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ON SEEING AN IMAGE OF A SPIRAL NEBULA: FROM WHEWELL TO FLAMMARION

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ABSTRACT

The following proposes to give a biography of an image. The image chosen will be that of the 3rd Earl of Rosse's 'Great Spiral' or M51 as published in the *Philosophical Transactions of the Royal Society* for the year 1850. We will follow the image as it is reproduced, copied, interpreted, and re-published, in the mid to late nineteenth century, in the works of William Whewell, Stephan Alexander, Dionysius Lardner, George Chambers, and finally Camille Flammarion. The biography of Rosse's image of M51 will reveal a series of different kinds of juxtapositions and relations, all made in order to make the object more accessible to different kinds of inquiry. But I would also like to suggest that this aspect may be better viewed as a strategy involving the active intervention and adjustment of the image which is employed in order to make some claims about the object possible or more plausible than others. It is by tracing some of the paths taken by this image of the Great Spiral that I hope to reveal the relevance and significance of advocating the notion of a biography of an image for the purposes of understanding scientific representations more generally.

Keywords: M51, 19th century Images of Nebulae, Earl of Rosse (William Parsons).

In the beginning of 1845, William Parsons (the third Earl of Rosse) had finally completed building the world's largest reflecting telescope in the backyard of his family's Castle in Parsonstown, Ireland. With a speculum of six-feet in diameter and a focal length of fifty-three feet, Lord Rosse immediately set the telescope to work, and very soon after made an "epoch-making" discovery. Using the newly built "Monster" he identified for the first time in the history of astronomy a "spiral nebula." This object was number fifty-one of Charles Messier's 1784 list of nebulae (or M51),

and number h1622 of Sir John F.W. Herschel's 1833 Catalogue. In fact, along with a description of this object Herschel included a sketch, for this was an object of special interest. Herschel described it as a "brother-system" to our own Galaxy, and in 1837 John Pringle Nichol gave an elegant visual "cross-section" of the object to demonstrate this point.[1] It is thus no wonder that so early on Rosse would, with much anticipation, turn the fresh speculum of the Monster onto this curious object. What was not at all expected, and what came as a definite surprise, was what he eventually saw through the eye-piece when he focused it on M51. He saw an object with a form totally unlike not only Herschel's sketch but any other nebulae known at the time. Rosse immediately set out to make his own sketch, which was exhibited at the June 1845 meeting in Cambridge of the British Association for the Advancement of Science (BAAS), and there it was instantly recognized not only as a major discovery, but also as vindicating the power and capacities of the new instrument.[2] The leading nebular researcher at the time was certainly John Herschel, who was overwhelmed with emotion when he saw the image and redrew for the audience the image of the object as it looked through his own telescope, and proclaimed that "he felt a delight he could not express when he contemplated the achievements likely to be performed by this splendid telescope."[3]

The original 1845 sketch by Rosse was never actually published by him, but was rather lent to Nichol to have it engraved for publication in his book *Thoughts on Some Important Points Relating to the System of the World* (1846). It was thus by way of Nichol that this magnificent object's image was first put into print.[4] The sketch was engraved and etched by

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[1] JOHN HERSCHEL, "Observations of Nebulae and Clusters of Stars, Made at Slough, with a Twenty-Feet Reflector, between the Years 1825 and 1833", *Philosophical Transactions of the Royal Society of London*, 1833, *123*: 359-505, on pp. 496-497. JOHN PRINGLE NICHOL, *Views of the Architecture of the Heavens* (Edinburgh: William Tait, 1837).

[2] For more on the 1845 discovery of M51 see: MICHAEL HOSKIN, "The First Drawing of a Spiral Nebula", *Journal for the History of Astronomy*, 1982, *13*: 97-101; and M.E. BAILEY – C.S. BUTLER – J. MCFARLAND, "Unwinding the Discovery of Spiral Nebulae", *Astronomy & Geophysics*, 2005, *46*: 2.26-2.28. This discovery is overcast, however, with a bit of mystery. It is not clear exactly when the spiral character was first discovered, and not clear as to whether it was only Lord Rosse alone who made this discovery, or if he was accompanied by James South and Dr. Robinson. I must thank Trevor Weekes for helping me to appreciate this point.

[3] Quoted in: "The Leviathan Telescope and its Revelations", *Fraser's Magazine* (Dec., 1850), *42*: 591-601, on p. 598. In this context one ought to keep in mind the hierarchy involved and the complexity of "conversing" in specific circles, see especially JAMES SECORD, "How Scientific Conversation Became Shop Talk", in *Science in the Marketplace: Nineteenth-Century Sites and Experiences*, edited by Aileen Fyfe and Bernard Lightman (Chicago & London: University of Chicago Press, 2007), pp. 23-59, on p. 26.

[4] It ought to be kept in mind, however, that much publicizing might have been going on

John Le Conte of Edinburgh, which was done in the positive (a white image on a black background), and approved by Rosse as "successful."[5] It was not until 1850 that Rosse published in the *Philosophical Transactions* a copper-plate stippled engraving done in the negative (dark image on a white background) by James Basire of a brand new sketch of M51 – it is this second image (Fig. 1), and not the 1845 sketch, that I will trace in the following.[6] By the time this engraving was published Rosse's project had been in full operation for three years with a partial interruption between

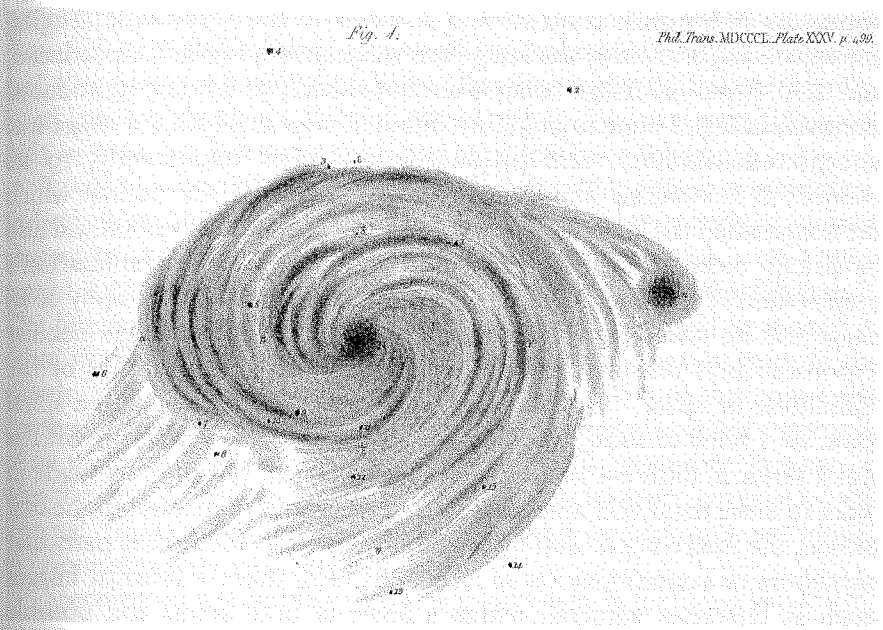

Fig. 1. The engraving of the Great Spiral as found in the 1850 *Philosophical Transactions*.

