JOHN BEVIS AND HIS *URANOGRAPHIA* (*ca.* 1750)*

WILLIAM B. ASHWORTH, JR.

Assistant Professor of History, University of Missouri, Kansas City**

INTRODUCTION

There are few artifacts of the history of astronomy which can rival, for sheer visual splendor, the Grand Celestial Atlases. Productions of a Golden Age which encompassed roughly the double-century from 1600 to 1800, these sumptuous folios must be ranked among the most magnificent books ever published. They are so appealing to the eye that we easily forget that the finest of the atlases were not only works of art but were also of great astronomical importance. Based on the most recent star catalogs at a time when positional astronomy was in its infancy, the atlases became the intimate working tools of astronomers until early in the nineteenth century. The number of the truly great ones, however, was small. Only four atlases published in this 200-year period acquired any professional standing; they were Bayer's *Uranometria* (1603), Hevelius's *Firmamentum* (1690), Flamsteed's *Atlas Coelestis* (1729, along with the important French quarto editions of 1776 and 1795), and Bode's *Uranographia* (1801).[1] Each of these is a lasting monument to the astronomer's science and the cartographer's art.[2]

Flamsteed's 1729 *Atlas* was probably the most acclaimed of the quartet. Although the engravings of the constellation figures were considerably less elegant than those of Bayer or Hevelius, the star positions were meticulously inserted according to an accurate system of projection, and these positions were taken from Flamsteed's own catalog, which set the standard for positional accuracy for the eighteenth century. To the French especially, Flamsteed's *Atlas* had no equal. To Lalande, it was "le plus bel ouvrage," "ce grand et magnificique recueil . . . le meilleur qu'on ait jamais fait."[3] Fortin praised it as "le plus estimé de tous ceux qui existent."[4] In France it was often referred to simply as "l'Atlas céleste"—*the* Celestial Atlas.[5]

To one French astronomer, however, "l'atlas céleste" meant something entirely different. Charles Messier, in his 1781 catalog of nebulous objects, made frequent reference to "l'Atlas céleste anglois" and "le grand Atlas anglois" as he pointed out previous depictions of many of his nebulae.[6] The reference,

* I wish to express a deep debt of appreciation to Prof. Owen Gingerich, who has researched this subject thoroughly himself and who generously shared with me the fruits of his labors; to the Linda Hall Library in Kansas City, whose acquisition of a Bevis atlas launched this research and whose Special Collection of Early Astronomical Works helped carry it to completion; to the Library of the American Philosophical Society, who provided me with copies of the very special Bevis atlas in their collection; and to the staffs of other libraries too numerous to mention, who answered my queries and often sent me on their own initiative much valuable information.

** Kansas City, Missouri 64110.

[1] Johann Bayer, *Uranometria* (Augsburg, 1603); Johann Hevelius, *Firmamentum Sobiescianum sive Uranographia* (Gdansk, 1690); John Flamsteed, *Atlas Coelestis* (London, 1729), *Atlas Céleste*, ed. J. Fortin (Paris, 1776), *Atlas Céleste*, ed. J. Lalande and P.-F.-A. Mechain (Paris, 1795); Johann Bode, *Uranographia* (Berlin, 1801).

[2] There is a fifth atlas which deserves to be added to the list, namely Julius Schiller's *Coelum Stellatum Christianum* (Augsburg, 1627). This atlas was remarkably up-to-date; the explanatory tables were filled with useful information; in fact, in many ways it was more satisfactory than Bayer's widely acclaimed *Uranometria* (although Bayer himself seems to have had a hand—a rather large hand—in the preparation of Schiller's atlas). But because of what we might call Schiller's apostolic fervor in replacing the traditional pagan constellations with biblical counterparts, the atlas met with little favor from succeeding generations of astronomers.

In addition, there are two other works which are often grouped with Bayer, Hevelius, Flamsteed, and Bode: Andreas Cellarius's *Harmonia Macrocosmica* (Amsterdam, 1660) and Johann Doppelmayr's *Atlas Coelestis* (Nuremberg, 1742). Neither however was a working atlas. Cellarius's thick folio, in its hand-colored version, was one of the most splendid books of its century, but it contains no catalog or tables, depicts the stars only on planispheres, and seems to have found its niche in illustrating modern history of science textbooks. The Doppelmayr *Atlas* is also a beautiful set of colored engravings, and its depiction of the Riccioli and Hevelius moonmaps is especially striking, but the six charts of the stars are neither reliable nor particularly usable. Jerome Lalande indicates that eighteenth-century opinion of both Schiller and Doppelmayr was rather low; see his *Bibliographie Astronomique* (Paris, 1803), pp. 190, 416.

[3] Jerome Lalande, *Astronomie*, 3rd ed. (3 v., Paris, 1792), 1: para. 722, p. 241; *Bibliographie Astronomique*, p. 388.

[4] P.-F.-A. Fortin, "Discours Preliminaire" to his edition of John Flamsteed, *Atlas Céleste* (Paris, 1776), p. iii.

[5] In retrospect Bode's *Uranographia* seems equally deserving of praise, since it depicted many more stars than Flamsteed's *Atlas* and also included the Messier and Herschel nebulae. Time, however, was out of joint for the Bode atlas; as positional accuracy in the early nineteenth century approached fractions of a second of arc, the large atlas simply ceased to be useful as a primary reference tool. Astronomers turned to smaller, unadorned sectional charts, and the handsome folio atlases were left to the interested public and amateur star-gazers. The *Uranographia* thus never became as much a part of the astronomer's working library in the nineteenth century as Flamsteed's *Atlas* had in the eighteenth century.

[6] Charles Messier, "Catalogue des Nébuleuses et des Amas d'Étoiles," *Connaissance des Temps pour 1784* (Paris, 1781), pp. 227–269. The quotations are from Messier's descriptions of M1 and M11. A translation of this catalog may be found in Kenneth Glyn Jones, *The Search for the Nebulae* (Chalfont St. Giles, Science History Publ., 1975), pp. 61–73. The 1781 catalog was reprinted unchanged in the *Connaissance des Temps pour 1787* (Paris, 1784), and a facsimile of this version (reduced) is now available in John H. Mallas and Evered Kreimer, *The Messier Album* (Cambridge, Mass., Sky Publishing Corp., 1978), pp. 18–27, which also contains an excellent historical introduction by Owen Gingerich.

however, was not to Flamsteed, since the Flamsteed *Atlas* contains no nebulosities. Messier instead was referring to one of the great curiosities of the Celestial Atlas Golden Age, the beautiful and mysterious *Uranographia* of John Bevis.

The *Uranographia*, or to be technically correct, the [*Uranographia*], is that rarest of bibliographic oddities—a book which predeceased its author.[7] Engraved at great expense and heralded with much fanfare in the late 1740s, the atlas was stillborn, a victim of the publisher's bankruptcy. Its premature demise was a considerable loss to astronomy, since the *Uranographia*, if published as scheduled, would certainly have joined the elite ranks of the Grand Atlases. Fortunately for posterity, a number of sets of impressions were taken from the plates before they were sequestered by the courts, and a large fraction of these have survived to the present day. An assessment of the *Uranographia* is thus possible. Surprisingly, it has never been undertaken, and this article attempts to remedy this deficiency. My purpose is fourfold: to introduce the atlas to the many historians and astronomers who are unfamiliar with it; to clear up the confusion surrounding its production and lay several "ghost" editions to rest; to call attention to a unique copy of the *Uranographia* which contains printed explanatory tables and a star catalog, long thought never to have been printed; and to analyze the contents of the plates, tables, and catalog in order to assess the importance of the *Uranographia* as an astronomical artifact.

SURVIVING COPIES OF THE *URANOGRAPHIA*

The *Uranographia* would certainly be described as "extremely rare" in a dealer's catalog, but it is not so scarce as one might think for a book which was never published. When Henry Sotheran and Heinrich Zeitlinger turned one up in 1923 while compiling their *Bibliotheca Chemico-Mathematica*, they were so excited by what was thought to be a unique specimen that they priced it at £250, and this, mind you, was when Bayer's *Uranometria* could be obtained for £3 10s.[8] By 1927, however, Sotheran had learned that other copies were extant, and the price dropped to £10 10s.[9] The number of complete or nearly complete known copies has since grown to twelve.[10]

A typical surviving copy, such as the one recently acquired by the Linda Hall Library, contains fifty-one star charts and an elaborate engraved frontispiece but lacks a title page.[11] The first forty-eight charts are devoted to each of the forty-eight Ptolemaic constellations, and there is in addition a plate of the southern constellations and two planispheres of the Ptolemaic stars. Anyone familiar with Bayer's *Uranometria* will find that this accounting has a familiar ring, and indeed the *Uranographia* is patterned very closely on Bayer's work. The star charts measure 375 mm by 275 mm, making them the same size as Bayer's, slightly larger than those of Schiller or Hevelius, and appreciably smaller than Bode's or Flamsteed's. The engraved constellation figures are quite beautiful, much more appealing than the often awkward renditions of the Flamsteed engravers. In addition to the star charts, each plate carries a rather elaborate dedication to an institution or individual, indicating that the atlas was issued by subscription.[12]

The most *atypical* surviving copy, and consequently the most interesting, is that in the Library of the American Philosophical Society. In addition to the 52 engraved plates, the APS copy has explanatory tables for 32 of the plates and a fourteen-page star catalog at the end. The additional information provided by this material is of great interest and importance, and we shall discuss their contents in detail below.

All of the surviving copies, however, lack important information. Although the 51 plates are numbered form I to LI, they bear no date, no reference to the title of the work, no attribution to an author, nor are any of the plates themselves named. This has resulted in some confusion as to the proper title and date of the atlas. The identity of the author, however, has never been in doubt. He was one of the more unrenowned astronomers of eighteenth-century England, John Bevis.

JOHN BEVIS

John Bevis, at least as a name, is reasonably familiar to both astronomers and historians of astronomy, since as the first observer of M1, the Crab Nebula, his name crowns the column labeled "Discovered By" in any list of the Messier objects. He has also achieved some distinction by being the last mortal to observe the oc-

[7] The irony of course is that the dice fell the other way for many authors of celestial atlases; Hevelius, Schiller, Flamsteed, and Lacaille all died before their masterpieces appeared in print.

[8] See "Catalogue 786" (1923) in Heinrich Zeitlinger and Henry Sotheran, *Bibliotheca Chemico-Mathematica*, 2nd Suppl. (London, 1937) 1: no. 2876.

[9] Henry Sotheran, *Catalogue 804* (London, 1927), no. 3093.

[10] These twelve copies may be found in the Linda Hall Library in Kansas City, the Library of the American Philosophical Society (henceforth referred to as the APS copy), the British Library (Map), the Royal Astronomical Society, the Royal Greenwich Observatory, Cambridge University Library, the Detroit Public Library, the private collections of Deborah J. Warner, John Booth, and Samuel Barchas, Blackwell's Antiquarian Department, and Robert Douwma Ltd (the last two at the time of this writing being offered for sale). Mr. Barchas has a second set which is 3/4 complete, and the British Library (Map) has a partial set of proof plates in an incomplete state. There is evidence of at least two other broken sets, since individual plates occasionally come on the market. Other copies probably exist and I would appreciate being notified as to their location.

[11] Several of the surviving copies have additional printed matter such as added indexes and title-pages. These will be discussed in more detail below.

[12] If the engraved dedication is included, each plate measures 375 mm by 310 mm.

cultation of one planet by another, since he saw Venus eclipse Mercury in 1737.[13] Otherwise, except for his ill-fated atlas, his life seems to have been relatively untouched by fame. Born on October 31, 1695, in Old Sarum, Wiltshire, he attended Christ Church, Oxford, where he studied medicine, and he began practicing as a physician in London in 1730.[14] He had however long indulged an interest in astronomy, and he began contributing papers to the *Philosophical Transactions* in 1737 on such topics as eclipses, comets, and occultations. In 1738 he embarked on an extensive program of nightly observations of the stars at an observatory he had constructed in Stoke-Newington, north of London. This endeavor seems to have lasted only a year or two, but Bevis accumulated in this period a great number of observations.[15] Subsequently he confirmed for Bradley the effects of aberration in right ascension (Bradley had done so only in declination), and in 1743 Bevis discovered, or so he thought, the great comet of 1744.[16] Much of the information Bevis collected was sent to Bradley, with whom he maintained a sporadic, and somewhat one-sided, correspondence.[17]

The star-atlas, which we will discuss in detail below, consumed much of Bevis's time from 1746 to 1750, although in the same period he was also preparing Halley's moribund astronomical tables for publication. This effort, unlike the atlas, was carried to fruition.[18] After the publishing fiasco of 1750, Bevis seems to have maintained his interest in astronomy, taking an active part, for example, in the observations of Halley's comet in 1759 and the transits of Venus in 1761 and 1769. He received some recognition from his contemporaries for his work, including membership in the Berlin Academy of Sciences and, rather belatedly, a fellowship in the Royal Society of London.[19] He died on Nov. 6, 1771, reputedly in good Baconian fashion, by falling from his telescope while taking the sun's meridian altitude.[20]

THE PRODUCTION OF THE *URANOGRAPHIA*

The complete story of the *Uranographia* enterprise will probably never be told. But we can certainly do better than has been done so far. Many modern scholars have trusted rather unwisely to the account given in Basil Brown's *Astronomical Atlases*.[21] Some of Brown's facts are accurate, such as his attribution of the atlas to Bevis, his estimated date of 1750, and his statement that publication was halted by bankruptcy.[22] But Brown provides no details concerning the production nor does he offer any evidence for the 1750 estimate. Moreover, he then goes on to state that the

[13] John Bevis, "Mecurius a Venere occultatus . . . ," *Philosophical Transactions of the Royal Society of London*, **40** (1738): pp. 394–395. There is a brief account of the significance of this observation by Joseph Ashbrook, "John Bevis and an occultation of Mercury by Venus," *Sky and Telescope* **16** (1956): p. 68.

