close-ups of galaxies and faint nebulae are attractive showpieces, but the art and technicalities of photographing such objects through a telescope are intimidating to the beginner. In high-resolution telescopic photography, the cost of the specialized equipment, the complexities of focusing fine, often invisible detail through the telescope, and guiding with extreme accuracy to achieve worthy results are obstacles to a novice sky shooter. Simpler non-telescopic wide-field astrophotography is an alternative that anyone who owns a camera can enjoy.

This text introduces techniques needed to mount ordinary 35-mm and medium format cameras atop an equatorially-driven telescope in order to produce stunning



portraits of constellations, the Milky Way, bright nebulae, and star clusters using wide-angle and telephoto lenses. Separate chapters extensively discuss cameras, lenses, filters, and photographic accessories suitable for astrophotography as well as the guiding techniques needed to accurately track moving celestial targets.

Additional chapters also detail powerful astrographs such as the Schmidt camera, and describe a number of homebuilt devices which can enhance the convenience and versatility of wide-field astrophotography. Further chapters discuss the characteristics of photographic film, how to test a film for its suitability for astrophotography, the current film selection available, hypersensitizing techniques used to increase the ability of commercial film to record dim celestial objects, and both digital and chemical dark-room techniques useful in astrophotography. This continues the introduction to wide-field astrophotography by discussing the specifics of meteor and comet photography, offering solutions to real problems encountered in astrophotography, and reviewing the history of photography as applied to astronomy.



BOOK REVIEW

I fear that Robert Reeves has done astrophotography a disservice. By titling his new book *Wide-field Astrophotography*, he risks having some amateurs dismiss the book's content as being too narrowly targeted for their interests. And in bypassing the book these people would be overlooking what just might be the finest volume ever published on amateur astrophotography in general. It's true that the book isn't filled with narrow-angle shots of tiny galaxies, but skipping the philosophical arguments, field size is simply an issue of focal length and film format.

I liked this book the second I flipped open its pages, and it kept getting better as I read the text. What makes it so good? For starters we have an author who's not only an accomplished wordsmith but one who has more than 40 years of first-hand experience with his subject matter. That's long enough to have made just about every mistake known to astrophotography, and there's no better way to learn how to do something right than by doing it wrong a few times first.

Since you can probably buy all the English-language astrophotography books currently in print for less than the cost of a few rolls of film and processing, and since they all contain useful information for beginners and veterans alike, there is none that I consider a waste of money. But if I could have only one book on my shelf that covers general night-sky photography, it would be *Wide-Field Astrophotography*.

Dennis di Cicco, *Sky and Telescope* magazine

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Astronomical Imaging

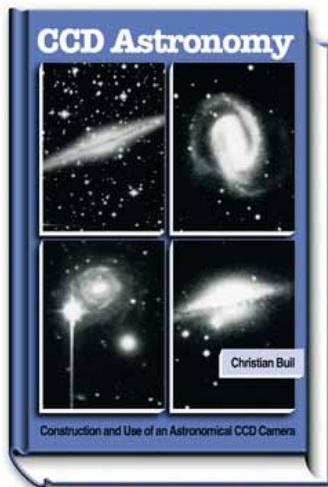
CCD Astronomy

Construction and Use of an Astronomical CCD Camera

by Christian Buil

Hardbound, 6.00" by 9.00", 321 pages, 2 Lbs. ship wt., **\$29.95.**

For almost 30 years Christian Buil the author of CCD Astronomy has been making and using astronomical CCD cameras. This book is based upon his experience and is written for both the builder and user of amateur CCD cameras. For those who choose to purchase their CCD camera ready-made it will provide valuable background information with which to judge the various commercial cameras. The builder will also find proven schematics, construction techniques and test procedures. Both the builder and user will find valuable information in the last two chapters which cover programming and use of the CCD camera once it is connected to a telescope and computer.



