Studies in History and Philosophy of Science 42 (2011) 67–84

Contents lists available at ScienceDirect

Studies in History and Philosophy of Science

journal homepage: www.elsevier.com/locate/shpsa

The 'Landmark' and 'Groundwork' of stars: John Herschel, photography and the drawing of nebulae

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ARTICLE INFO

Article history:
Available online 26 January 2011

Keywords:
Ebenezer Porter Mason
Cartography
Draughtsmanship
Observation
Scientific Representation
Philosophy of Scientific Practice

ABSTRACT

This paper argues for continuity in purpose and specific results between some hand drawn nebulae, especially those 'descriptive maps' by John F. W. Herschel and E. P. Mason in the late 1830s, and the first photographs made of the nebulae in the 1880s. Using H. H. Turners' explication in 1904 of the three great advantages of astrophotography, the paper concludes that to some extent Herschel's and Mason's hand-drawings of the nebulae were meant to achieve the same kinds of results. This is surprising not only because such drawings were conceived and achieved over forty-years earlier, but also because the procedures used in the production of these pictorially and metrically rich images were those directly inspired by cartography, geodesy, and land-surveying. Such drawings provided the standard for what was depicted, expected and aimed at by way of successful representations of the nebulae; standards that seemed to have been used to judge the success of nebular photographs. Being conditions of expectation and possibility for later photography, these drawings were themselves made possible by such techniques of representation and measurement as isolines and triangulation, so fundamental to Imperial and 'Humboltian science.'

1. Introduction

It was over forty-years after the daguerreotype process was announced in Paris on January 7, 1839 that for the first time someone successfully photographed a nebula. This photograph was made by Henry Draper and was of the nebula in Orion (M42); an object, to be sure, represented by hand-drawings since Christiaan Huygens in 1659, and significant for first suggesting to Edmond Halley the possibility of the existence of a self-luminous material in the heavens. By the end of the 19th century celestial photographs of the nebulae captured the scientific and aesthetic imaginations of many. Though the wet collodion process was sensitive enough to have had captured the light of other faint celestial objects, such as individual stars, double stars, and star clusters, it was basically due to the faintness of the nebulae, and thus to the very long exposure times required, that earlier daguerreotype and wet collodion process could not successfully be applied to them.

The application of photography to stellar objects outside our solar system was unsatisfactorily begun using the daguerreotype process by William Bond in 1850, and later continued much more adequately with the wet collodion process by his son George Bond in 1857. This accomplishment by the Bonds was regarded in the next century as 'the greatest advance in astronomical photography' (Norman, 1938, p. 569).[1] By the mid 1860's Lewis Morris Rutherfurd succeeded in photographing the Pleiades star cluster, and built a measuring machine to take the position-angles and relative distance measurements of some visible stars in the cluster directly off the plate. Stellar photography was heralded as a major advance mainly because it revealed photography's power in being able to accurately preserve delicate and exceedingly minute relative distances and position-angles of the stars. But these 'great advances' in the 'new

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[1] Also see: de Vaucouleurs (1961), Lankford (1984).

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doi:10.1016/j.shpsa.2010.11.019

method of observation' were not immediately recognized as such, and confidence in the ability of the plates to preserve metric properties had to be built over time and standards had to be recognized.[2]

These measured photographic plates were regarded in contrast to photographs of objects like the planets, the Sun, and the Moon which were far more prominent instances of astrophotography at the time. The latter sort of astrophotography, of the objects within our solar system, were of a form that frequently emphasized more of the descriptive, pictorial, and sensual details that dazzled as much as they informed. But as one champion of using photographic plates for accurate measurements was to later stress in relation to stellar photography, that in comparison to the pictorial 'the images of star-clusters possess no popular attractiveness. They are but black spots upon the albuminized surface of glass plates; and their value consists solely in the accuracy with which the relative positions of these several dots may be measured. But this is no slight value' (Gould, 1878, p. 15).

The invention of dry gelatin plates, also known as bromide or silver bromide, allowed celestial photographers to photograph by following faint sidereal objects, like nebulae and clusters, with long exposures times, with the help of a clock driven mechanism in tandem with large refractor or reflecting telescopes. One of the leading British celestial photographers at the time regarded 'the photographing of nebulae ... as being almost the only actually modern achievement of photography' (Common, 1888, p. 391). Apart from being able to reveal extremely faint details, some imperceptible to the eye even when assisted by powerful telescopes, the most important feature in the application of new photographic technologies to the nebulae was certainly the accurate preservation of the arrangements, relative positions of the stars *and* the visual, pictorial elements, such as bright nebulous patches, 'strata', 'knots', outline, nebulosity, etc. One may say that what made this a great achievement in the eyes of many was the fact that a photographed nebula presented astronomers with a well proportioned visual image preserving the object's form, copious detail, and metric properties, and was thereby regarded as a 'map' by some (e.g. Bond, 1890 [1857a], p. 302; Holden, 1886, p. 468).