elsewhere and in different "sites" like the salons, lectures halls, and exhibitions where it might have been displayed. For more on this aspect generally see the volume *Science in the Marketplace: Nineteenth-Century Sites and Experiences*, edited by Aileen Fyfe and Bernard Lightman (Chicago & London: University of Chicago Press, 2007), especially BERNARD LIGHTMAN, "Lecturing in the Spatial Economy of Science", pp. 97-132. An important resource on scientific publications in the period, see JONATHAN R. TOPHAM, "Scientific publishing and the reading of science in nineteenth-century Britain: a historiographical survey and guide to sources", *Studies in History and Philosophy of Science Part A*, 2000, *31*: 559-612.

[5] JOHN PRINGLE NICHOL, *Thoughts on Some Important Points Relating to the System of the World* (Edinburgh: William Tait, 1846), in the Preface.

[6] LORD ROSSE, "Observations on the Nebulae", *Philosophical Transactions of the Royal Society of London*, 1850, *140*: 449-514, and see accompanying Plates.

1845-48 due to Ireland's disastrous famine. Rosse had also by this time hired two assistants, Rev. W.H. Rambaut and George Johnston Stoney, to make observations with the telescopes, while he could engage his duties as the President of the Royal Society of London.

After giving a brief account of the 1850 engraving of the "Great Spiral," as it became known, I will give a selective biography of this image. Beginning with William Whewell's frontispiece, I trace some of the places where this image was reproduced and copied, and used in specific ways and contexts. I spend a considerable amount of time on Whewell because his peculiar use of the image was the earliest instance, apart from Rosse's, of this image appearing in a public context, and it seems to have had wide ranging consequences for the way the image was subsequently viewed, reproduced, and used. From the image being taken individually to it being reproduced alongside others, I hope to point out different ways in which the image was interpreted, oriented, and produced, and most importantly, to its connection to resulting knowledge claims. In addition, the ways in which the image aided the imagination in connection with popularization will also be briefly considered, especially in relation to Camille Flammarion's presentation of the Great Spiral. All these episodes in the biography of an image will be linked by certain themes such as the controversial nebular hypothesis and the plurality of worlds, to more general issues of the "infinitude of space," and the mechanics and constitution of the spiral form. As I hope to show, the biography of Rosse's 1850 image of M51 is also a series of different kinds of juxtapositions and relations, all made in order to make the object accessible to different kinds of inquiry. In the first section, the image is put into a comparative relation with either particular metaphors or conceptions (as in Whewell), with other influential images (such as Descartes vortices), within a *series* of both actual and possible objects (as in Alexander); and in the second section, the image is put into relation with other sorts of images of the same object (Lardner and Chambers), and finally the image in relation to itself, specifically to its own dark background (Flammarion). But I hope to show that there is more going on than a mere comparing and contrasting of images. Rather I would like to suggest that it might be better to consider a simple contrasting and comparing to be a species of a more general strategy; namely, a strategy involving judicious maneuvering of the image, which is employed in order to make some claims about the object more plausible than others – this will be highlighted by taking the notion of a "biography of an image" seriously. It is by tracing some of the paths taken by this image of the Great Spiral that I hope to thereby reveal the relevance and significance of advocating

the notion of a biography of an image for the purposes of understanding scientific representations more generally.

The records at Birr Castle document that observations of the "Great Spiral" were resumed on March 27 1848. By the time the first paper containing the results of the 6-ft telescope and which contained the first published figure of the object by the Rosse team was received by the Royal Society in June 1850, M51 had been already observed at least twenty-eight times. The figure was produced over a two-year period, wherein many descriptions and drawings were accumulated from which the final drawing made for the engraving was produced.[7] This figure, certainly was not the last one published by the Rosse team. In 1861 the project published a small dissected part of the object as a wood-cut embedded into the numerical and descriptive records reproduced. Another assistant, Samuel Hunter, hired later for his artistic abilities, completed another exquisite drawing of M51 in 1864, but it was not published until 1880, as a lithograph.

Looking at the image one immediately gets an impression of movement. Indeed, Rosse believed "that such a system should exist, without internal movement, seems to be in the highest degree improbable... we cannot regard such a system in any way as a case of mere statical equilibrium."[8] The internal movement was not actually seen in "the object in space," in other words, but the strong *impression* of its dynamics was given in the sketch; thus it was expected that measurements taken of this object and compared with future ones would reveal and confirm suspected movement of its parts, especially in the form of a rotation. At this point, however, it was the image itself which seemed to display, however tentatively, this internal dynamic, and thus the difficulties posed seemed to be overlooked in favour of further speculation.

Speculations as to possible change and movement in the Great Spiral, to be sure, were essential to any subsumption of the object under the laws of classical mechanics. Thus far, nebulae had eluded such an explanation because of the

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[7] For a more sustained and detailed look at these aspects *within* the record books of the Rosse project see: OMAR W. NASIM, "Beobachtungen mit der Hand: Astronomische Nebelskizzen im 19. Jahrhundert", in *Daten sichern: Schreiben und Zeichnen als Verfahren der Aufzeichnung*, ed. Christoph Hoffmann (Zurich and Berlin: Diaphanes Verlag, 2008), pp. 21-46. An English version was published as ID., "Observations, Descriptions, and Drawings of Nebulae: A Sketch", in *Max Planck Institute for the History of Science Pre-Print Series, no. 345* (Berlin, 2008). For more on the representations of nebulae by the Rosse team see: SIMON SCHAFFER, "The Leviathan of Parsonstown: Literary Technology and Scientific Representation", in *Inscribing Science: Scientific Texts and the Materiality of Communication*, edited by Timothy Lenoir (Stanford: Stanford University Press, 1998); and ID., "On Astronomical Drawing", in *Picturing Science Producing Art*, edited by Caroline A. Jones and Peter Galison (New York & London: Routledge, 1998), pp. 441-474.