[14] The only known contemporary account of Bevis's life is that of his executor, James Horsfall, and it survives only in a French translation in Jean Bernoulli, *Recueil pour les astronomes* (3 v., Paris, 1771–1776), **2**: pp. 331–336. According to J. Houzeau and A. Lancaster, *Bibliographie générale de l'astronomie* (2 v., Brussels, 1882–1889), **2**: col. 85, Condorcet wrote a memoir in the *Histoire de l'academie royale des sciences* for 1783, but I have been unable to locate it in this volume, or indeed in any other eighteenth-century volume of the *Histoires* or *Memoires*. A "Life of John Bevis" by T. S. Evans, mostly derived from Horsfall, appeared in *The Philosophical Magazine* **23** (1805): pp. 247–252. Charles Hutton gave a short biographical account in *The Philosophical Transactions of the Royal Society of London . . . Abridged* (18 v., London, 1809), **8**: pp. 117–118, which also seems to have been based entirely on the Horsfall narrative. This account reappeared substantially unaltered in Hutton's *A Philosophical and Mathematical Dictionary* (2 v., London, 1815), **1**: p. 226. J. H. V. Mädler, *Geschichte der Himmelskunde* (2 v., Braunschweig, 1873), **1**: p. 485, offers merely a distillation from Hutton. The only biography to provide any new information is the article by Agnes Clerke in the *Dictionary of National Biography* **4** (London, 1885–1901): pp. 451–452. While relying for the most part on Horsfall, her account differs in some respects; for example, she has Bevis born in 1693 in Tenby, Pembrokeshire. Since my concern in this article is primarily with the atlas, I have made no attempt to resolve such discrepancies, although there is probably a great deal of manuscript material relating to Bevis in various British libraries which, when unearthed, will settle such disputes. The biographical account given here is by way of introduction only, and the reader should consult Clerke or Hutton for additional details.

[15] The fact that Bevis's ambitious observing program was relatively short-lived was not noticed by either Clerke or Horsfall; in fact both give the impression that observations were made right up to 1745. However the explanatory tables in the APS copy (discussed below) reveal frequent references by Bevis to his own observations, and they all date to 1738 or 1739 (with one lone mention of 1740). This is consistent with the fact that when Horsfall makes reference to the records of Bevis's observations, he mentions only three folio volumes which were filled between March 6, 1738, and March 6, 1739; see Bernoulli, *Recueil* **2**: p. 332. It is of course possible that Bevis continued his observing program beyond 1739, but there is no record of it.

[16] In both instances Bevis was anticipated by other astronomers. Eustachio Manfredi demonstrated aberration in right ascension nine years before Bevis, in 1730, while Cheseaux's comet was observed on the Continent three weeks before Bevis saw it in England. See Stephen P. Rigaud, *Miscellaneous Works and Correspondence of the Rev. James Bradley* (Oxford, 1832), pp. xxxiii, lvii.

[17] There are six letters from Bevis to Bradley which were printed in Rigaud, *Miscellaneous Works of Bradley*. There is one reply by Bradley.

[18] Edmond Halley, *Tabulae Astronomicae* (London, 1749), and *Astronomical Tables with Precepts* (London, 1752). Bevis, as seems to have been his fate, was unmentioned in either edition, although he wrote the introductory precepts. See his letter to Bradley of April 24, 1745, in which he mentions some of his editorial tribulations, Rigaud, *Miscellaneous Works of Bradley*, pp. 431–432.

[19] His election to the Berlin Academy came in 1750; he was not made a Fellow of the Royal Society until 1765. Bevis subsequently became foreign secretary of the Royal Society, and in 1768 he was made a foreign correspondent of the Paris Academy. See Horsfall in Bernoulli, *Recueil* **2**: p. 335.

[20] The obituary in *The Gentleman's Magazine* **41** (November, 1771): p. 253, read: "John Bevis, M.D. and F.R.S., in the Middle Temple, whose great abilities were well known to the learned all over Europe."

[21] Basil Brown, *Astronomical Atlases, Maps and Charts: An Historical and General Guide* (London, Search, 1932).

[22] *Ibid.*, pp. 51–52.

atlas *was* finally published in 1786 with the title of *Atlas Celeste*, using the original plates, and he adds that there was a further edition in 1818.[23] None of this is true, and there are numerous other errors in Brown's short description which have led to considerable confusion.[24] In order to dispel this confusion, it will be well worthwhile to attempt a new reconstruction of events from the various scattered bits of data which can be assembled. We will see that a much clearer—if still incomplete—picture of the *Uranographia* enterprise then emerges.

Chronologically the first mention of the *Uranographia* comes in a letter written to Bevis by Abbé Lacaille, sometime before December, 1748. Lacaille wrote that he was astonished to learn that Bevis had made him a present of the *Uranographia*, and he offered Bevis a set of tables for "taking out Dr. Bradley's two motions" (i.e., nutation and aberration) from the star positions. An extract of this letter survives because Bevis then sent it to Bradley, asking in a covering letter what he should do about the offer.[25] In this same letter, dated Dec. 23, 1748, Bevis commented that he had little spare time because he was "tied down to the direction or correcting of the press in Mr. Neale's affair." Since Mr. Neale is the person mentioned in the Horsfall account as the publisher of the *Uranographia*, it is clear from Bevis's somewhat plaintive remark that by late 1748, production of the atlas was reasonably far along.[26]

Horsfall dates the beginning of the enterprise to 1745.[27] There is no concrete basis for such an assertion, but as a conjecture, it is quite plausible. The best circumstantial evidence supporting such a chronology comes from the newly-discovered explanatory tables in the APS Bevis atlas, where we find that the stars have been reduced to the epoch 1746. This does not prove that the reduction was done in or near that year; after all, the Flamsteed *Atlas*, published in 1729, was reduced to epoch 1690. But it seems unlikely that Bevis would have chosen the epoch 1746 unless he began work in that year or shortly before; had he begun later, he would certainly have selected 1750 for the base epoch, as he would subsequently do for his printed catalog.

Sometime between 1747 and 1749 subscriptions were taken and the plates were engraved. There is a great deal of evidence to support this statement, most of it deriving from the plates themselves. The dedicatory inscriptions on each plate are rather explicit as to titles and positions, and these often provide either upper or lower limits to the period of the subscription process and presumably the actual engraving. The Gemini plate, for example (XXIV), is dedicated to William Stukeley, "Rector of St. Georges Queen's Sq."; since Stukeley did not receive this appointment until 1747, the plate must postdate this year. On the other hand, the subscriber of the Cygnus plate (IX), John Montagu (see fig. 3), died in 1749, and must have subscribed to the atlas before then. The best single example comes from the Pegasus plate (XIX), which carries the dedication: "To the Reverend James Bradley, D.D. F.R.S., Royal and Savilian Professor of Astronomy, and Member of the Royal Academys of Paris and Berlin." Since Bradley became a member of the Berlin Academy in 1746, the Paris Academy in 1748, and the St. Petersburg Academy in 1750, we can only conclude that the plate was engraved between 1748 and 1750.[28] When all such limits are collated,

[23] *Ibid.*, pp. 57–58.

[24] For example, Brown states, *ibid.*, that the constellation figures of the supposed 1786 *Atlas Celeste* at the British Library resemble those of Flamsteed's *Atlas*. This is completely untrue, but it was sufficient to mislead the Detroit Public Library into classifying their Bevis atlas as a 1786 *Flamsteed* atlas. Brown says that the 1786 work was "based" on Bevis's 1750 edition, which makes little sense if it used the original plates, as he subsequently claims. Brown states that the royal figure on the frontispiece of the 1786 version is George III, and that it may have been altered in the supposed 1818 edition; neither is true. There are other mistakes of sheer carelessness, such as his reference to the 1750 Bevis atlas first as the *Uranographia*, and then as the *Uranometria*. Brown's errors are easily understood once you realize that he never saw a Bevis atlas in any of its supposed editions. But I am not certain that this constitutes a valid excuse.

Brown's book has mercifully been superseded quite recently by Deborah J. Warner's *The Sky Explored: Celestial Cartography, 1500–1800* (Amsterdam, Theatrum Orbis Terrarum, 1979). This work is masterfully done and will prove invaluable to the student of star atlases. I regret that my research came too late to be of use, because the only serious blemish in the book is the account of Bevis, pp. 22–23; it unfortunately repeats many of Brown's errors and has regrettably given extended life to the spurious editions of 1786 and 1818.

[25] The extract from Lacaille is in Rigaud, *Miscellaneous Works of Bradley*, pp. 457–458. Bevis's covering letter is on p. 456. He also sent along an extract of a letter from De l'Isle, reprinted on pp. 456–457. Apparently both Lacaille and De l'Isle were having trouble getting responses from Bradley and were using Bevis for leverage to pry answers from the Astronomer Royal.

[26] The identification of the publisher is not actually made by Horsfall himself, but by a certain Magalhaens, who was the person responsible for sending Horsfall's account to Bernoulli, and who also added some details in the form of footnotes. Bernoulli printed both Horsfall's narrative and Magalhaens's notes. The note identifying Neale is on p. 333.

[27] Bernoulli, *Recueil* 2: p. 333; Agnes Clerke repeats this in her biographical article.

[28] I am grateful to Prof. William McCrea, Fellow, and Mrs. E. Lake, Librarian, of the Royal Astronomical Society, for suggesting the possible fruitfulness of this approach toward dating the plates and for providing some of the examples. They have also made a very thorough study of the allegorical frontispiece, which depicts Urania, the muse of astronomy, presenting a copy of the atlas to a royal figure seated on a throne, and they conclude that the recipient is Frederick, Prince of Wales, and not George II or George III, as has been sometimes suggested (for example, by Brown, *Atlases*, p. 57). Their conclusion is based not just on facial resemblance, but on such details as the fact that the Feathers of the Prince of Wales are on the back of the throne. Since Frederick died in 1751, this also provides an outside limit for the time of the engraving.

Prof. McCrea and Mrs. Lake also noticed that there is one plate dedication which is somewhat anomalous. The Eridanus plate (XXXVI) is inscribed "To the Right Reverend Thomas Hayter, D.D., Lord Bishop of Norwich and Preceptor to His Royal Highness, the Prince of Wales." Hayter did not become Lord Bishop until

the outer limits of 1747 to 1749 emerge clearly, with a strong suspicion remaining that much of the activity occurred in 1748.[29]

Such a chronology is given further support by a printed "Proposal for Publishing by subscription: Uranographia Britannica," two copies of which may be found in the Glasgow University library.[30] The proposal itself carries no date, but since it contains a long list of persons who have already subscribed to the *Uranographia*, the proposal may be dated by the same process as the plates, and with even more precision, since there are 181 individuals and institutions listed with their titles.[31] If we concentrate on Fellows of the Royal Society, we see that Leonard Euler has FRS appended to his name (he was admitted in 1749), while John Canton and Jorge Juan (also elected in 1749) do not.[32] The proposal must date then to the middle of 1749. And because the proposal states that the plates are already engraved and available for inspection, we may conclude that the star charts had indeed been completed by the middle of 1749.

The proposal is informative in several other ways. First of all, it identifies the "undertaker" as John Neale, the only hard evidence we have for the attribution in the Horsfall narrative. More interestingly, it identifies John Neale as a watchmaker, rather than a printer or bookseller.[33] In fact, we learn from the proposal that more than thirty copies of the *Uranographia* had already been subscribed to by five instrument-makers, which suggests that the *Uranographia* undertaking may have been the brainchild of a consortium of instrument-makers, with Neale as either the instigator or designated individual-in-charge.[34] It is also fascinating to note that John Bevis is nowhere mentioned in the proposal, although it is certain that he was responsible for the scientific content of the *Uranographia*. The omission indicates that perhaps something was amiss in the relationship at this point, and it also suggests that Neale, and not Bevis, had the ruling hand in the enterprise.[35]

The language of the proposal also indicates how much of the additional printed matter had been completed and what was still in the planning stage. "Each plate *is* accompany'd with a double Nomenclature," states the writer (presumably Neale); however, an Introduction "*will be* prefixed, " this "*will be* followed by a general alphabetical Index," and a Catalogue of Stars "*will be* added." (emphasis added). If the tenses are taken at face value (and they seem explicit enough), we may conclude that the plates and some of the tables had been printed by mid-1749, while the introduction, index, and catalog were still awaiting production.[36] That not all of the tables had been completed is a conclusion drawn from Neale's remark, in the "Conditions" section of the proposal, that the plates and "several of the Nomenclatures" may be inspected by prospective subscribers at his house in Leadenhall Street.[37]

Between the time of the proposal and mid-1750, Bevis and Neale apparently worked at compiling and printing some of the remaining material. The catalog was definitely printed, because a copy survives and is bound in with the APS *Uranographia*. This catalog was apparently an afterthought, or at least was not

1749 and Preceptor until 1751 (to Frederick's successor as Prince of Wales, the future George II). Either some of the engraving continued as late as 1751, or Hayter was also Preceptor to Frederick before assuming this position for the future George II. If the latter were true, then the engraving could have been done in 1749.

[29] Some other date limitations are provided by the following dedications: The Orion plate (XXXV) is dedicated to Maupertuis, president of the Royal Academy of Berlin; he obtained this position in 1746. The Hydra plate (XLIV) honored Peter Thompson, FRS; he was elected a fellow in 1746. The plate of southern constellations (XLIX) carries the name of Count Cyrillus de Rasumowsky, president of the Imperial Academy of St. Petersburg; he did not become president until 1746. The planisphere of the southern skies (LI) is inscribed to Don Jorge Juan, FRS; his fellowship did not come until 1749. The Taurus plate (XXIII) is dedicated to Rev. Philip Doddridge; Doddridge died in 1751. There are at least a half-dozen more examples which provide helpful outer limits. Except for the Eridanus plate mentioned above (note 28), all are consistent with a period of 1747–1749.

[30] The proposal is a single large sheet, 267 mm by 420 mm, printed on both sides; the Glasgow copies are held at Sp. Coll. f465. Since the text of the proposal is all on one page, references to it will not be further footnoted. The existence of this document was brought to my attention by Sarah Tyacke of the British Library via Prof. Owen Gingerich. I am also indebted to the Glasgow University Library for providing a copy on very short notice.

[31] The list of subscribers takes up the entire verso side of the proposal.

[32] The dates for Canton and Juan were taken from *The Signatures in the First Journal-Book and the Charter-Book of the Royal Society* (London, Oxford Univ. Pr., 1912), p. 25, which however gives only the year of election; my conclusions as to early or late are deduced from the order of the signatures.

[33] Neale's true profession explains a lacuna that mystified me until I saw the proposal: why Neale did not show up in that great treasure-house of eighteenth-century publishing lore, John Nichols's *Literary Anecdotes of the 18th Century* . . . (9 v., London, 1812–1813). Bevis, by the way, was mentioned several times by Nichols, but the information provided is of marginal interest to our subject.

[34] This conjecture is given added support by the fact that in the "Conditions" section of the proposal, it is stated that subscriptions will be taken at, among other places, the shops of the six instrument-makers. These artisans were John Bennet, John Cuff, Thomas Heath, Jeremiah Sisson, Francis Watkins, and Neale. James Short, the most famous of the London instrument-makers, was also taking subscriptions, although he subscribed to only one copy.

[35] The conclusion that Neale was in charge is consistent with Bevis's reference to the enterprise as "Mr. Neale's affair," in his letter to Bradley, discussed above.

