THE EARLIEST MAPS OF THE MOON

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Abstract. The aim of the present paper is to give a brief account of the history of lunar mapping in the pre-telescopic era, and that immediately following the discovery of the telescope. It is pointed out that the first (and also last) extant map of the Moon based on naked-eye observations was prepared some time before 1603 by William Gilbert – discoverer of the terrestrial magnetism – though it was published only posthumously in 1651. Moreover, the recently unearthed drawings of the Moon by Thomas Harriott in England based on telescope observations between 1609 and 1610 are in no way inferior (if not otherwise) than those published by Galileo Galilei at the same time. As G. C. La Galla's drawings of the Moon published in Venice in 1612 are in reality identical with those of Galileo, the third independent contribution to lunar mapping was made by P. Christoph Scheiner in Germany between 1611 and 1613; preceding those by C. Malapert (1916) or Gassendi and Mellan more than twenty years later.

The manned landing on the Moon in July 1969 has focussed new interest on the history of the human efforts to get acquainted with the topography of the surface of our satellite. That sustained efforts to this end antedate the commencement of the 'space-age' within our lifetime is, of course, well known; and the history of lunar mapping in the past 350 years has recently been written up by several authors (e.g., Kopal, 1962; 1966; or Maffei, 1963). Less well known is, however, the fact that serious attempts to depict the visible details of the lunar face antedate the discovery of the telescope, and go back to the days when the naked eye was the only means of astronomical observation. The aim of the present note will be to provide some additional information on this earliest chapter of the history of lunar mapping, in the light of the contemporary documents.

No tracings of the face of the Moon have come down to us from antiquity. Although the ancients (such as Plutarch) wrote freely about the "man in the Moon", a reference by Von Humboldt (1858) to a drawing of the Moon by Anaxagoras appears to be based on a misunderstanding (of the text of Plutarch's *Life of Nicias*). Occasional references to Renaissance drawings of the Moon by Leonardo da Vinci remain likewise unsubstantiated by published documents; and a more specific evidence – if any – is yet to come to light.

The first scientist who indubitably did so – and before the advent of the telescopic era – was William Gilbert (1540–1603), physician-in-ordinary to Queen Elizabeth I and – his more important title to fame – the discoverer of terrestrial magnetism. In a book entitled, *De Mundo Nostro Sublunari* etc., which remained unfinished at the time of his death, and did not appear till in the year of 1651 in Amsterdam through the good offices of James Boswell, Gilbert gave what appears to be first extant map of the Moon (Figure 1), based on naked-eye observations (Gilbert died more than six years

before the discovery of the telescope) and bearing some resemblance to the fact of the Moon as we know it today.

It is interesting to correlate Gilbert's nomenclature, inscribed on his map, with the terminology in modern usage. His 'Regio Magna Orientalis' coincides pretty well in position with our Mare Imbrium; while 'Regio Magna Occidentalis' represents a conglomerate of Mare Serenitatis, Tranquillitatis and Foecunditatis; and 'Britannia', Mare Crisium. On the other hand, 'Continens Meridionalis' and 'Insula Longa' are parts of our Oceanus Procellarum. It should be stressed that – in contrast to Plutarch and (later) Galileo, who considered the dark spots on the Moon to be seas – Gilbert