[8] ROSSE, "Observations on the Nebulae" (cit. note 6), on p. 504.

difficulties in making measurements and in identifying with some degree of certainty any kind of change in the nebulous objects. Furthermore, identifying the type of movement could very well also reveal the nature of the object's constituents – whether it was made up of stars or a nebulous fluid. This was directly related to the controversial nebular hypothesis, which had been advanced earlier in the century as a theory about the *nebular* origins of our solar system (as construed by P. Laplace) and/or of star-clusters (as construed by William Herschel). Many thought that if the nebulae could be "resolved" into truly nebulous fluid it would provide support to the nebular hypothesis. While the Monster telescope was originally constructed in order to decide the question of resolvability, the discovery of the Great Spiral actually shifted the primary focus of the Rosse team. Instead of now resolving the nebulae into stars, the primary task became the resolution of the nebulae into a few "normal forms," the spiral form being the most prominent.[9]

However, Rosse and, as we shall soon see, William Whewell both agreed that there was enough evidence to suggest that in the main nebulae were much closer than astronomers had previously thought, and that, therefore, variations in the distance of the objects could now be contained within a certain range – attempting to preclude, thereby, any further surprises similar to the one instanced by the appearance of M51.[10] In any case, the one who seemed to have taken the impression of movement given by the 1850 image the furthest in the speculative direction was William Whewell, who ranked astronomy as one of the paradigm sciences wrote much on the plurality of worlds issue and astronomy's relation to religion, and used the image in order to make specific conclusions as to the object's constitution and mechanics. In fact, Whewell thought the spiral form demonstrated that life on other planets analogous to our own was physically impossible.

Mechanics, Constitution, and Formation

In a letter dated Sept. 3 1853, Whewell asked Rosse the "favour" of sending his publisher the latest and "most distinct spiral nebulae

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[9] Id. [Nov. 30, 1853], "Address Delivered before the Royal Society", *Abstracts of the Papers Communicated to the Royal Society of London*, 1850-1854, *6*: 343-372, on pp. 347-348. Also see Nasim, "Observation, Images, and Procedure: Observing the 'Great Spiral' (M51) in the Nineteenth-Century" (forthcoming).

[10] In a letter from Rosse to Whewell, from March 1854, Rosse agreed with Whewell saying, in Michael J. Crowe, *The Extraterrestrial Life Debate 1750-1900* (New York: Dover Publications, 1999), on pp. 311-312.

copied."[11] The image provided, of course, was the Great Spiral of 1850, which was printed along with another spiral nebula (M99), both on the same plate, as they were presented in Lord Rosse's original publication. The plate was published in the positive however, and formed the frontispiece to Whewell's 1853 book *Plurality of Worlds*, wherein he infamously argued against the proposal that there could probably be life on other planets analogous to our own.[12] Knowing that *actual* motion in the object was yet to be ascertained, Whewell worked with the impression of motion imparted to him by the image – he worked *as if* there were motion and attempted to explain this hypothesis.[13] I am especially interested in the way features of the image were used as a source for explanation of the appearance itself, and ways in which the image was incorporated into arguments that depended on some analogue between two otherwise different images. What Whewell saw in the image, therefore, suggested particular conclusions with regard to the constitution, mechanics, and the general nature of the phenomena, but such viewing was supposed to be disciplined by science. With such wide and productive application it is no wonder that the image was made the frontispiece to Whewell's work.

The *Plurality of Worlds* contains an entire chapter dedicated to the nebulae. Whewell is at pains to show that nebulae have an internal constitution much too tenuous for it to be resolved from "thin," "rare", and "filmy" elements into stars, suns, solar systems and planets like our own.[14] To block this resolution is to also block the analogy required for there to be life on other planets. There are two key premises for this blocking to work. The first is that the nebulae are not as distant as some have thought, rather, they are as near as the brighter of the "Fixed Stars."[15] Second, is that the presumed motion of the Great Spiral strongly

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[11] Whewell to Rosse, Sept. 3 1853, Birr Castle Archives, K.17.18.

[12] For more on the Plurality of Worlds debate see CROWE, *The Extraterrestrial Life Debate 1750-1900* (cit. note 10); and more recently, LAURA J. SNYDER, "'Lord only of the ruffians and fiends'? William Whewell and the plurality of worlds debate", *Studies in History and Philosophy of Science*, 2007, *38*: 584-592.

[13] In David Brewster's "savage" attack against Whewell's work, he made it a point to take on this very suggestion. "An appearance which *might* be caused by motion," Brewster countered, "is certainly no ground for believing that motion caused it". This, as already noted, is not only against Whewell, but also Rosse's ardent belief. DAVID BREWSTER, *More Worlds Than One: The Creed of the Philosopher and the Hope of the Christian* (London, 1854), pp. 175-176, on p. 174. Also see SNYDER, "Lord only of the ruffians and fiends?" (cit. note 12), p. 589.

[14] Schaffer notes the opportunism of Whewell choice in SCHAFFER, "The Nebular Hypothesis and the Science of Progress", in *History, Humanity and Evolution*, ed. J.R. Moore (Cambridge: Cambridge University Press, 1989), pp. 131-164, on p. 140.

[15] WHEWELL, *Of the Plurality of Worlds: An Essay, Also, A Dialogue on the Same Subject*, 4th edition (1855) (reprinted by Thoemmes Press, 2001), p. 24; 1st edition was published in 1853.

suggests a thin, filmy and highly attenuated constitution. The two premises are not disconnected: the premise from distance contributes and shapes the way we come to see and understand the constitution of the Great Spiral. I hope to show how in explaining the presumed appearance of the Great Spiral as given in his frontispiece, Whewell's argument also results in a new way of looking at an image of any spiral nebula. Let me begin with how Whewell uses the first premise to show that spiral nebulae are not constituted from stars.

Whewell's principle idea in urging that the nebulae are no further away than the brighter stars may be summed up by saying that the determination of the resolvability or non-resolvability by the most powerful telescopes was no longer dependent on their distance. If the nebulae are no further away than the brighter of the Fixed Stars, the determination of the constitution of the nebulae will no longer rest on more and more powerful telescopes capable of penetrating into further and further distances, but rather only on those capable of bringing out fainter details in the nebulae. Whewell provides two analogies to explain the point. In one, while defending his curious claim that nebulae may be resolvable not into stars but rather into mere "lumps" of light, Whewell says, that stars and lumps, "differ as a cloud of dust differs from a rock. The dust may be resolvable into microscopic masses of stone... [But] I would not call a cloud of dust a host of rocks, merely because a small speck of stone may possibly appear, in the microscope, as a rock." In another place, and even more notable for our purposes, is Whewell's portrayal of the power of Rosse's telescope: "what seems to the unassisted vision a nebula, a patch of diluted light, in which no distinct luminous point can be detected, may, by such an instrument, be discriminated or *resolved* into a number of bright dots, as the stippled shades of an engraving are resolved into dots by the application of a powerful magnifying glass." If we maintain that the distance of nebulae are roughly the same and as near as the brighter of the Fixed Stars, then the nebulae which have resisted resolution are not therefore further away but only have a material constitution much fainter and/or smaller. After examining the paradigm example of the Magellanic Clouds, as described by Herschel in his *Cape Results* (1847), Whewell concludes, "whatever inference we may draw from the resolvability of some of the nebulae, we may not draw this inference; – that they are more distant, and contain a larger array of systems and of worlds, in proportion as they are difficult to resolve."[16]

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[16] ID., *Of the Plurality of Worlds* (cit. note 15), on pp. 23, 24, 224, 230.