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Astrophotography

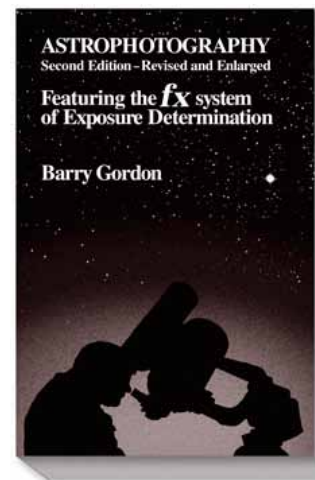
Featuring the fx system of Exposure Determination

Second Edition—Revised and Expanded

by Barry Gordon

Softbound, 6.00" by 9.00", 224 pages, **\$18.95.**

This book is intended to take the novice by the hand and rapidly get him or her taking good astrophotographs right from the beginning. The big difference between this book and all others is that for the first time an exposure system is presented that enables you to move between different lenses/telescopes, films and astronomical subjects and still get good photographs — something that the experts used to advise against. It would have been no trick at all to make this book a truly dazzling visual treat, using professional observatory photographs taken with the world's greatest telescopes. That temptation has been scrupulously resisted.



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Introduction to Observing and Photographing the Solar System

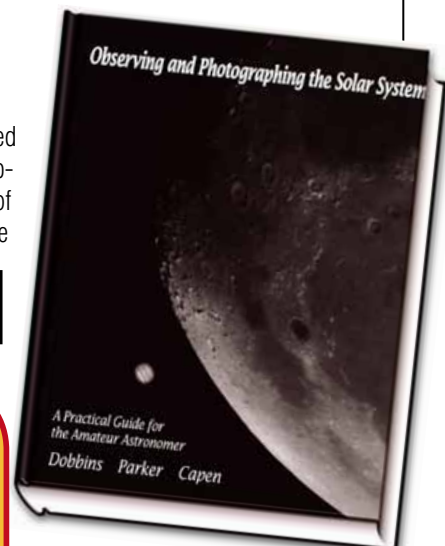
A Practical Guide for the Amateur Astronomer

by Dobbins, Parker and Capen

Hardbound, 8.50" by 11.00, 215 pages, **\$24.95.**

This book systematically covers amateur observation and photography of the planets. Several hundred photographs and line drawings of exceptional quality compliment the clearly written text. Unlike deep-sky observing, meaningful observations can be made in your own backyard. One of the authors of this book, Donald Parker, routinely takes pictures from his home in Coral Gables, Florida which have been favorably compared to those taken at professional observatories under the best sky conditions.

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BOOK REVIEW

Scanning the planets is an enjoyable visual experience, often a moving one for the newcomer. Helpfully, the 'wanderers' are readily observable for all amateurs, regardless of instrumentation or location. Becoming an expert scrutineer, though, of one particular planet use to require a book specializing in that body. Not any more. this present book encompasses all the planets but in doing so does not sacrifice observational detail. All but the most intense observer will be satisfied with the planetary chapters, which form two-thirds of the very pleasingly-presented volume. The last third covers planetary photography and shows the book-title's prefix 'Introductions . . .' is unnecessarily modest. This section is remarkable in being both particular and comprehensive, a result of Donald Parker's skill and experience — his astonishing photographs are scattered throughout the book. In entirety, this is an absorbing read as well as being an excellent reference and instructional text.

Journal of the British Astronomical Association

Telescope Making Supplies

For 37 years, we've offered the finest in Mirror Kits, each with two top-quality Pyrex® blanks



MIRROR KITS

During the past 75 years thousands have made telescopes with not much more than their hands, two Pyrex or glass blanks, abrasives, pitch, polishing compounds and a book describing the simple steps. Young and old, the very rich, and the not so rich have all successfully turned their hands and minds to the task.

Willmann-Bell offers a full range of books, abrasives, polishing compounds, waxes, and Pyrex to help you quickly and easily make a first-class telescope. Unlike other firms supplying the amateur and professional, our merchandise is not limited to fast moving items, but also includes the hard-to-find. It is no longer necessary to search far and wide to find optical quality supplies. With Willmann-Bell as your supplier, your mail box is as far as you have to go to find complete, fast service.