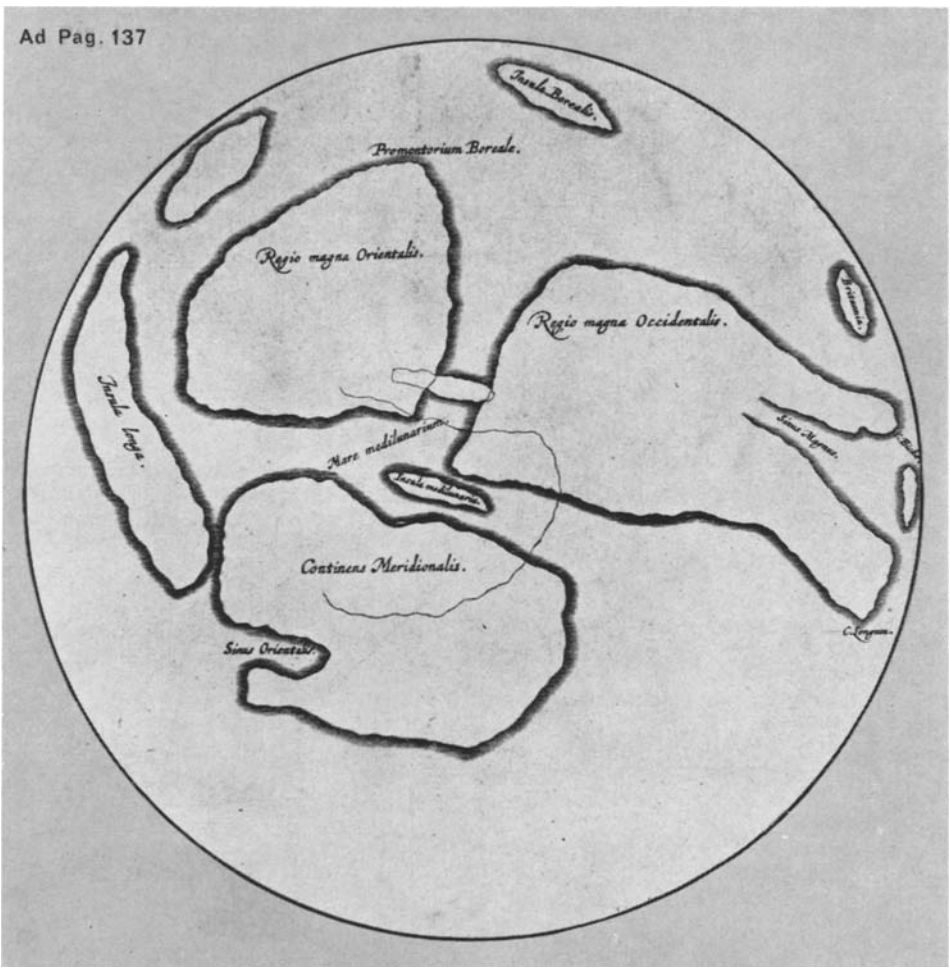

Fig. 1. A drawing of the face of the Moon as it appeared to the naked eye, prepared by William Gilbert some time before his death in 1603, and facing p. 137 of his rare tract *De Mondo Nostro Sublunari* etc. published (posthumously) in 1651 in Amsterdam. The present illustration is reproduced from a copy of this book in possession of the Glasgow University Library.

(like his Italian contemporary, Giordano Bruno) regarded dark spots as continental ground, and bright spots as seas ("ita tellus erga Lunam maculas representat, terrarum continentium minus relucentium; aquarum vero et Oceani, propter laeviorem et luminis apprehensivam naturam magis splendentem"; cf. Gilbert, 1651; Chapter XIV, p. 173).

But the reasons which led Gilbert to construct his map of the Moon were not a mere curiosity. In another passage of his book he regretted that no one did the same in antiquity; so that he could not say whether after the lapse of almost twenty centuries the face of the Moon underwent any change – a surprisingly modern point of view! It would, perhaps, have consoled Gilbert if he knew that no such changes have been noted since the advent of the telescope up to the present time.

Although Gilbert's map of the Moon did not see the light of day till 1651, it must have been completed before 1603 – the year of his death; and as such it happens to be the first as well as the last contribution made by human hand to selenography in the days of pre-telescopic astronomy. Its existence remained generally overlooked; for at the time of its appearance it was no longer more than of historical interest. The book itself in which it appeared is now excessively rare – only two copies of it are known to exist in Great Britain: one at the British Museum, the other at the University Library in Glasgow; and it is from the latter that the map shown on Figure 1 has been reproduced.

The advent of telescopic astronomy introduced also a new era in lunar mapping. The Moon was the first prominent celestial object to attract the attention of Galileo's early cannocchiales; and his drawings of the Moon published in his *Sidereus Nuncius* (1610) are too well known to call for much additional comment in this place. A glance at such drawings as are reproduced on Figure 2 from the Galilean MSS still extant (cf. pp. 66–67, vol. 3, 1 of his *Opere*, Firenze 1964) discloses eloquently that Galileo Galilei was scarcely a great astronomical observer; and too much in a haste to 'get to the press' to bestow sufficient attention to detail. As a result, none of the formations depected (schematically) on his drawings can be safely identified with any known lunar objects. It is possible that the large ring recorded by Galileo near the centre of the apparent lunar disc – which Galileo compared in the text of his *Sidereus Nuncius* with the central-european land of Bohemia – is identical with the crater Ptolemaeus; but this is by no means certain.