A further instance is offered by Whewell in order to strengthen his distance premise. This instance is taken from a meeting of the BAAS on the 7th of September 1853, where once again were displayed drawings produced by the Rosse project; this time, however, it was *two* drawings of the Great Spiral placed next to one another. One drawing was made using the smaller 3-foot reflector and the second from the Monster telescope. "With the smaller telescopic power," notes Whewell, "all the characteristic features were lost" – these characteristic features being those subsequently recognized and drawn using the larger telescope. Whewell continues,

> No one can suppose that these newly seen portions of the nebulae are immensely further off than the other parts. However little we know of the nature of the object, we must suppose it to be one connected object, with all its parts, as to sense, at the same distance from us [...] We are led irresistibly as it seems, to regard the whole mass of such a nebula, as an aggregation of vaporous roles and streaks.[17]

The differences apparently so obvious in the two drawings exhibited at the meeting by Rosse demonstrated two things: one is that since the fainter streaks, only seen with more powerful telescopes, are parts attached to the same nebula these must also be at the same distance as those other parts previously seen; and second, if we accept the distance premise, then we must "irresistibly" conclude that the constitution of this nebula and its parts must be made-up of "thin films," "rare" and attenuated matter. In this way, in explaining the appearance we come to, at the same time, seeing the image anew. Whewell, in another place, generally describes this process as a productive interplay between the creative, inductive and speculative aspects of research: "that the creative and directive Principles which have their lodgment in the artist's mind, when *unfolded* by our speculative powers into systematic shape, become Science, is true... *it is for Science to direct and purge our vision* so that these airy ties, these principles and laws, generalizations, and theories, become distinct objects of vision."[18] Images,

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[17] *Ibid.*, p. 236, fn.

[18] Id., *Novum Organon Renovatum*, 3rd edition (1858) (reprinted London: Thoemmes Press, 2001), on pp. 133-134; my italics. It is of some significance to point out the fact that the two drawings exhibited at the British Association for the Adavncement of Science (BAAS) meeting were actually used for entirely different purposes than those employed by Whewell. The display was meant to gather support for a second attempt to apply to the Government for a grant in order to fund an expedition to the Southern Hemisphere equipped with a brand new telescope. The chances for securing the funding from the Government and Her Majesty, according to the President of BAAS, were looking pretty good, and that if successful in their application the project would, "afford a new proof that the Association is doing effectively what it professes to do as an Association for the Advancement of Science." See: [William Hopkins], "President's Address,

then, are to be used by science to bring out and properly display scientific claims or generalizations. But this is done, not by merely looking at what is displayed, but by looking in a particular and refined way.

While the exhibit at the meeting might have been largely used to consolidate and create an agreement among the scientists of the association as to the importance of having more powerful telescopes in the Southern Hemisphere, Whewell, on the other hand, was especially interested in the images of the Great Spiral as scientific images. These images were an important step in an argument meant to give some flesh to the intuition that motion of these objects may be mechanically explicable. The "spiral films," which "resemble a curled feather, or whirlpool of light," are forms which conspicuously display a sense of motion. After Whewell directs the reader to the frontispiece, he goes on to make a significant and operative visual connection:

> Now when this thought [of form and motion] has occurred to us, since mathematicians have written a great deal concerning the mechanics of the universe, it is natural to ask, whether any of the problems which they have solved give a result like that thus presented to our eyes. Do such spirals as we here see, occur in any of the diagrams which illustrate the possible motions of celestial bodies? And to this, a person acquainted with mathematical literature might reply, that in the second Book of Newton's *Principia*, in the part which has especial reference to the Vortices of Descartes, such spirals appear upon the page.[19]

Here the image of the Great Spiral is incorporated into a visual comparison with another illustration resembling it, where the latter, in light of its mathematical context, is used to mechanically explain a possible phenomenon in the former – its peculiar structure and motion.[20]

Twenty-Third Meeting of the British Association for the Advancement of Science", in *The Athenaeum*, Sept. 10, 1853, on p. 1066 and p. 1067. For Rosse's on this issue, see: ROSSE, "Address Delivered before the Royal Society" (cit. note 9), on p. 349.

[19] WHEWELL, *On the Plurality of Worlds* (cit. note 15), on p. 238.

[20] See especially Book 2, Section 4 and Book 2, Section 9 of ISAAC NEWTON'S *The Principia: Mathematical Principles of Natural Philosophy*, a new translation by I. Bernard Cohen and Anne Whitman (Berkeley and Los Angles: University of California Press, 1999). A more direct attack by Newton against the Vortex theory may be found in NEWTON, "De Gravitatione", in *Philosophical Writings*, ed. Andrew Janiak (Cambridge University Press, 2004), pp. 12-39. On Descartes' and the subsequent Cartesian theories of the Vortex, see E.J. AITON, *The Vortex Theory of Planetary Motion* (New York: American Elsevier Publishing Co., Inc., 1972). For a good survey account of how vortices went from Cartesian natural philosophy to being a powerful literary motif in England, see KEVIN L. COPE, "Spinning Descartes into Blake: Spirals, Vortices, and the Dynamics of Deviation", in *Spiral Symmetry*, ed. István Hargittai and Clifford A. Pickover (World Scientific, 1992), pp. 399-441.

