The British Astronomical Association
Historical Section

Director: Mike Frost – FrostMA@aol.com
Deputy Director: Bill Barton – barton.bill@hotmail.com

Newsletter No. 22 Autumn 2020

Contents:

From the Director

Mike Frost

You won't be surprised to learn that the coronavirus is affecting our plans for the historical section. We had hoped to hold a section meeting on November 21st. This was planned to take place at the Birmingham and Midland Institute, home of the Society for the History of Astronomy's Sir Robert Stawell Ball library. We held a very successful meeting here three years ago. However, the BMI emailed me a few weeks back to inform me that meeting could not go ahead. Social distancing severely limited the numbers of people who could meet in the BMI's lecture theatres, and the Gallery, in which the SHA held a book sale at our last meeting, is closed.

So we have decided to switch to a virtual meeting (Zoom and Youtube, similar to the Wednesday webinars). This will also take place on the afternoon of November 21st, starting at 2:30 PM.

Our speaker will be Dr Geoff Belknap, Head Curator of at the National Science and Media Museum, Bradford, with a particular interest in photography and photographic technology. Geoff will be talking to us about the early history of astrophotography.

***

We have added a new section to the historical section web site, for "Officers of the British Astronomical Association". We list all the officers of the Association – presidents, branch presidents, treasurers, secretaries, librarians, curators of instruments and section directors – from the association's foundation in 1890 to the present day. Where applicable, we link to our database of obituaries from the Journal, or in some cases to the biographies of past directors which appear on section website.

As with our obituaries, the hard work to produce these lists was done by section deputy director, Bill Barton. We acknowledge research and assistance by my predecessor Tony Kinder; also the comprehensive lists of section officers which were produced for the Association's centenary in 1990.

The obituaries database has been a research boon to historians of astronomy, and we hope that our database of past-officers is of similar use. We're hoping that it will be given greater prominence on the BAA website in due course.

***

Talking of obituaries … In the last edition of the newsletter, I wrote a short piece celebrating some of our members who reached the top of their tree in non-astronomical subjects. Over the years, BAA membership has included two Nobel Prize winners (in literature and medicine), one Oscar winner (for best adapted screenplay) and one winner of the Victoria Cross. I wondered if we had any other members who had reached such distinguished heights.

As it turned out, we lost a distinguished former member even as we were preparing the newsletter. John Horton Conway, the eminent mathematician, passed away from complications arising from Covid-19 at Princeton on 2020 April 11th. Conway was a member of the BAA in his teens, joining in 1955. There's an excellent biography of him by Siobhan Roberts which says he was a member of the British Astronomical Society, rather than Association – I queried this by email with the author, who checked her notes and replied that that was what he had told her. So perhaps Conway misremembered.

Conway was most famous for inventing the Game of Life, the mesmerising cellular automaton which used to run as a screen-saver on PCs in days gone by. In later years, Conway came to feel that "Life" dominated his many other achievements; for example his discovery of Surreal Numbers, and his central contribution to the Classification Theory for Finite Simple Groups, which appears in the Guinness Book of Records as the longest mathematical proof ever published.

Conway was one of my lecturers when I was an undergraduate at Cambridge in the early 1980s. As a teacher he was inspiring, entertaining, and wholly useless, as he could never understand why the most complicated mathematical concepts weren't immediately obvious to journeymen undergraduates such as myself. But I forgave him.

He is, I think, probably the one actual genius I have ever met.

***

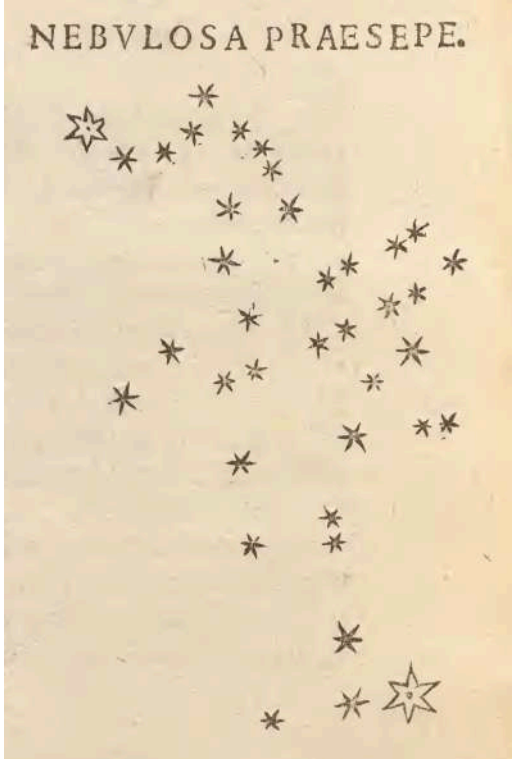
And finally ... my favourite obituary in the database is for another mathematician, Samuel Raby, who died in 1916 at the age of 87. The obituary is anonymous.

"…He was a pupil of the late Prof de Morgan, who expressed a high opinion of his mathematical abilities, and urged him to devote himself exclusively to mathematics. This Mr. Raby was not inclined to do, but, nevertheless, occupied himself, from time to time with mathematical investigations. Readers of Knowledge [a popular science journal] *will remember that Dr. Crommelin, in a recent No. Of that periodical, passed some strictures on a pamphlet by Mr. Raby on "Newton's Seventy-seventh Proposition," in which the author contends that he had discovered a flaw in Newton's proof. Dr Crommelin, however, has no difficulty in showing the erroneous nature of the contention…"*

Which, I suspect, may be a prime example of the old adage that:

If you want to be sure of the last word in an argument – put it in the obituary!