[36] One table contains an additional chronological clue beyond the epoch of 1746. On the Auriga Table (XII), Bevis refers to a memoir written by Le Gentile in 1748; the date then provides a lower limit for at least this table. Unfortunately there is no other internal evidence of this kind which can fix a more precise date for the composition of the tables.

[37] It may have been that the plates available for inspection in 1749 were themselves incomplete. This possibility is suggested by the partial set of engravings in an unfinished state now in the British Library. Some of these plates have not yet had the nebulae added; others have the dedication section left blank. Sarah Tyacke and Helen Wallis have a short note forthcoming on this set in the *British Library Journal*.

envisioned when Bevis began the project in 1746, for the epoch of the catalog is 1750, four years later than the plates and the tables.[38] I strongly suspect that Bevis would hardly have undertaken two sets of reductions if the catalog had been planned from the beginning.

With the plates engraved, the catalog printed, and more than half of the explanatory tables completed, one might have thought that little stood in the way of successful publication. Maupertuis clearly thought so, when he arranged for Bevis's election to the Berlin Academy of Sciences in June, 1750, and congratulated him on the impending *Uranographia*.[39] But the hope and toil were all in vain. If anything else was ever printed, it has not survived. The unhappy end to the affair is revealed by the laconic notices in the London monthlies in the fall of 1750, under the heading, Bankruptcies: "John Neale, of Leadenhall Street, watchmaker."[40]

The events of the ensuing thirty-five years are somewhat obscure. According to Horsfall, the plates were sequestered by the courts during the bankruptcy proceedings.[41] J. F. Weidler, in a 1755 supplement to his history of astronomy, mentions Bevis and the *Uranographia*, and he gives the impression that he still expects publication.[42] Lalande remarks that when he asked Bevis about the fate of the atlas in 1763, he also was given some hope for its eventual production.[43] However, the annotator of the Horsfall narrative, Magalhaens, offers another side to the story. Apparently some of the subscribers had hinted at some complicity between Bevis and Neale which led to the loss of their funds. Bevis consequently became so sensitive on the issue that, so Magalhaens says, to the end of his life he could not refer to the matter without losing his usual good humor. This fact plausibly explains why a more serious attempt was not made to secure the release of the plates and resume publication.[44]

Only one person is known to have secured a copy of the *Uranographia* in this period: Charles Messier. We do not know how or when this occurred, but we do know of one interchange that took place between Bevis and Messier in June, 1771. After Messier had compiled his first catalog of nebulae, Bevis wrote him a letter, informing him that he (Bevis) had discovered the first object, Ml, in 1731.[45] No one has ever remarked at how curious it is that Messier accepted this claim without any evidence to support it. However, there was one piece of evidence that at least established priority for Bevis, and that is the *Uranographia* itself, since Ml appears on several of its plates (see fig. 1). My suspicion is that Bevis presented Messier with a set of impressions to establish his claim. At any rate, we know that Messier had a copy before 1781, when he published the enlarged catalog with its references to "le grand Atlas anglois."[46]

When John Bevis died in 1771, his estate passed into the hands of his executor, James Horsfall. Horsfall does not seem to have done much executing, for when he himself died in 1785, his library was sold at auction, and the auction included the library and manuscripts of John Bevis. The auction catalog survives in at least one copy,[47] and the last six of the 770 lots are of great interest:

765 Dr. John Bevis's Uranographia Britannica, being an Exact survey of the Heavens, on Fifty-One large Copper-Plates with a double Nomenclature, and Tables of all the fixed Stars: A work never published. Some Sheets of the Nomenclature are wanting.

766 Another copy

767 Another copy, interleaved

768 Several duplicate Impressions, and Sheets of the Nomenclature, and complete Catalogues of the fixed Stars.

769 Ditto

770 Drawings and Proof Sheets of several of the Plates

---

[38] The epoch of the catalog is given in the title on the first page: "A Compleat Catalogue of all the Fixed Stars to the Beginning of the Year MDCCL. in the Julian Style"; see fig. 6.

[39] Horsfall, in Bernoulli, *Recueil* 2: p. 335. According to Horsfall the praise for the "inimitable atlas" was written by Maupertuis on Bevis's diploma of membership.

[40] See *The Gentleman's Magazine* **20** (October, 1750): p. 477, or *The London Magazine* **19** (November, 1750): p. 525; the bankruptcy presumably took place in October, 1750. There is unfortunately no other mention of Bevis, Neale, or the subscription process in any other issue of the monthlies between 1746 and 1750.

[41] Bernoulli, *Recueil* 2: p. 334.

[42] J. F. Weidler, "Supplementa Historiae Astronomiae," in his *Bibliographia Astronomica* (Wittenberg, 1755), p. 42. (The supplement is paginated separately; the *Historia Astronomiae* itself had been published in 1741.) Weidler was one of the subscribers to the *Uranographia*, and his description in the Supplement seems to have been taken from the printed proposal of 1749, or perhaps from an earlier proposal which has not survived. Weidler rather surprisingly concludes by stating that James Bradley is now (1755) in charge of publishing the work. There is no evidence to support this statement in the Bradley correspondence and it is certainly unfounded.

[43] Lalande, *Astronomie* 2: p. 242, para. 725.

[44] Bernoulli, *Recueil* 2: p. 334, note**.

[45] The letter does not survive, but Messier noted in his own copy of the *Connaissance des Temps pour 1784*, alongside Ml: "Seen by Dr. Bevis in about 1731 according to his letter to me of 10th June 1771," translated and quoted in Kenneth Glyn Jones, *Messier's Nebulae and Star Clusters* (New York, American Elsevier, 1969), p. 99. Owen Gingerich informs me that Messier's annotated copy is now in the Flammarion collection of the Société Astronomique Française.

[46] It has been stated that Messier used tracings from Bevis's atlas when making his comet maps which were published in various *Memoires* of the French Academy (Glyn Jones, *Search for the Nebulae*, p. 25). If this were true, it might be possible to determine when Messier first acquired his *Uranographia*. However, after inspecting over twenty of these maps from 1759 to 1790, I could not find any instance in which the Bevis figures provided the model. Messier's constellation figures are clearly in the Flamsteed tradition, particularly those after 1776, when the Fortin edition of the Flamsteed atlas seems to have been followed.

[47] There is a copy of the catalog at the Whipple Museum in Cambridge. I am grateful to Owen Gingerich for informing me of its existence and for sharing with me copies of certain pages; I have not yet been able to secure a copy of the entire catalog.

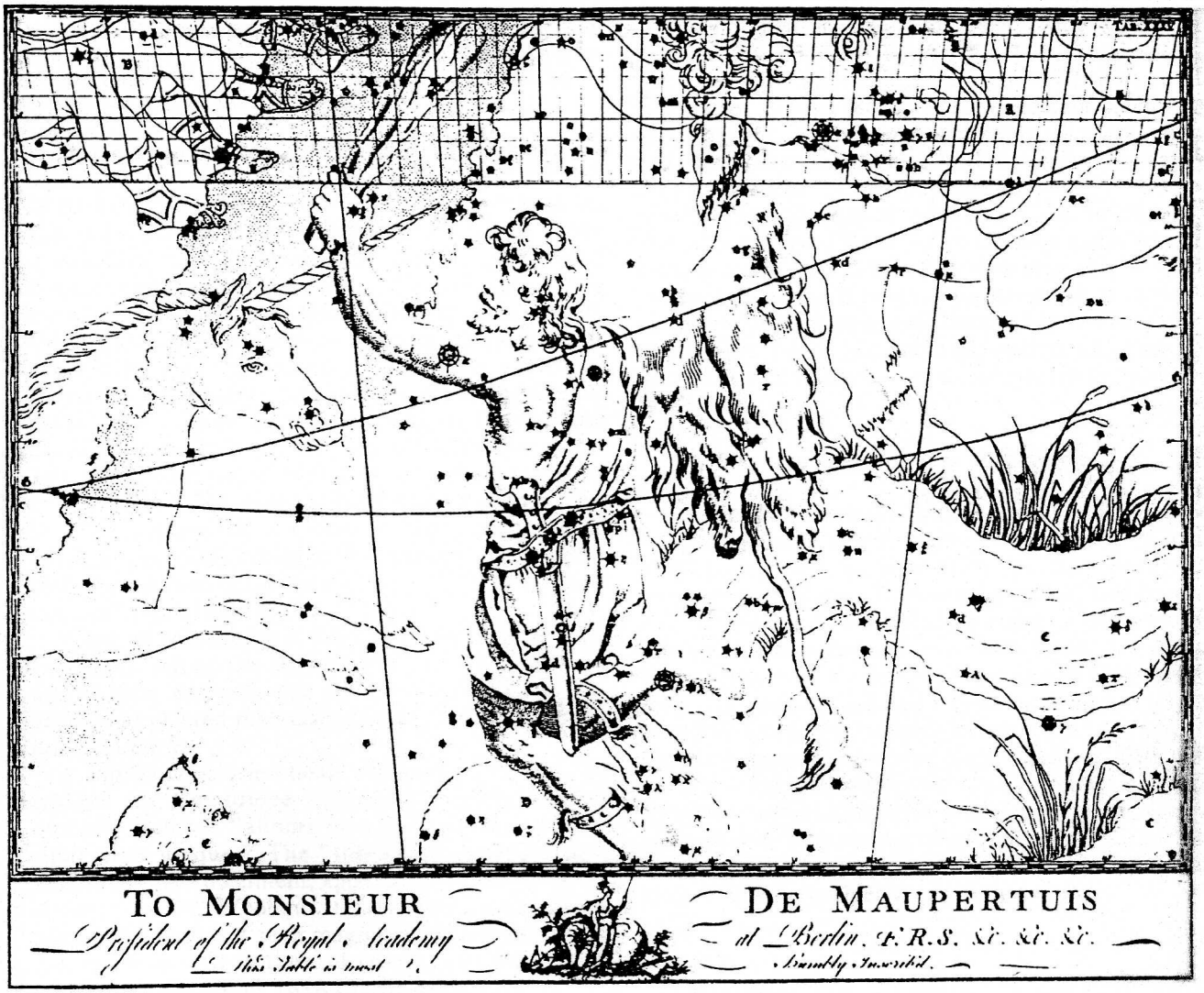

FIG. 1. The Orion plate of the *Uranographia* of John Bevis, *ca.* 1750. The Crab Nebula, Ml, which Bevis discovered, is indicated by the cloudy symbol near the tip of the horn of Taurus. This reproduction is approximately $^4/_9$ natural size (courtesy of the Linda Hall Library).

> with Editor's Corrections, and various Manuscript papers relating to the said valuable work

While one cannot be certain what each of these lots contains, it does seem as if at least three and possibly a half-dozen or more complete sets of plates from the pre-1750 undertaking were sold, at least one of them containing a partial set of explanatory tables and a catalog.[48] What happened after the sale is a matter of conjecture, but the following piece of circumstantial evidence I find most convincing. The British Library copy of the *Uranographia* contains a folio sheet occupying the place of the missing title page, on which the following is printed:

> Atlas Celeste; or, the Celestial Atlas. Being the most correct, copious and superb Work of the Kind, that has ever been offered to the Public. The Expence of the Engravings was immense, as the most Capital Artists in Europe were employed in executing them, and the learned and ingenious Delineators and Directors of the Work had determined to sell it by way of Subscription at Five Guineas the Set. The Heavy Charge attending it, rendered some of them Insolvent, others were removed by Death, which with divers adverse Occurrences were the Means of retarding the Publication until the present Period 1786. Many of the Copies have been destroyed by Fire and Removals; the few that remain are now offered at One Guinea and a Half each Set. This elegant

[48] The Whipple copy belonged to Mrs. Horsfall, and the auction prices have been carefully entered. Lots 765, 766, and 767 sold for £2 2s, £2 3s, and £2 18s respectively. Mrs. Horsfall entered by hand a duplicate lot 766 for £2 5s; probably this represents still another copy of the atlas. By way of interest, Flamsteed's 1729 *Atlas* sold in the same auction for 17s and the three-volume *Historia Coelestis* of 1725 brought £1 13s.

and useful Work is not, nor ever has been in the hands of any Bookseller. The Copies saved are all of the first Impression, and will be an Ornament to any Library, and highly worthy the Notice and Patronage of the Sciences.

Basil Brown referred to this remarkable document as a title-page, and it is the basis for his 1786 "edition" of the atlas, and for the title, *Atlas Celeste*.[49] And yet this is clearly not a title-page in any accepted sense; it provides no publication information whatsoever, does not even name the author, and is a little too chatty even for an eighteenth-century title-page. It is instead, and rather obviously, an advertising broadsheet. It appears evident that someone, possibly a bookseller (although he seems to disclaim being one) bought up one or more lots of the *Uranographia* at the Horsfall auction, printed up the advertisement and an index, and then resold the sets.[50] The seller had a certain devious streak, for it seems likely that he changed the title and omitted Bevis's name so that no one would check the auction catalog or the proposal and discover that the claimed subscription price of "Five Guineas the Set" was a bald lie.[51]

What all this means is that the 1786 *Atlas Celeste* is a ghost. All of the copies dated 1786 by librarians and dealers are only the pre-1750 impressions with additional printed material (usually just the 1786 Index) bound in.

A similar conclusion holds with respect to the 1818 edition at Cambridge University. Brown rather quaintly terms it "almost unique," and he is almost right: it *is* unique.[52] The "title-page" in this case is a hand-lettered document, apparently drawn up by the owner, J. J. W. Woollgar, to alleviate his distress at possessing a book of such magnificence with no proper identification.[53] It is thus, of course, no title-page at all, and no edition of 1818 can be associated with it.

The publication history of the *Uranographia* can then be summed up rather briefly. The *Uranographia* was *never* published and there exist no editions at all, whether of 1750, 1786, or 1818. A certain amount of material was *printed* in anticipation of publication, and all the surviving atlases in their various forms are simply remains of pre-publication runs. A bibliographic entry for one of these sets, to be strictly correct, should read: [Bevis, John. *Uranographia Britannica*. London, *ca.* 1750]. But whatever title is used, the owners of the surviving sets are entitled to occasional feelings of smug superiority, because they possess a work which has survived, against all odds, the best efforts of Fortune to eradicate its traces from the face of this earth.