It is important to emphasize that this visual analogy is being made in reference to an illustration employed within a scientific context. Whewell, elsewhere, warns against analogies between forms that are not "*referred to Conceptions of the Intellect only*" but those which illicitly refer to "all emotions of fear, admiration, and the like... The mixture of fancy and emotion with the observation of facts has often disfigured them... We have an example of this result, in the manner in which Comets are described... as they assume the form of a sword, of a spear, of a cross, and so on. When such resemblances had become matters of interest, the impressions of the senses were governed, not by the rigorous conceptions of form and colour, but by these assumed images; and under these circumstances, we can attach little value to the statement of what was seen."[21]

In relation to Newton's discussion of the vortices, which is set in the context of motion in a resisting medium, Whewell goes on to try explaining the "whirlpool of light" by another analogy, that of a comet on its path through the solar system and around the Sun.[22] The material making up a comet had long been confused with and compared to nebulous material. But here Whewell goes further: If both are made up of tenuous material, a "loose and vaporous mass," and if several comets with their long "lines of light" were to trace a circular or elliptical spiral converging to the center of attraction, they "would exhibit the wheel-like figure with bent spokes, which is seen in the spiral nebulae." It is then, says Whewell, an "extraordinary coincidence," that we have both an instance of a comet with a spiral path, namely Encke's comet, and one that breaks apart to form at least two portions, as in Biela's comet which accounts for more than one spiral streak.[23] Not only is the appearance thus accounted for, or at least made conceptually and physically plausible, but Whewell goes on to advance conclusions about the nature of the material involved and the type of motion and force required for the peculiar spiral arrangement. These conclusions are spurred on by questions that directly arise from comparisons made between the nebulous material of a spiral arrangement and comets; questions such as: "Can we compare its density with theirs?

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[21] WHEWELL, *Novum Organon Renovatum* (cit. note 18), on pp. 54-55. Whewell would thus have probably been doubly dismayed by Admiral William Henry Smyth's well-known description of M51 given in his *A Cycle of Celestial Objects*, 2nd edition (Clarendon Press, 1881, 1st edition 1844), on pp. 383-384.

[22] David Brewster takes Whewell literally and concludes that "a hypothesis more wild and gratuitous than this was never before submitted to the scientific world", in BREWSTER, *More Worlds Than One* (cit. note 13), on p. 218.

[23] WHEWELL, *On the Plurality of Worlds* (cit. note 15), on pp. 240, 243, 239.

Can we learn whether the luminous matter, in such nebulae, is more diffused or less diffused, than that of the comet of Encke? Can we compare the mechanical power of getting through space, as we may call it, that is, the ratio of the inertia to the resistance, in the one case, and in the other?" Such questions lead Whewell to conclude that the spiral nebula is "so much more rare than the matter of the comet, or the resisting medium so much more dense; or, combining the two suppositions, because in the case of the comet, the luminous matter has *much* more inertia, more mechanical reality and substance, than the medium through which it moves; but in the nebula, very *little* more." And that compared to the Solar System, the nebula is an incomplete, unfinished, "confused, indiscriminate, incoherent" and chaotic mass of rare "or gaseous mater, of immense tenuity... destitute of any regular system of solid moving bodies;"[24] thus making these systems not at all suitable for life analogous to our own. In conjunction with the proposal that many nebulae may be "resolved" into a few normal forms, the most important being the spiral form, we may thereby exclude the vast majority of nebulae, even those not apparently spiral, as candidates for life.

Finally, although Whewell might have been writing mainly for a wider audience, he still intended some of the material to be taken seriously by astronomers themselves, because he believed it had a definite "scientific interest."[25] This seems to be the case with regard to his speculations on the nature of the nebulae, some of which, as we have just seen, were based on specific impressions imparted to him by the spiral nebula exhibited in the frontispiece.[26] It is for this reason I regard Whewell's work as explicitly intended as a contribution to nebular research at the time. I emphasize the scientific interest of this frontispiece, *printed in the positive*, and the role it played within a series of speculations partly in response to the temptation to consider the conversions into the positive image from the original negative, as a kind of cosmetic touch-up made in order to appeal to a wider audience – something equivalent, it might be thought, to contemporary imaging techniques in the production of astronomical images.[27] But this is

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[24] *Ibid.*, on pp. 243-244, 245-246, 248-249, 251.

[25] *Ibid.*, Preface to the 1st edition, p. 15, where Whewell says that, "the Author may be allowed to say, that he has tried to give to the book, not only a moral, but a scientific interest [and] may be not unworthy of some attention on the part of astronomers and observers, as an occasion of future researches in the skies."

[26] The second nebula (M99) also included in the frontispiece seems to play less of the kind of direct role I am interested in here.

[27] On issues related to such aesthetic and scientific uses of images, see MICHAEL LYNCH and

not the case. On the one hand, one finds *negative* images of the nebulae being used in expressly popular astronomical works, such as in Dominique F.J. Arago's widely read *Astronomie Populaire* (1854) and Sir John Herschel's hugely popular *Outlines of Astronomy* (1858). In both these works Rosse's 1850 image of M51 is reproduced –, Arago's, however, is a *new* reproduction based on the original Rosse print (Fig. 2). On the other hand, aside from Whewell's clearly intended scientific use of the images, there are other instances of an overtly scientific and expert use of the *positive* image, such as in Stephan Alexander's eight part monograph "On the Origin of the Forms and the Present Condition of Some of the Clusters of Stars and Several of the Nebulae, to which we now turn."[28]

Fig. 2. From ARAGO's *Astronomie Populaire* (1854).

While Whewell reasoned from an image of an individual nebula and its peculiar form to the nature of its constitution, Alexander was much more interested in the formative origins of the nebulae and used a *series* of objects including spiral nebulae, all figured on the same plate (Fig. 3). Whewell goes about explaining the order and arrangement seen in the spiral at a distance in order to conclude that *within* it, that is locally, it is much too chaotic for there

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SAMUEL Y. EDGERTON Jr., "Aesthetics and digital image processing: Representing craft in contemporary astronomy", ed. Gordon Fyfe and JOHN LAW, in *Picturing Power: Visual Depiction and Social Relations* (London: Routledge, 1988); and ELIZABETH KESSLER, "Resolving the nebulae: the science and art of representing M51", *Studies in History and Philosophy of Science*, 2007, *38*: 477-491. Also see A. PANG, "Victorian Observing Practices, Printing Technology, and Representations of the Solar Corona (1): the 1860s and 1870s", *Journal for the History of Astronomy*, 1994, *25*: 249-274.

[28] STEPHAN ALEXANDER, "On the Origins of the Forms and the Present Condition of Some of the Clusters of Stars and Several of the Nebulae", *Astronomical Journal*, 1852, *2(12)*: 95-96; *2(13)*: 97-103; *2(14)*: 105-111; *2(15)*: 113-115; *2(16)*: 126-128; *2(18)*: 140-142; *2(19)*: 148-152; *2(20)*: 158-160.