Mike Frost



The History of Star Clusters

Hannah Dalgleish

The nebulae that were not nebulae at all

Throughout history, our understanding of the Universe has been deeply entwined with the advancement of technology. Four hundred and ten years ago, on 13th March, Galilei (1610) published the *Sidereus Nuncius* (The Starry Messenger) which changed the course of astronomy forever. The work was the first examination of the heavens based on telescopic observation — his ideas were extremely controversial and led to a radical deviation away from an Aristotelian understanding of the Universe. Galilei revealed that the Moon's surface was neither translucent nor a perfect orb — as Aristotle had claimed — but instead covered with craters and mountains. Other breakthroughs include the discovery of four of Jupiter's moons; this revelation contradicted the notion that all heavenly bodies orbited the Earth, a key principle of Aristotelian astronomy.

Figure 1. Sketch of Praesepe, a "nebula" in the constellation Cancer. The two larger stars (upper left and lower right) are visible with the naked eye. The other 40+ stars are visible only with a telescope. Reproduced from Galilei (1610).

Less known is Galilei's study of Praesepe, a so-called "nebula", the Latin name for 'cloud' or 'fog'. For millennia, misty patches in the night sky have been referred to as nebulae, from comets to open clusters to the Andromeda galaxy (Jones 1975; Archinal &Hynes 2003; Hoskin 2008). As Galilei looked through the lens of his telescope Praesepe was not nebulous, but instead revealed faint stars clustered together (Figure 1). Of all the nebulae observed at the time, the Orion nebula was the first true nebula to be discovered, by Nicolas Claude Fabri de Peiresc in 1610 (Chapin 1957). Intriguingly, Galilei never mentioned the nebula in any of his works, despite devoting copious time observing the

constellation, giving rise to the thought that perhaps it was not visible to him at the time (Harrison 1984). Giovan Battista Hodierna also observed the Orion nebula, as noted in his remarkable 1654 publication. Hodierna was devoted to cataloguing and classifying nebulae (Figure 2), and presented a unifying (cosmological) theory to try and explain all that he saw. Unfortunately his work has gone by entirely unnoticed for centuries, save an in-depth account from Serio, Indorato, &Nastasi (1985).

Figure 2. The three classifications (Luminosae, Nebulosae, and Occultae) of nebulae as determined by Hodierna (1654).

Just as open clusters and galaxies were misidentified as nebulae, so too were globular clusters — as far as we know, Johannes Hevelius was the first to detect a globular, namely Messier 22. This was about 15 years before Edmond Halley (1679) observed a fuzzy blob, Omega Centauri, during his trip to St Helena in the South Atlantic Ocean (Burnham 1978; Cook 1998). Dick (2013), however, makes an interesting point: should the discovery of an object be attributed to the first person who observed it, or to the first person to have accurately described it? Following this reasoning, it is perhaps William and Caroline Herschel who are the true discovers of globular clusters, the first to resolve a cluster into its constituent stars, and thereafter the vast majority of clusters in the northern hemisphere (Herschel 1786, 1789, 1802).

After decades of study, the Herschels consequently faced the difficult question: are all nebulae simply congeries of stars waiting to be resolved? Inspired by observations of the Orion nebula (Figure 3), and after much deliberation, Herschel (1791) eventually came to judge that “the nebulosity about the star is not of a starry nature”, meaning that he had come to believe in the possibility of true nebulosity (Hoskin 2011b, 2011c; Nasim 2013). Solid proof came when William Huggins spectroscopically analysed the light from the nebula in Draco, confirming that it was made up of gas.

