Observing by Hand

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The following is a short excerpt from a long introduction in my Habilitationsschrift*, entitled:* Observing by Hand. *It examines hundreds of hand drawings of the nebulae found in the private and unpublished observing books of six nineteenth century nebular observers: Sir John Herschel (1792–1871), William Parsons, the third Earl of Rosse (1800–1867), William Lassell (1799–1880), Ebenezer Porter Mason (1819–1840), Ernst Wilhelm Leberecht Tempel (1821–1889), and to a lesser extent George Phillips Bond (1825–1865). The book aims to develop an empirical and theoretical basis for dealing with «handedness» in astronomical observation, by emphasizing the diverse roles played by the stylus and the notebook. For the sake of readability and inclusion for this issue, I've dramatically reduced the number of footnotes and references.*

Considering that in many cases published images constituted what most scientists regarded to be their finished, stabilized, visual results worthy of the kind of attention they continue to receive as «immutable mobiles,» the widespread privileging of public visualizations of scientific phenomena in visual studies is justifiable and understandable. [1] After all, it was the published images of a phenomenon that were reproduced in scientific journals and newspapers, to be widely distributed, used, and discussed. It is no wonder, then, that the privileging of the published scientific representation in the visual studies literature (particularly in relation to the history and sociology of science) has tended to place a considerable amount of prominence on the notion of visual or non-verbal communication.

While issues of visual communication will play a part in our story, *Observing by Hand* will have for its chief purpose to bring to center stage the ways in which hand sketches and drawings were gradually made bit by bit *within* the private and unpublished observing books of an astronomer. When turning to the internal contexts of an observational program one encounters, for instance, a multiplicity of techniques that were exploited in order to enhance the possibilities of what had been seen, might be seen, or will be seen. No matter how different the panoply of preliminary sketches of one and the same object within the observing books were, they never indicated nor were ever used to indicate actual or apparent change in an object. This is in sharp contrast with the published images of a nebula. The drawings found within the privacy of the observational program functioned in ways that were different from the published images. *Observing by Hand* will be a detailed exploration of the ways in which the former operated and functioned.

The privileging of the public and published has tended to overshadow fundamental factors in the study of scientific visualization, such as the nature of and the significant role played by visual inscriptions and processes *within* a scientist's journals, notebooks, observing books, laboratory books, or just ordered sheets of unbound paper. Such internal, tentative, and preliminary sketches or drawings, or what I label «working images» (a variety of sketches or drawings including diagrams, outlines, schematics, «skeletons», mimetic representations, and so on, to be found within the internal records of an observational program) have to some extent or other, to be sure, been used as sources for historians, sociologists, and philosophers of science. But for the most part this has been true only in so far as they have been employed to shed light on final published images or text, and the printing and editorial processes involved. I am, however, more interested on what light a study of the working images and their various functions can shed on the nature of the practices and processes involved in scientific observation.

The general driving force behind this book, therefore, will be the question: what can the drawings of the nebulae and star clusters tell us about the nature of scientific observation in the 19th century? This question has been typically answered, to be sure, by way of photography and self-writing instruments, stereoscopes and kaleidoscopes; but rarely, if ever, by way of the hand, its implements (paper and pencil), and the pragmatic processes into which these were embedded. In the very least, we must ascertain and get the multifarious practices of the latter right (which are neither homogenous nor obvious) before we can go on to discover what precisely was supplanted by the incursion of the former; and it is this that I attempt to do in the following work. [2]

Furthermore, one of the important features overshadowed by the privileging of the published has been the multiple ways in which all sorts of working images move through a series of observing books or sheets of paper. A working image does not stand alone, nor does it stand still. But nor do working images have some kind of intrinsic agency of their own. Rather, they are processed and managed, copied and traced, added to and supplemented, compared and contrasted, selected and multiplied. This is made possible for the working images by internally established and selected processes in which they are made to perform and operate through a systematic, routine, and ordered array of observing books or unbound sheets of paper.