Fig. 3. Stephen Alexander's 1852 plate representing the formation of the spiral nebulae.

to be life.[29] In contrast to Whewell, Alexander was much more interested in the global "destructive powers",[30] which over large periods of time led to the formation of the spiral form. Alexander attempts to capture this formation by *animating* the Great Spiral by placing it into a series of both hypothetical and real objects temporally and physically related to it.

In speculating about the formation of star-clusters, Sir William Herschel had earlier emphasized a "clustering power" that aggregated and condensed the nebulous matter towards its center, thereby forming stars out of nebulae.[31] Alexander, however, suggested that the "remarkable spirals, unknown in Sir William Herschel's day, but recently discovered, in the use of an increased optical power, by Rosse, evidently require something other than the mere *clustering power* for their explanation." Using images of both hypothetical nebulae and clusters, and actual nebulae, such as the spiral reproduced from Rosse's 1850 illustration, and by placing them into a series determined by and corresponding to the mechanical processes of formation described in the text, Alexander argued that the spiral form, among others, is the result of a "catastrophic" and "chaotic" breaking up of the material in a slowly rotating nebula shaped in the "primitive form" of an "oblate spheroid". In the plate presented here (Fig. 3), Alexander's

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[29] For more on the literary chaos of spirals see KEVIN COPE, "Spinning Descartes into Blake", (cit. note 20).

[30] ALEXANDER, "On the Origins" (cit. note 28), *2(13)*: 97-103, on p. 99.

[31] See: MICHAEL HOSKIN, *William Herschel and the Construction of the Heavens* (New York: W.W. Norton & Co., 1964); SIMON SCHAFFER, 'Herschel in Bedlam: Natural History and Stellar Astronomy', *The British Journal for the History of Science*, 1980, *13*: 211-239.

images numbered 1, 2, 3 and 4 are not actual objects. His number 1 (upper left hand corner) is any primitive spheroid, while number 2 is the spheroid being rent asunder by destructive forces, and figures 3 and 4 are on their way to becoming a spiral nebula. It is not until image 5 that we are presented with a real instance or an "appearance *realized*" of a nebula, namely M99. In comparing the appearances of the spiral nebula M99 and that of M51 (his number 6 in the figure), Alexander makes the following *mechanical* conclusions about the latter engraving, "The figure [of M51] is much more convoluted than the other [M99], and we may hence conjecture that the catastrophe in this case is of a more ancient date, as *many* rotations seems to have occurred since the spheroid was broken; the density of the equatorial ring appears, moreover, to have been quite considerable, and the oblateness of the spheroid, it may be, was less than that of the other."[32] Finally, Alexander spends a considerable amount of time detailing reasons for considering our own Galaxy to be of a spiral form. With much less detail, but six years earlier, Nichol did the same in his *Thoughts on Some Important Points Relating to the System of the World* (1846), even though John Herschel, after seeing the sketches made by Rosse of the newly discovered spiral nebulae at the Cambridge meeting of 1845, publicly declared the idea destroyed – a view reiterated in Robert Grant's classic of 1852, *History of Physical Astronomy*.[33] The variety of opinions here certainly must have been due to how one at the time might have understood the drastic alteration of appearances between Herschel's representation of M51 and Rosse's. These "unexpected changes"[34] in the object's appearance is the main focus of Dionysius Lardner's use of the images.

Appearance and Reality

Lardner considered a variety of nebulae and star-clusters all of which displayed some alteration in form and structure due to the application of more powerful telescopes. This he did by juxtaposing images of an object as sketched by both Herschel using his 18-inch aperture, and by Rosse

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[32] Alexander, "On the Origins" (cit. note 28), *2(13)*, pp. 97, 100 and 101.

[33] Robert Grant, *History of Physical Astronomy From Earliest Ages to the Middle Nineteenth Century* (reprinted from the London edition of 1852 [New York and London: Johnson Reprint Corporation, 1966]), p. 569.

[34] Dionysius Lardner, *Popular Astronomy* (London: Walton and Maberly, 1856), on p. 22.

using his 72-inch aperture – the most extraordinary and exemplary of course being M51. Beginning his chapter on star-clusters and nebulae with the fact that our sun belongs to a star-cluster known as the Galaxy, and "that this cluster has limited dimensions, has ascertainable length, breadth, and thickness, and in short, forms what may be expressed by a *universe of solar systems*," Lardner goes on to suggest that, "we should therefore infer, even in the absence of direct evidence that *some* works of creation are dispersed through those spaces which lie beyond the limits of that vast stellar cluster of which our system is a part." As we have seen, Whewell restrained his reasoning with the distance premise, which limited possible future alterations of the appearances of star-clusters and nebulae, and it played a major role in weakening the case for life in other clusters. It is precisely this premise, interestingly enough, that Lardner rejects by emphasizing the "infinitude of space," and by expressly claiming that the appearances "may be explained by differences of distance."[35] Moreover, while the 1850 figure of the Great Spiral is reproduced and used by both Whewell and Alexander in their explanations of the object's "physical conditions," Lardner explicitly uses the differences exhibited by contrasting two images of M51 to conclude that they present another "striking example... [that] proves how unsafe it is to draw any theoretical inferences from apparent peculiarities of form or structure in these objects, which may be only the effect of the imperfect impressions we receive of them, and which, consequently, disappear when higher telescopic powers are applied." And earlier, after describing the discovery of the spiral nebulae as "the most extraordinary and unexpected which modern research has yet disclosed in stellar astronomy," he goes on to claim (*contra* Whewell) that the "forms are so entirely removed from all analogy with any of the phenomena presented either in the motions of the solar system, or the comets, or those of any other objects to which observation has been directed, that all conjecture as to the physical condition of the masses of stars which could assume such forms would be vain."[36] Only his admission that some appearances do give some indication that a general law may be governing their apparent structure seems to have saved Lardner from a general skepticism with regard to our knowledge of these mysterious sidereal objects.

The common practice of presenting Herschel's and Rosse's figures of M51 together in order to demonstrate the importance of powerful telescopes or the caution required when relying on appearances, continued

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[35] *Ibid.*, pp. 17, 18, 20.

[36] *Ibid.*, pp. 39, 30-31.

late into the nineteenth-century. What is surprising to notice, furthermore, is that up and until the end of the century many new books, or even new editions of old works, continued to reproduce either old or newer reproductions of the same 1850 image of the Great Spiral.[37] This is despite the fact that in 1867 William Lassell published two figures of M51, which were considered by some as definitive enough to finally confirm Rosse's discovery, and that the Rosse team itself had published another two illustrations of the same object as late as 1880. Neither of these more recent figures of the Great Spiral seems to have found their way into mainstream works on nebulae at the time.[38] In later material what one finds, rather, are a few interpreted copies of either the 1850 original, or, what seems to have been much more common, a reproduction of an earlier reproduction of the original.