Galileo did, to be sure, more than leave us only a few rather imperfect drawings of the face of our satellite. His inquisitive mind speculated already about the ways in which the altitudes of lunar mountains could be determined from characteristics of their illumination by the Sun; though his observations were again weaker than theory; and he overestimated the heights of the lunar mountains 2–3 times.* In fact, the geo-

* This notwithstanding the efforts of all his apologists in the years to come. Thus John Wilkins, in his tract on the *Discovery of a New World ... in the Moon*, published (anonymously) in London in 1638, claimed (in propositio ix) that mountains as high as 9000 metres exist on the Moon. In actual fact, the highest lunar mountains (Leibnitz and Doerfel Mts. near the Moon's south pole) scarcely attain the altitude of 6000 m; and these (being on the limb of the Moon) do not cast any shadows that could have been used by Galileo to estimate their height.

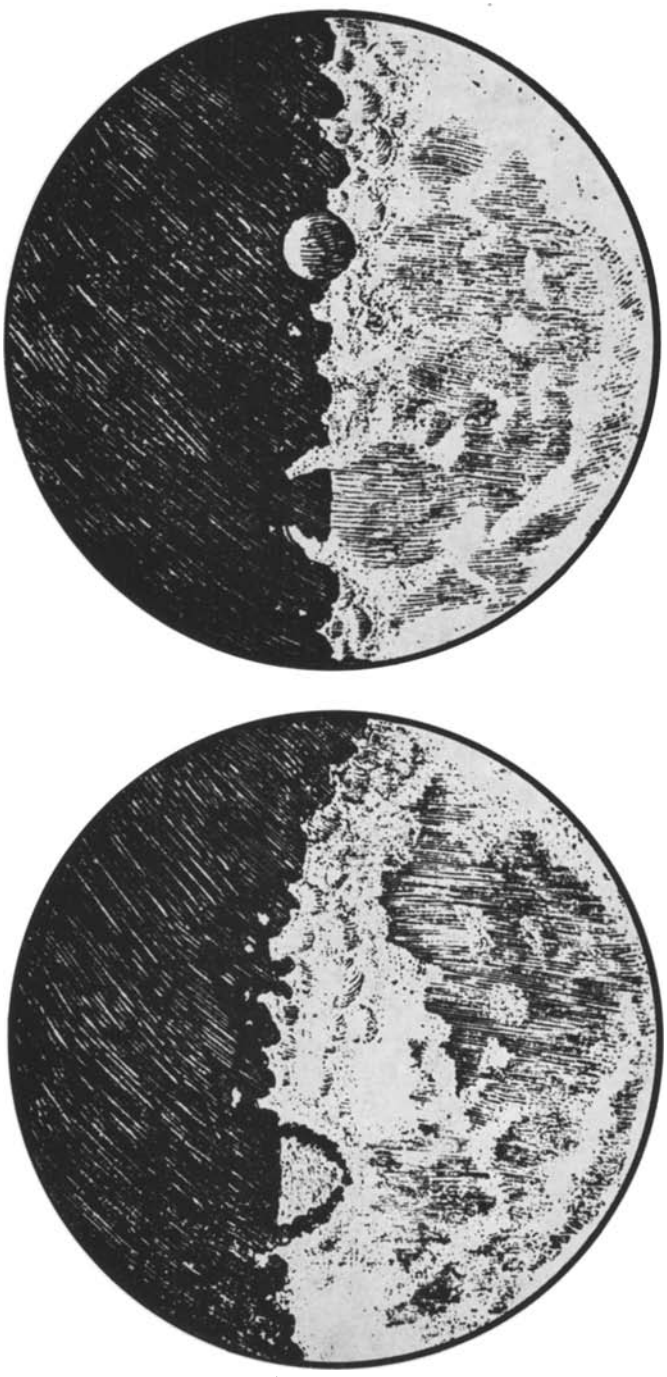

Fig. 2. Two of the four drawings of the Moon made by Galileo Galilei and reproduced in his *Sidereus Nuncius* (Venice, 1610; also on p. 67 of vol. 3, 1 of his Edizione Nazionale, 1964). The drawings reproduce apparently but schematized views of what Galileo saw with his telescope; for none of the features recorded on them can be identified with certainty with any known formation.

metrical basis of lunar topography was not properly laid down till by Johannes Kepler (cf. his *Letter to P. Guldin*, published posthumously in 1634) some years later.