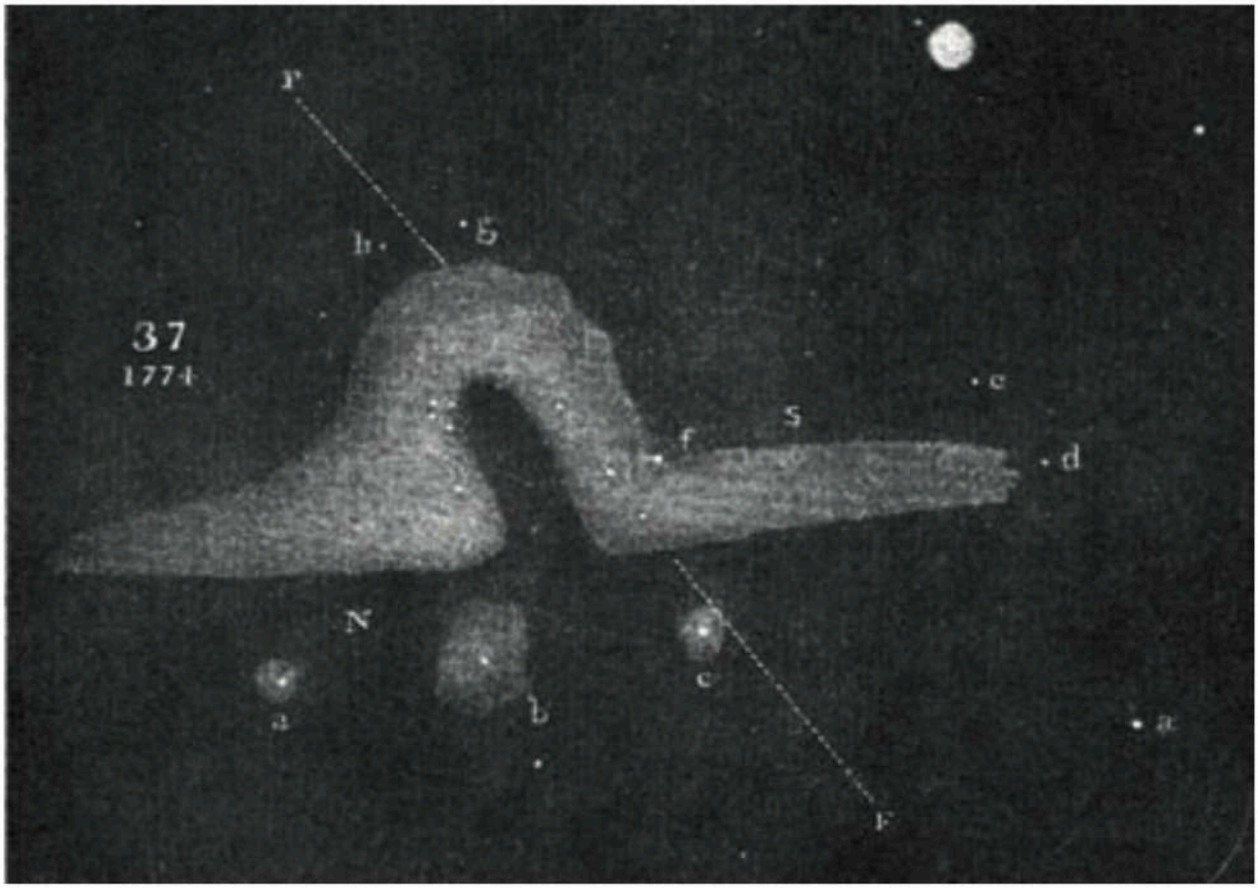


Figure 3. William Herschel's drawing of the nebula in Orion (1774). Reproduced from The Scientific Papers of Sir William Herschel, Vol. 2, Plate III, Fig. 37.

Having observed nebulae and star clusters in the thousands — significantly more than any other astronomer alive at the time — the Herschel's came to other fundamental conclusions. Herschel (1814) reasoned that each object was a snapshot in time under the order of a much greater evolutionary sequence (Figure 4). Beginning with nebulae, the luminous material would condense and collapse into stars; those stars would then gravitate together and form globular clusters, which he would go on to describe as "undoubtedly the most interesting objects in the heavens".

