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The Value of Archives in Writing the History of Astronomy

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Abstract. History of astronomy written without the aid of manuscripts and other unpublished material would be immeasurably impoverished. Two examples of this are given, one from the twentieth century and the other from the seventeenth/eighteenth.

1. Fleshing Out the Printed Record

In astronomy, as in other branches of science, published articles and books are by convention artificial. The authors are allowed, and expected, to present a sanitized account of their researches: all trace of the false-starts, the bungled observations, the agonizingly slow emergence of clarity out of confusion, will have been excised, and instead a picture is painted whereby accurate observations led inexorably to what are believed to be correct conclusions.

It is a task of history of astronomy to humanize such artificial and therefore inhuman presentations, and to make of astronomy an exciting, creative and therefore worthwhile activity; and the primary materials that allow the historian to do this are informal documents, such as letters, diaries, and observational notebooks. Unless reasonable steps are taken to preserve these, it becomes impossible for the historian to flesh out the bare bones of the published records and to reveal something of the struggles, and even dramas, that lie behind discoveries.

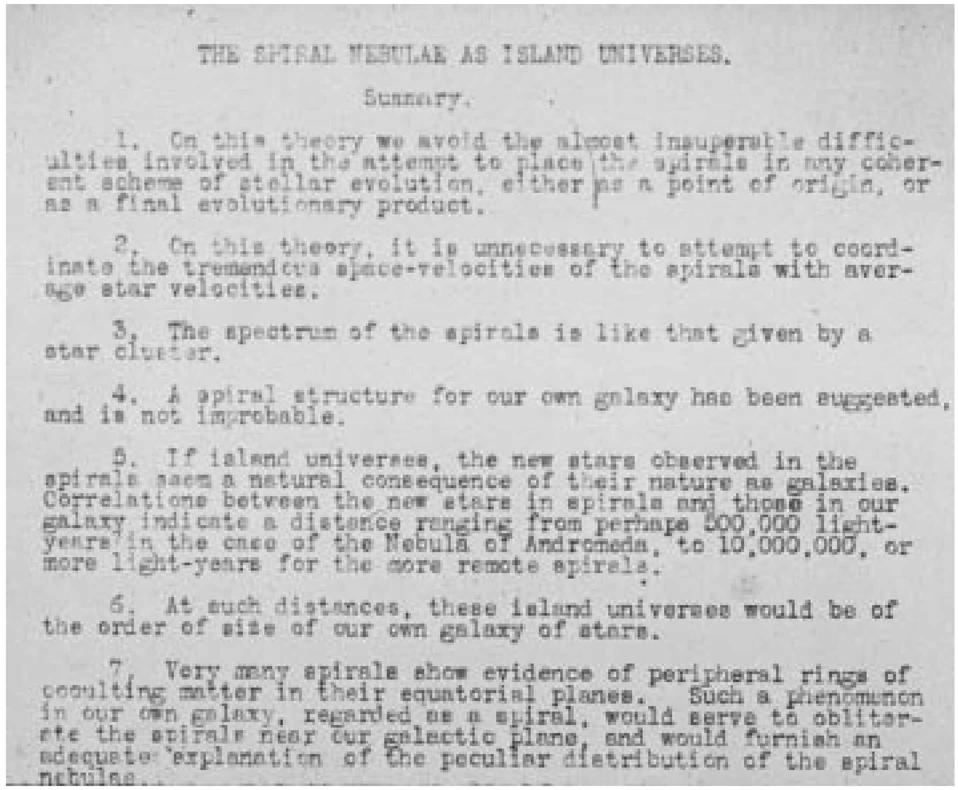
2. "The Great Debate": Shapley vs. Curtis, Washington DC, 1920

To illustrate this I take two examples, one from the twentieth century and one from the seventeenth and eighteenth. The twentieth-century example centres on what has become known as "The Great Debate", a meeting at the Academy of Sciences in Washington on 26 April 1920 at which Harlow Shapley of Mount Wilson and Heber Doust Curtis of Lick gave talks on "The Scale of the Universe". Curtis, like most astronomers of the time, saw no reason to doubt that the Sun is near the centre of the Galaxy; while Shapley had recently published a paper in which he suggested that the spiral nebulae might be insignificant wisps of matter being driven off from the Galaxy by radiation pressure. But Curtis believed that the spirals were other galaxies, while Shapley argued that the Sun was far from the galactic centre, which lay in the midst of the globular clusters. Both men were seriously right about some things and seriously wrong about others, and in the emergence of the modern picture of the universe the meeting was a significant event.