About simultaneously with Galileo's observations in Italy, the Moon came under telescopic scrutiny in England through the work of Thomas Harriott (1560–1621) – a rather shadowy figure among the British astronomers of the Elizabethan era. The results of his observations remained unpublished much longer than was the case with Gilbert. Their existence was first publicly noted by von Zach (1788) and Rigaud (1833); though it was not till four years ago that a few of Harriott's drawings were at last reproduced by Strout (1965) from the MSS in possession of the Earl of Egremont; and the accompanying Figures 3 and 4 came from the same source.

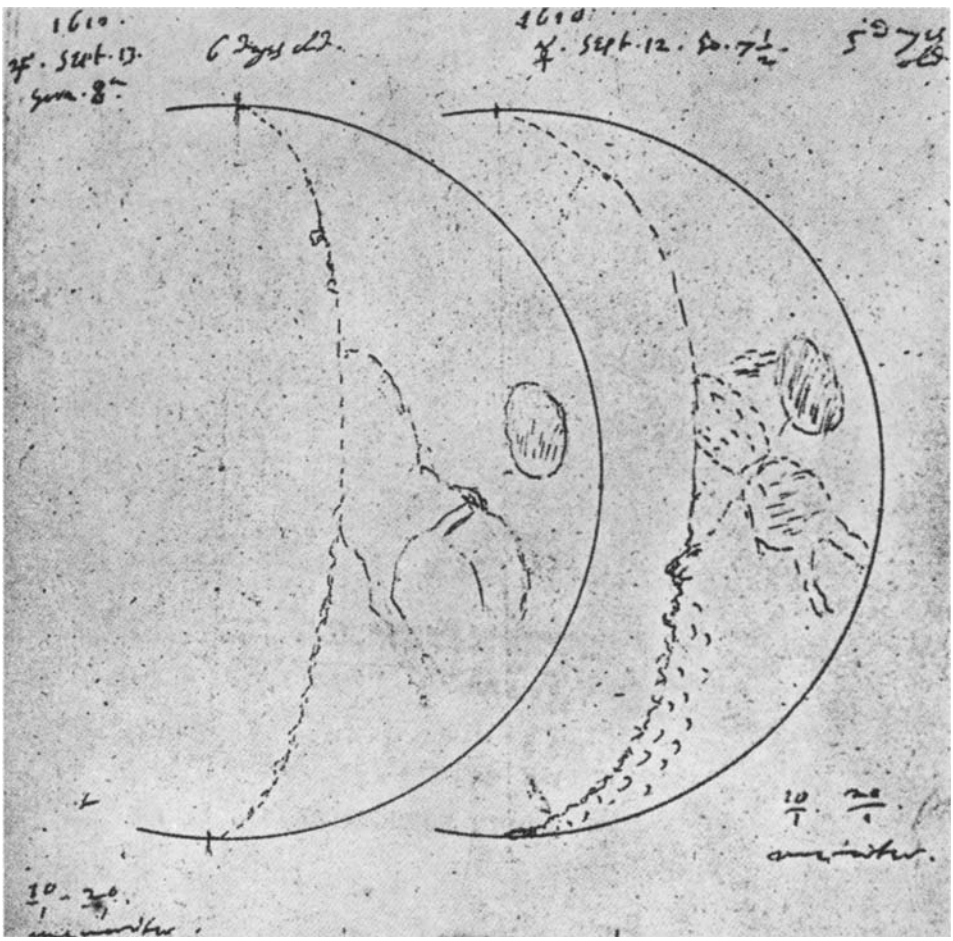

Fig. 3. Two of the drawings of the waxing Moon by Thomas Harriott, dated 1610 September 12 and 13, based on telescopic observations, and showing clearly Mare Crisium as well as what appears to be outlines of Mare Tranquillitatis and Nectaris.