Once we begin to take working images with their orderings and movements seriously, we will not only begin to appreciate their productive role as essential elements within a procedure, and become more sensitive to the number of different *kinds* of internal notebooks that may be employed. But we will also begin to appreciate the power attached to their *mutability* as observational tools in the service of exploration, control, and seeing; again, something that sets them fundamentally apart from the immutable mobiles, or the published images in wide circulation in the service of a collective empiricism. I am particularly at pains to show how the active manipulation and variability of the working images found within the observing books were managed, ordered and arranged so as to serve the individual scientific observer. As elements constantly unsettled and on the move through the procedures, working images contributed to the stabilization and immutability of what visually resulted. It is precisely these features of the working images as observational tools that have gone unnoticed when the focus is placed on them as *individual* sketches, standing alone, rather than as active participants of a larger, internal process.

A blank piece of paper when understood as being a part and parcel of a procedure of observation, was rarely ever treated by an observer as a mere *tabula rasa*. For one thing, all that had come before it in the procedures actively informed an apparently empty page; and a piece of paper was often prepared in order to receive and fix an appearance. Before one even sat down at the eyepiece, that is, a paper was prepared by such implements as grids, lines, dots, and triangles that went into controlling and sharpening the attention, the mind, the hand and the eye. These preparations were an explicit attempt to «fix» the phenomena. It is these sorts of preparations made on a piece of paper, whether lines and dots, boxes or circles, squares and triangles, that Bruno Latour's otherwise helpful notion of «paperwork» does not capture. Paperwork, for him, has much more to do with the collective or socio-cultural processes set in motion *with* paper (particularly as it travels in the service of a collective empiricism) rather than with the individual processes that occur on paper. I turn instead to the multiple ways in which preliminary drawings and sketches made and ordered on paper acted to stabilize and enhance observations and the resulting phenomena. I look to processes on paper as tools in the service of research that not only directs sight but also internally coordinates the actions of an observer, and consolidates the hands of many.

Once the shift in focus to unpublished observing books and the abundant graphical inscriptions found therein occurs, some factors of ordinary scientific practice begin to be underscored and made salient. Take for instance the clear shift that occurs from Sir William Herschel's late eighteenth century general representations of whole classes of nebulae in one single image, to the abundantly pictorial representations of specific, individual objects visualized around the early to mid nineteenth century. This significant move might be explained by proposing that some general change in attitude took place during the relevant period, perhaps a shift from what has been called «truth to nature» to «mechanical objectivity.» [3]

But when we begin to focus on the commonplace materials and tools used in the observing books, the shift in the way nebulae were visualized and presented may in part be modestly explained by, for instance, the introduction and availability of greatly improved graphite pencils of varying hardness from 1790 onwards. Along with the introduction of new kinds of paper (e.g., wove paper), Joseph Meder explains that in the case of such improved pencils, «we have true simplicity in means of expression: a sharp but sensitive pencil, and well-sized white paper. The maturing of this technique led to a new school of drawing.» In further clarifying the importance of these new set of instruments, Meder cites the German artist Adrian Ludwig Richter who recollects that as a result of the new graphic means made available in the early part of the nineteenth century, «we paid more attention to drawing than to painting. The pencil could not be hard enough or sharp enough to draw the outline firmly and definitely to the very last detail. Bent over a paintbox no bigger than a small sheet of paper, each sought to execute with minute diligence what he saw before him. We lost ourselves in every blade of grass, every ornamental twig, and wanted to let no part of what attracted us escape … in short, each was determined to set down everything with the utmost objectivity, as it were in a mirror.» [4]

There can be little doubt that Sir John F. W. Herschel too was a part of the same ethos that is represented by this «new school of drawing» initiated by technical advances in the production of improved graphite and paper. With the aid of a *camera lucida*, which went in to enhancing the precision and exhaustive detail included in pencil drawings, Herschel spent the early part of the nineteenth century making exceedingly detailed drawings of monuments, landscapes, and buildings during his travels through the Continent. [5] When one compares some of these exquisite graphite pencil drawings [fig. 1] made by Herschel with those pencil drawings he was to later make of the nebulae [fig. 2], one instantly recognizes a continued enthusiasm for minutiae; for an abundant, individual, and detailed depiction.