THE CONTENTS OF THE *URANOGRAPHIA*

The Bevis atlas has always been of bibliographic interest, because of the mystery surrounding its nonpublication, and also because of the sheer beauty of the engraved plates. The *Uranographia*, however, is also of great interest from the point of view of the history of astronomy. There is little doubt that it was being offered as a contender to succeed Flamsteed's atlas and catalog, and had it been published, it would certainly have been judged in that light. A contemporary judgment was never made, because of the unfortunate circumstances, but an assessment can still be made, in fact should be made, and I am going to attempt one. This will necessitate a more detailed discussion of the contents of the plates, tables, and catalog. We will consider them in that order.

i. The Star Charts

The scholar who has heard that the Bevis plates were based on those of Bayer is scarcely prepared for his first side-by-side comparison of the two. His initial reaction is likely to be: Good Lord, they are identical! Both have 51 plates of the same size, in the same order, with each plate in one atlas covering exactly the same section of the heavens as its counterpart. The principal constellation figures of the Bevis atlas are exact copies of those in Bayer, as identical as the engraver could possibly make them. And the principal stars in both atlases are labeled with the now-familiar Greek letters of Bayer (see figs. 2 and 3).

Once the *doppelgänger* shock has worn off, however, the many dissimilarities manifest themselves. The Bevis plates obviously contain many more stars—

[49] Brown, *Atlases*, p. 57. Brown also gives a short extract from this document.

[50] One other specimen of the advertisement survives in the incomplete atlas in the private collection of Samuel Barchas, but the lower half has been torn away. The Royal Astronomical Society atlas contains a handmade copy of the broadsheet made in 1906. The accompanying index is not so scarce; it is found, without the advertisement, in the Royal Astronomical Society, Cambridge University, Booth, Barchas, and Warner copies of the atlas. Presumably the original possessors of these atlases realized what Basil Brown did not—that the advertisement was not a title page—and threw them away. The index was definitely printed at the same time as the broadsheet; the type-faces are identical.

[51] The proposal clearly states the price as £2 15s. Owen Gingerich has suggested, quite plausibly, that the seller also destroyed the explanatory tables when he resold the plates, since, being incomplete, they might have deterred buyers. This would explain why only one of the twelve Bevis atlases has a set of tables, and would further suggest that the APS *Uranographia* did not derive from the 1786 resale, but was probably bought independently at the 1785 auction—possibly it was lot 765.

[52] Brown, *Atlases*, p. 58, gives the supposed 1818 title in full.

[53] The Cambridge University Library had until recently described this as a lithographed title-page. However, Owen Gingerich discovered several years ago, upon personal inspection, that the title-page was inked by hand (the pencil guide-lines still being visible), and Cambridge University is in the process of reclassifying their copy. I might add that Woollgar's name comes up in the provenance of several of the Bevis atlases; he donated the one to the Royal Astronomical Society in 1824, and a copy of his letter of presentation is bound into, of all places, the APS atlas. Woollgar's letter, interestingly, incorporates a lengthy quotation from the 1786 broadsheet.

FIG. 2. The Cygnus plate from Bayer's *Uranometria*, 1603 (courtesy of the Linda Hall Library).

almost twice as many, in fact—and they include stars down to eighth magnitude.[54] In addition to the featured Ptolemaic constellation, each Bevis chart also includes the neighboring constellations (which Bayer had omitted), and these are labeled by capital Gothic letters. Bayer had included a total of sixty-four constellations on his charts; Bevis added the ten Hevelius constellations and five other seventeenth-century innovations, bringing his constellation total to seventy-nine.[55] The Bevis stars are evenly graduated in size to indicate magnitude, as were those of Bayer, but the brighter stars are much less ostentatiously depicted, making it easier to take stellar positions from the charts. In addition to the Bayer Greek-letter designations, some of the Bevis stars are labeled with lowercase Gothic letters. And finally, it is apparent that the epoch of the Bevis charts differs from that of Bayer, since the various colures and equators are shifted by several degrees with respect to the stars. The exact epoch is difficult to determine from the plates alone, but the surviving explanatory tables allow us to fix it at 1746.[56]

The constellation figures on the Bevis plates are without exception strikingly beautiful. For the basic forty-eight Ptolemaic constellations the engraver can of course take little credit, since he unabashedly copied the Bayer figures. However, for the peripheral constellations on each plate, the engraver had no explicit

[54] The Bevis plates contain approximately 3,550 stars. Bayer's *Uranometria* had 1,706 formed stars plus 325 unformed stars (Warner, *Sky Explored*, p. 18). Thus the statement, seemingly originated by Sotheran and often repeated, that the Bevis atlas has five times as many stars as Bayer, is unfounded (Sotheran, *Bibliotheca Chemico-Mathematica*, 2nd Suppl., 1: no. 2876).

[55] The Bevis constellations include the following: the traditional forty-eight Ptolemaic constellations, the twelve southern constellations of Keyser-Houtman, Coma Berenices, Antinous, Crux, and Columba (all of these had been included in Bayer's *Uranometria*), plus the ten Hevelius constellations (Lynx, Scutum, Leo Minor, Canes Venatici, Vulpecula, Sextans, Lacerta, Cerberus, Mons Maenalus, Triangulum Minus), and Camelopardalus, Monoceros, Robur Carolinum, Musca, and Cor Caroli.

[56] Woollgar, for example, not possessing the explanatory tables, had to estimate the epoch, and he arrived at 1744 (or at least that is what he put on his hand-lettered title page in 1818), which indicates he had eyes with extraordinary resolution.

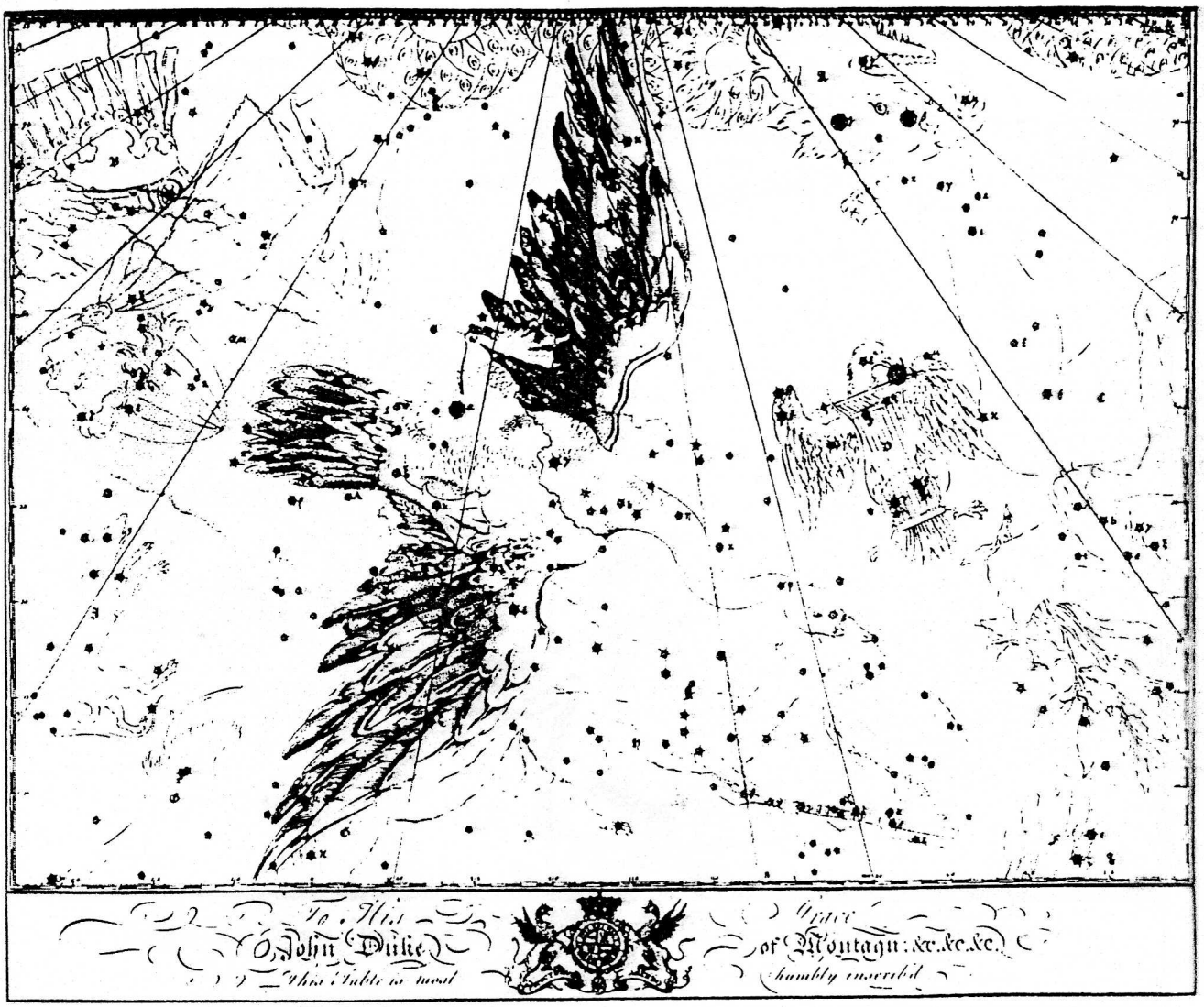

FIG. 3. The Cygnus plate from Bevis's *Uranographia*; also shown are the constellations Draco, Hercules, Lyra, Vulpecula, Lacerta, and Cepheus, and a little of Aquila and Pegasus. See fig. 8 for detail (courtesy Linda Hall Library).

model to copy, so he had to take the basic Bayer prototypes and alter them to fit changes in projection; this task he accomplished with noticeable success. Moreover, he showed great sensitivity in choosing models for the fifteen constellations which do not appear in Bayer and integrating them with the existing sixty-four figures. For the most part he patterned these remaining constellations after the figures in Hevelius's atlas rather than, as one might have expected, the more accessible planispheres of John Senex.[57] The engraver faced one additional difficulty: the star positions for many of the southern stars were rather inaccurate in Bayer's work, and they were replaced for early eighteenth-century astronomers by those of Edmond Halley.[58] The engraver had to make these new positions conform to the older figures, and this he did rather well, although it meant curling up the tail of Pavo and rotating Crux about 45 degrees.

One curious feature of the *Uranographia* plates is

[57] The Senex planispheres first appeared around 1721, and they became quite popular and were often incorporated into geographical works. Senex included all of the Hevelius constellations on his planispheres, although slightly altered in figure. The Hevelius atlas was purportedly hard to obtain in England. However, a comparison of the Bevis, Senex, and Hevelius charts reveals that Bevis's engraver had the Hevelius original in hand and followed it almost exactly, not only for the Hevelius constellations themselves, but for Monoceros and Camelopardalus. Several of the Bevis constellations, however, such as Musca and Robur Carolinum, were adapted from a source not yet identified. There is a good discussion of the figures of both Senex and Hevelius in Warner, *Sky Explored*, pp. 112–116, 239–244.

[58] Edmond Halley, *Catalogus Stellarum Australium* (London, 1679).

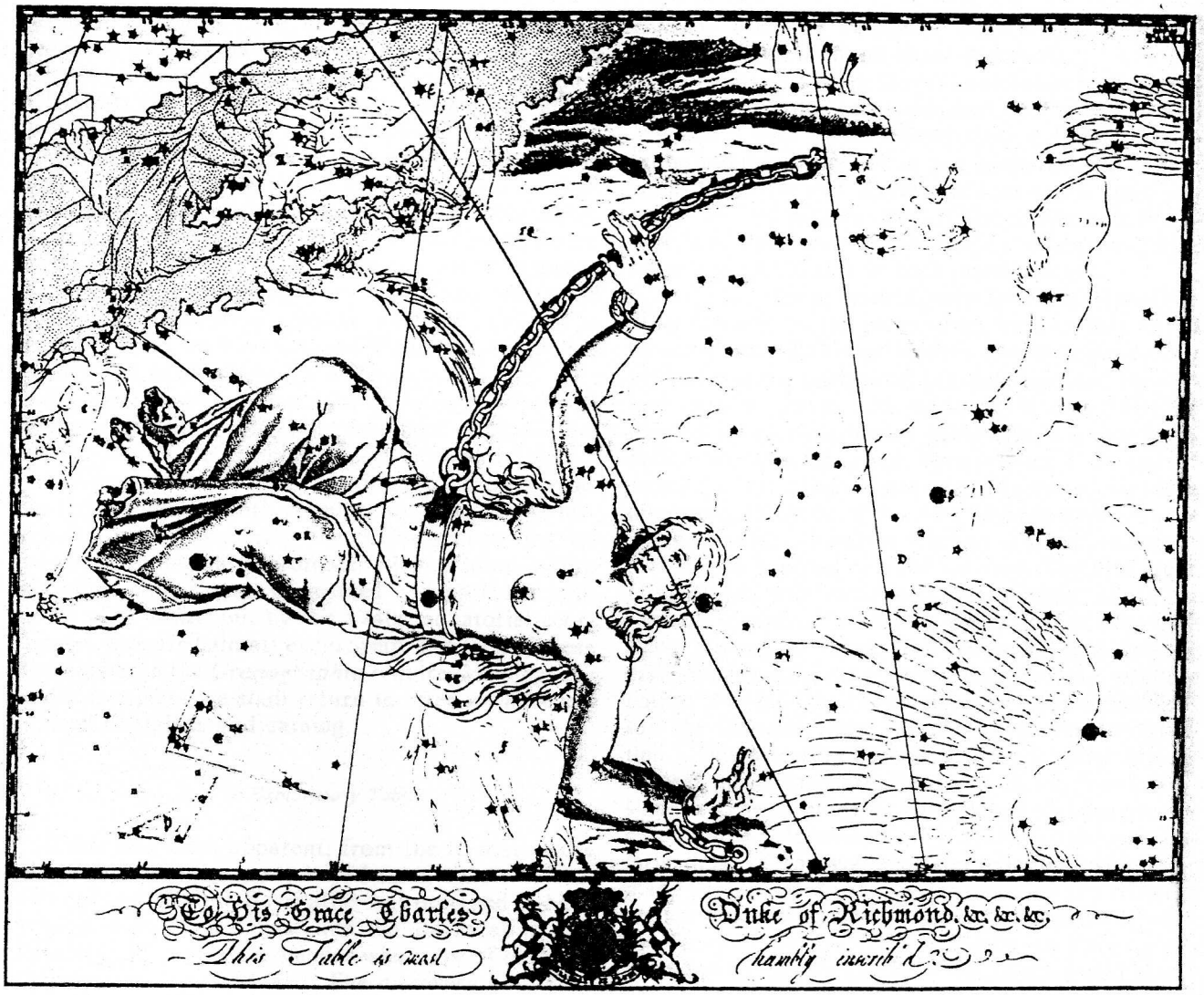

FIG. 4. The Andromeda plate from Bevis's *Uranographia*. The Andromeda nebula, M31, is depicted just to the right of the first link in Andromeda's chain. A spurious "nebulose" object lies just below Andromeda's knee (courtesy Linda Hall Library).

that there is an occasional inconsistency between some of the constellation drawings. The constellation Cerberus, an innovation of Hevelius, appears several times in the hand of Hercules, but in several other plates Hercules holds the traditional apple branch.[59] Musca buzzes above Aries on the Perseus plate (XI); on the Aries plate itself (XXII), the stars are there, identified by gothic letters, but the outlines of the fly have not been drawn in. These inconsistencies seem to suggest that the engraving process encompassed at least a moderate span of time, enough to allow for editorial changes of heart, but it is impossible to be more conclusive from these two examples alone.[60]

There are two serious questions raised by the Bevis plates. The first is: Why did Bevis elect to base his atlas on Bayer? After all, in the 150 years since the *Uranometria* appeared, both Hevelius and Flamsteed had produced important atlases, and both had departed from the Bayer tradition, for more than aesthetic reasons. Hevelius had decided to depict the constellations from the outside of the celestial globe, reversing all the figures, and he preferred the constellation figures of Plancius in many cases to those of Bayer.[61] Flamsteed had been very critical of Bayer because the figures in the *Uranometria* did not conform to Ptolemy's nomenclature, often reversing right and left.[62] In returning to the Bayer models, Bevis

[59] Plates VII, IX, XVI show the apple branch; plates VIII, XIII, and XIV depict Cerberus.