One of the most widely used astronomical works of the late Victorian period was certainly George F. Chambers' *A Handbook of Descriptive and Practical Astronomy*, first published in 1861.[39] Like many others, this work included a chapter on "Clusters and Nebulae" that was mainly dedicated to the classification of these objects and to a collection of images as typical specimens of each category. Chambers classifies clusters and nebulae into three general headings: (1) Irregular groups, visible more less to the naked eye; (2) Clusters resolvable into separate stars with the aid of a telescope; and (3) Nebulae, for the most part irresolvable. Under the last, he places the spiral nebulae.[40] Chambers then presents the Great Spiral, along with Herschel's earlier 1833 figure of the same, as the primary example of this type of nebula (see Fig. 5). When one looks at the spiral nebula reproduced here by Chambers, one immediately notices that it is not a copy of the original 1850 figure by Rosse as found in the *Philosophical Transactions*, but rather a copy of the reproduction found in Lardner's book of 1856 (Fig. 4). Furthermore, I would like draw the reader's attention to the orientation

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[37] For instance see the following: GEORGE CHAMBERS, *The Story of Stars* (New York: D. Appelton & Co., 1908, 1st edition, 1895); JOSEPH GILLET and WILLIAM JAMES ROLFE, *The Heavens Above: A Popular Handbook of Astronomy* (New York and Chicago: Potter, Ainsworth, & Co., 1882); J. NORMAN LOCKYER, *Elementary Lessons in Astronomy* (London: MacMillan and Co., 1868); Rev. THOMAS MILNER, *The Gallery of Nature: A Pictorial and Descriptive Guid Tour Through Creation* (London: W. and R. Chambers, 1860); DENISON OLMSTED, *The Mechanism of the Heavens* (London: T. Nelson and Sons, 1880 edition).

[38] There are even instances, such as ELIAS LOOMI's *A Treatise on Astronomy*, which, in its 1880 edition, actually contains a reproduction of John Pringle Nichol's 1846 engraving of Rosse's original 1845 sketch.

[39] GEORGE F. CHAMBERS, *A Handbook of Descriptive And Practical Astronomy*, 1st edition (London: John Murray, Albemarle St., 1861).

[40] *Ibid.*, p. 294.

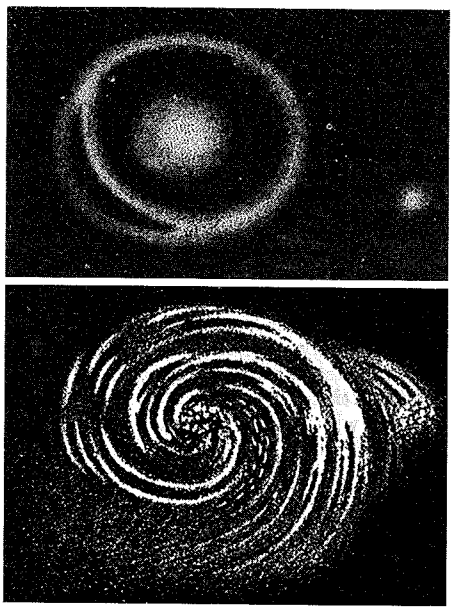

Fig. 4. Lardner's comparison of Herschel's 1833 sketch of M51 (reproduced in the positive) on top, and an interpreted reproduction of Rosse's 1850 image of the same object. Herschel's sketch is realigned from the orginal in order to correspond to Rosse's image.

of the figures in Lardner's juxtaposition of M51, and to compare it with the juxtaposition of the same in Chambers. While Chambers' plate XL of his first edition, leaves the two drawings of the same object in their original non-corresponding orientations (see Fig. 5), Lardner rotates Herschel's original drawing of M51 over ninety-degrees to the right so as to give it the same orientation as Rosse's drawing of the same, which is left in its original situation.

By the second edition of Chambers' work, which appeared in 1867, things are different. A year before Chambers wrote a letter to the Editor of the *Astronomical Register*, stating, "Sir, – I have lately made a discovery which, whether it be really such or no, at any rate has not, so far as I am aware, ever been pointed out. *All Sir J. Herschel's drawings of Clusters and Nebulae are represented as they cannot be seen.*"[41] This is so, Chambers explains, due to the draftsman directly sketching onto paper an object which was inverted by the telescope, so that when it is engraved and etched onto the copper-plate exactly as it is on the paper, the object in the published figure is once again reversed right to left. This is why, generally speaking, when an exact copy of an original is desired, the engraver is apt to copy a mirror image of the original. "The inconvenience," continues Chambers, "of this plan is manifest as concerns observers working with the telescope and seeking to make comparisons between what they see and what Sir John indicates he saw; but worse than all this, Rosse and, so far as I have noticed, all other celestial draftsmen, adopt the common-sense plan of making

[41] CHAMBERS, "Sir John Herschel's Drawings of Nebulae: To the Editor of the *Astronomical Register*", 1866, *4*: 220.

their drawings to show exactly as the telescope shows, consequently other sketches placed in juxtaposition with Sir J. Herschel's wholly mystify and delude the reader."[42]

After noting the "unduly exaggerated" brightness of the engraved nebulae and clusters, typical of the positive images made of nebulae, Chambers goes on to include in the Preface to the second edition of his *Handbook of Astronomy* the very same complaint against the inverted sketches of "celestial draftsmen." When one then turns to the engraving of M51 in the second edition, one is not surprised to find Herschel's figure corrected so that the small companion is no longer situated to the left of the ring, but now to the right.[43] One is surprised to find, however, that the Great Spiral as copied from Lardner's reproduction of Rosse's 1850 figure is no longer used, but that a very different reproduction is now figured (Fig. 6). Unlike Lardner who re-orients Herschel's 1833 figure of M51 to align itself with Rosse's, Chambers actually re-orients the spiral image to fit Herschel's newly adjusted figure, itself adjusted, that is, in relation to the telescopic object. In other words, while Lardner adjusts his images in relation to another image, Chambers adjusts the images in relation to the object as seen through his telescope in order to properly delimit and identify what may be seen through any telescope of a particular type.