Abb: 1 >

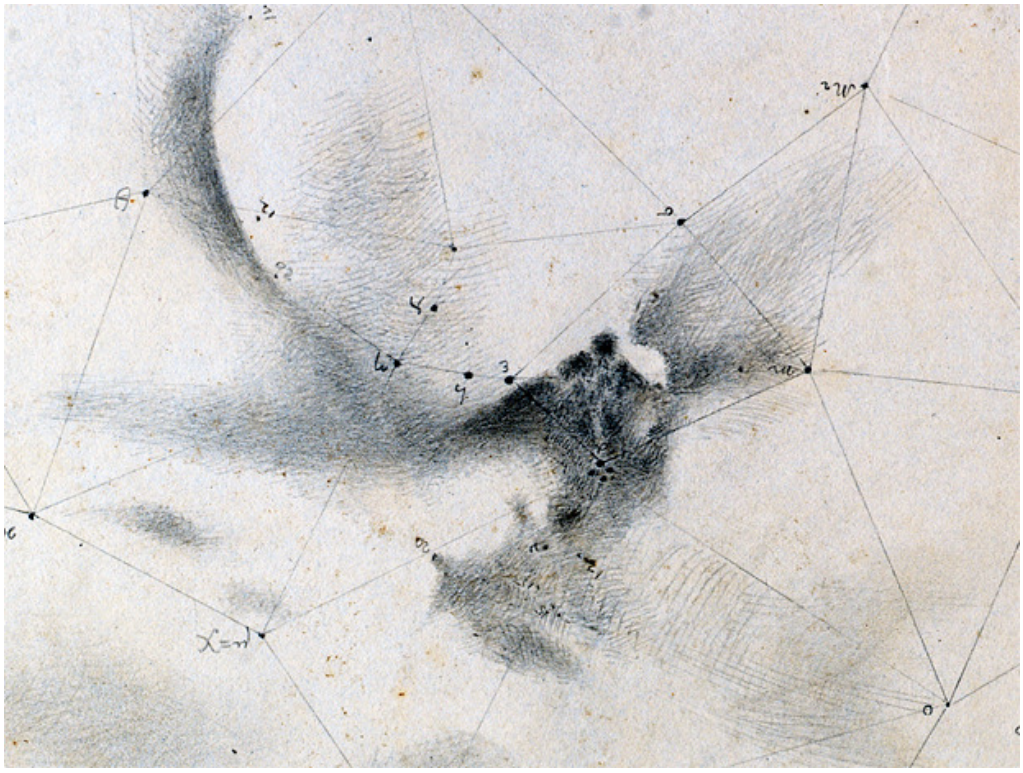

Abb: 2 >

It is no coincidence therefore that one of the central figures of nebular research in the nineteenth century reveled in exquisite and detailed pencil drawings, made with an expert hand. And unlike in many other areas of nineteenth century science, where the kind of work that went into visualization was associated with perfecting nature, for instance, or with the abstraction from the appearance of the phenomena (as in diagrams, graphs, charts, outlines and schematics), in the case of nebular astronomy the tendency was to mimetically and minutely capture as much as was possible. We will, in fact, even encounter techniques used by Herschel in his detailed drawings of the nebulae that enabled him to avoid losing himself in the labyrinth of details that he attempted to see his way through, and this, again, with the aid of paper and pencil.

As has been suitably established, in many cases in the history of science the ways in which phenomena were pictorially represented often depended on the introduction and availability of new or improved instruments. But such instruments as the graphite pencil, if we begin to take them seriously as such, heralded not only new schools of drawing, with new ways of representing, gesturing and even positioning the body, but also altered the very acts of drawing, seeing and knowing. With the kind of care, precision, and «minute diligence» made available to a draughtsman, the world might be attended to and seen differently. Consequently, what I wish to emphasize throughout this work is that specific acts of drawing, exemplified in what follows by pre-published sketches of the nebulae, were used in order to see with, to see more with, to see differently with, to make out with, to tease out visual details with, and to explore or probe with.

