

HOW TO MAKE
AND USE
A TELESCOPE

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H. PERCY WILKINS, Ph.D., F.R.A.S.
and PATRICK MOORE, F.R.A.S.



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FOREWORD

THERE have been many books written on the subject of telescope making; such works as *Amateur Telescope Making*, edited by A. G. Ingalls, are of course extremely well known, and are indispensable to the advanced student. So far, however, there seems to be no work which caters for the beginner who wishes to construct a small or moderate-sized telescope, and then use it to make useful astronomical observations. The present book is an attempt to fill this gap in the literature. If it encourages even one would-be astronomer to make an instrument of his own, and then contribute something to the great science, the authors will be more than content.

The book has naturally been planned, discussed and worked out by both writers, working in the closest collaboration. The second author wishes, however, to make it clear that the technical chapters dealing with telescope construction are almost entirely the work of Dr. Wilkins, and that Moore's contribution has been confined in the main to Chapters I, VIII, IX, and XII.

Our thanks are due to Miss Patricia Cullen, who has given great artistic assistance with many of the technical line diagrams, particularly those in Chapter III.

H. P. W.

P. M.

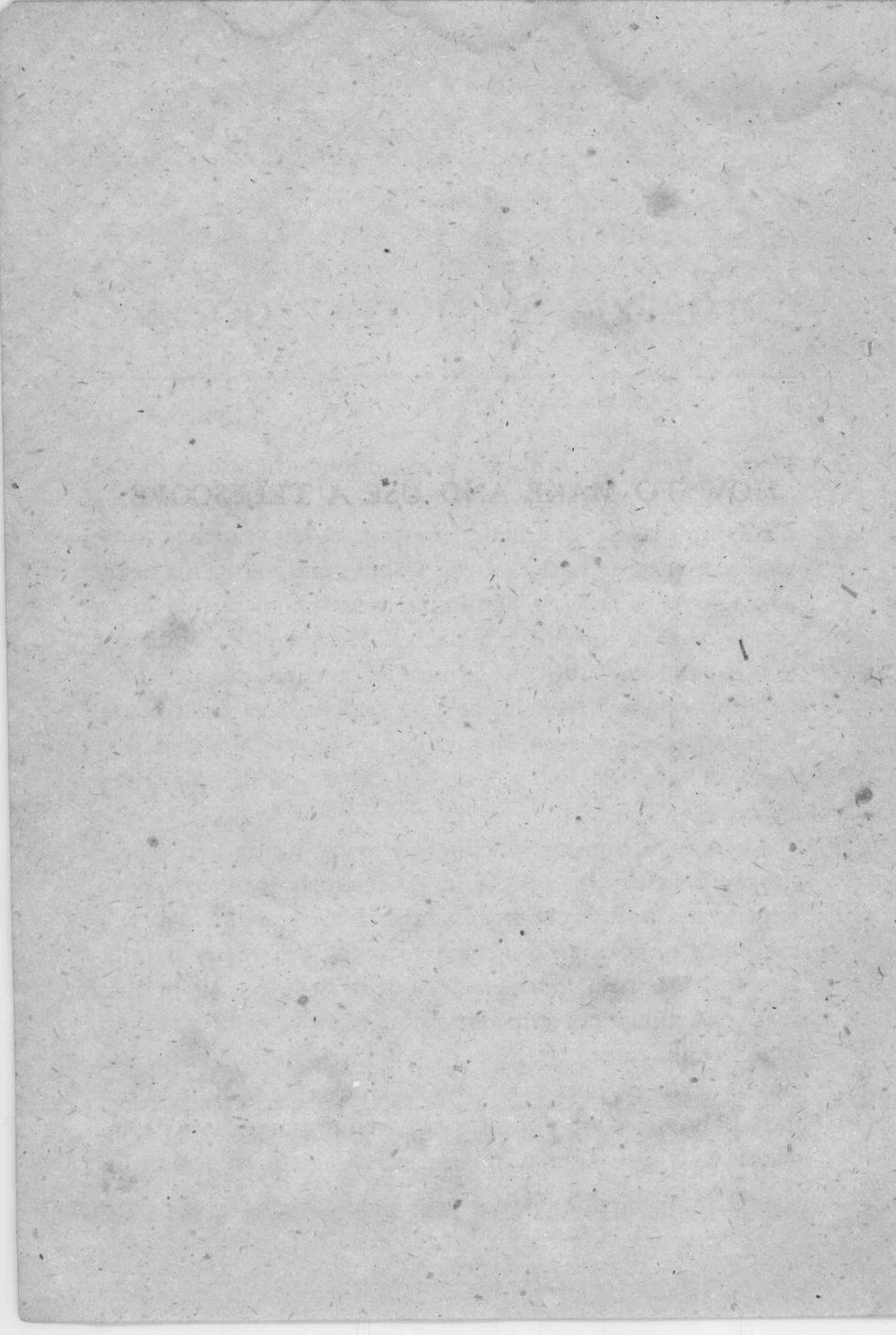
FOOTNOTES

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HOW TO MAKE AND USE A TELESCOPE



I

THE EARLIEST TELESCOPES

IT HAS often been said that astronomy is the oldest of the sciences. The statement is perfectly true; even the primitive man who roamed the dense forest of 25,000 years ago must have taken some notice of the wonders far above his head, while some of the early religions were based purely upon the worship of the celestial bodies. The ancient Chaldeans divided the stars into the groups of constellations that we still know to-day; the Chinese observed eclipses and comets, while some of the more enlightened Greeks realized that the Sun, not the Earth, was the centre of the planetary system.

