image: *www.nasa.gov/content/hubble-sees-a-smiling-len*

episode 4 (2018 April) *Personal records of the sky*

Heather: Hello everyone! Welcome to the fourth episode of the RASC 150 History Podcast, in which we metaphorically and surreptitiously peer yet again around the corner in pursuit of our astronomical predecessors, as they pursued things astronomical. My name is Heather Laird, I am a Director of The Royal Astronomical Society of Canada, and my co-host is the RASC Archivist, Randall Rosenfeld. Say hello, Randall!

Randall: *[some mumbled greeting, or other]*.

Heather: This episode is concerned with Personal Records of the Sky. What do we mean by that?

Randall: Amateur astronomers are often counselled to keep records of their observations. From a scientific standpoint, the observation in the log book is the primary record of a phenomenon visually observed, and for phenomena detected by other means (*e.g.*, photographically on glass plates, or on electronic photodetectors), the log book provides the meta-data recording the circumstances of the observation, and it's that data about the data which can render the observation conveniently retrievable, and readily usable. Amateur and professional practices started from the same place, but the scale and complexity of professional science now means there are considerable differences between the two, yet the ideal evidential value of observational notebooks is a constant.

Heather: The primary records of the science which has been performed—our observational notebooks, scientific journals, lab books, and logbooks—are the key artifacts for knowing what was done in the places where fundamental and applied research took place. They are where one turns, to know what actually happened in the lab or at the eyepiece; what apparatus, experimenters, and techniques were involved; what the original sequence of the experiment was, what went right, what went wrong; and how those present initially received the results. They are the most important scientific artifacts.

Having said all that, it must be acknowledged that observational notebooks are documents produced first and foremost for the benefit of the researchers conducting the experiments. Like any genre of document, they are shaped by convention, and may omit information desired by those from outside the immediate research environment. To read them with understanding, it is important to understand those conventions. Information may not be noted because it wasn't foreseen as useful at the time. It may not be possible to recover the meaning of all the conventions used in notebooks reflecting the practice of a lab, and only partial recovery of an experiment or observation may be possible based on the surviving notebooks. None of this reduces the importance of observational notebooks.

Randall: There is something almost sacred about the status of scientific notebooks, which is understandable given their function, and contents. They can be consulted if doubts arise about reported results; they can be mined for data which had been omitted from the published record, or for reprocessing data with techniques developed after the observations; they can be turned to if the published data seems suspect; and they can play a role in priority disputes. Belief in the integrity of the scientists doing the science is crucial for progress within and outside scientific disciplines, and, in some respects, scientists' notebooks are repositories of that integrity.

The history of astronomy offers several instructive examples. Among the most famous, concerns the integrity of the Jesuit astronomer Maximilian Hell's transit of Venus observations from 1769 (yes, that is his real name). Fr. Hell's expedition enjoyed observational success from arctic Norway, but his decision to delay release of his transit observations till he could present them to the patron of his expedition, King Christian VII of Denmark, caused friction with his contact at the Royal Academy of Sciences in Paris, the influential and very colourful Jérôme Lalande (Lalande courted celebrity—he was famous for eating spiders, he published a supplement to Maréchal's *Dictionary of Atheists* (1805), and he championed the scientific education of women, and their active involvement in research; unfortunately, he lived too early to be a RASC member). In anti-Jesuit Europe it was put about that Fr. Hell withheld his observations because his expedition was unsuccessful, but his publication of them, duly dedicated to his patron, followed the year after the transit, and all was well in the Republic of Scientific Letters—for a time.

Heather: In 1835, long after all the principals were dead, Karl Littrow, of the Imperial Observatory in Vienna, which Fr. Hell had formerly directed, claimed that Fr. Hell had falsified his observational results in his notebook, delaying publication so that he could make his published data agree with that of other astronomers. Such a charge strikes at the very heart of a scientist's integrity, for it asserts the worthlessness of his data, with his notebook as the evidence of his crime, the whole thing made worse by the fact that the charge was brought by an astronomer of Fr. Hell's own institution. Karl Littrow claimed that the changes in Fr. Hell's notebook were obvious because data were entered in inks of different colour. The case did not end there, however, for in 1883, after Littrow himself had died, RASC member Simon Newcomb, Director of the US Nautical Almanac Office, in connection with his project to re-reduce 18th-century transit of Venus observations, examined Fr. Hell's notebook in Vienna. Simon Newcomb's conclusion was that erasures and corrections were indeed on the pages of Fr. Hell's transit observations, but they "...were made at the time of writing, and without the slightest intention of giving [anything] but the actually observed moment when Venus was first seen". And Newcomb discovered that Littrow's colour blindness meant that Littrow was incapable of discerning if Fr. Hell used different batches of ink, or not. The integrity of Fr. Hell's practice of science in his transit of Venus observations was upheld by Newcomb, on the basis of establishing the integrity of Fr. Hell's observational notebook. Notebooks matter.