[60] One inconsistency was inherited; Bayer had shown Coma Berenices as tresses of hair on the Ursa Major plate (II) and as a sheaf of wheat on Bootes (V); Bevis's engraver did exactly the same thing.

[61] Warner, *Sky Explored*, p. 116.

[62] See for example Flamsteed's diatribe in the introduction to the *Atlas Coelestis*, pp. 3–4.

seems to be ignoring and/or deemphasizing these criticisms. The Proposal, however, explains the choice. The Bayer figures, it states, have "become in a manner Classical, and to substitute new ones in their stead, would introduce a deal of Confusion in Astronomy." Bevis, in an era that saw a host of new constellation depictions, was simply trying to reinstill some element of tradition and continuity into celestial cartography. And as for the complaint that the Bayer figures do not conform to Ptolemy's nomenclature, Bevis responds by providing two planispheres at the end where the figures *do* illustrate Ptolemaic nomenclature.[63] The gesture would not have pleased Flamsteed, but it was an attempt to reconcile the differences.

The second and more serious question prompted by the Bevis plates is this: Why are there no equatorial coordinates on the star charts? When Bayer published the *Uranometria*, ecliptic coordinates were the rule. By the early eighteenth century, however, as the meridian arc was becoming the primary observing instrument, equatorial coordinates became more useful, and more widespread. Flamsteed had provided both in his 1729 *Atlas*, but by the 1740s, equatorial coordinates were used almost exclusively. The lack of these coordinates in the *Uranographia* requires explanation, and it is a point we shall return to after we have examined the tables and catalog.

ii. The Explanatory Tables

It has long been apparent, from the format of the plates and from the many keyed stars, constellations, and colures, that the Bevis atlas was designed to have accompanying tables, just like the Bayer atlas, but until now we could only wonder what type of material they would have contained. The discovery of the incomplete set of these tables in the APS *Uranographia* now allows us to do considerably more than conjecture.[64]

The principal purpose of the tables is to identify the stars on the charts and give their positions (see fig. 5). Bevis provided two "Nomenclatures." The first lists the stars according to Ptolemy, in the order of his catalog, with a translation of Ptolemy's description, and with stellar positions and magnitudes for the epoch A.D. 130. The Ptolemaic stars are also cross-indexed to Bayer's Greek-letter designations.

Following this is the Bayer nomenclature, in Greek alphabetical order (cross-indexed to Ptolemy's catalog), along with Bayer's description in English translation and the star positions and magnitudes to 1746.[65] Both Ptolemaic and Bayer positions are ecliptic and to the nearest minute only. If Bayer missed a Ptolemaic star, Bevis usually assigned it a lowercase Gothic letter and included it in both nomenclatures.

A third section, immediately following, identifies other features on the plate which were usually keyed by uppercase Gothic or Roman letters; these consist primarily of the peripheral constellations and the various colures, poles, and equators. If any room remained on an explanatory table after all this information had been furnished, Bevis inserted a "Remarks" section. These remarks are certainly one of the most interesting features of the APS *Uranographia*, and it is regrettable that only a fraction of the intended remarks were printed, or have survived. The first table, Ursa Minor, with so few stars to identify, allowed a remarks section of a full half-page, and yet even here Bevis ran out of room even before he had finished discussing Polaris, terminating his comments with the notice: "For the Continuations of these Remarks, Consult the General Index which follows the Introduction." This direction becomes all too familiar as subsequent plates are consulted, and all too frustrating, since no general index or introduction was apparently ever printed. Moreover, many of the plates, particularly those of the zodiacal constellations with their many designated stars, have no room for any remarks section whatsoever. Such is the case, for example, with the Taurus plate (XXIII), and thus we have no opportunity to learn what Bevis might have said about his most famous discovery, M1, the Crab nebula.

The tables which *have* survived, however, enable us to get an occasional and sometimes intimate glimpse of Bevis the astronomer. Aside from some necessary attention to differences in star identifications by various authorities, the bulk of his remarks are addressed to one of several subjects. By far the most frequently-mentioned topic is the possible proper motion of stars: this subject comes up nearly a dozen times on as many different tables.[66] In the aftermath of Halley's discovery of proper motion, such attention is not surprising. The possible variability of stars also arises at least five times, usually as a result of discrepancies in magnitude estimates by various observers.[67] The pre-

[63] In Bayer's *Uranometria*, the two Ptolemaic planispheres do not have any constellation figures drawn in.

[64] The APS *Uranographia* has tables for thirty-two plates; they are printed on separate leaves and are, with several exceptions, bound so as to face the plates. (It might be recalled that the Bayer atlas had the tables printed on the verso sides of the star charts, making identification awkward.) The plates *lacking* tables are: Corona (VI), Lyra (VIII), Sagitta (XV), Delphinus (XVII), Equleus (XVIII), Triangulum (XXI), Cancer (XXV), Libra (XXVIII), Lepus (XXXVII), Canis Major (XXXVIII), Canis Minor (XXXIX), Crater (XLII), Corvus (XLIII), Lupus (XLV), Ara (XLVI), Corona Australis (XLVII), and Piscis Australis (XLVIII).

17 lacking tables

[65] The star positions however are not those of Bayer (or Tycho), precessed to 1746, but are instead taken from Flamsteed's own positions in the 1725 British catalog, reduced to 1746; the same applies to the magnitudes.

[66] See tables II, V, IX, XIV, XVI, XIX, XXIV, XXIX, XXXI, XLIV.

[67] Tables III, XIV, XX, XXIV, XXXI.

ΑΝΔΡΟΜΕΔΑΣ ΑΣΤΕΡΙΣΜΟΣ. *ANDROMEDA.* Tab. XX.

PTOLEMY's NOMENCLATURE.

Ptol. Ord.	Bay. Ord.		Year of Christ 138. Longit.	Latit.	Mag.
			° ′	° ′	
1	λ	That between the Shoulders	♑ 25 20	24 30	n 3
2	π	That in the right Shoulder	26 20	27 00	n 4
3	ι	That in the left Shoulder	24 20	23 00	n 4
4	σ	The ſouthermoſt of the three in the right Arm	23 40	32 00	n 4
5	θ	The northermoſt of them	24 40	33 30	n 4
6	ρ	The middle one of the three	25 00	32 30	n 5
7	ι	The ſouthermoſt of the three in the End of the right Hand	19 20	41 00	n 4
8	κ	The middle one of them	20 40	42 00	n 4
9	λ	The northermoſt of the three	21 40	44 00	n 4
10	ζ	That in the left Arm	24 10	17 30	n 4
11	ν	That in the left Elbow	25 40	15 30	n 4
12	β	The ſouthermoſt of the three under the Girdle	♈ 03 50	25 40	n 3
13	μ	The middle one of them	01 50	30 00	n 4
14	ν	The northermoſt of the three	02 00	32 30	n 4
15	γ	That above the left Foot	16 50	28 00	n 3
16		That in the right Foot (Bayer's *υ in Perſeus*)	17 10	37 20	n 4
17	A	That which is ſouth of it	15 10	35 40	n 4
18	ß	The northern of the two in the left Ham	12 20	29 00	n 5
19	τ	The ſouthern of them	12 40	28 00	n 4
20	ρ	That in the right Knee	10 10	36 20	n 5
21	ξ	The northern of the two in the Train	12 40	33 15	n 5
22	χ	The ſouthern of them	14 10	32 00	n 5
23	b	The extraneous one which preceds the three in the End of the right Hand	11 40	44 00	n 5

BAYER's NOMENCLATURE.

		Year of Chriſt 1746. Longit.	Latit.	Mag.
		° ′	° ′	
α	The Head of Andromeda, the ſame as the Navel of Pegaſus	♈ 10 45	25 41	n 2
12 β	The Girdle	26 49	25 56	n 2
15 γ	The bright one in the ſouthern Foot (*Leg*)	♉ 10 42	27 46	n 2
1 δ	The northern in the Eduction of the left Arm	♈ 18 14	24 21	n 5
3 ε	The ſouthern	17 23	23 01	n 4
10 ζ	That in the Arm	17 02	17 36	n 4
11 η	That in the Elbow	18 52	15 55	n 4
5 θ	The northermoſt of the three in the right Arm	17 38	33 23	n 4
7 ι	The ſouthermoſt of the three in the End of the right Hand	12 33	41 01	n 4
8 κ	The middle one	13 46	41 43	n 4
9 λ	The northermoſt	14 47	43 49	n 4
13 μ	The northern in the Girdle	25 35	29 39	n 4
14 ν	The conſequent in the Chain	25 35	32 33	n 4
21 ξ	That near the Calf of the right Leg	♉ 06 35	34 31	n 5
ο	That in the Ring of the Chain	♈ 01 07	47 33	n 5
2 π	That in the Breaſt	19 06	27 08	n 4

BAYER's NOMENCLATURE.

Ptol. Ord.	Bay. Ord.		Year of Chriſt 1746. Longit.	Latit.	Mag.
			° ′	° ′	
6	ρ	The middle one of the three in the right Arm	♈ 18 03	32 27	n 5
4	σ	The ſouthermoſt	16 50	31 36	n 5
19	τ	That in the ſouthern Thigh	♉ 05 22	27 54	n 5
	υ	That in the Knee	06 29	29 42	n 6
20	φ	That in the right or northern Thigh	02 54	36 20	n 5
22	χ	The inferior near Calf of the left Leg	06 57	31 28	n 6
	ψ	That in the Thumb of the right Hand	♈ 16 25	42 56	n 5
	ω	The middle one of the northern Ham	♉ 05 15	33 18	n 5
17	A	That in the Leg	06 35	34 31	n 5
	b	That in the Train	13 18	28 52	n 6
	c	That in the Sole of the northern Foot	15 50	31 22	n 6
16		(*Bayer's υ in Perſeus*)	08 55	35 24	n 5
18	ß	- - - - - - - - - - - - - - - - - - - -	05 02	28 58	n 6
23	b	- - - - - - - - - - - - - - - - - - - -	♈ 04 15	43 45	n 3

♇ Caſſiopea. ♇ Pegaſus. ♋ The Lizard.
♋ The Swan. ♎ The Triangle. ♎ The Little Triangle.
♏ Perſeus. ♐ The conſequent Fiſh. ♓ The Equinoctial Colure.

REMARKS.

α. Belongs more properly to the Conſtellation of Pegaſus than to this.

β and γ. The Magnitudes of theſe ſhould induce us to examine if they have altered their Poſitions; but we are, at preſent, deſtitute of the Means, as they were never obſerved together with any ſmall ones at *Greenwich* or *Newington*.

ξ. *Bayer* has repreſented this as of the 4th Mag. M. *I. D. Caſſini* about eighty Years ago found it to be conſiderably diminiſhed. Both Editions of the *Brit. Cat.* make it between the 4th and 5th, in the former of which it is the 46th, though not diſtinguiſhed by its Character, which is there wrongly affixed to the 49th. At this Time it exceeds not the 5th Mag.

ε. This is wanting in the *Brit. Cat.* but belongs to the Lizard of *Hevelius*, who places it in the Back of the Creature. It is the 9th according to Mr *Flamſteed*'s Arrangement of that Catalogue. In both Editions of the *Brit. Cat.* this Character is applied to *Ptolemy*'s 23d, which differs from *Bayer*'s Star above three Degrees both in Longitude and Latitude. *Tycho* places one of the 4th Mag. in the Ring of Andromeda's Chain, as *Bayer* does this, who probably imagined that there was an Error of 10 Degrees in the Latitude of *Tycho*'s; otherwiſe indeed it would be among thoſe of the Swan. However the above-mentioned M. *Caſſini*, as his Son informs us in his *Elements d'Aſtronomie*, ſaw *Tycho*'s Star, but ſo very ſmall that he was juſt able to diſcern it with the naked Eye.

υ. M. *Caſſini* could no ways perceive this Star, but inſtead of it he diſcovered two a little further northward. It is not to be found in the 1ſt Edit. of the *Brit. Cat.* where the Character is wrongly placed before the 50th or *Ptolemy*'s 18th. It is the 71st of the 2d Edit. where the Character is aſcribed to the 67th, the ſame as in the other Edition. This 71st is there ſet down between the 6th and 7th Mag. It is now of the 5th.

χ. Inſtead of this Character, λ is prefixed to the 52d of the 2d Edit. of the *Brit. Cat.*

ω. This Character is omitted before the 48th of the 2d Edit. of the *Brit. Cat.*

A. This which had been for ſome time imperceptible to M. *Caſſini*, became again viſible in 1695. 'Tis the 49th of the 2d Ed. of the *Brit. Cat.* of the 5th Mag. but wrongly marked ξ. It ſtill appears of the 5th.

See the General Index for the Reſt of theſe Remarks.

FIG. 5. The Explanatory Table for the Andromeda plate of the Bevis *Uranographia* (courtesy of the American Philosophical Society).

history of the discovery of aberration merits a lengthy discussion, as does the nova of 1572.[68]

The topic which gets the most extended single discussion is that of the ancient position of the pole star. In what amounts to a 1,200-word essay, Bevis shows himself rather well-versed in the literature on the subject.[69] His narrative draws on the ancient writings of Eudoxus and Hyginus, on the seventeenth-century chronological studies of Petavius, and on the contemporary work of Manfredi and Maraldi. Bevis seems to have been especially taken with Newton's *Chronology*, with its calculation of the position of the equinoxes on the sphere of Eudoxus, and Newton's "Primitive" colures and equators are depicted on many of the plates.