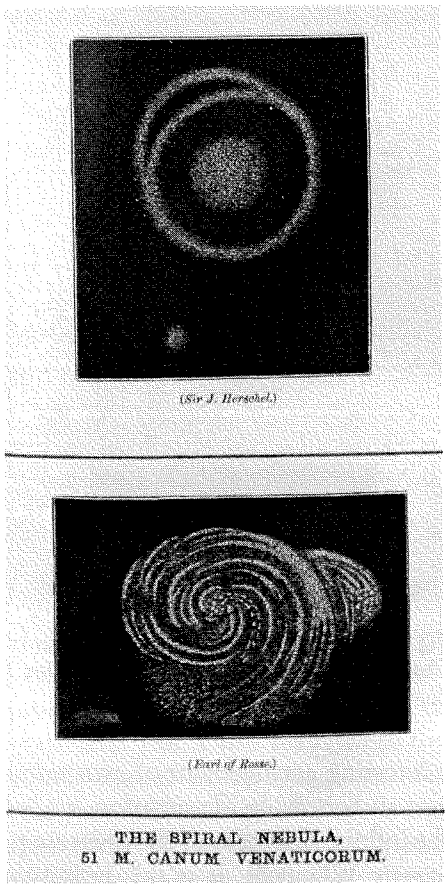

Fig. 5. A plate from CHAMBER's *A Handbook of Astronomy*, 1st edition, 1861.

[42] *Ibid.*, 220.

[43] CHAMBERS, *A Handbook of Descriptive and Practical Astronomy*, 2nd edition (Oxford: Clarendon Press, 1867).

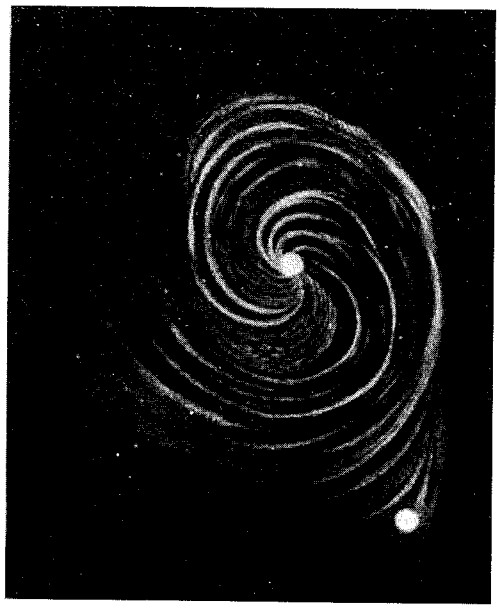

Fig. 6. The Great Spiral as reproduced in Chambers' 2nd edition, which was copied from Flammarion's 1867.

Chambers' new and adjusted image of Rosse's 1850 figures strikes the viewer as positively in movement and dare I say falling through space. Instead of appearing only to display an internal motion, as in Whewell and Rosse, here we are confronted with the appearance of movement through space. As a matter of fact, one finds that Chamber's reproduction was directly reproduced from Nicholas Camille Flammarion's *Le Merveilles Celestes: Lectures du Soir*, which itself was done after the figure given in Arago's *Astronomie Populaire* (see Figure 2).[44] A major popularizer of astronomy in France, Flammarion wrote in a poetic style that along with an interesting arrangement of astronomical facts captured the imagination of vast audiences. In Flammarion, we see visually documented once again how the infinite distances of the universe point to the possible plurality of worlds (*contra* Whewell). It is this infinity of space, moreover, in which "float" clusters and nebulae that are "lost in the depths of the sky"[45] – dying away, to be sure, into the infinite darkness. Indeed, it seems that the play of light and dark in the engraving of M51, the bright luminous object set into stark contrast with its dark background, is also meant to capture the "deep abyss [that] our gaze [must] plunge when we contemplate this distant creation!" Flammarion presents the reader with a whole host of objects, from the spherical, elliptical, and on to the spiral; from double nebulae to those falling, floating, speeding on, and "blazing," he hurries us through this

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[44] CAMILLE FLAMMARION, *Le Merveilles Celestes: Lectures du Soir*, 2nd edition (Paris: Libraire de L. Hachette, 1867), translated into English as *Marvels of the Heavens*, 1870. I was unable to track down the first edition of the French version.

[45] ID., *Popular Astronomy: a description of the heavens*, translated by J. Ellard Gore (London: Chatto & Winder, 1894), p. 665. This work reproduces Rosse's 1850 original in the same orientation, but done in the positive.

"museum" of a "veritable *universal history*." The objects here, however, are not merely in some stationary repose, they rather "rush through the boundless infinite," where "nothing is fixed... swarming... falling in all directions of the eternal void."[46]

We have seen how a particular image may partake in a dialectic of claims, speculations, and judgments with regard to a mysterious and difficult astronomical object. This dialectic includes many different strategies, interventions and employments of the image, resulting in a variety of interpretations, copies and recopies of either the original or some reproduction of it. Despite this variety of claims and images, and however inconsistent they sometimes may appear to be, I have nevertheless claimed to have given a *biography of an image*. If we take this metaphor seriously as giving a history of some one thing as it proceeds through time, then it may rightfully be asked: what holds all these disparate components together? Or how might one formulate this continuity which seems to be present in the given account? Such continuity, in spite of a tremendous amount of diversity, may be an important factor to account for, since it is this continuity which allows us to pin-point in the narrative (whether acknowledged or not, explicit or not) a type of memory of what went before and a loose formulation of the parameters of what is to come after.

One possible answer might be that it is the object signified by the set of images that holds together the above narrative. But if this really were the case it then would not seem to particularly matter which image out of a whole variety of alternative images of the same object might be used, and we have also seen that this choice was not always determined by an appeal to some kind of accuracy either. I would like to suggest, therefore, that it is not so much the signified object as much as it is the *original image* which unites and provides some kind of continuity to the narrative. This gives definite meaning to the idea that a type of memory is active in this dialectic, especially in the implicit and constant reference to the original 1850 image, and it also highlights the tacit appeal to authority in the steady use made of the Rosse figure, even when it is interpreted and reproduced to the point of no obvious resemblance. It is thus the history of this specific image which unites all these disparate statements and

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[46] *Ibid.*, pp. 673, 669, 670-671. It is within this array of immensity and terror that Flammarion places the sublimity of the Great Spiral, which is consequently presented here as an aid to our fleeting imagination. It was most probably this use of the Great Spiral by Flammarion that inspired VAN GOGH'S *The Starry Night* of 1889, as demonstrated by ALBERT BOIME, in "Van Gogh's Starry Night: a history of matter and a matter of history", *Art Magazine*, 59: 1984, pp. 86-103, on p. 96. Also see, LAUREN SOTH, "Van Gogh's Agony", *The Art Bulletin*, 68: 1986, pp. 301-313, on p. 301.

images, which fundamentally, one may claim, is nothing but a series of different images containing the same one throughout.

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