Because star clusters and nebulae remained, even at the end of the century, 'hidden', mysterious and evasive, from the very outset of nebular research, especially with the work of Sir William Herschel in the latter part of the eighteenth century, one of the primary challenges was to trace changes that might indicate some directed motion or development in the nebulae and clusters. As Williams' son, one of the chief nebular observers of the next generation, John Herschel (1826, p. 487) succinctly put, 'the nature of nebulae, it is obvious, can never become more known to us than at present; except in two ways—either by the direct observation of changes in the form or physical condition of some one or more among them, or from the comparison of a great number, so as to establish a kind of scale or gradation from the most ambiguous to objects of whose nature there can be no doubt.'[3] This meant that ideally speaking, drawings of nebulae and clusters had to be qualitatively (descriptively), and quantitatively (numerically) accurate in their detail and structure. This demand, however, was rarely ever met because one was usually achieved at the expense of the other – sometimes due to associated difficulties with large reflecting telescopes (to see details with, but difficult to make refined measurements with) and smaller equatorial telescopes (used to make measurements with, but rarely to show nebulae in their detail), and because of the acknowledged problems in applying mathematical means to these nebulous objects.

Whatever the difficulties, however, the methods and results of hand drawing were meant to help detect apparent and proper motions of the parts of a nebula in a way that could help answer such 'natural philosophical' questions as, 'under what dynamical conditions do [nebulae and clusters] subsist? Is it conceivable that they can exist at all, and endure under the Newtonian law of gravitation without perpetual collisions?'[4] There were also such 'natural historical' problems as the possibility of a physical course of development from one sort of object (or class) to another—this was famously coined the 'Nebular Hypothesis.' The practical and theoretical tensions between the descriptive and numerical, or generally, the 'natural historical' and 'natural philosophical,' were often, throughout the nineteenth century, apparent in the drawings made—the trick was to attempt to include as much of both as possible.[5]

It is thus not surprising that at the Royal Astronomical Society's meeting of January 14th 1881, where the very first nebular photograph was presented and discussed, that it was immediately compared to the hand drawings of the nebula in Orion (M42) made by George Bond, John Herschel, William Lassell, Lord Rosse, Wilhelm Tempel, and other nebular observers. Arthur C. Ranyard, who presented and introduced Draper's photograph, concluded, 'The drawings differ very greatly amongst themselves, and they differ in type as well as in minor details. They do not appear to differ continuously in order of time, so that the drawings do not afford any proof that the form of the nebula is changing. Photographs will of course afford much more valuable evidence with respect to any such change in the future.' What might be surprising, however, was Andrew Common's initial reaction: 'I do not agree with Mr. Ranyard,' began Common, 'that we must look to photography to explain or prove any change in the form of the nebulae, because various kinds of plates give different results ... If you want to detect any change in the form of the nebulae you must entirely rely on the hand drawings.' What ensued thereafter was a detailed look at the drawings made of the nebula in Orion, some at the meeting declared Lord Rosse's drawing of the nebula as being superior to Father Angelo Secchi's, others disagreed.[6] The drawings of the nebulae, in other words, continued to play an important role in nebular research.[7]

[2] Gould (1895), p. 435 recalls, 'most [astronomers] paid it no attention; others feared distortion of the relative positions of the stars as photographed, while others still distrusted the adequacy of the corrections to be applied; but the most serious criticism was based on the supposed liability of the film to contract or expand, thus introducing new sources of error.'

[3] Also consider C. P. Smyth's statement that 'no vague expression or semblance of that which exists must be allowed to take the place of painstaking, accurate, and detailed delineation; for the passage of a celestial object from one state to another, which it is our prime object to ascertain, can only be established by the comparison of very exact and faithful representations' (Smyth, 2000 [1846], p. 73).

[4] Herschel (1857c [1845]), p. 662.

[5] For more on these issues and the interactions between natural philosophy and natural history in astronomy, see Schaffer (1980), Schaffer (1995).

[6] Ranyard (1881), p. 82. For another direct reaction, which basically included a comparison of Bond's, Lord Rosse's and Secchi's drawings to the first photograph of M42, see: Knobel (1881).

[7] Even for Ranyard this was also the case. See for instance Ranyard (1889), where he continues to compare photographs, reproduced using the half-tone process, to a drawing, specifically one made by William Lassell of M42. Good discussion of this in Mussell (2009), esp. pp. 361–66. And as Alex Soojung-Kim Pang (1997) reminds us, the intervention of the artist's hand continued to play an important part in the successful production and publication of astronomical photographs. The artist's hand and the photograph would often coincide, as when hands might contribute to a composite, or to corrections made on a photographic plate. For an excellent discussion on the issues surrounding the difficulties involved in the standardization of photography in mid to late 19th century, see Rothermel (1993), and for late century issues in astrophotography see Canales (2009), and Macdonald (2010). The latter, however, attributes differences among celestial photographers in procedures to psychology. For a treatment of the vast diversity of concerns of the new technologies of photography in Victorian England, see Tucker (2005), and more generally within an array of different epistemological contexts, see Daston & Galison (2007). For a treatment of the complexities of the relationship between science and photography see Wilder (2009, esp. ch. 1 and ch. 4).