Randall: The observational notebook, or lab book used by amateurs takes many forms: it can be that most traditional repository of record, an elegantly bound notebook in black, like the small Parisian *carnets* which have been recently revived, or printed lined paper in a binder, pad, or permanent binding, or any customary notebook form; or it can be a word processing program, or app, on a tablet or smart phone. Any technology for making notes can and likely has been used, it's a matter of personal preference, and what's to hand. The modern observational notebook's origin goes back to a time when amateurs and professionals habitually made use of the same technologies; an amateur of today who uses a *carnet*-form book is employing a technology not too distant in spirit and appearance from Charles Darwin's notebooks, and those who use lined printed paper for notes follow in the footsteps of RASC members James Edward Keeler, and Edwin Hubble.

Heather: How old is the noting of what we would now call scientific data in a retrievable form? That is rather hard to say. In the era of the Space Race, Alexander Marshack argued that “time-factored, relational” marks on mobilary Upper-Palaeolithic artifacts constitute evidence of the systematic recording of astronomical observations. Central to his discussion were engravings on the abri Blanchard bone, dating to the Auginacian period (that's about 32,000 years before the present!). Marshack's claims remain controversial, although not without a few respectable supporters. With the Babylonian Astronomical Diaries, the earliest of which dates to the mid seventh century B.C., we're on more secure, if still alien ground, which symbolically and more than symbolically can stand for the beginning of the long accumulation of astronomical data on which modern astronomy is built.

Randall: The RASC Archives, alas, do not possess any observational notebooks which could remotely be considered “ancient”. The RASC does not even possess a reasonably complete log book used by any of the Society's founders. What we do have are single pages of a few planetary observations from 1868, and these appear to be second-generation copies of the graphic records of the observations by the original observer, probably executed the day after the observations were made. We’re grateful even to have those second-generation copies, given the role of chance in the survival of vestiges of the past.

Heather: In the period bounded by the Society’s founding and the grant of our Royal appellation, the early members of the Society could turn to observing guides for prescriptive advice on using observational notebooks.

Among the most respected of those guidebooks was the Prebendary Webb’s *Celestial Objects for Common Telescopes* of 1859, which went through numerous editions, the most important of which the Society was publicly thanked for furthering.

Webb advises: *[quote]* "Do not avoid the trouble of recording regularly all you see, under the impression that it is of no use. If it has no other good effect, it tends to a valuable habit of accuracy: and you might find it of unexpected importance. And, like old Schroter, trust nothing to memory. If there has been haste,—and sometimes if there has not,—it is surprising what unforeseen doubts may arise the

next day: make at least rough notes at the time, and reduce them speedily into form, before you forget their meaning... But whatever is seen should always be recorded...” *[close quote]*. And, regarding lunar observation in particular, he states: *[quote]* “My own very limited opportunities have satisfied me, not only how much remains to be done, but how much a little willing perseverance might do...The record, to be of value, must possess four data: 1. *Hour of Observation*;—2. *Moon's Age*, from our near to the nearest change;—3. *Position of Terminator*, referred to any adjacent well-marked spots;—4. *Libration*, indicated by time reckoned to or from nearest epoch of greatest libration...” *[close quote]*. This advice remains good. Its Victorian style aside, the gist of the advice could be issued today.

Randall: One of the most significant meteoriticists of the late nineteenth and early twentieth centuries, William F. Denning, devoted a brief section of his demanding observational guide to the subject of the amateur’s notebook. Denning, a respected member of the RASC and a contributor to the earliest editions of our *Observer’s Handbook*, was very concerned to raise the quality and quantity of real science produced by amateurs. He recommended: *[quote]* “With regard to records, every observer should make a note of what he sees, and at the earliest possible instant after the observation has been effected. If the duty is relegated to a subsequent occasion it is either not done at all or done very imperfectly. The most salient features of whatever is observed should be jotted down in systematic form, so as to permit of ready reference afterwards. It is useful to preserve these records in a paged book, with an index, so that the matter can be regularly posted up. The negligence of certain observers in this respect has resulted in the total loss of valuable observations. Even if the details appear to possess no significance, they should be faithfully registered in a convenient, legible form, because many facts deemed of no moment at the time may become of considerable importance. The observer should never refrain from such descriptions because he attributes little value to them. Some men keep voluminous diaries in which there is scarcely anything worth record; but this is going to the other extreme. All that is wanted is a concise and brief statement of facts. Some persons have omitted references to features or objects observed because they could not understand them, and rather distrusted the evidence of their eyes; but these are the very experiences which require careful record and reinvestigation” *[close quote]*. As with the Rev’d Webb’s advice, Denning’s recommendations were, and remain very sound.