CHECK AND COMPARE WHAT YOU GET BEFORE YOU BUY ANY KIT. FEATURE FOR FEATURE YOU CAN'T BEAT A W-B Experience Proven Kit™.

- ✓ **Two Fine Annealed Pyrex Blanks:** With the Pyrex supplied in our kit you have a total of 4 surfaces to choose from. The best others offer is 2, whether they have two raised rim Pyrex blanks or a single Pyrex blank and a glass or ceramic tool. Further, since both blanks are the same thickness and are made of the same material, flexure, temperature and differing wear rates are all minimized or nonexistent. Finally, there is never any risk of hot pitch breaking the tool as can happen with glass.
- ✓ **Fast Cutting Silicon Carbide:** The average 6 inch mirror is hollowed out about a tenth of an inch at the center. When you

consider the amount of material that has to be removed, fast-cutting, long-lasting silicon carbide makes sense. For more details on this excellent abrasive consult the abrasive section.

- ✓ **White Aluminum Oxide Lapping Powders:** Final grinding or lapping is the key to faster and easier polishing. White aluminum oxide gives you the finest possible surface because of its unique purity and discus shaped particles that plane the glass away rather than chipping and gouging like other abrasives. To our knowledge no other kit maker offers you this unique product.
- ✓ **Fast Polishing Cerium Oxide:** For years red rouge was used to polish and figure mirrors. While capable of producing excellent surfaces it is slow and very messy. Cerium Oxide is faster and much cleaner.
- ✓ **Micro-Facet Netting:** Netting has been used by professionals for years but seldom by amateurs. It makes the lap much more responsive and promotes a smoother surface since the pitch can flow over a smaller area without restriction.
- ✓ **Tempered Burgundy Pitch:** This special mixture has the ideal flow rate to ensure an accurate surface with no turned edge. Never needs straining.
- ✓ **Pure Packaging:** Many suppliers pack their abrasives in shaker-top containers. While this appears to be a real advantage to first-time users, the experienced know that it is of dubious value. First, you will be using a large range of abrasive sizes; just as you learn to control one size you will be moving on to an even smaller and harder to control size. Second, the closures do not completely seal, which often leads to contamination in shipment and use. Professional workers either make a water-abrasive slurry and apply it with a brush, or they spoon the abrasive and cover the container with a small sheet of glass. Either way the exact quantity is placed precisely where it is desired. Therefore we seal our abrasives in a heavy-duty plastic bag to ensure its purity, and we recommend that you do what professionals do—transfer it to a small bowl and apply by spoon or make a slurry and apply it by brush.

Willmann-Bell Mirror Kits, FOB

Size (inches)	FOB Price (\$)
4.25	59.95
6.00	75.95
8.00	145.95
10.00	312.95
12.50	579.95

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ABRASIVES, POLISHING COMPOUNDS AND PITCH KITS

This is a “kit” of the abrasives, polishing compound (cerium oxide) and pitch that we package with our complete mirror kits. We offer these for people who have their own glass but nothing else

Willmann-Bell Abrasive, Polishing Compound & Pitch Kits, FOB	
Size (inches)	FOB Price (\$)
4.25	24.95
6.00	29.95
8.00	38.95
10.00	61.95
12.50	74.95

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PYREX® MIRROR BLANKS

Each blank has straight sides, two flat faces, few or no bubbles, and is fine annealed. They are ideal as primary and secondary mirrors, small flats and test plates.

Pyrex® Mirror Blanks*, FOB	
Size (inches)	FOB Price (\$)
1.00	7.95
1.75	8.95
2.50	9.95
3.00	11.95
3.25	16.95
4.00	17.95
4.25	18.95
5.00	21.95
6.00	24.95
8.00	54.95
10.00	125.95
12.50	253.95
*Strain Birefringence: 10 millimicrons, or less	

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OPTICAL GRADE ABRASIVES

The glass used to make telescope lenses and mirrors is usually molded with flat or roughly curved surfaces. First, coarse abrasives are used to form the basic surface—flat or curved. Next, finer and finer grades are brought into play to smooth out the pits left from each preceding size. Finally, the surface is fine enough to take an optical polish.