Incautious historians have treated the published version as a verbatim account of what was said; but consideration of the length of time that this would have required shows that this cannot be so. The true story emerges from the observatory archives at Mount Wilson and Lick, the files of the Academy of Sciences, the family letters sent by Curtis to his children and preserved by them, the correspondence of Shapley, Curtis, Henry Norris Russell and others involved, and so forth, all vulnerable documents fortunately kept for us by generations of secretaries and librarians and archivists.

These show that beneath the scientific controversy ran two currents. The first was a rivalry between two great Californian institutions, the second Shapley's stated ambition to become the next director of Harvard College Observatory. Harvard were in fact considering Russell for the post, with Shapley in a junior position; but their enquiries led Shapley to suppose that he was in the frame for the top job, and he realized that a poor performance at Washington would put paid to his chances. He therefore, in the run-up to the meeting, tried various ploys to avoid a conflict in which he might well be the loser; and indeed Harvard did send a delegation to observe his performance, and another to assess Mrs Shapley. Shapley tried to persuade Curtis to see their contributions as given in partnership rather than in confrontation, but Curtis had enough Irish blood to relish a fight. Shapley then tried to have the time for each contribution reduced, so that less of substance could be said. He wrote to his mentor, Russell, to insist that he speak from the floor and undo any harm that Curtis had done, and indeed there was later talk of Russell's being a contributor to the published version. But his final, desperate ploy, was to claim that the Academy of Sciences knew no astronomy and therefore needed educating, and Shapley delivered a talk so elementary (and therefore relatively uncontroversial) that only on page 6 (out of a total of 19) does he define the term "light year". Indeed the last three pages are devoted to an intensifier he had developed to permit photography of faint stars, irrelevant to the subject of the meeting but very relevant to his claim to be qualified to direct an observatory.

In investigating these events, Richard Berendzen and I were very anxious to establish exactly what was said. Curtis, we found, had presented his case by means of slides carrying typed material. He later became director of Allegheny Observatory; and in the Allegheny slide collections were nine unidentified, typewritten slides that proved to be those used in the Debate (see Figure 1). Shapley eventually achieved his ambition to become director of Harvard, and among his archives preserved there is the typescript, with amendments in longhand and in shorthand, that he read at Washington. Also preserved in the various archives is every one of the letters exchanged between Shapley and Curtis, and between Shapley and Russell, as the two protagonists negotiated their way to an agreed published text. Yet without the work of secretaries, librarians and archivists in preserving these papers and slides, we would have little more than the (very misleading) published text by which to assess "The Great Debate".



THE SPIRAL NEBULAE AS ISLAND UNIVERSES.

Summary.

1. On this theory we avoid the almost insuperable difficulties involved in the attempt to place the spirals in any coherent scheme of stellar evolution, either as a point of origin, or as a final evolutionary product.

2. On this theory, it is unnecessary to attempt to coordinate the tremendous space-velocities of the spirals with average star velocities.

3. The spectrum of the spirals is like that given by a star cluster.

4. A spiral structure for our own galaxy has been suggested, and is not improbable.

5. If island universes, the new stars observed in the spirals seem a natural consequence of their nature as galaxies. Correlations between the new stars in spirals and those in our galaxy indicate a distance ranging from perhaps 500,000 light-years in the case of the Nebula of Andromeda, to 10,000,000, or more light-years for the more remote spirals.

6. At such distances, these island universes would be of the order of size of our own galaxy of stars.

7. Very many spirals show evidence of peripheral rings of occulting matter in their equatorial planes. Such a phenomenon in our own galaxy, regarded as a spiral, would serve to obliterate the spirals near our galactic plane, and would furnish an adequate explanation of the peculiar distribution of the spiral nebulae.