It has long been known to art historians that a hand drawn study, a preliminary sketch, a scribble, or a finished drawing, permit an intimate entry point into a master's «signature» style, in a way that painting, for instance, which tends to cover the movements of the hand and its unique strokes, may not. In many cases, an individual drawing's own history, left behind in the traces made by pen or pencil, ink or graphite, is palpable to an expert examination, and contains within itself an immediate «record of a physical act.» As the art historian David Rosand has put it: «the drawn mark is the record of a gesture, an action in time past now fixed permanently in the present; recalling its origins in the movement of the draughtman's hand, the mark invites us to participate in that recollection of its creation.» [6] Rosand goes on to accentuate the act of drawing's dynamic «probing,» «groping,» «grasping,» and «exploratory» features. [7] It will become evident that the working images in the observing books of the astronomers behaved exactly in these dynamic ways as well.

What is more, Rosand goes on to connect these exploratory features of the act of drawing to ways of seeing and knowing, especially as they are famously exemplified in the case of Leonardo da Vinci. Whether in the latter's drawings of horses, his anatomical drawings, or the sketches made of whirlpools and locks of hair, one thing that becomes unmistakably clear, according to Rosand, is that «Leonardo's mode of drawing is a mode of knowing» – something that was acknowledged by the Italian polymath himself. [8] In fact the very stylus and paper used, the pressures of the hand, and the quality and species of the line employed in a drawing may have all effected and influenced the way in which Leonardo might be said to come to see *and* know what was drawn. [9]

Whether in the case of Leonardo or in the case of our nebular observers; whether it was John Herschel standing before an Italian landscape with a pencil and paper in hand or at the eyepiece of a telescope, the following observation by Paul Valéry, a keen draughtsman himself and an aficionado of Leonardo's drawings, is therefore apt: «There is a tremendous difference between seeing a thing without a pencil in your hand and seeing it while *drawing* it.» [10] It was this difference that was exploited by the observers of the faint, optically delicate, and unfamiliar nebulous objects.

In accord with the observational and epistemological potentials of seeing while drawing by hand an object, Barbara Wittmann has explicated a case in which a contemporary scientific draughtsman at the Berlin Museum of Natural History discovered through the act of drawing a specimen significant features of it that went entirely unnoticed by the scientist(s) for whom the drawings were made. [11] But notice, the draughtsman and scientist in this case are not one and the same person. This division between an hired artist and a scientist has its own history, as the work of Kärin Nickelsen has amply shown. Using cases from eighteenth century botany, she shows that many drawings meant for scientific purposes were a part of a process that divided the labor between the hands of a hired artist and the expert eyes of a scientist. [12] Daston and Galison have referred to this division in labor as a «four-eyed sight». [13]

Yet there is another entire category of scientific observer who draws for himself or herself; where eye and hand remain undivided. It was this category of observer (or observer-draughtsman) that Julius von Sachs wished to extol in his influential *History of Biology* (1875). In direct opposition to any perceived value of a four-eyed sight in the observations with a microscope, Sachs writes:

«It is exactly in the process of drawing a microscopic object that the eye is compelled to dwell on the individual lines and points and to grasp their true connection in all dimensions of space; it will often happen that in this process relations will be perceived, which previous careful observation had disregarded, and which may be decisive of the question under examination or even open up new ones. As the microscope trains the eye to scientific sight, so the careful drawing of objects makes the educated eye become the watchful adviser of the investigating mind; *but this advantage is lost to the observer who has his drawings made by another hand.*» [14]

From this vantage point, part of what I attempt to do in this book is explicate what kinds of epistemic and scientific advantages there might be in making one's own hand drawings; that is, I am seeking to articulate those advantageous components to observation which Sachs says are at risk of loss not only by a four-eyed sight, but by extension, photography too. For it just so happens that for most of the nineteenth century the vast majority of nebular observer's made their own hand drawings of the nebulae and star-clusters. And even in the case of Lord Rosse, where many assistants were hired to make observations and drawings, the act of drawing and seeing by one and the same observer was something that was emphasized and incorporated into the procedure. For the Rosse project the problem was not a division of labor as much as it was the coordination and consolidation of the observational work of many different observer-draughtsmen. [15]