Because of the poor survival of early observational notebooks from the beginning of the Society, we don't know how many of our first members followed the advice and example of Webb, and Denning. Both were clearly respected and admired figures. It would have been a shame if they hadn't been heeded.

Heather: Amateurs weren't the only ones advised to keep records. It comes as no surprize to learn that undergraduates in contemporary astronomy courses were expected to keep observational notebooks, and told how to go about doing so. A clear example is from a course textbook by Mary E. Byrd, one of the Harvard College Observatory computers, who went on to direct the Smith College Observatory, and earn a doctorate in astronomy. In late 19th- and early 20th-century North America some very competent female astronomers begin to carve out a place for themselves in the professional discipline in the wake of Mariah Mitchell. Progress was not rapid.

Mary Byrd's instructions are worth quoting in full. They are as sensible as that of Webb and Denning, but more systematic:

[quote] "Rules for recording. Many of the following rules are observed by astronomers in keeping their own records, and most students, it is believed, will find all of them serviceable.

1. Begin each night's record on a separate page.

2. Date each page, giving both the day of the week and the day of the month.

3. Record, each night, the place of observing and the time of beginning and ending.

4. Enter the record in connection with the observation or immediately afterward.

5. Name in connection with every observation any instrument employed.

6. Give a full description of every instrument, if possible when it is first used.

7. Write out the notes in detail so that others following them could take the same observation in the same way.

8. For every answer give some data obtained directly from observation.

9. Make all answers complete in themselves.

10. Keep all records of direct, original observations in pencil.

11. Make all corrections of the original record in ink.

12. Enter copied observations in ink, giving two dates, the date of observing and the date of copying.

13. Write in ink answers that depend upon several observations taken on different nights, giving references to the different dates." *[close quote]*

What comes through uppermost in her instructions is the scientific integrity of the process. Her recommendations for the use of different recording media, pencil and ink, are direct, simple, clear, and above all functional. At a glance anyone examining observational records followed according to her instructions would know which was the original observation, which the copy, and what was corrected. Her advice could have served as well for amateurs as for undergraduates.

Randall: Observational notebooks, particularly amateur ones, or those of natural philosophers or astronomers from the early modern period to the Enlightenment, can be more than just repositories of observational data. In the realm of human experience, a log book can be an author's *aide-mémoire*, evoking the circumstances of observations decades after they were made, along with associated sites, sounds, and companions now long gone. They can also say quite a lot about the discipline and style of observing of the person who created them.

A prime example from our day is David Levy's extensive corpus of observing logs chronicling his varied and productive career as an observer spanning six decades—a career which is far from over. Except for his currently active observing log, the originals of his logbooks now reside in the Linda Hall Library of Science, Engineering, and Technology in Kansas City, Missouri, with the electronic facsimiles hosted on the RASC website.

Heather: Roy Bishop offers us a useful description of the features of David's logbooks: *[quote]* "Each page of his observing logs, in Levy's distinctive handwriting, typically contains records of half a dozen sessions. The record for each session begins with the session number, an indication of whether the session took place in daylight or dark (and if in dark, the portion of the night), the date (occasionally the month is indicated, but seldom the year), the clock times when

the session began and ended, an indication of sky conditions, the location, telescope(s) used, other people present, and observations. Levy developed a concise code for the basic information such that many of the session reports occupy no more than two or three lines. Asterisks precede observing sessions of particular significance, with up to three asterisks for those that were extraordinary" *[close quote]*. Remarkably enough, many of the practices recommended by Webb, Denning, and Byrd can be found embodied in David's observational notebooks. He likely would have known of Webb when he started his project, but as a young teenager he might not have known of Denning and Bryd. That his logbooks share the features they recommend attests to the soundness of their shared practice.

Randall: At the start of this podcast we spoke of "Personal Records of the Sky", and asked "What do we mean by that?". What we mean by that is what's found in David's logbooks beyond the individual practice of science. He mentions who observed with him, and one can find the comments and drawings of his observing companions in his observational notebooks as well. He mentions where he's observing from, and other details of the setting and social situation of doing, sharing, and communicating astronomy. The personal is also apparent in the particular conventions he adopts for abbreviations, and in the graphic style of his serious drawings, and the amusing, memorable, and recurrent Levy comet icon. His is a personal record of the sky which gives up nothing as a scientific witness by bearing the traces of the person who created it. And that, one way or another, can be said for all observational notebooks.

Heather: Thanks to everyone who tuned in, and we hope you enjoyed this podcast. If you have any questions, please visit www.rasc.ca/rasc-2018-podcasts for contact details.

Our next podcast is scheduled for a month from now, and is on doing science—or is it? Stay tuned to find out.

Our sound engineer is Chelsea Body, and our theme music is by Eric Svilpis.