One noticeable feature of the remarks is that Bevis rarely has anything complimentary to say about Flamsteed. He frequently criticizes Flamsteed's star identifications, and several times he points out where Flamsteed made serious errors in measuring transit times or declinations.[70] Bevis seems to take unnecessary pains detailing the story of Flamsteed's purported discovery of stellar parallax, when he misinterpreted some effects which were actually due to aberration.[71]

[68] Aberration is discussed on table IV; the 1572 supernova on table X.

[69] The discussion begins on table I and is continued on table IV.

[70] On the very first table Bevis castigates both Halley and Flamsteed for misidentifying certain Ptolemaic stars in Ursa minor. Halley however is never again subjected to criticism, while Flamsteed is singled out for mistaken identifications on tables IV, IX, XI, XII, XIV, XX, XXII, XXIX, and XXXIV. The criticisms on XII and XXXIV are particularly pointed.

[71] See table IV. For a recent account of this episode, consult M. E. W. Williams, "Flamsteed's Alleged Measurement of Annual Parallax for the Pole Star," *Jour. Hist. Astron.* **10** (1979): pp. 102–116.

The criticism of Flamsteed is rarely overt or venomous (it is certainly no match for any of Flamsteed's comments about Halley), and it was very probably subconscious, but it does remind us that Bevis was associated with Halley at a time when partisans of Halley and partisans of Flamsteed were still not on speaking terms.

There is one last point to be made about the explanatory tables, and that is that the "Remarks" sections had little precedent in the Grand Atlases of the period. Bayer had ventured comments on a few special topics, such as Tycho's nova, and Schiller did likewise, but both Hevelius and Flamsteed eschewed a running commentary on the fixed stars. The annotations of Bevis added a great deal of color and interest to a genre that, if visually magnificent, was rapidly becoming factually stifling. In the nineteenth century such commentaries, such as William Smyth's *Cycle of Celestial Objects* (1844) became popular, but they were a genre quite apart from the star atlases and catalogs, and they have remained so to the present day. Perhaps if the *Uranographia* had been published, the annotated atlas such as Bevis envisioned would have been the rule, rather than the exception.

iii. The Bevis Star Catalog

The most unexpected surprise of this entire inquiry was the discovery that Bevis not only compiled a new star catalog but managed to have it printed, and that a copy—apparently unique—is preserved in the APS *Uranographia*. Major star catalogs appeared almost as infrequently as atlases in the seventeenth and eighteenth centuries, and the recovery of a hitherto unsuspected catalog promised to be of major significance. The Bevis catalog unfortunately does not quite live up to its promise, but it is nevertheless of great interest.

The catalog is printed on fourteen large oblong folio pages of the same size as the plates. It contains 3,551 stars, 600 more than Flamsteed's 1725 catalog.[72] These stars are grouped into 69 constellations,[73] and within each constellation the stars are listed in order of increasing longitude.[74] The stars are numbered from 1 to n for each constellation, these numbers occupying an initial column titled "Uranog."[75] (see figs. 6 and 7). The second column gives the number of the star in Flamsteed's 1725 catalog, if it could be found there, or in some other catalog, if Flamsteed omitted it. These other sources are Halley, Hevelius, Anthelme, Tycho, Halley's Southern, Bartsch, Pound, and Manfredi.[76] And there are 53 stars which are attributed to I.B., who is presumably Bevis himself.[77] The third column lists the Bayer characters (as well as the Gothic-letter additions made by Bevis); the fourth and fifth contain the longitude and latitude to the nearest second, and the last and sixth column provides the magnitude.

The reason why the Bevis catalog does not merit major billing in the select pantheon of important star catalogs is that very few of the star positions are based on new observations. Bevis compiled the catalog by taking the positions given in various earlier catalogs and precessing them the appropriate amount to bring them to the epoch 1750. Thus, for example, the longitude for any Flamsteed star is precisely 50′21″ greater than its value in the 1712 or 1725 catalogs; the Hevelius stars are increased by 1°16′, and the Tychonic stars by 2°5′.[78] So far as I can determine by sampling, there is no exception to this procedure.

Moreover, although it appears that Bevis used all the major catalogs in compiling his derivation, in fact he used only four: the Flamsteed 1712 and 1725 cat-

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[72] Flamsteed's 1725 Catalogue, also known as Flamsteed's British Catalogue or The British Catalogue, appeared in volume three of his *Historia Coelestis* (London, 1725). The actual star count is 2,935; but if duplicates are discarded, the total number of different stars cataloged is 2,913, according to Francis Bailey, *An Account of the Revd. John Flamsteed* . . . (London, 1835), p. 392. Bevis himself had at least 44 duplicate stars, making his true count close to 3,500.

[73] Bevis's catalog contained fewer constellations than the plates because Bevis chose to combine a number of them in the catalog. Thus we find "Hercules with Cerberus," "The Eagle with Antinous and Sobieski's Shield," etc.

[74] In Flamsteed's catalog, the stars are in order of increasing right ascension.

[75] The column labeled "Uranog." provides us with the only internal evidence that Bevis intended to call his atlas the *Uranographia*. Of course other sources, particularly the proposal, leave little doubt as to the proper title of the work.

[76] The catalog which Bevis calls "Halley's" is actually the Flamsteed catalog included in the first edition of the *Historia Coelestis* (London, 1712); Edmond Halley was only the editor. Even in Bevis's time it was very scarce, since the 1712 catalog was one of the sections of the *Historia* that Flamsteed destroyed when he obtained ¾ of the edition in 1715. Johann Hevelius's *Catalogus Stellarum Fixarum* was issued along with the *Firmamentum* in his *Prodromus Astronomiae* (Gdansk, 1690). A catalog by Dom Anthelme was included in Augustin Royer's *Cartes du Ciel* (Paris, 1679). Tycho's catalog was available in two forms: the shorter one in Tycho's own *Astronomiae Instauratae Progymnasmata* (Prague, 1602), and the augmented version in Johann Kepler's *Tabulae Rudolphinae* (Ulm, 1627). "Halley's Southern Catalogue" refers to Edmond Halley, *Catalogus Stellarum Australium* (London, 1679). Jacob Bartsch published his *Catalogus Fixarum seu Inerrantium Stellarum* (Strassburg, 1624) to accompany his planispheres of the same year. James Pound, James Bradley's uncle, did not publish a catalog; he probably personally communicated some observations to Bevis. Eustachio Manfredi also published no catalog, but Bevis gleaned several star positions from his *De Annuis Inerrantium Stellarum Aberrationibus* (Bologna, 1729). In several cases Bevis did not use the original catalogs; see below.

[77] The initials do not rule out the possibility that James Bradley, at this time Astronomer Royal, provided the positions of these fifty-three stars. However external evidence, principally the statement by Horsfall that Bevis included in his *Uranographia* a number of stars of which he was the first observer, make it far more likely that I.B. stands for John Bevis. See Bernoulli, *Recueil* 2: p. 333.

[78] The epoch of both Flamsteed catalogs was 1690; of Hevelius, 1660; Anthelme, 1700; and Tycho, 1600. Bevis accepted an annual precession of 50.35″.

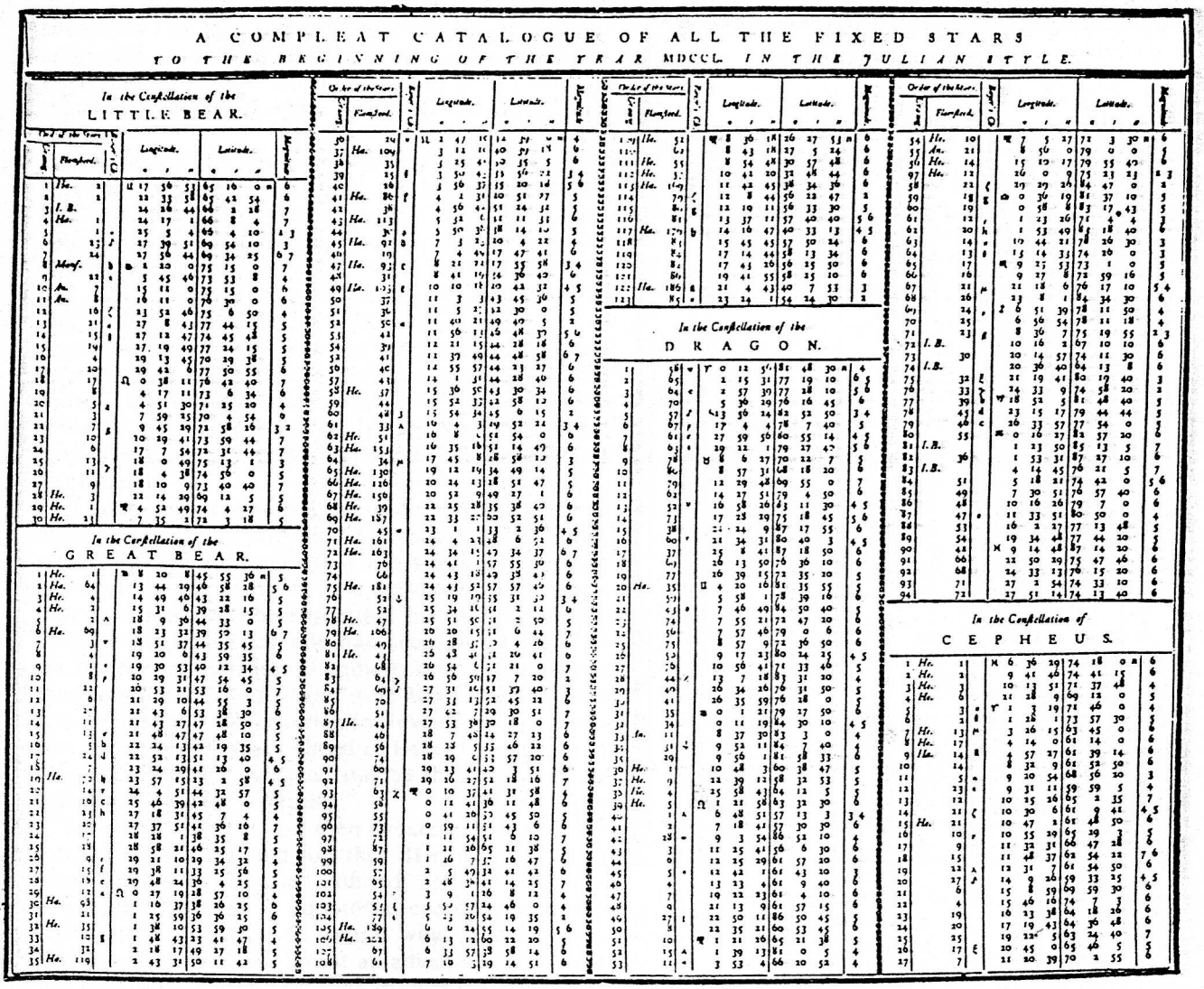


FIG. 6. The first page of the Bevis star catalog. See fig. 7 for detail (courtesy of the American Philosophical Society).

alogs, the Anthelme catalog in Royer's *Cartes du Ciel*, and the Tychonic catalog in Kepler's *Tabulae Rudolphinae*. The Bartsch stars were taken from the list included in Kepler, rather than from Bartsch's own catalog, and the positions of the Hevelius, Ptolemaic, and Halley southern stars were all derived, not from the original catalogs, but from the reprints in volume three of the 1725 *Historia Coelestis*.[79] This fact is important, because the editors of the *Historia Coelestis* rearranged the order of the stars in several catalogs to produce increasing right ascension. Thus when Bevis lists a star in Ursa Minor as "He. 3" (see fig. 7), it is *not* the third star in that constellation in Hevelius's original catalog, but rather the third in the 1725 Flamsteed reprint. This might well have caused some confusion to the unwary catalog user, although presumably the catalog sources would have been explained in the lost introduction to the *Uranographia*.

The method of compilation helps to explain the curious feature of the plates (and the catalog) noted earlier: that they contain only ecliptic coordinates. If Bevis had been using his own observations, which in the 1740s would have been taken with a meridian instrument and a clock, the frame of reference would certainly have been the celestial equator. But in calculating precession, it was far simpler to use celestial longitude and latitude, since then no spherical trigonometry is involved. After calculating the ecliptic po-

[79] Volume three of the 1725 *Historia Coelestis* contains, besides Flamsteed's own catalog, the catalogs of Ptolemy, Tycho, Wilhelm Landgrave of Hesse, Ulugh Beg, and Hevelius, all maintaining the original epochs. Abraham Sharp, one of the editors, also inserted a truncated version of Halley's southern catalog, this time changing the epoch from 1679 to 1726, perhaps to disguise the fact that it was derived from the work of the arch-villain Halley, a cause he furthered by also omitting Halley's name.

sitions for 1750, Bevis could have determined the right ascension and declination by calculation, but the enormity of the task, and possibly the hurry-up nature of the catalog, seems to have prevented him from doing this.

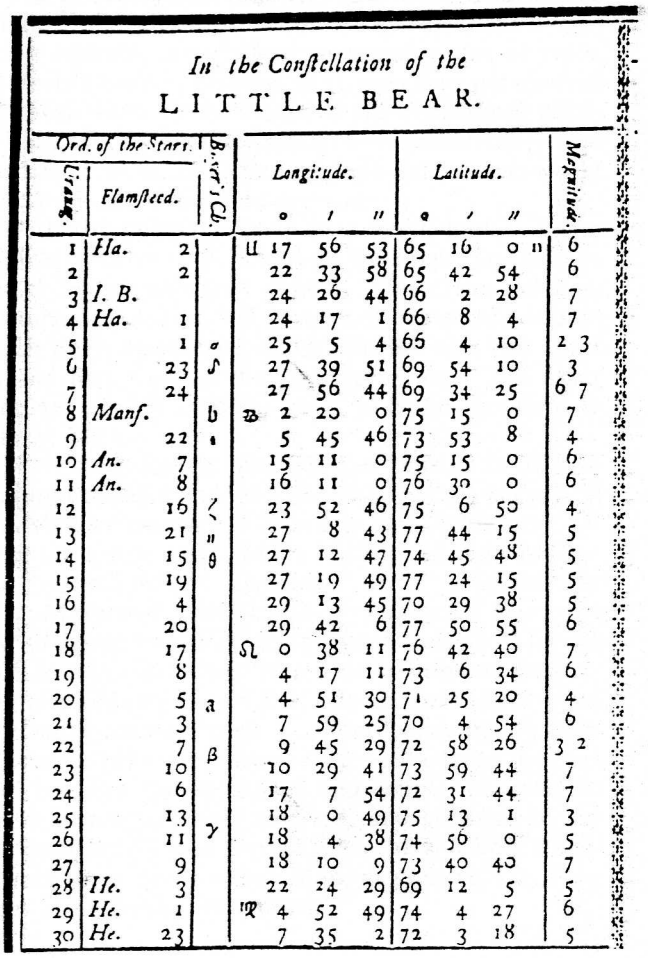
There is one arresting innovation of the catalog that deserves comment: Bevis used English names for all the constellations, replacing Aquila with The Eagle, Libra with The Scales, etc. In all English atlases and planispheres prior to Bevis, Latin is the absolute rule, but Bevis does not even provide the Latin names as alternatives in the catalog (although he had done so on the explanatory tables). Perhaps Bevis was goaded into the vernacular by the fact that the French had increasingly come to assign French names to the constellations; his "The Ram" and "The Whale" may just have been the anglophiles answer to "le Belier" and "la Baleine."