You can rely on Willmann-Bell's abrasives because they are accurately graded to ensure that no larger, scratch producing sizes or foreign materials are present. Further, special processing steps are used to produce abrasive grains of like shape and edge for longer and more economical grinding action.

There are many different ways to designate abrasive sizes. W-B uses two—Grit and Micron sizing. A one micron size abrasive particle measures one millionth of a meter. The table on page 41 shows the range of both grit and micron sizes and their relationship to one another stated in inches.

SILICON CARBIDE

Very Sharp, Long Lasting to Help You Form Your Curve Fast and Accurately. Silicon carbide is an extremely sharp, synthetic abrasive which approaches the diamond in hardness. It is made by mixing

Telescope Making Supplies

finely ground petroleum coke with pure glass sand. The mixture is loaded into a crucible and heated by electric arc to temperatures in excess of 2000°C. The intense heat of the arc causes the carbon in the coke and the silicon in the sand to fuse into silicon carbide. By varying the speed of the heating and cooling cycle the final crystal size is determined. A long, slow cooling cycle allows a few crystals to grow to a very large size while quick cooling forms numerous small crystals. The cooled mass is then broken up and rough graded by screening. The individual crystals are treated by impact, crushing or air blasting to remove brittle edges. Finally, it is graded by screening, water sedimentation, hydraulic flotation or air classification, with the latter used for the very fine grades.

Because of its extreme hardness, silicon carbide is ideal for grinding Pyrex, which is harder than glass, or very deep curve generation used for refractor, Maksutov, or richest field objectives. The very coarse sizes (40 and 60) are used for diameters larger than six inches or deep curves where a large amount of glass must be removed.

Willmann-Bell's silicon carbide is the very best optical grade available. Every step of manufacture and packaging is controlled to ensure the high purity and scratch free qualities sought by the precision optical worker. Accurately graded sizes from 40 to 500 grit are stocked. We recommend this abrasive.

Silicon Carbide, FOB

Grit	40z	80z	1lb	5lbs
40			\$4.50	\$20.00
60			\$4.50	\$20.00
80			\$4.50	\$20.00
120	\$1.30	\$2.50	\$4.75	\$21.00
220	\$1.30	\$2.50	\$4.75	\$21.00
320	\$2.20	\$4.30	\$8.00	\$30.00
500	\$2.80	\$5.50	\$10.00	\$35.00

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ALUMINUM OXIDE

Slower Cutting, Ideal for Softer Flint, Crown and Low Expansion Optical Glasses. In its naturally occurring crystalline state, aluminum oxide, or corundum has been used as an abrasive for thousands of years. The purest, natural form is the gem-white sapphire. Blue sapphires and rubies are also composed of aluminum oxide but have been colored by mineral oxides. Emery, another common natural abrasive, is impure corundum containing iron oxides. The natural occurring abrasives of this family were subject to large variations in quality. Occasionally, a very fine pocket of aluminum oxide would be mined and provide the optician with exceptional finishes, but,

Abrasive Size Relationship

Grit Size*	Inches	Micron Size**
40	0.0258	684
60	0.0160	406
80	0.0105	226
120	0.0056	142
220	0.0026	66
320	0.0013	32
500	0.0007	16
-	0.0005	12
-	0.0002	5
	0.0001	3

*Grit: Number of grains laid end to end in one inch

**Micron: One millionth of a meter

more commonly, quality was very uneven and the material had to be cleaned and separated by the difficult, time consuming water flotation process. As you read some of the older books on telescope making you will understand the serious the quality control problems and the great pains that were taken to purify abrasives.

Today, modern technology is capable of producing consistently high quality aluminum oxide which has practically replaced the natural forms for precision optical work. Aluminum oxide, like silicon carbide, is made in the electric furnace. Bauxite (aluminum ore), coke and powered iron are combined, heated, cooled, crushed, treated to produce a uniformly shaped particle and finally graded. This process results in a nearly pure aluminum oxide crystal with a hardness of 9 on a Mohs scale. It is somewhat slower cutting than silicon carbide and is therefore ideally suited for smoothing operations involving the softer optical glasses used for refractors, corrector plates and optical windows.

