The Planet Observer's Handbook

This is an informative, up-to-date and well-illustrated guide to planetary observations for amateurs. After a brief description of the Solar System and a chapter on the celestial sphere, readers are shown how to choose, test and use a telescope with various accessories and how to make observations and record results. For each planet and the asteroids, details are given of observational techniques, together with suggestions for how to make contributions of scientific value. From a general description and detailed observational history of each planet, observers can anticipate what they should see and assess their own observations. The chapter on planetary photography includes the revolutionary use of videography, charge coupled devices and video-assisted drawing. There are also chapters on making maps and planispheres and on photoelectric photometry.

This carefully updated new edition:

- discusses the latest spacecraft research
- includes a new section on the Kuiper Belt and Oort Cloud
- contains the latest information on video imaging and film for planetary photography

The Planet Observer's Handbook

Second Edition

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To the memory of my beloved Mother and Father
Corona A. and William C. Price,
who first encouraged me in astronomy.

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FOREWORD

Many amateur astronomers have a fascination for the objects of the Solar System. This is not surprising; some of these objects are bright enough to observe from urban skies and can look interesting even in small telescopes; also, unlike many vaster and further-distant objects, the bodies that we share our sun with *move* and *change in appearance*.

A person becomes an amateur 'planetarian' because the planets and their cousins the asteroids, meteors and comets interest that person. By definition, amateurs receive no pay, neither do they need formal certificates to pursue their interest. These self-motivated amateur students of the Solar System belong to at least three categories (often overlapping) and I think that *The planet observer's handbook* offers something for each:

The armchair amateur Many amateur astronomers have no telescopes. They educate themselves about the history of this field, perhaps through the most current developments. This book pays due attention to the work that has gone on before from Galileo's 30-power telescope to *Voyager II*, unlike many amateur and most professional works in this field.

The intelligent observer This amateur probably has a telescope, but he or she wishes to know what to look at and to understand what is seen. This observer may well be interested in challenges – finding the rare, the elusive or the transitory object or event in the heavens. Such targets may include eclipses, occultations, faint asteroids, comets or satellites, or perhaps simply something like Jupiter's Great Red Spot. This book can tell you what to turn your telescope (or binoculars, or even your eyes) toward.

The amateur planetary scientist This person wants to contribute to the human knowledge of our Solar System. This is demanding work, but well within the reach of the well-prepared and dedicated amateur. This book describes a variety of scientifically-useful observing projects and how to go about them.

This last form of amateur astronomer is probably the rarest of the three types. The novice in amateur Solar System research needs to understand that many very bright people have already been carefully studying the Solar System for centuries, recently with very 'sophisticated' and expensive equipment. They certainly have not discovered everything there is to be discovered, but it is true that casual observation is no longer sufficient for the scientific study of the Solar System, if indeed it ever was. What the scientifically-inclined amateur most needs is perseverance and organisation; in particular the ability to follow a demanding observing schedule.

What the amateur has above all is telescope time. What *type* of telescope is less important than the dedication to use it effectively. For example, even the unaided eye is a valuable tool in meteor observing. Binoculars can be used to advantage for the brighter asteroids and comets. The next step up, a small telescope in the 4- to 8-inch range, allows its owner to take part in the great majority of the planetary programmes of the Association of Lunar and Planetary Observers or the British Astronomical Association.

Speaking of organizations, the advanced amateur (armchair or observing) needs to become part of the amateur-astronomer information network. First, our knowledge of the Solar system is not static; there are always new discoveries to be aware of and upcoming events to plan for. Even the best books go out of date. Thus, in order to keep abreast, a person needs to subscribe to at least one of the major astronomy magazines, and to belong to an observing-oriented organisation as well. You can obtain first-hand knowledge about instrumentation by attending star parties and the meetings of your local astronomy club. Finally, knowledge must flow both ways; the other purpose of magazines and organisations is as recipients of your observations. However well they are made, observations are useless unless communicated to others.

If you want to observe, you need some equipment, but don't get carried away. This book describes the basic equipment you will need, and this may be all that you will ever need. If, after serious observing, you find that you have exhausted the capabilities of your telescope and its accessories, that is the time to move up, not before. Upgrading may mean a larger telescope, or one of better optical or mechanical design. Or it may mean joining the electronics revolution that is sweeping amateur (and professional) astronomy. Many amateurs own and use photoelectric photometers now. Others are experimenting with telescopic video recording. Still others are beginning to experiment with digital CCD cameras. What is exciting about these newer techniques is that they allow the amateur to make *quantitative* observations that are of professional quality, even with moderate-sized telescopes.

Amateur study of the Solar System is experiencing profound changes. Some once feared that space-probe observations of the planets would make earth-based studies obsolete. However, spacecraft really are just another form of scientific instrument, and every new instrument ends up raising more questions than it answers. So there is a continued need for ongoing amateur scrutiny of the Solar System; to discover, for example, lunar transient phenomena, storms in planetary atmospheres, and new comets, to give a few examples. In addition, new instruments and techniques allow the dedicated amateur *routinely* to make professional-level observations.

The planet observer's handbook is also of use to those who are not interested in spending their leisure time in directed research. There is plenty of room for the casual or even armchair observer in amateur astronomy. The idea is to do what one wants to do. Whatever form your interest in our Solar System takes, I think this book will help you to pursue it.