Ancient astronomy was bound to be limited in scope, simply because the people of those times were forced to depend upon observations made with the eye alone. It was therefore impossible for them to make out many details. Even the Moon, by far the nearest of all the heavenly bodies, is about a quarter of a million miles away—a distance equal to ten times round the Earth's equator—while Venus, the closest of the planets, is a hundred times as distant, and the stars themselves are almost inconceivably remote. At such distances, close observation is clearly out of the question without optical aid.

Yet the ancients did succeed in finding out a great deal. By the end of the sixteenth century, when the first Queen Elizabeth ruled in England, it was known that our Earth—once supposed to be the most important body in the universe—is nothing more than a small, cool world or “planet” circling an unimportant star, the Sun; that the Moon is no goddess, but a secondary body or “satellite” keeping company with the Earth; that the bright “moving stars,” Mercury, Venus, Mars, Jupiter, and Saturn, are other planets belonging to the solar family, and that the twinkling, cool-looking stars of the night sky are in reality blazing suns, many of them far more brilliant than our own. When we remember the difficulties under which they laboured, the achievements of our ancestors must be considered as most remarkable.

The principle of the ordinary refracting telescope is so simple that one is inclined to be surprised that it was not discovered until the seventeenth century, particularly as glass had been known from very early times, and spectacles had been in use since about 1270 (some authorities consider that they were invented by Roger Bacon, though the evidence is decidedly slender). It is also just within the bounds of possibility that the story of the telescope goes back to Egyptian times, and that the astronomer-priests of the Nile had developed some sort of optical instrument, the secret of which was later lost.

Bacon himself has been said to have known the principles of the telescope, and a similar claim has been advanced in favour of an Englishman named Leonard Digges, but the true history of telescopes begins in or about the year 1608, when Hans Lippersheim, a spectacle-maker of the little

town of Middelburg on the Isle of Walcheren, announced that he had invented an instrument with which he could "see at a very great distance." On October 4, 1608, a committee sent from The Hague tested the instrument. Evidently they were satisfied, for on October 6 they agreed to give Lippersheim 900 florins for it. It has often been stated that the original discovery was accidental, but this seems dubious, and the question is in any case unimportant.

Before long, several telescopes seem to have been made and distributed in Holland and neighbouring countries. The first astronomical observations were, of course, those of the great Italian scientist Galileo Galilei, who first heard of the discovery of the telescope in May, 1609, while paying a visit to Venice, and hastened to copy and improve upon Lippersheim's work. At about the same time, telescopic observations were being made in Germany by Simon Marius, and in Great Britain by Thomas Harriot and Sir William Lower, but the work of these men is of secondary importance.

Galileo's own words, written in his *Sidereal Messenger* of 1610, are worth quoting: "I prepared a tube, at first of lead, in the ends of which I fitted two glass lenses, both plane on one side, but on the other side one spherically convex, and the other concave. Then bringing my eye to the concave lens, I saw objects nine times larger than when they are seen with the natural eye alone. I shortly afterwards constructed another telescope with more nicety, which magnified objects more than sixty times. At length, by sparing neither labour nor expense, I succeeded in constructing for myself an instrument so superior that objects seen through it appeared magnified nearly a thousand times, and more than

thirty times nearer than if viewed by the natural powers of sight alone."

Galileo's greatest telescope seems a puny thing when compared with even a small home-made telescope of to-day. Yet in the years following 1609, Galileo made a series of discoveries that laid the foundations for all the work now in progress at the great observatories of Palomar, Mount Wilson, Meudon, and the rest. The wonderful panorama of the universe was spread before his astonished gaze. The craters of the Moon, the satellites or "Medicean stars" circling Jupiter, the spots of the Sun, the "infinite multitude" of stars in the Milky Way, the phases of Venus and Mars—all these were revealed to him; even the rings of Saturn were seen, though not clearly enough for Galileo to make out just what they were.

All pioneers, from Aristarchus in classical times down to the Wright brothers and Hermann Oberth in our own century, have had their detractors. Galileo was no exception. His discoveries seemed to prove that the new and revolutionary theory of a Sun-centred system was in fact correct; as such, they were frowned upon by the Christian Church. Some eminent men suggested that Galileo had bewitched his telescopes, while others refused to look through them at all. The story of how the great scientist was summoned to Rome and forced to "curse, abjure and detest" his theory of the universe is too well known to need repetition. However, the truth could not be suppressed indefinitely, and by the time that Galileo died, in 1642, the idea of an Earth-centred universe had been abandoned by all-thinking men.

The theory of a simple refractor is shown in Fig. 1. The light from the object under observation is collected by a