Aluminum Oxide, FOB

Grit	40z	80z	1lb	5lbs
120	\$1.30	\$2.50	\$4.75	\$21.00
220	\$1.30	\$2.50	\$4.75	\$21.00
320	\$2.20	\$4.30	\$8.00	\$30.00
500	\$2.80	\$5.50	\$10.00	\$35.00

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Telescope Making Supplies

WHITE ALUMINUM OXIDE LAPPING POWDERS

Super Fine, Smooth Cutting, Scratch Free Final Stage Abrasives. Final lapping is the key to smooth, regular surfaces that polish out quickly with no turned edges. The professional optician knows that a very fine, closely controlled abrasive makes it possible to grind out in a few minutes slight irregularities which would take hours of polishing to correct. But, when this stage is reached, it is absolutely key to have an abrasive that does not scratch. To meet this need a special abrasive has been developed. Because the ore for this product is nearly pure, no additives in the form of coke or iron are needed as flux which significantly lowers the risk of contamination. The intense heat of the electric arc fuses the white aluminum ore and then by controlling the rate of cooling the very small individual crystals are grown to a uniform size, edge and hardness. The result is a pure white discus shaped particle that cuts by a planing action rather than the fracture method of the more common grey aluminum oxides. We recommend a 12 and 5 micron sequence after 500 grit and before polishing. Usually 3 or 4 wets are needed for each mirror, therefore one quarter pound will last all but the most active worker a long time.

White Aluminum Oxide Lapping Powers, FOB

Micron	40z	80z	1lb	5lbs
25	\$2.00	\$3.60	\$7.00	\$24.00
12	\$2.20	\$4.00	\$7.50	\$26.00
5	\$2.30	\$4.50	\$8.50	\$30.00
3	\$2.40	\$4.70	\$8.70	\$30.00

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OPTICAL GRADE POLISHING COMPOUNDS

Throughout the grinding and final lapping stages, the objective has been to reduce pits and scratches to the smallest possible size. However, no amount of grinding can produce a surface smooth enough or sufficiently transparent to meet the needs of a first-class telescope objective. Different techniques are needed. While there is still considerable discussion on the subject, it appears that polishing is a result of one or more of the following: removal/wear, athermic surface flow, or the formation of a silica-gel surface by hydrolysis. The result, whatever the cause, is an incredibly smooth surface, if optical techniques and supplies are used.

Until recently there were three principle types of optical polishing compounds available; Barnesite, cerium oxide, and the iron oxides (or more commonly, rouge). Barnesite production was curtailed

when the manufacturer determined that the process could not meet federal anti-pollution controls. Fortunately, cerium oxide and the various rouges are more than sufficient to meet the needs of the precision lens maker.

All of W-B's polishing compounds will give a first-class polish, but each differs from the other in speed, action, cleanliness and cost. By changing from one to another during the polishing and figuring stages, it is possible to finish a mirror or lens faster and more accurately because the primary difference is speed. Therefore you may want to polish out your surface rapidly with cerium oxide and then switch to one of the slower acting rouges that allow you literally to creep up to the exact figure you are working for without fear of overshooting.

CERIUM OXIDE

Fast, Clean, Scratch and Slek Free Polishing. This compound is the oxide of the rare earth cerium. It was first discovered by Klaproth in 1803 and is the most abundant of the rare earth metals. When refined by electrolysis a grey, malleable and ductile metal is produced. The metal is most commonly used in the manufacturing of lighter flints. The oxidation of cerium to cerium oxide produces a pure white powder which is insoluble in water, organic solvents and most acids. It is easily removed from work, clothes, and hands with soap and water. Polishing speed is about three times faster than rouge, with no sacrifice in surface quality.

There are many grades of cerium oxide sold today, but we sell only the highest optical grade. It is micro-pulverized and graded by air classification for the absolute in uniformity, speed of action, and freedom from contamination.