It is in coming to terms with the role played by the observer-draughtsman in the procedures of observation that I will come to draw attention to what I will call the *process of familiarization*. The process begins at the intimate level of an individual observer as he begins to mark down, usually in a manner peculiar to him and/or to his training, a variety of inscriptions into his own individualized observing book. The exploratory and discerning features of the act of drawing are important for the process. Through an observer's intimate and idiosyncratic act of drawing he gradually comes to familiarize himself with an object that is not only unfamiliar, but one which is in most cases difficult to understand, to see and to draw. The familiarization that takes place at this personal, visceral, and haptic level, therefore, acquaints one (even in the process involved in the making of one sketch) with what is being seen, with how to draw what is being seen, and with an object's known, unknown, and challenging features. [16] But it is also especially the *repeated* drawing of an object that contributes to an observer's familiarity.

It is this process, which is usually at its most potent and efficacious in its *coming-to-know* aspects early on in an observer's work on the nebulae, that over time translates into an acquaintance with what sorts of eyepieces, for example, are best for showing what has become visually familiar, or what requires calibration in the procedures or instruments employed, and so on. This personal and intimate set of actions contributes to the slow, gradual familiarization with an «epistemic object.» [17]

In stressing the processual, repetitive and gradual character of familiarization, however, we have already moved beyond the initial, momentary sketch that an observer-draughtsman began the process with. This is necessary, because the true potential of the operations of pencil on paper occurs gradually and piecemeal over time, as they unfold within a systematic procedure of observation. What is characteristic about many of the nineteenth century nebular observational programs is that the published image of an object is always preceded by a collection of many kinds of sketches of the same object done on a number of nights. To remain solely at the very preliminary and initial stages of a process would therefore not reflect nor capture what is most fascinating about the published standard visual figures of the nebulae produced: their purported ability to transcend a particular night and its observational conditions, an observer's idiosyncrasies, the many individual and nightly sketches made of the object, the idiosyncrasies of a nebulous object, and even in some cases the particular specs of the telescope used.

What made the published figures well suited in their capacity to visualize the phenomena, it was thought, was exactly their facility, reflected in the manner of their production, to overcome the peculiarities and specificities of site, observer, instrumentation (whether telescope or stylus) and individual glimpses. In order to understand this capacity of the published image, one must understand how it was that an observer went from an individual sketch imbibed with personality, idiosyncratic preferences, a situatednesss in a particular place, temporary scaffolding, errors, and so on, all the way to a final pictorial representation deemed fit for engraving, publication, and ultimately for the scientific gaze.

Observing by Hand will therefore attempt to articulate the productive role of the hand into the history of scientific observation, a history that tends to be told primarily by means of minds, eyes, and novel instruments.

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Fussnoten

Seite 66 / [1]

On immutable mobiles, see: Bruno Latour, Visualization and Cognition: Thinking with Eyes and Hands, in: Knowledge and Society: Studies in the Sociology of Culture Past and Present 6, 1986, pp. 1–40.

Seite 67 / [2]

For more on the history of scientific observation see the collection of essays in Lorraine Daston, Elizabeth Lunbeck (ed), Histories of Scientific Observation, Chicago/London 2011. Also see: Jonathan Crary, Techniques of the Observer: On Vision and Modernity in the Nineteenth Century, Cambridge, MA 1992. But the best work on scientific observation in the early to mid part of the nineteenth century still remains: Christoph Hoffmann, Unter Beobachtung: Naturforschung in der Zeit der Sinnesapparate, Göttingen 2006.

Seite 69 / [3]

See: Lorraine Daston and Peter Galison, Objectivity, New York 2007. This is not to say that my results will necessarily contradict their more general story, it may even go on to supplement it in the particulars.