Figure 1. One of the slides used by Curtis in the course of "The Great Debate", and preserved (anonymously) at Allegheny Observatory. Comparison of the text of the slide with the printed version of the Debate confirms the identification.

3. Newton and the Origins of Olbers's Paradox

My second example concerns the famous pair of papers published by Edmond Halley in Philosophical Transactions in 1721, in which he discusses a universe that consisted of infinitely-many stars regularly distributed, and in particular how the night sky would then appear. As is well known, the question was discussed again by Olbers a century later, and the darkness of the night sky is today known to cosmologists as posing Olbers's Paradox.

Thus far the published record. But long ago it occurred to me that at the heart of Isaac Newton's claim that gravity is a universal force lies a true paradox: for in Newton's day the stars were, it seemed, motionless, no single star being known to have altered position since the first catalogues were compiled in Antiquity. Forces result in motions; yet among the stars it seemed that the universal force of gravity resulted in no motion whatsoever.

In his Principia (1687) Newton has next to nothing to say about the stars, but I knew that five years later the young theologian Richard Bentley wrote

Figure 2. Part of a working draft in Newton's own hand (made less legible by "show-through" of ink from the verso), and revealing one stage in his formulation of a planned theorem that would justify his view of the stellar universe as an infinite and nearly-symmetric system of stars. Newton's habit of preserving successive drafts enables the historian to look over his shoulder and see him at work. (CUP Add MS 3965, f. 280r, courtesy of the Syndics of Cambridge University Library.)

and put to him questions of cosmology. At that time Newton was planning a new edition of the Principia, the manuscript drafts of which survive in chaos in Cambridge University Library. I therefore went through these drafts, taking copies of every page with a mention of the stars (Figure 2). Laying these out on the floor of a large room, I was able to establish a series of versions of a theorem in which Newton sought to justify his world picture. Believing that God had revealed himself not only through the Book of Revelation but also through the Book of Nature, Newton held that the stars were infinite in number, roughly symmetric in their distribution, and at rest or nearly so. Each star was therefore pulled almost equally in every direction by the surrounding stars, and therefore in the short term displayed no motion: the universe was the stable creation of God the Clockmaker. However, the symmetry was imperfect, and therefore in the long term there was the danger of gravitational collapse. To prevent this, Providence intervened from time to time, to restore the original situation: Providence had, so to speak, a servicing contract with the universe, and this demonstrated to mankind the goodness of God.

In the theorem, Newton sought to demonstrate that the evidence in modern star catalogues was consistent with his picture of an infinite and symmetric system of stars. But unfortunately the planned second edition never saw the light of day, and Newton's world picture was known only to a few intimates, until around 1720 the young physician William Stukeley discussed cosmology with the great man. Stukeley saw that each of the stars affects the rest of the universe, not only by its gravitational pull, but by the light it emits; and he suggested that in an infinite universe of stars, the entire sky would have the appearance of the "luminous gloom of the Milky Way". Halley breakfasted with Newton and Stukeley a few days before he read his papers to the Royal Society, and it seems almost certain that Stukeley repeated his remarks, for Halley writes: "Another Argument I have heard urged, that if the number of Fixt Stars were more than finite, the whole superficies of their apparent Sphere would be luminous."

The author of the recent excellent biography of Halley, knowing only of this published text, can only wonder as to where the idea had originated. But the preservation of the manuscripts of Newton, David Gregory, Stukeley and others, enables us to show that the idea came from Newton and in fact embodied the great man's conception of the universe. Without the manuscripts, this would have been well-nigh impossible and a major episode in the history of astronomy lost to view.

4. A Concluding Appeal

In these days of electronic mail, easy telephonic communication, and frequent international travel, many of the hand- or typewritten sources on which historians have traditionally depended will be denied to historians of the future. If those working today to understand the past evolution of our science are able to penetrate deeply into the minds of the great creative astronomers of the past, this is due very largely to the devotion of librarians and archivists in preserving the informal record. Long may it continue.

Further Reading

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