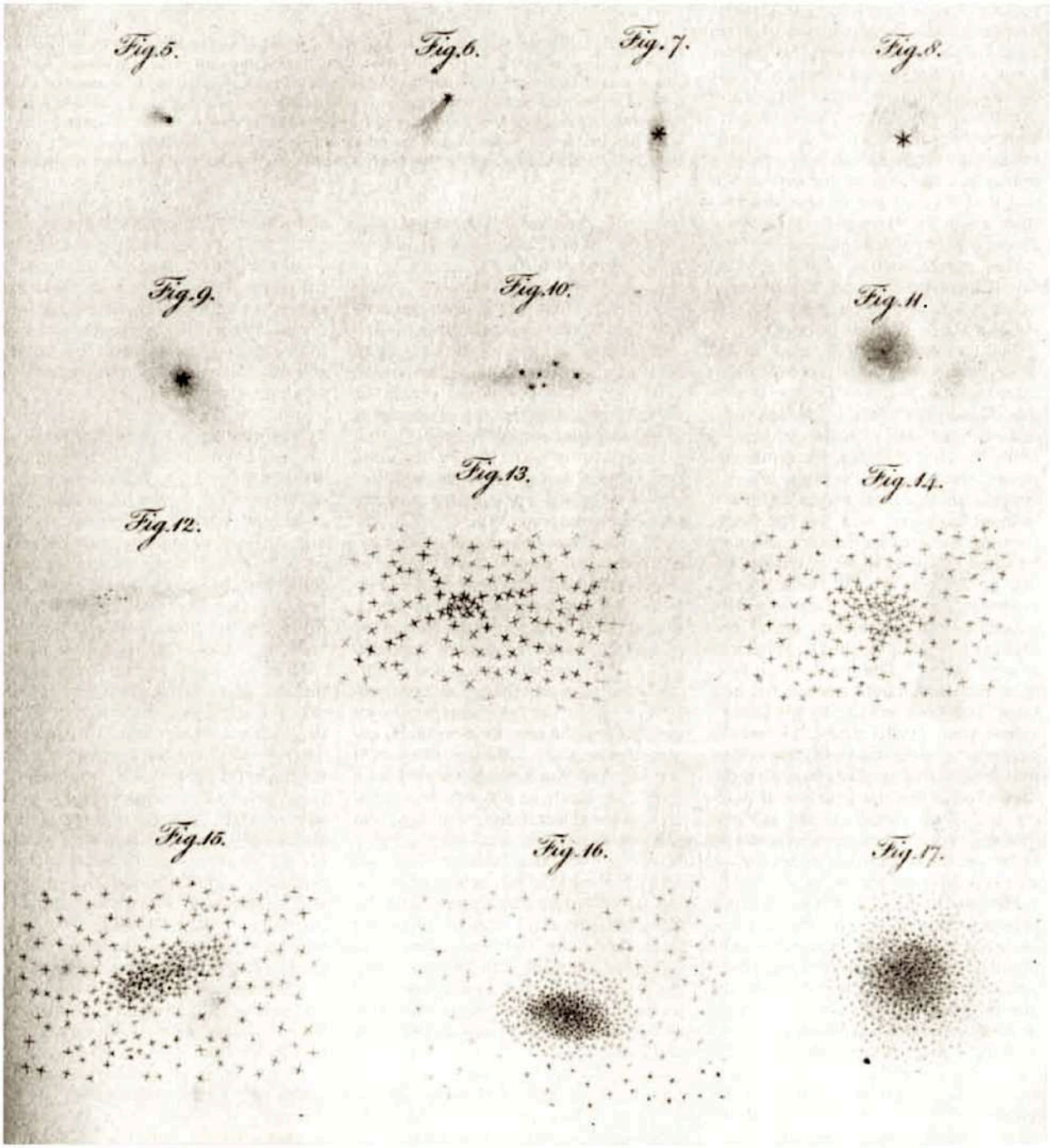


Figure 4. Herschel illustrates the maturation of nebulae and star clusters. Luminous matter congeals and accumulates, from which individual stars form. The stars continue to grow by accreting nebulosity and are then drawn together by gravity. The resultant globular cluster eventually tends toward collapse (bottom right). Reproduced from Herschel (1814).

Spectroscopy and photography: paving the way to stellar kinematics

It is said that modern astrophysics as we know it originates in spectroscopy and the explanation of the Fraunhofer lines. In recording the spectra of six different elements from flames and sparks, Kirchhoff & Bunsen (1860) reflected that a similar method could also be applied to stellar atmospheres, demonstrating the huge potential for the chemical analysis of stellar spectra.

At roughly the same time, it emerged that spectroscopy could do much more than detect elements in the firmament — the technique was central to further breakthroughs (i.e. radial velocities), which would open into a new branch of kinematics. The Doppler (1842) principle shows that the motions of an observer or source cause a shift in perceived frequency. Although incorrect, Doppler was certain that this effect explained a long-standing puzzle regarding the observations of different coloured stars. Unaware of Doppler's work, Fizeau gave a lecture in 1848 which accurately suggested that spectral line displacements could be used to measure celestial velocities. In two decades time it would become possible to measure the first line-of-sight velocity of a star, thus confirming Fizeau's prediction (Huggins 1868).

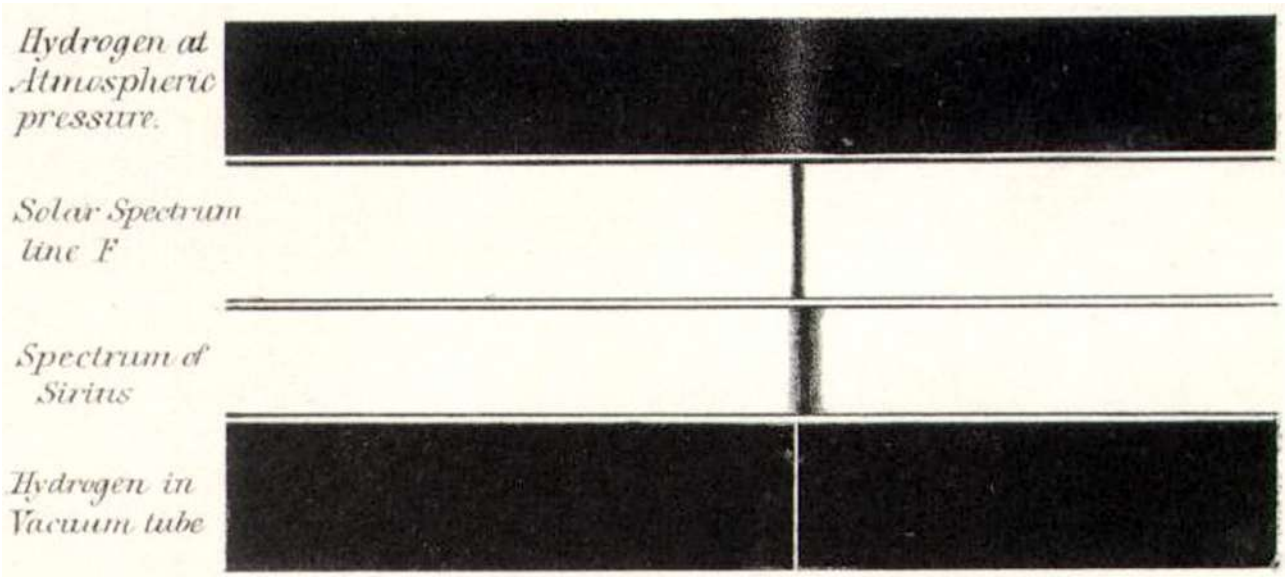


Figure 5. Spectra of Sirius, used to determine radial velocity. Reproduced from Huggins (1868), Figure 4.

Despite observing the brightest star in the sky, Sirius, Huggins' experiment was a tremendous feat as he had to measure the spectrum visually (Figure 5), before the invention of the dry gelatin photographic plate (Maddox 1871). Though his value was out by an order of magnitude, Huggins' efforts piqued the interest of other astronomers who would go on to record spectra on photographic plates and hence determine more accurate velocities for stars (Vogel 1873, 1889; Maunder 1885, 1892; Keeler 1890b) and nebulae (Keeler 1890a). But it would be many years until astronomers calculated stellar velocities in star clusters; first in open clusters (Trumpler 1935; Smith & Struve 1944; Struve 1944; Feast 1958), and later for globulars (Wilson & Coffeen 1954; Feast & Thackeray 1960).