John E. Westfall,
Executive Director,
Association of Lunar and Planetary Observers

PREFACE

Many books have been written about practical amateur astronomy which cover the entire field of observational astronomy – the planets, sun and moon, stars, galaxies, comets and so on. The space allocated to planetary observation in such books is thus necessarily limited which is a pity because planetary observation has a special appeal and fascination unique to itself. The keen planetary observer deserves something more than a few brief notes about what to look for on each planet. I believe that there is a need for a book-length work on planetary observation that goes much further than this. In compiling this book, which is an attempt to meet this need, I have striven to remedy some of what I perceive to be deficiencies in the sections devoted to planetary observation in the usual books on general amateur astronomy.

First, I believe that an intelligent planetary observer should have a good background knowledge of the relevant observational aspects of each planet (as opposed to the planet's internal structure and composition, mass, presence of a magnetic field, for example). This can, of course, be obtained from the comprehensive treatises dealing with these matters but I consider that it is better to have the relevant information together with the practical observational aspects under one cover in the observer's handbook, for convenient study and reference.

Second, as well as detailed descriptions of observing equipment, accessories and methods of observation, the detailed chronological history of observation of each planet is given so that the significance of results of the observer's own telescopic research can be better appreciated and evaluated.

Third, plentiful illustrative material in the form of planetary drawing by observers of the past and present, using telescopes large and small, is provided. This enables the planetary observer not only to gain a good idea of what he can expect to see when starting out but also to assess the significance and value of his observations on becoming experienced in planetary work.

The first three chapters briefly review the basics of the Solar System, the celestial sphere and celestial coordinates, observing equipment and accessories. In the latter chapter is described the construction of an easily and cheaply made telescopic accessory – the apodising or antidiffraction screen – which significantly improves the clarity and contrast of planetary images and reduces the effects of atmospheric turbulence without reducing the working aperture of the telescope.

The effect of local atmospheric conditions on planetary observation and the assessment and recording of atmospheric 'seeing' and transparency at the time of an observation are described in chapter 4.

Chapters 5 to 13 inclusive treat each individual planet. The telescopic characteristics of each, visibility, best times for observation and recording of observations are described. In addition the text gives a detailed history of observation of each of the planets, the phenomena recorded by the great observers of the past and the history of discovery where applicable as in the case of the planets Uranus, Neptune and Pluto. The planetary observer of today will thus be enabled to put his own observations into better perspective and will thereby be helped to decide what is worth pursuing and what will be merely repetitive. In addition, each planet chapter is illustrated with many drawings made by various observers with telescopes of various apertures. The practical planetary observer will thus gain a good idea of what he may expect to see with his own telescope and also to compare what he sees with observations of other observers of the past and present. The book concludes with a chapter each on planetary photometry, photography and videography.

Although knowledge of the planets of our Solar System has been greatly increased by close-up photography by space probes and in some cases by craft actually landing on planetary surfaces as in the case of Mars and our own Moon, this does not mean that Earth-based telescopic observations of the planets is obsolete or futile. It is certainly true that no Earthly telescope, however large, can hope to compete with the highly detailed views of planetary surfaces and atmospheres that are possible with these space probes. However, planetary research is not entirely a matter of resolving finer and finer detail; the long-term study of the major atmosphere phenomena of the planets Jupiter and Mars and the seasonal and secular changes undergone by the dusky markings on the surface of Mars, for example, are obviously not feasible by orbiting spacecraft. In fact, it would be wasteful to do so. It is best to think of Earth-based telescopic observation of the planets and close-up studies from space probes and orbiting craft not as being in competition but as complementary. The advent of the electron microscope with its great resolving power and the enormous magnifications of microscopic objects thus made possible did not make the light microscope obsolete. The two instruments are complementary and each is adapted to different kinds of microscopic investigation.

If, in writing this book, I succeed in convincing even a few of my readers to take up planetary observation as a scientifically worthwhile pursuit and a fascinating hobby, then it will have been well worth all the time and effort that I have put into it.

Buffalo, NY, USA — Fred W. Price, Ph.D.

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Ernst E. Both, Director of the Buffalo Museum of Science, Buffalo, NY, USA, and former Curator of Astronomy, supplied his beautiful observational drawing of the planet Saturn made using the Museum's Kellogg Observatory's 8-inch refractor for the illustration in fig. 10.19.

My friend Eugene Witkowski, a clever astrophotographer and a long time member of the Buffalo Astronomical Association, used his 14.25-inch Newtonian reflector to secure the photographs of Mars and Jupiter which appear in figs. 9.13, and 15.5–15.7. His generosity in letting me use these pictures is appreciated.

Special thanks are due to Richard M. Baum, the noted planetary observer, for providing me with several of his splendid observational drawings of planets for fig. 5.18 (Mercury), figs. 6.4, 6.9, 6.22, 6.23, 6.25 and 6.26 (Venus), figs 7.7, 7.27 and 7.29 (Mars), fig. 9.28 (Jupiter) and fig. 10.24 (Saturn).

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I am grateful to the many publishers, organisations and individuals for permission to reproduce published photographs, drawings and diagrams, whose names are separately acknowledged in the captions attached to the relevant illustrations in the text.

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ABBREVIATIONS USED IN THIS BOOK

BAA	British Astronomical Association
ALPO	Association of Lunar and Planetary Observers
IAU	International Astronomical Union
JBAA	Journal of the British Astronomical Association
JALPO	Journal of the Association of Lunar and Planetary Observers
CCD	Charge-coupled device
RA	Right ascension
UT	Universal time