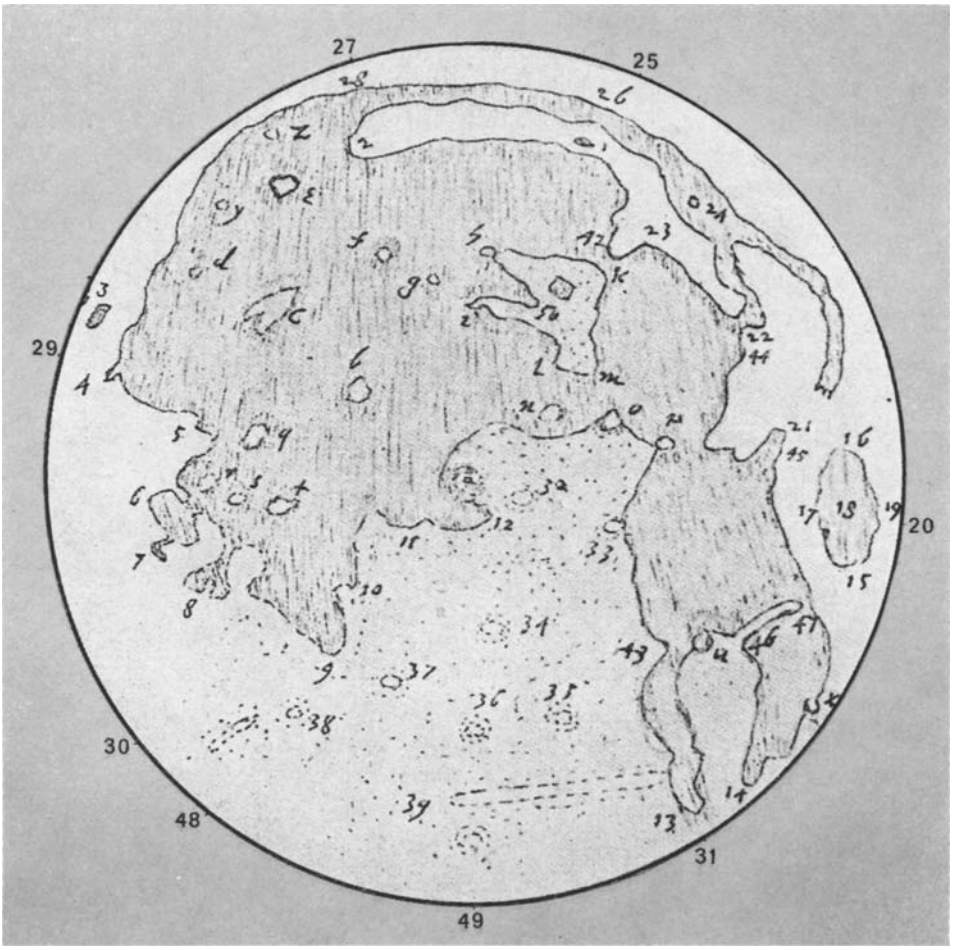

Fig. 4. The first telescopic map of full Moon prepared by Thomas Harriott in England. Although, according to Rigaud (1833), Harriott commenced his observations of the Moon as early as July 1609, the present drawing probably followed the publication of Galileo's *Nuncius*. It is, however, superior in detail to all his drawings (Galileo did not draw full Moon) and contains many features which can be clearly recognized today. Note (under No. 39) a feature which appears to be one of the rays of Tycho.

A cursory comparison of Gilbert's and Harriott's maps as reproduced on Figures 1 and 4 makes it evident that Harriott's map required telescopic observations; for many details shown on it could not be seen with the unaided eye; therefore, it is certain that by September 1609 telescopes were already in use in Great Britain (cf. Mee, 1908).

Several recent historians of science (cf. e.g., Houzeau, 1882; Wolf, 1890) referred to the existence of drawings of the lunar surface in the volume *De Phoenomenis in Orbe Lunae*, etc., by La Galla (1612), which as regards publication date would be second in age to those of Galileo. In actual fact, none of the copies of La Galla's book preserved

in the National Library of Florence contains any lunar drawings at all; nor do the copies extant in the Bibliothèque Nationale de Paris. However, according to Maffei (1963) the copy in possession of the National Library of Rome does contain drawings of the Moon attributed to La Galla – but these are identical with those published previously by Galileo in his *Sidereus Nuncius*! This becomes intelligible when we