The invention of photography was key to further astronomical revolutions. Prior to photographic plates and charge-coupled devices, astronomers depended on textual descriptions which were difficult to visualise, or drawings made by hand (e.g. Figure 6). Trouvelot was one such artist who was world-renowned for creating hundreds of accurate and evocative depictions of the Universe.

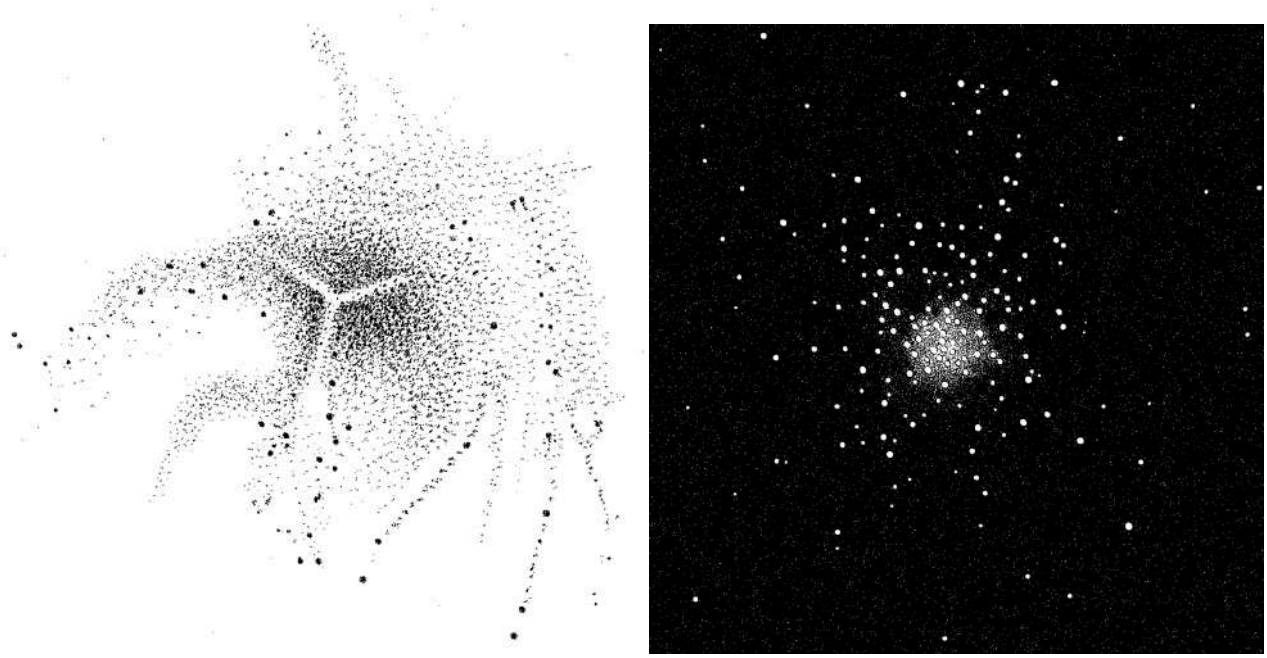


Figure 6. Drawings of the Herculean globular cluster, M13. Illustrated by Bindon Stoney in 1855 (left) and Trouvelot in 1874 (right). Reproduced from Rosse (1861) and Winlock & Trouvelot (1876).

As astrophotography grew in popularity, Isaac Roberts and Dorothea Klumpke became two of the most distinguished experts in the practice. They photographed hundreds of star clusters (e.g. Figure 7) and nebulae over several years and their work was of great value to the scientific community (Roberts 1893, 1899; Klumpke-Roberts 1929, 1931):

> *Every astronomical reader is familiar with Dr. Roberts' celestial photographs... He may be said to have continued with the photographic plate the work that the Herschel's accomplished visually with their giant telescopes. Dr. Roberts has not only nobly enriched astronomical science, but has a monument to himself which will last as long as astronomy has any interest for mankind. This handsome book, besides being a most valuable mine of information, serves as a demonstration of the success that has rewarded his efforts after an infinite amount of most skilful instrumental adjustment and working.*
>
> William Lockyer (1900)

Figure 7. M13, taken on 22nd May, 1887 with an exposure of 60 minutes. One of the first photographs of a globular cluster. 'Dark lanes' can be seen in the shape of a Y. These lanes were also noticed by previous artists (Figure 6). Reproduced from Roberts (1893).

So far, the aforementioned work has primarily focused on the Northern Hemisphere and the need for cataloguing the Southern skies was becoming evermore apparent. Edward Pickering, the fourth director of the Harvard College Observatory, was keen to achieve worldwide coverage of the sky and advance his *Harvard Photometry* catalogue. Pickering seemed to have a natural ability to secure funding; through procuring a $238,000 bequest left by Uriah A. Boyden (Bailey 1931), in combination with additional funds from the New England elite, he was able to undertake an ambitious quest — the construction of a Southern observatory at high altitude.

In 1889, Solon Irving Bailey, Pickering's closest and most trusted collaborator, embarked on an expedition to the Andes to scout for an elevated site worthy of astronomical research. Bailey travelled with his wife, three-year-old son, and brother (Ruth, Irving, and Marshall), reaching as far south as Santiago. After two years of arduous search, Bailey settled on a site near Arequipa in Peru, at 8,055 feet. The Boyden Station would remain in active operation until the end of 1926; Ruth and Solon Bailey went on to visit Arequipa five times in total, alternating between the Station and Cambridge (MA).