Cerium Oxide, FOB

40z	80z	1lb	5lbs
\$6.50	\$12.50	\$21.00	\$99.00

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For more info or to order over the web



Telescope Making Supplies

ZIRCONIUM OXIDE

Slow, Clean, Scratch and Slick Free Polishing. Zircon is a fairly soft, ductile, gray or black metallic chemical element which is used in alloys and ceramics. The zirconium oxide we sell is white and very slow acting. Ideal for final figuring.

Zirconium Oxide, FOB			
40z	80z	1lb	5lbs
\$5.00	\$9.50	\$18.00	\$75.00

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RED ROUGE

Low Cost, Time Proven High Quality Polishing Compound. Red rouge is produced by combining ferrous sulfate, ammonium hydroxide and ammonia water. The solution is then filtered, burned in the presence of air and finally powered and graded. Its close cousin is iron rust, although optical rouge is many times finer and purer. Generations of skilled craftsmen have used rouge to produce surfaces of the highest quality.

W-B's red rouge is soft, slow polishing, and leaves no streaks. It gives the polishing lap a smooth, velvety feel. Care is needed in its use since it does not readily wash out of clothes. Ideal for the final 8 to 10 minutes of figuring when fast changes can cause you to overshoot the desired curve.

Red Rouge, FOB			
40z	80z	1lb	5lbs
\$4.00	\$6.00	\$9.00	\$30.00

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OPTICAL GRADE PITCH, WAX AND ROSIN

The polishing stage of mirror making accomplishes two things. First, it smooths the surface so that light can pass through or be reflected without scattering to form a clear, sharp image. Second, the surface is then changed (or "figured") to match an ideal curve to further sharpen the image. These two steps produce surfaces that do not deviate by more than 1/4 to 1/20 wavelength of light or one-two hundred thousandth to a millionth of an inch. To achieve this high degree of precision, pitch, wax and rosin are used to form a polishing lap that behaves like a very thick liquid and slowly flows and conforms to the mirror's surface. The very highest quality astronomical surfaces are made on pitch laps. While laps of paper, plastic and felt have been used, none have proven to be a match for the pitch lap.

ROSIN

Ideal for Tempering Laps. Rosin is a solid resinous material that occurs naturally in the oleo resin of the pine tree. Commercially, pine trees are tapped for their sap or gum. The collected gum is thinned with turpentine and a small amount of oxalic acid is added to remove the trace of iron that southern pine trees absorb from the red soils. This solution is then steam heated to between 180° and 200°C., filtered and washed with water to remove the remaining oxalic acid and other soluble acids. Finally, high pressure steam is used to drive off the turpentine, and the liquid is cooled into a solid. The rosin mass does not flow like pitch but rather remains stable over a reasonably wide temperature range. The highest quality rosin is amber colored and is transparent. Rosin is soluble in most organic solvents—turpentine or ethyl alcohol. It is a valuable additive to pitch (where it acts to temper the pitch so that it flows more predictably and evenly) as an ingredient in blocking pitches, or as a lap in very high temperature zones.

Rosin, FOB			
40z	80z	1lb	5lbs
\$2.00	\$3.75	\$7.00	\$26.00

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For more info or to order over the web

POLISHING PITCH

The Key to Outstanding Surfaces. Willmann-Bell's pitch, like rosin, begins with the gum from a pine tree. However, unlike rosin, pitch is produced by heating the gum in the absence of air. As the temperature increases the very volatile elements, then light through heavy oils, boil off, until only cyclic organic acids or pine-tar pitch remains. It is cleaned and processed until it is a clear burgundy colored homogeneous mass. Pitch is soluble in organic solvents.

Willmann-Bell offers pure pitch in hard, medium and soft grades and in a special tempered, ready to use, formula. The pure pitches can be used alone or as a base to which rosin, beeswax and linseed oil can be added. The hard pitch is ideal for f/8 mirrors and flats because the curves are shallow or non-existent so pitch flow can be very slow. Hard pitches also tend to fight turned edges. The medium grade is good for deep mirrors or lenses where the flow rate must be higher. The soft grade is very fluid and is ideal for figuring corrector plates used in Schmidt cameras.