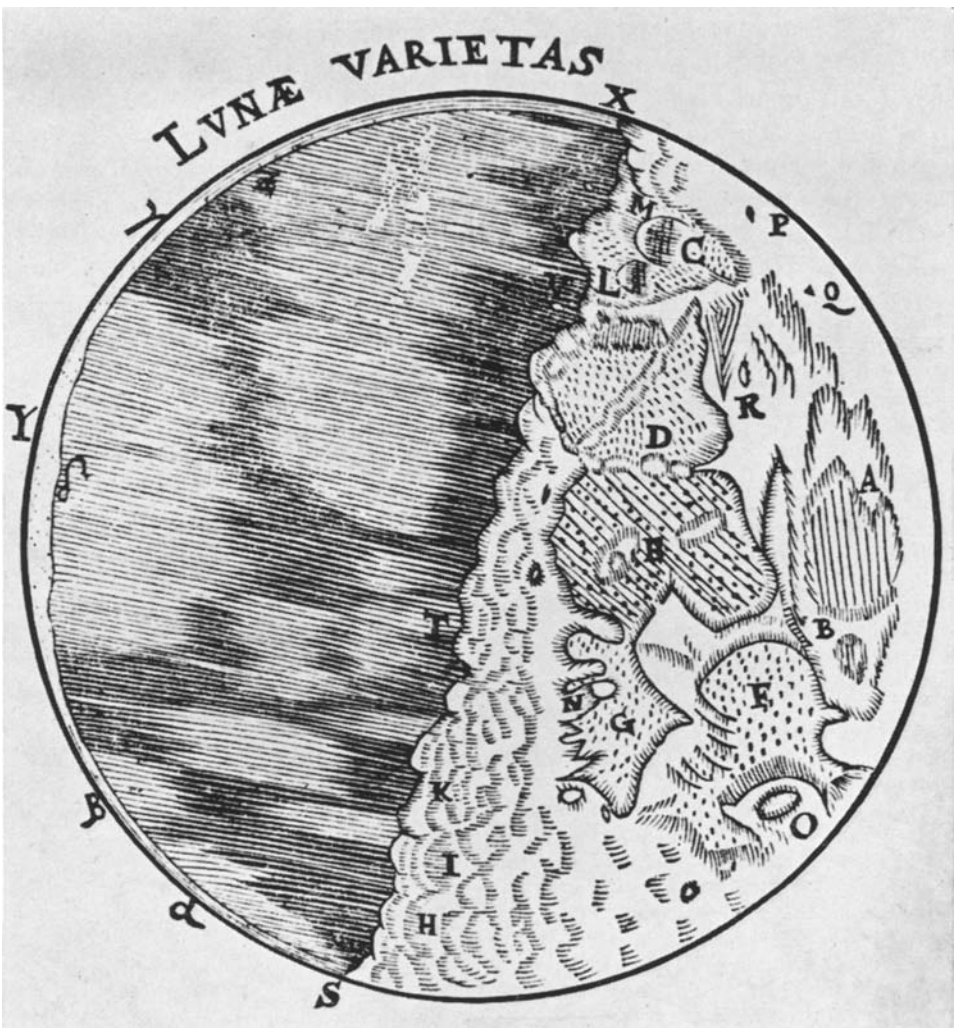

Fig. 5. A drawing of the first quarter of the Moon, prepared by Christoph Scheiner probably before 1613, and published a year later in *Disquisitiones Mathematicae*. Some of the surface features labelled by letters can be readily identified. Thus A denotes Mare Crisium; E, Mare Tranquillitatis; F, Mare Foecunditatis; G, Mare Nectaris; and M, the crater Aristoteles. Like on all drawings reproduced on Figures 1–4, North is on top (as the Moon is seen by the naked eye, or the Galilean telescope). As Scheiner is known to have used the Keplerian (inverting) telescopes since 1613, it is believed that the drawing reproduced above was made before that time.

realize that the publisher of La Galla's work was the same Tommasso Baglioni of Venice who published also Galileo's *Nuncius* only two years before. It is, therefore, probable that lunar drawings (obviously Galileo's) were inserted in at least a part of the edition of La Galla's book (otherwise lacking any illustrations altogether) by the publisher himself – perhaps in order to increase its attractiveness for the more general reader.

Almost simultaneously with the contemporary work of Galileo and Harriott, telescopic drawings of the Moon were prepared in Germany by P. Christoph Scheiner, S. J. (1575–1650) of Ingolstadt – the historic adversary of Galileo Galilei in their subsequent dispute over sunspots – and published on p. 58 of his *Disquisitiones Mathematicae de Controversiis et Novitatibus Astronomicis* (Ingolstadt, 1614). From a technical point of view, Scheiner's map – reproduced on Figure 5 – goes little beyond that of Harriott. At a later date, Scheiner drew an improved chart which was published (after his death) by P. Anasthasius Kircher in the latter's *Mundus Subterraneus* (Amsterdam, 1664); for its reproduction, cf. Figure 15.12 of Kopal (1966). Long before that time, however, selenography made great strides through the efforts of many subsequent investigators; but for their account following 1614 the reader must be referred to Kopal (1962, 1966) or Maffei (1963).

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