In Peru and on his various trips through tropical wilds, Bailey encountered many exciting situations, including rapids, earthquakes, a revolution, and a mild naval battle. He passed through all these vicissitudes with his usual alert serenity.

Edward S. King (1931)

Over the years spent at Arequipa, Bailey made thousands of photographs, never wasting a moment of clear sky. Every plate was sent back to Cambridge and analysed by the Harvard Computers, led by Williamina Fleming. Their detailed investigations revealed thousands of unseen astronomical objects, including nebulae, variable stars, novae, asteroids, satellites, and more (Bailey 1931). Bailey's plates of the Magellanic Clouds enabled Henrietta Leavitt's discovery of the Cepheid period-luminosity relationship. It was Bailey who discovered the existence of a new type of variable star (RR Lyraes). Undoubtedly, his observations built the foundations upon which Shapley would later become so famous (Cannon 1931). In particular, Bailey also partook in exciting and novel work in the realm of globular clusters. Bailey (1893) was the first to try and quantitatively infer the distribution of stars within a globular cluster (Figure 8). Further work was carried out by Palmer 1899; Pickering & Fleming 1897; Bailey 1916, and included the first radial density profiles.

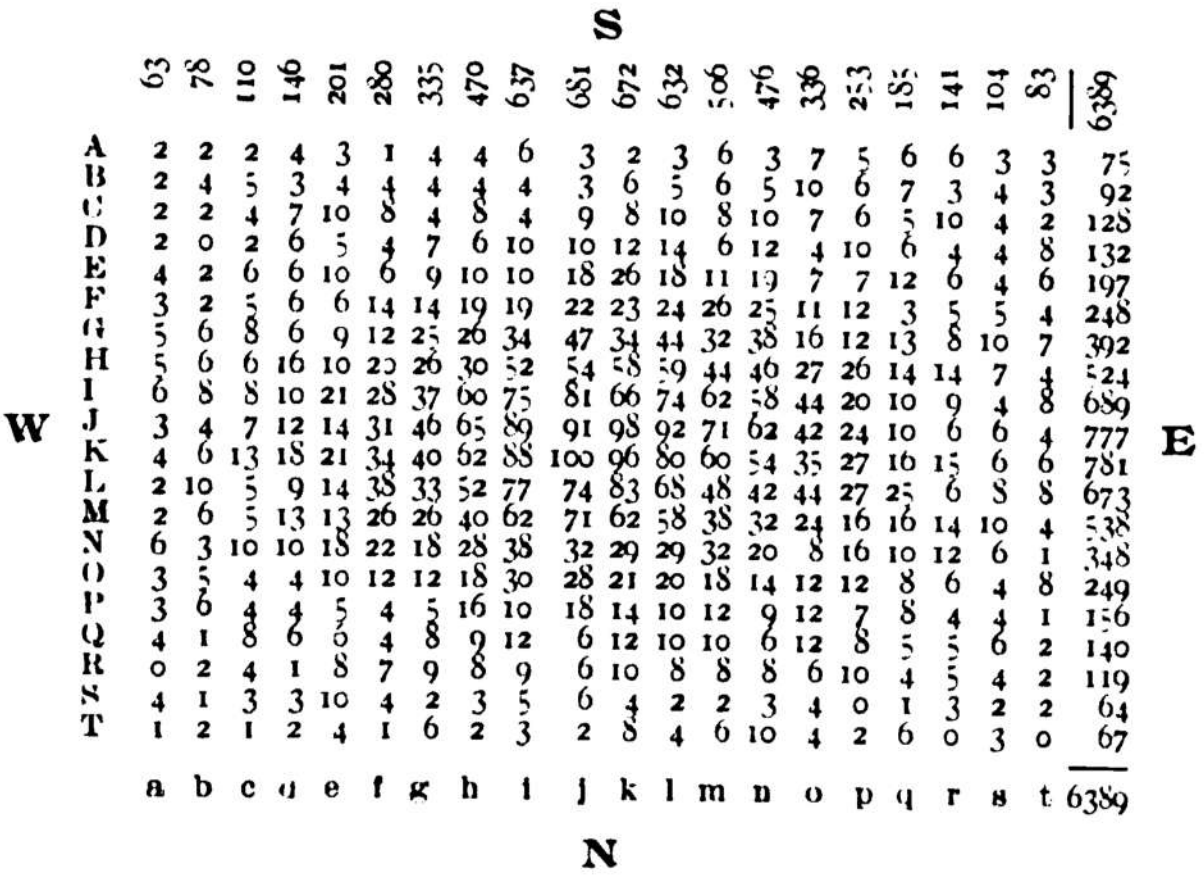


Figure 8. The mean number of stars distributed in Omega Centauri as counted by Solon and Ruth Bailey. The data was obtained from a two-hour exposure taken on a photographic plate in Arequipa, Peru. Reproduced from Bailey (1893), Figure 2.

To this end, I conclude a brief history of star clusters with an aim to cover the discoveries which eventually led to the field of kinematics. There is much more globular-related

science that has not been discussed; for an excellent overview which extends to chemistry, distance measurements, proper motions, binaries, stellar populations, Leavitt's period-luminosity relation, the Hertzprung-Russell diagram, etc. see Shapley (1930) and Sawyer Hogg (1959).