For the beginner or advanced worker who does not want to mix his own pitch we offer a unique combination of rosin, beeswax and pitch that melts at 174°F, flows accurately for normal focal length mirrors and flats and is consistent from package to package and year after year. This pitch is the favorite of thousands of ATMs and professionals. Sold only in 8 Oz. containers.

Telescope Making Supplies

Polishing Pitch, FOB

	80z	1lb	5lbs
Burgundy Polishing Pitch			
Hard	\$8.00	\$14.00	\$45.00
Medium	\$8.00	\$14.00	\$45.00
Soft	\$8.00	\$14.00	\$45.00
Tempered	\$9.00	\$15.00	\$60.00

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For more info or to order over the web

REFINED BEESWAX

Ideal for Tempering Laps, as a Top Coating to Laps and a Low Melt Blocking Wax. To store honey, the honey bee builds a comb with wax produced in his body. To retrieve the wax, empty combs are melted in boiling water, and the wax floats to the top and is skimmed off. The non-optical grade beeswax is not usually further processed. The optical grades are refined to remove color, residual honey and grit. The result is a clean, creamy white product.

When 5 to 10% beeswax is added to pitch it reduces chipping when channels are cut in the lap. Further, the addition of beeswax tends to temper the lap making flow more predictable. Many workers apply a thin, pure coat of beeswax over the squares in a channeled lap to ease binding of the mirror and to stop sneaks. It can also be used as a low melting point blocking wax that softens with hot water.

Refined Beeswax, FOB

40z	80z	1lb
\$4.50	\$8.00	\$17.00

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For more info or to order over the web

BLOCKING PITCH

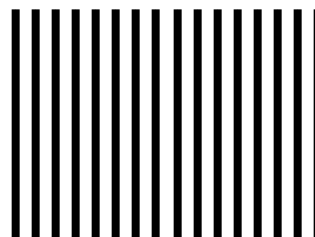
Holds Firm Without Strain. This is a special formulation of a loaded pitch which can be used to join tools or other glass together for working. It holds extremely well but comes off quickly after chilling in the refrigerator for a few minutes. Since the objective of blocking is to hold glass firmly but without stress we offer two grades—Hard and Soft. The hard generally is used for temperatures above 75°F and the soft for colder room temperatures. Both grades may take up to 24 hours to relieve strain.

Blocking Pitch, FOB

	40z	80z	1lb
Hard	\$5.00	\$9.00	\$17.00
Soft	\$5.00	\$9.00	\$17.00

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For more info or to order over the web

Ruled Grating for Ronchi Test



The Ronchi Test has been used for many years as a quick qualitative method to evaluate overall mirror surface smoothness and figure. We stock 65, and 85 line gratings with equally spaced opaque lines that occupy 50 percent of the total area. The grating is a highly accurate photographic reproduction on a thin, transparent, and durable film. The thin film base minimizes annoying diffraction effect common to thick glass substrates. We recommend the 65 or 85 line gratings for preliminary evaluation

65 Line Grating 2"x 2" \$9.95

85 Line Grating 2"x 2" \$9.95

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For more info or to order over the web

THE MOBSBY NULL TEST



The November 1974 issue of *Sky & Telescope* (page 325) carried an article by Eric G.H. Mobsby of Blandford Forum, Dorset, England, describing a method of testing medium and long focus mirrors with a special inverse grating that can be interpreted with the ease of a Null Test. Robert A. Cox, then Co-editor of the *Gleanings for ATM's* column, proposed that the test be called the Mobsby test.

Willmann-Bell is pleased to offer precision inverse gratings at reasonable prices so that you can make that perfect mirror. For less than

Telescope Making Supplies



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Jeremy Graham Ingalls and Wendy Margaret Brown



the cost of doing it yourself you can get a precision grating that has been individually shot using one of the sharpest lenses available (a 55mm Auto Micro Nikkor f/3.5) mounted on a heavy, vibration damping industrial optical bench. Further, test shots were measured on a Mann-Engine under 50x magnification to insure that exactly a 100 to 1 reduction of the carefully computed and drawn targets was achieved.