Even more interesting is the second column of numbers in the catalog, labeled "Flamsteed." One might make a strong argument that Bevis was the inventor of the Flamsteed numbers. It is reasonably well known that Flamsteed numbered neither his catalog nor the stars on his atlas. Lalande has been put forward as the inventor of Flamsteed numbers, since he numbered the stars in his 1783 *Ephémérides* according to Flamsteed.[80] If that is the criterion for invention, then Bevis was clearly thirty years ahead of Lalande, since Bevis referred to every Flamsteed star by the number of its place in Flamsteed's catalog.[81]

The Bevis star catalog then evokes a string of adjectives not often found together. It is disappointing, being almost entirely secondhand, and seriously deficient, in that it lacks equatorial coordinates. However, it was innovative in several ways, and its organization of authorities gave it an advantage unique to star catalogs of its day (we will discuss the advantage of the catalog layout below). Moreover, it *was* the largest star catalog ever published, or almost published, which is no mean distinction. Whether the catalog deserves the epithet which Bevis tried to bestow upon it—"The Third British Catalogue"—is, however, open for debate.

AN ASTRONOMICAL ASSESSMENT OF THE *URANOGRAPHIA*

This somewhat detailed look at the plates, tables, and catalog has it is hoped been sufficient to indicate that a partisan of the Bevis atlas could have made a strong *prima facie* case for conferring "Grand Atlas"



In the Conſtellation of the

LITTLE BEAR.

Ord. of the Stars.	Flamſteed.	Mag.	Longitude. °	′	″	Latitude. °	′	″	Magnitude.
1	*Ha.*	2	♊ 17	56	53	65	16	0 N	6
2		2	22	33	58	65	42	54	6
3	*I. B.*		24	26	44	66	2	28	7
4	*Ha.*	1	24	17	1	66	8	4	7
5		1	25	5	4	65	4	10	2 3
6		23	27	39	51	69	54	10	3
7		24	27	56	44	69	34	25	6 7
8	*Manf.*	b	♋ 2	20	0	75	15	0	7
9		22	5	45	46	73	53	8	4
10	*An.*	7	15	11	0	75	15	0	6
11	*An.*	8	16	11	0	76	30	0	6
12		16	23	52	46	75	6	50	4
13		21	27	8	43	77	44	15	5
14		15	27	12	47	74	45	48	5
15		19	27	19	49	77	24	15	5
16		4	29	13	45	70	29	38	5
17		20	29	42	6	77	50	55	6
18		17	♌ 0	38	11	76	42	40	7
19		8	4	17	11	73	6	34	6
20		5	4	51	30	71	25	20	4
21		3	7	59	25	70	4	54	6
22		7	9	45	29	72	58	26	3 2
23		10	10	29	41	73	59	44	7
24		6	17	7	54	72	31	44	7
25		13	18	0	49	75	13	1	3
26		11	18	4	38	74	56	0	5
27		9	18	10	9	73	40	40	7
28	*He.*	3	22	24	29	69	12	5	5
29	*He.*	1	♍ 4	52	49	74	4	27	6
30	*He.*	23	7	35	2	72	3	18	5

FIG. 7. Detail of fig. 6, showing the stars in Ursa Minor, from the first page of the Bevis star catalog.

laurels on the *Uranographia*. But tradition has always played a large role in astronomy (recall the nearly universal rejection of Schiller's atlas in the seventeenth century), and it seems to me that the Bevis atlas, before being accepted by astronomers, would have had to elicit affirmative answers to three questions: Is the atlas current and timely, in touch with contemporary developments? Does it maintain an acceptable level of accuracy? Does it in some way offer advantages over earlier atlases? We will attempt to assess the *Uranographia* by considering these questions in order.

i. Timeliness

The mere thought that stellar astronomy could be timely or untimely would have raised many eyebrows in the Renaissance and early seventeenth century. But by the eighteenth century it had become apparent that there was more to observing the stars than determining once and for all their unchanging positions and magnitudes. Some stars had disappeared, others had seemingly been born. Some stars varied in magnitude, oth-

[80] The suggestion is made by Deborah J. Warner, most recently in *Sky Explored*, p. 81.

[81] In my opinion, however, the real honor of that invention (if of course it matters at all) belongs not to the person who first numbered his columns after Flamsteed, but to the one who first referred to a star as "61 Cygni" or the like, or who first numbered the stars on an atlas or planisphere after Flamsteed. Who this was I do not know, but it was neither Bevis nor Lalande.

ers exhibited proper motion, still others resisted resolution into points of light. The number of such discoveries had increased greatly since Tycho observed the nova of 1572, and so in a very real sense, a celestial atlas in the mid-eighteenth century could be out of date.[82]

Not that everyone realized this immediately. After all, the moving, variable, or nebulous stars were still a tiny minority in the heavens. To many, they could be omitted in celestial surveys; a *Catalogus stellarum fixarum*, almost by definition, is entitled to avoid objects of a changeable nature. Flamsteed clearly felt this way, and you will find no brilliant novae or cloudy nebulae on any of the plates of his *Atlas Coelestis* (although he did occasionally describe the magnitude of a star as "neb" in his catalog). And Hevelius before him had included only a few nebulae and only one new star (the one he himself had observed). Even as late as 1750 Bevis could probably have chosen to follow this path without undue criticism from astronomers.

It is to his great credit then that Bevis made a concerted attempt in the *Uranographia* to include depictions and discussion of the not-so-fixed stars. Let us consider first the nebulous objects.[83] The *Uranographia* contains nineteen of them, if we include the two Magellanic Clouds and omit Praesepe and the Pleiades, which Bevis represents by individual stars. These objects are divided into two types, "nebulose" and "nebulae," each represented by different symbols on the plates. The nebulose are for the most part asterisms, traditional nebulosities handed down from Ptolemaic times. These time-worn objects include Ω_1 and Ω_2 Cygni; ν_1 and ν_2 Sagitarii; and π, σ, and θ Capricorni; none is actually nebulous. One nebulose, 55 Andromedae, is not traditional, but it is not nebulous either; Bevis picked it up from Flamsteed, who erroneously designates it as "neb" in his 1725 catalog. Two other objects are indeed nebulous, but would have been better included with the "nebulae"; these are M11 in Scutum and Ω Centauri. One nebulose, ζ Scorpii, was first recorded by Halley on St. Helena and has been dismissed by historians as an asterism; in my opinion it was probably the cluster NGC 6231 and a true nebula.[84] Of all the nebulose only M42, the Great Orion Nebula, does indeed surround a star or stars. Of Bevis's twelve nebulose, then, only four get modern approval. Had Bevis discarded the traditional nebulosities, all of which he carried over uncritically from the Bayer atlas, his score of four out of five would have been much more impressive.

With the nebulae, Bevis does much better. There are five of them to be found on the maps, and all five are in reality nebulous objects, either true nebulae, clusters, or galaxies. M1 is there of course, the nebula which Bevis discovered, and it appears on a star chart for the first time in the *Uranographia*.[85] The other nebulae are M13, M22, M35, and the Andromeda galaxy, M31.

Bevis thus depicts nine Messier objects in all (including Praesepe and the Pleiades) and two additional non-Messier clusters, Ω Centauri and NGC 6231. Of these nine, five—M1, M11, M13, M22, and M35—had never before appeared in a celestial atlas.[86] Moreover, Bevis came very close to being the first to depict two more: the galactic clusters M36 and M38 in Auriga. In the "Remarks" section on the Auriga explanatory table (XII), Bevis notes that he has received a memoir from Le Gentil announcing their discovery. However, since there was a large discrepancy between the equatorial and ecliptic coordinates in the transcript Bevis received, and because he did not know which was correct, "we think it best not to express these Spots in our Map, at present, but leave them to be further examined."[87]

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[82] An excellent account of the growing awareness of novae and variables in the seventeenth century is Michael Hoskin, "Novae and Variables from Tycho to Bullialdus," *Sudhoffs Archiv* **61** (1977): pp. 195–204, which should be followed by the same author's "Goodricke, Piggott and Variable Stars," *Jour. Hist. Astron.* **10** (1979): pp. 23–41, which treats the period following 1780. I am covering the intervening century in a forthcoming article, "The search for variable stars in the early 18th-century." The prehistory of nebulae discovery is comprehensively surveyed by Glyn Jones, *Search for the Nebulae*, *op. cit.* There has been no study to my knowledge of the detection of proper motion after Halley, probably because the research would be rather tedious. The results however would certainly be of interest.

[83] Glyn Jones, *Search for the Nebulae*, pp. 25–26, contains a brief discussion of the nebulous objects in the Bevis atlas. The treatment is generally sound, but because we differ on several points, and since I also have new information from the explanatory tables unavailable to Glyn Jones, another discussion here seems justified.

[84] Glyn Jones, in his analysis of Halley's role in nebulae discovery, identifies the nebulous ζ Scorpii as an asterism, *ibid*, p. 24. A defense of my claim that the object was actually NGC 6231 would necessitate a detailed discussion of the confusing Scorpio nomenclature of the seventeenth century, and I will defer it for a more appropriate time.

[85] M1 may be found not only on the Taurus plate (XXIII), but also on the Orion plate (XXXV) and the Canis Minor plate (XXXIX). It should be depicted at the edge of the Gemini plate (XXIV) but it was not drawn in. There is a nice reproduction of a colored Taurus plate in *Sky and Telescope* **54** (1977): p. 378, accompanying an article by Owen Gingerich, "Laboratory Exercises in Astronomy—The Crab Nebula." The plate is owned by Prof. Gingerich.

[86] John Senex, however, did include M11, M13, and M22 on his planispheres of 1721 and later.

[87] Bevis failed to include one prominent nebula, namely M7, the great globular cluster between Scorpio and Sagitarius. This omission justifiably evoked surprise from Glyn Jones, *Search for the Nebulae*, p. 25, since the object was known in Ptolemaic times. Here is one instance where Bevis was led astray by his reliance on reprinted catalogs rather than the original sources. Halley's *Catalogus Stellarum Australium* includes M7 as a nebula, but in the reprint published by Sharp in the 1725 *Historia Coelestis*, the nebulous identification was erroneously omitted. Bevis, using the reprint, seems to have concluded that Halley was denying the nebulosity of the object, and this suspicion was probably confirmed in Bevis's mind by Halley's failure to include M7 among the six nebulae he discusses in his widely read article, "An Account of several Nebulae . . . ," *Philosophical Transactions of the Royal Society of London* **29** (1716): pp. 390–392. Ironically, M7 *does* appear once in the

Bevis also made a greater attempt than his forerunners to include stars which had appeared, disappeared, or which varied in magnitude. He used two special symbols for such objects. One is a rather appropriate empty star which is used to designate "extinct" stars. The other is a rather ostentatious large star which is very similar to the symbol Bayer had used for the nova of 1572, although slightly less obtrusive. With these two symbols, used however rather indiscriminately, Bevis denotes on his atlas a total of six stellar objects, or former objects. The giant symbol not surprisingly designates the novae of 1572 and 1604. The symbol for "extinct" stars appears four times. One denotes the nova of 1670, or CK Vulpecula; another marks the position of the nova of 1600, P Cygni. In addition, Bevis places an extinct star just south of ϵ Ursae Minoris and another one on the back of Vulpecula; neither of these corresponds to a known nova or long-period variable.[88]

In addition to the novae, there were three variable stars known by Bevis's time: o Ceti (discovered by Fabricius in 1596), χ Cygni (discovered by Kirch in 1686), and R Hydrae (discovered by Maraldi in 1704). Since Bevis does not have a symbol for variable stars, none of these is specially distinguished on the plates. However, he does in the tables comment on the variable nature of two of these. He labels R Hydrae with a Gothic c and explains in the table (XLIV) that "it is one of those which appear and disappear by turns. We shall give its History in the Continuation of these Remarks." When he discusses χ Cygni on the Cygnus Table (IX) it is only to point out that the star is improperly identified in Flamsteed's catalog and atlas. However, the last comment on the table is that Cygnus "is noted for having in the last Century, produc'd no less than three new Stars," so he clearly knew χ Cygni was variable. Bevis has nothing to say about o Ceti. But his comments on this constellation are terminated by lack of room, and the ever-present conclusion—"The Rest of the Remarks are referr'd to in the General Index"—prevents us from knowing what, if anything, he might have had to say about the "wonderful" star.

It is highly probable then that in the *Uranographia* as projected Bevis would have depicted or discussed all of the known novae and variable stars of his time. Moreover, in many of the remarks sections he proposes further candidates for variable stars. These nominees include α Draconis, α and/or β Geminorum, ξ Andromedae, and θ and ϕ Serpentis.[89] Many of these stars would indeed be watched closely for variability in ensuing years. In 1786 Pigott thought it highly probable that α Draconis was variable, was open to the possibility that β Geminorum might have increased in brightness, was undecided about ξ Andromedae, and remained doubtful about θ Serpentis.[90] Bevis probably cannot be credited with advancing the study of variability a great deal, since most of his proposed variable stars had been suggested by earlier observers such as Cassini and Montanari. But he was certainly aware of developments, and the *Uranographia* reflects that awareness.

As for the remaining topics of current interest in stellar astronomy—proper motion, aberration, and nutation—Bevis is chatty without being especially informative. In the Bootes table (V) he does recapitulate Halley's discovery of the proper motion of Arcturus, Sirius, and Aldebaran, although lack of space terminates this discussion. And the subject of possible proper motion is one of his favorite topics throughout the remarks sections; he seems to have taken a particular interest in the alpha, beta, and gamma stars of a number of constellations, and in the question of whether their positions might have changed. In most cases, however, he concludes that no change has taken place. About a few stars he is still undecided, and in these instances he provides a meridian observation so that future astronomers may determine whether proper motion exists.[91] All in all, however, while the reader of the *Uranographia* would have been made acutely aware that proper motion was a hot topic, he would not have learned any more about the subject than he could have gained from Halley's 1718 paper. On the subjects of aberration and nutation he would have learned even less. Bevis has little to say except to recount the story of Flamsteed's attribution of aberration effects to stellar parallax. However, we should remember that in 1750 tables for determining nutation and aberration were just being developed, and Bevis was hardly being remiss in failing to provide them.[92]

I think then that on the criterion of timeliness the

Uranographia—on the very last plate (LI), which shows the southern skies according to Ptolemy.