For the fascinated reader who wishes to delve deeper, see Archinal & Hynes (2003) for a historical study of star clusters; Hockey et al. (2007) for a splendid encyclopedia of astronomers; Hoskin (2008, 2011a, 2012) for all things William and Caroline Herschel; Hearnshaw (2009, 2014) for the cultural and social history of astronomical spectroscopy; Steinicke (2010) for the making of the New General Catalogue; Gingerich (2010) for the birth of astrophysics (*c.*1850 – *c.*1920); Dick (2013) for discussion on the concept of 'extended discovery' as the engine of progress; and Nasim (2013) for the production and reception of hand-drawn images of nebulae in the 19th century.

References

Adams, W. S., A. H. Joy, R. F. Sanford, and G. Stromberg. 1929. "The radial velocities of 741 stars." 70 (November): 207–36. https://doi.org/10.1086/143220.

Archinal, Brent A., and Steven J. Hynes. 2003. *Star Clusters*.

Bailey, Solon I. 1893. "Omega Centauri" 12: 689.

———. 1916. "Globular Clusters." *Annals of Harvard College Observatory* 76 (4): 43–82.

———. 1931. "The history and work of Harvard observatory, 1839 to 1927; an outline of the origin, development, and researches of the Astronomical observatory of Harvard college together with brief biographies of its leading members." In *Harvard Observatory Monographs*, 4:1.

Ballot, Buijs. 1845. "Akustische Versuche auf der Niederländischen Eisenbahn, nebst gelegentlichen Bemerkungen zur Theorie des Hrn. Prof. Doppler." *Annalen Der Physik* 142 (11): 321–51. https://doi.org/10.1002/andp.18451421102.

Burnham, Jr., Robert. 1978. *Burnham's Celestial Handbook: An Observer's Guide to the Universe Beyond the Solar System, in three volumes.*

Cannon, Annie J. 1931. "Solon Irving Bailey, 1854-1931" 43 (255): 317. https://doi.org/10.1086/124151.

Chapin, Seymour L. 1957. "The Astronomical Activities of Nicolas Claude Fabri de Peiresc." *Isis. Journal of the History of Science Society* 48 (1): 13–29.

Cook, Alan. 1998. *Edmond Halley. Charting the heavens and the seas*.

Dick, Steven J. 2013. *Discovery and Classification in Astronomy*.

Doppler, C. 1842. "Ueber das farbige Licht der Doppelsterne und einiger anderer Gestirre des Himmels." *Abhandlungen Der K. Böhm* 2: 465–82.

Draper, Henry. 1880. "Photograph of the Nebula in Orion" 22 (573): 583. https://doi.org/10.1038/022583a0.

Feast, M. W. 1958. "Spectral types and radial velocities in the galactic cluster NGC 3293" 118 (January): 618. https://doi.org/10.1093/mnras/118.6.618.

Feast, M. W., and A. D. Thackeray. 1960. "47 Tucanae : Radial velocities and spectral types of individual stars" 120 (January): 463. https://doi.org/10.1093/mnras/120.5.463.

Galilei, Galileo. 1610. *Sidereus nuncius*. https://doi.org/10.3931/e-rara-695.
Gingerich, Owen. 2010. *The General History of Astronomy*.
Hafez, Ihsan, F. Richard Stephenson, and Wayne Orchiston. 2015. “The Investigation of Stars, Star Clusters and Nebulae in ’Abd al-Rahman-Sufi’s Book of the Fixed Stars.” In *New Insights from Recent Studies in Historical Astronomy: Following in the Footsteps of F. Richard Stephenson*, 43:143. https://doi.org/10.1007/978-3-319-07614-0_10.
Halley, Edmund. 1679. *Catalogus Stellarum Australium sive Supplementum Catalogi Tychonici exhibens Longitudines et Latitudines Stellarum fixarum...*
Harrison, T. G. 1984. “The Orion Nebula - where in History is it?” 25 (March): 65–79.
Hearnshaw, John. 2009. *Astronomical Spectrographs and their History*. https://doi.org/10.1017/CBO9780511735288.
Hearnshaw, John B. 2014. *The Analysis of Starlight*.
Herschel, William. 1786. “Catalogue of One Thousand New Nebulae and Clusters of Stars.” *Philosophical Transactions of the Royal Society of London Series I* 76 (January): 457–99.
———. 1789. “Catalogue of a Second Thousand of New Nebulae and Clusters of Stars; With a Few Introductory Remarks on the Construction of the Heavens.” *Philosophical Transactions of the Royal Society of London Series I* 79 (January): 212–55.
———. 1791. “On Nebulous Stars, Properly so Called.” *Philosophical Transactions of the Royal Society of London Series I* 81 (January): 71–88.
———. 1802. “Catalogue of 500 New Nebulae, Nebulous Stars, Planetary Nebulae, and Clusters of Stars; With Remarks on the Construction of the Heavens.” *Philosophical Transactions of the Royal Society of London Series I* 92 (January): 477–528.
———. 1814. “Astronomical Observations Relating to the Sidereal Part of the Heavens, and Its Connection with the Nebulous Part; Arranged for the Purpose of a Critical Examination.” *Philosophical Transactions of the Royal Society of London Series I* 104 (January): 248–84.
Hockey, Thomas, Virginia Trimble, Thomas R. Williams, Katherine Bracher, Richard A. Jarrell, Jordan D. Marché, F. Jamil Ragep, Joann Palmeri, and Marvin Bolt. 2007. *The Biographical Encyclopedia of Astronomers*. https://doi.org/10.1007/978-0-387-30400-7.
Hodierna, Giovanni Battista. 1654. *De systemate orbis cometici deque admirandis coeli characteribus explicantur, necnon vie Com etarum, per orbem cometicum multiplices opuscula duo, in quorum primo cometarum causae disquiruntur, & indicantur. In secundo vero quid, quales, quotue sint stellae luminosae, nebulae, necnon, & occultae, manifestantur & rerum caelestium studiosis commendantur*. https://doi.org/10.3931/e-rara-444.
Holden, E. 1882. “Appendix I - Monograph of the central parts of the nebula of Orion.” *Astronomical and Meteorological Observations Made at the U.S. Naval Observatory* 18 (January): a1–a230.
Hoskin, Michael. 2011a. *Discoverers of the Universe: William and Caroline Herschel*.
———. 2012. *The Construction of the Heavens*.
———. 2008. “Nebulae, Star Clusters and the Milky Way: From Galileo to William Herschel.” *Journal for the History of Astronomy* 39 (August): 363–96. https://doi.org/10.1177/002182860803900306.