CERA-HEX-TOL™



Mobsby Null Test Grating Ranges

Mirror Diameter (inches)	Radius of Curvature (inches)
4.25	34 to 90
6.00	52 to 120
8.00	80 to 180
10.00	115 to 200
12.50	155 to 250

Please do not order your grating until you have completely polished out your mirror and can accurately measure your radius of curvature to 1/4" (there is no need to exceed 1/4" accuracy).

[CLICK HERE](#)
For more info or to order over the web

A low cost, time proven tool. Do what professionals do for large surfaces. Use our 1" Hexagonal optical grade ceramic to make a low cost tool on a back of metal, stone, or wood. Ideal for 10" or larger mirrors where the tool is costly if made of glass or Pyrex. In addition to low cost, the open channels of a tool made with these tiles promotes much faster grinding with more economical use of abrasives. We have also found that flats grind out more easily and without turned edges. Epoxy glue is used to cement the tiles to the backer but is not supplied. Shipped with detailed instructions.

One (1) sq ft CERA-HEX-TOL 2 Lbs. 15 Ozs. ship wt., \$8.95.

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For more info or to order over the web

Shipping Information

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delivery dates on Media Mail nor is it traceable while in transit.

Other shipping options are available at additional costs, these are charged at actual cost. Options include Priority Mail, Express Mail, UPS ground and air. It is no longer possible to provide compact tables in this catalog to calculate shipping charges (UPS rates vary with about "80,000 address exceptions" in addition to residential surcharges and "remote" surcharges). However, our web shopping cart can estimate these charges prior to you entering any personal data.

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There is a \$2.00 handling charge for international orders, there are no additional fees for customs document preparations.

The methods available for international mail and the shipping rates significantly changed on May 14, 2007. Beginning on that date the U.S. Post Office no longer provided international surface (sea mail) service, all post office mail is now by air. We now calculate costs for three methods of shipment: First Class Mail, Priority Mail and Express Mail. These three methods are not available to all countries.

- 1. International First Class Mail is registered to guarantee delivery.** It is limited by weight to 4 pounds (1.82 kilos) and insurance is limited to \$47.93. Our experience with this service is that, because it is registered and has the highest postal security, packages are seldom lost. The post office issues no estimate of delivery times for this class of mail.
- 2. International Priority Mail can be used to insure shipments to most countries.** Included in the postage is limited insurance coverage which is based on the weight of the shipment. We include in our shipping quotes, if necessary, the additional cost for supplemental insurance if the value of the shipment is more than

what is covered the weight of the shipment. If insurance is not available to a country we will not ship by this method and our on-line software will not generate a quote. Typical delivery times average 6 to 10 business days but are not guaranteed and may be greater based upon destination and customs clearance.

- 3. International Express Mail has quicker delivery than Priority Mail.** It also is more expensive. There are some countries that do not have insurance available for Priority Mail. It is possible to insure Express shipments to most countries so this method of delivery is used either for faster delivery or delivery when no other method is available. Typical delivery times average 3 to 5 business days but are not guaranteed and may be greater based upon destination.

PLEASE NOTE: Additional duties, customs and clearance fees may be imposed on this shipment by your government after it arrives in your country. Local laws apply and vary greatly from country to country.

ABOUT THE COVER IMAGE: This composite image of the Crab Nebula (NGC 1952) uses data from three of NASA's Great Observatories. The Chandra X-ray image is shown in light blue, the Hubble Space Telescope optical images are in green and dark blue, and the Spitzer Space Telescope's infrared image is in red. The size of the X-ray image is smaller than the others because the outwardly streaming higher-energy electrons emitting X-ray light radiate away their energy more quickly than the lower-energy electrons emitting optical and infrared light. The neutron star, which has the mass equivalent to the sun crammed into a rapidly spinning ball of neutrons twelve miles across, is the bright white dot in the center of the image. Credit: NASA, ESA, CXC, JPL-Caltech, J. Hester and A. Loll (Arizona State Univ.), R. Gehrz (Univ. Minn.), and STScI

Prices subject to change without notice

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