Seite 69 / [4]

Joseph Meder, The Mastery of Drawing, translated by Winslow Ames, New York 1978, pp. 117–118.

Seite 69 / [5]

See: Larry Schaaf, Tracings of Light: Sir John Herschel and the Camera Lucida, Drawings from the Graham Nash Collection, San Francisco 1990.

Seite 71 / [6]

David Rosand, Drawing Acts: Studies in Graphic Expression and Representation, Cambridge 2002, p. 2.

Seite 71 / [7]

Idem., Drawing Acts: Studies in Graphic Expression and Representation, Cambridge 2002, p. 14; Also compare to: Gottfried Boehm, Zwischen Auge und Hand. Bilder als Instrumente der Erkenntnis, in: Jörg Huber,Martin Heller ed., Konstruktionen Sichtbarkeiten, Wien/New York 1999, pp. 215–227.

Seite 72 / [8]

David Rosand, Drawing Acts: Studies in Graphic Expression and Representation, Cambridge 2002, p. 107.

Seite 72 / [9]

This has been beautifully brought out from a detailed examination of Leonardo's notebooks in: Hana Gründler, Against «the fatigue in mind»: Leonardo's anatomical drawings as multiperspectival epistemic spaces, in: Alessandro Nova, Domenico Laurenza (ed.), Leonardo da Vinci's Anatomical World: Language, Context and Disegno, Venice 2011, pp. 131–155.

Seite 72 / [10]

In David Rosand, Drawing Acts: Studies in Graphic Expression and Representation, Cambridge 2002, p. 13. Valery's insight comes as a result of his own active efforts with an array of writing and drawing processes in his own Cahiers , see: Karin Krauthausen, Zwischen Aufzeichnung und Konfiguration. Der Beginn von Paul Valérys Cahiers, in: Karin Krauthausen, Omar W. Nasim (ed.), Notieren, Skizzieren. Schreiben und Zeichnen als Verfahren des Entwurfs, Zürich/Berlin 2010, pp. 89–118.

Seite 72 / [11]

Barbara Wittmann, Das Porträt der Spezies. Zeichnen im Naturkundemuseum, in: Christoph Hoffmann (ed.), Daten sichern. Schreiben und Zeichnen als Verfahren der Aufzeichnung, Zürich/Berlin 2008, pp. 47–72.

Seite 72 / [12]

Kärin Nickelsen, Draughtsmen, Botanists and Nature: The Construction of Eighteenth-Century Botanical Illustrations, Dordrecht 2006.

Seite 72 / [13]

Lorraine Daston and Peter Galison, Objectivity, New York 2007, p. 84.

Seite 73 / [14]

Julius von Sachs, History of Biology (1530-1860), translated from the German by Henry Garnsey, Oxford 1890 (revised edition), p. 260.

Seite 73 / [15]

Consequently, with its focus on the observer-draughtsman my work is closely related to Horst Bredekamp's profound analysis of Galileo's drawings of the Moon's surface and the sunspots, wherein we have another instance of the scientific value of the act of drawing for astronomical observations: Horst Bredekamp, Galilei Der Kuenstler: Der Mond. Die Sonne. Die Hand, Berlin 2007.

Seite 73 / [16]

The gestural aspects are essential to the process of familiarization, and therefore relate well to Sibum's helpful notion of «gestural knowledge,» see: Otto H. Sibum, Working Experiments: A History of Gestural

Knowledge, in: Cambridge Review 116, 1995, pp. 25–37.

Hans-Jörg Rheinberger, Towards a History of Epistemic Things:
Synthesizing Proteins in the Test Tube, Stanford 1997, pp. 28–30.

Abbildungen

Seite 70 / Abb. 1

Camera Lucida Drawing by John Herschel in August 1824 in Tivoli. Reproduced from Schaaf 1990: 59, plate 14.

Seite 70 / Abb. 2

A detail from a working skeleton for M42, the work for December 28, 1836, «Monograph θ Orionis», John Herschel Papers, Royal Astronomical Society: JH 3/2, p. 41. Courtesy of the Royal Astronomical Society.