[88] The extinct star below ϵ Ursae Minoris was no doubt so depicted because Bayer showed a star there on his *Uranometria*, but no one since had been able to find it. Thirty years after Bevis, Edward Pigott also searched for a sign of this star, without success; see his famous paper, "Observations and Remarks on those Stars which the Astronomers of the last Century suspected to be changeable," *Philosophical Transactions of the Royal Society of London* 66 (1786): pp. 189–219; see p. 210. The extinct star on the back of Vulpecula is probably an error, since it appears only on the Hercules plate (VII) and not on the Cygnus plate (IX) where Vulpecula is much more prominent.

[89] The discussions are found on tables III, XXIV, XX, and XIV respectively.

[90] Pigott, "Observations and Remarks," pp. 203, 206, 208.

[91] Bevis specifically considers and rejects the possible proper motion of the following stars: α and β Cygni; α Serpentis; α, β, and γ Pegasi; β Geminorum; α and β Scorpionis; and α_2 Capricorni. He remains undecided about β Serpentis, α Hydrae, and α, β, and γ Aquilae.

[92] We might recall Lacaille's letter to Bevis of 1748, discussed earlier for its chronological importance, in which Lacaille reveals that he has just developed tables for aberration and nutation which are at last usable. Bevis apparently rejected Lacaille's offer to have these tables included in the *Uranographia*, probably because, as Bevis himself says in the cover letter to Bradley, he thought Bradley might be planning a work of his own on the subject. See the letters previously cited on Rigaud, *Miscellaneous Works of Bradley*, pp. 456–458.

FIG. 8. Detail of fig. 3, the Cygnus plate from the Bevis *Uranographia*. The two "empty" stars designating the novae of 1600 and 1670 may be seen on the breast of Cygnus and by the ear of Vulpecula, respectively. This detail is approximately natural size.

Uranographia comes off quite well. Considering that we have only 60 per cent of the tables and probably only 25 per cent of the intended remarks, it seems safe to conclude that Bevis was making a deliberate and largely successful attempt to include up-to-date information on nebulae, novae, variables, and proper motion. His performance in this area certainly far outshines the Flamsteed atlas and catalog, and in fact the *Uranographia* rather effectively bridges the gap between the "pure" atlas of Flamsteed, devoid of nebulae and variables, and the Bode *Uranographia* at the end of the century, with its plethora of non-stellar objects.

ii. Accuracy

It is not necessary that a star catalog and atlas be free from error to be useful; the very nature of their compilation and publication makes them fiendishly susceptible to mistakes, and even the best were liberally salted with misinformation. Flamsteed's atlas and catalog were widely extolled in the eighteenth century as setting new standards of perfection, and yet Caroline Herschel managed to find enough errors to fill twenty-four folio pages, and Francis Baily was later able to enlarge on the list considerably.[93] So complete accuracy was understood to be an impossible goal and was not expected. But there certainly was a point, however hazily defined, where tolerance gave way to mistrust, and if the number of errors was so large that a work could not be trusted, it would certainly not find acceptance in the astronomical community.[94]

I had no wish to subject the *Uranographia* (or myself) to an inspection of Herschel-Baily intensity. But it was important to make some determination of the level of accuracy of the atlas. I settled for a detailed comparison of two large constellations, Orion and Andromeda, which between them contain a total of 150 stars. For these stars I compared the positions on the charts with those given in the catalog, and I also compared the catalog positions with the sources from which they were derived (which for these constellations was mostly one source, the 1725 Flamsteed catalog). The results were surprisingly good. One hundred and forty-one of the 150 stars were correctly reduced in both the charts and the catalog. The charts themselves were very nearly perfect; one star was omitted, one had a latitude error of 1°, another an error of 30′. The catalog was slightly more error-prone; six stars reflected errors in position ranging from 10″ to 10°.[95] In addition to errors of position, the catalog contained several stars with Bayer letters improperly assigned.

In several ways Bevis improves on the 1725 Flamsteed catalog for these constellations. Flamsteed had been particularly sloppy when it came to assigning Bayer letters; Bevis reshuffles many of these (eight of them in Andromeda alone), and in every case he takes the same step that Baily would take eighty years later.[96] Bevis also adds to Flamsteed's 1725 listings a total of seven other stars derived from the 1712 Flamsteed catalog or from Hevelius; Baily subsequently supports the inclusion of each one of these. So in terms of star *identification*, the *Uranographia* was more accurate than any of its predecessors.

However, this improvement in designation must be balanced by the fact that the star *positions* are no more accurate than previous catalogs, because they are entirely dependent on these catalogs (except for the fifty-three times when Bevis used his own observations). Bevis for some reason was reluctant to correct star positions, even clearly erroneous ones, and as far as I could tell, he never did so. This conservatism is epitomized by the case of α Aquilae. In the explanatory table to Aquila (XVI), Bevis includes a quotation from Cassini of 1738, explaining that the star had a latitude of 29°18′11″ in Tycho's time, 29°19′11″ in Flamsteed's time, and 29°18′8″ "by our own." And yet in the catalog, Bevis used Flamsteed's 29°19′11″ with absolutely no change.

Bevis also refused to delete stars for any reason, even if they were synonymous or spurious. He was clearly aware of many duplicate entries in the Flamsteed catalogs, but he did not choose one over the other; he retained them both.[97] He may not have been aware that many stars in the Flamsteed catalogs were

[93] Caroline Herschel, *Catalogue of Stars, Taken from Mr. Flamsteed's Observations . . . [and] a Collection of Errata* (London, 1798); Francis Baily, *An Account of the Revd. John Flamsteed . . . to which is added, his British Catalogue of Stars, Corrected and Enlarged* (London, 1835).

[94] A good example of a work which was relegated to the astronomical graveyard because of its high error content is the first attempted publication of Tycho Brahe's observations, the *Historia Coelestis* (Augsburg, 1666), edited by Albertus Curtius under a pseudonym. Although such a collection was highly desirable, hardly anyone in the eighteenth century used the book, because it was so unfaithful to Tycho's manuscripts.

[95] The fact that the catalog contains errors which are not on the star maps is additional evidence that the maps were produced from some earlier reduction, and that the printed catalog was compiled in some haste and consequently with less care.

[96] Baily corrects erroneous Bayer letters in his notes to Flamsteed's British Catalogue; for example, in his note to 46 Andromedae (Baily's no. 159), Baily explains that Flamsteed omitted the letter xi, since he had already "erroneously affixed" it to 49 Andromedae; Baily restored the letter to its proper place. In this case, as in most cases, Bevis anticipated Baily. Baily also included a table I at the end which lists all those stars for which Bayer letters have been corrected; there are 169 of these in all. See Baily, *Account of Flamsteed*, p. 655.

[97] For example, in his catalog, Bevis labels the ninety-third star in Gemini with a Gothic letter d, and the same star appears as the fourteenth in Cancer with Bayer's zeta. This dual identification is carried over onto the plates; on Gemini (XXIV) the star has a gothic d; on Cancer (XXV) it has a zeta. Bevis could not have done this without being aware that he was listing the same star twice, in two different ways; he must have considered it acceptable practice. He exhibits the same care, and disregard for duplication, with most of the other double-listed stars, including the most famous pair, α Andromedae and δ Pegasi.

non-existent, the result of calculation errors; if he was aware of this, he did not modify the catalogs to reflect such knowledge.[98]

I think however it is fair to say that even with the shortcomings, the *Uranographia* had more than an acceptable level of accuracy. It fell slightly short of Flamsteed for accuracy of position (since Bevis made no improvements while adding a few errors of his own), but it was considerably better in reconciling Flamsteed stars with the stars of Bayer's *Uranometria*. There is little doubt that both star charts and catalog were accurate enough to have been eminently usable to astronomers.

iii. Advantages

If I were asked to characterize the *Uranographia* in a sentence, I would describe it as essentially the Flamsteed 1725 catalog precessed to 1750, augmented by 600 stars from other catalogs, and adapted to the plates of Bayer's *Uranometria*, with tables added to facilitate identification. In what sense might this format have been an improvement over existing atlases and catalogs, particularly Flamsteed's works, which would have provided the major competition?

There are some obvious advantages to the Bevis approach which I shall simply state. The *Uranographia* is considerably handier to use than the oversize Flamsteed *Atlas*. The tables opposite the plates permit easy identification of stars (Flamsteed's *Atlas* had no tables at all). The separately printed catalog, whether bound with the plates or not, would have been much easier to consult than the bulky third volume of the *Historia*. From a purely artistic viewpoint, the *Uranographia* is a more attractive work than its predecessor. The inclusion of novae and nebulae increased its utility, and indeed would prove prophetic. And by adapting itself to easy comparison with Bayer's *Uranometria*, the first modern star atlas, the *Uranographia* closed the circle on 150 years of stellar astronomy by reasserting the importance of tradition.

The remarks on the explanatory tables were also an important innovation and one that I think would have proved quite successful. Bevis was certainly not an astronomer of the first rank, but he knew and corresponded with those who were, and the information he gained on current developments showed up on the tables in a readily accessible form. A catalog user could learn that a certain star was suspected of proper motion, or that various authorities disagreed on its Bayer designation, or that it had disappeared, or that Flamsteed's time of transit was erroneous, and none of this information, in 1750, was readily available elsewhere. In my opinion many eighteenth-century astronomers would have greatly appreciated the advantages of an annotated celestial atlas.

A more subtle advantage, but a very important one, derives from the format of the catalog. Although admittedly derivative, the catalog, by grouping together observations of different astronomers within each constellation, functions as a kind of variorum edition of all earlier star catalogs. Flamsteed may have reprinted the catalogs of Hevelius, Tycho, and Halley, but he did not collate their observations with his own. Bevis did. Nowhere else that I know of, for example, are the star positions from the 1712 Flamsteed catalog interpolated into those of the 1725 catalog. In the 1750s such a compilation would have been extremely useful, since it would have relieved the astronomer of the task of trying to compare the separate catalogs in the two editions of Flamsteed, to say nothing of trying to locate a 1712 *Historia Coelestis* in the first place.[99]

Weighing against these *Uranographia* selling points are two very real disadvantages. The less serious shortcoming is that the division of the heavens into forty-nine parts according to Ptolemy was less than ideal for astronomy in 1750. Devoting one entire plate to the two Triangles, while forcing another to accommodate the expanse of Eridanus is hardly defensible from the logical standpoint. One might counter that the cost of tradition is often a small loss in convenience or flexibility, but there would undoubtedly have been a number of astronomers who would have preferred the advantages of consistent projection.

The more serious drawback to the *Uranographia*, the one we have already noted several times, is that it uses ecliptic coordinates exclusively in both charts and catalog. In 1750 this was an anachronism, and one that I suspect would have caused considerable dissatisfaction among users if the atlas had been published. It is even quite possible that for this reason alone the *Uranographia*, no matter how well received initially, would have fallen into disuse, and that its own progenitor, the Flamsteed atlas and catalog, would have reasserted its supremacy. It is more likely

[98] In some instances it does seem as if Bevis attempts to remove spurious stars from Flamsteed's catalog. For example, Bevis deletes Flamsteed's 35 Cassiopeiae from his own catalog, and Baily will later confirm that there is in fact no star at the position given by Flamsteed. However, on closer investigation, the real reason for Bevis's action becomes apparent. In his 1725 catalog Flamsteed failed to provide the latitude and longitude of this star, and finding this a hindrance to calculating precession, Bevis apparently just omitted the star from his catalog. Moreover, Bevis *did* retain 29 and 41 Cassiopeiae, and these stars are also spurious. See Baily, *Account of Flamsteed*, notes to nos. 150, 120.

[99] I can personally attest to the value of a collation of the 1712 and 1725 Flamsteed catalogs. It was while trying to unravel the identity of two stars on the Bevis Cassiopeia plate, one of which came from the 1712 catalog and one from the 1725 edition, that I discovered that one of these stars was in fact the only known seventeenth-century observation of the Cassiopeia A supernova. See my forthcoming article in the *Journal for the History of Astronomy*.

however that the complaints of subscribers would have produced a different course of events; I suspect that Bevis and/or Neale would have been inspired to reissue at least the catalog with both equatorial and ecliptic positions. This would have required only a little time and money and a room full of calculating assistants. The charts could not have been rescued in this way once they had been printed, but if the catalog contained both sets of positions, the maps could easily have fulfilled their main purpose, that of star identification.

If an equatorial/ecliptic catalog had been provided for the *Uranographia*, I believe that the advantages of the Bevis atlas would have far outweighed its drawbacks and that it would probably have become the working atlas of choice among astronomers; at the very least it would have become an essential reference work for any observatory. Of course the part of the atlas dealing with the southern stars would have been rendered instantly obsolete with the publication of Lacaille's catalog in 1763.[100] But it is intriguing to conjecture that if the *Uranographia* had been published, then perhaps when Fortin undertook in 1776 to produce a revised celestial atlas incorporating Lacaille's observations, he might well have chosen the Bevis atlas rather than that of Flamsteed. If he had, there really would have been a Bevis *Atlas Celeste*!

[100] Nicolas-Louis Lacaille, *Coelum Australe Stelliferum* (Paris, 1763).

CONCLUSION

The *Uranographia* of John Bevis, had it been published as planned, would almost certainly have been elevated to the ranks of the Bayer, Hevelius, Flamsteed, and Bode works as one of the great celestial atlases. Not only did it seek to restore the celestial atlas to the high artistic levels characteristic of Bayer and Hevelius, but the *Uranographia*, as demonstrated by the newly revealed contents of the APS copy, had a scope exceeding that of all other atlases published so far, particularly in its integration of plates, catalog, identification tables, and extensive annotation.

Speculation about the probable reception of the *Uranographia* is a valuable exercise, since it requires us to view the atlas in its proper historical setting, and it also allows us to infuse the work with a life and vitality which circumstances denied it. In actuality, of course, the *Uranographia* will always remain one of the dead ends of stellar astronomy: the Grand Celestial Atlas that never was. Estimates of its accuracy or appraisals of its timeliness cannot alter the fact that no astronomer of later generations plotted comets, nebulae, or new planets on its maps. In the exciting world of Pigott, Herschel, Bessel, and Argelander, the *Uranographia* simply made no difference. But like the unearthed artifacts of ancient tombs, which reach across centuries they did not touch, the *Uranographia* can speak to us today, reminding us in the most eloquent way of the unified quest for beauty, utility, and discovery which characterized the Golden Age of the Celestial Atlas.