———. 2011b. “William Herschel and the Nebulae, Part 1: 1774-1784.” *Journal for the History of Astronomy* 42 (2): 177. https://doi.org/10.1177/002182861104200204.
———. 2011c. “William Herschel and the Nebulae, Part 2: 1789-1818.” *Journal for the History of Astronomy* 42 (3): 321. https://doi.org/10.1177/002182861104200303.
Huggins, William. 1868. “Further Observations on the Spectra of Some of the Stars and Nebulae, with an Attempt to Determine Therefrom Whether These Bodies are Moving towards or from the Earth, Also Observations on the Spectra of the Sun and of Comet II., 1868.” *Philosophical Transactions of the Royal Society of London Series I* 158 (January): 529–64.
Jones, Kenneth Glyn. 1975. *The Search for the Nebulae*.
Keeler, J. E. 1890a. “On the Motions of the Planetary Nebulæ in the line of Sight.” 2 (11): 265. https://doi.org/10.1086/120168.
———. 1890b. “The Motion of Arcturus in the Line of Sight.” 2 (11): 284. https://doi.org/10.1086/120170.
King, Edward S. 1931. “Solon Irving Bailey (1854-1931).” *Popular Astronomy* 39 (January): 456.
Kirchhoff, G., and R. Bunsen. 1860. “Chemical analysis by spectral observations.” *Poggendorfs Annalen Der Physik* 110 (6): 161–89.
Klumpke-Roberts, Dorothea. 1929. “L’Atlas d’Isaac Roberts de 52 Regions.” *L’Astronomie* 43 (January): 284–87.
———. 1931. “William Herschel’s fifty-two extensive diffused nebulosities.” *Popular Astronomy* 39 (January): 23.
Maddox, R. L. 1871. “An experiment with Gelatino Bromide.” *The British Journal of Photography* 18 (September): 422–23.
Marius, Simon. 1614. *Mundus Iovialis Anno M.DC.IX.DetectusOpe Perspicill Belgici, Hoc est, Quatuor Jovialium Planetarum, cum Theoria, tum Tabulæ, Propriis Observationibus Maxime Fundatæ*.
Maunder, E. W. 1885. “The motions of stars in the line of sight.” *The Observatory* 8 (May): 162–70.
———. 1892. “Potsdam observations of motion in the line of sight.” *The Observatory* 15 (November): 393–98.
McGrath, Alex. 2019. “‘You Take Our Stars’: Harvard Astronomers in Peru, 1889-1900.” Master’s thesis, Simmons College, Boston, Massachusetts.
Moore, Joseph Haines. 1932. “A general catalogue of the radial velocities of stars, nebulae and clusters.” *Publications of Lick Observatory* 18 (January): v–220.
Nasim, Omar W. 2013. *Observing by Hand: Sketching the Nebulae in the Nineteenth Century*.
Palmer, H. K. 1899. “The distribution of stars in the cluster Messier 13, in Hercules.” 10 (November): 246–54. https://doi.org/10.1086/140642.
Pasachoff, Jay M. 2018. “Simon Marius’s Mundus Iovialis and the Discovery of the Moons of Jupiter.” In *Simon Marius and His Research, Historical &Amp; Cultural Astronomy*, edited by Hans Gaab and Pierre Leich, 191. https://doi.org/10.1007/978-3-319-92621-6_5.
Pickering, Edward C., and M. Fleming. 1897. “Miscellaneous investigations of the Henry Draper Memorial.” *Annals of Harvard College Observatory* 26 (January): 193–P.XI.2.

Roberts, Isaac. 1893. *A Selection of Photographs of Stars, Star-Clusters and Nebulae, together with Information concerning the Instruments and the Methods employed in the pursuit of Celestial Photography*.
———. 1899. *A Selection of Photographs of Stars, Star-Clusters and Nebulae, together with Records of Results obtained in the pursuit of Celestial Photography (Volume 2)*.
Rosse, Earl Of. 1861. "On the Construction of Specula of Six-Feet Aperture; and a Selection from the Observations of Nebulae Made with Them." *Philosophical Transactions of the Royal Society of London Series I* 151 (January): 681–745.
Sawyer Hogg, Helen. 1959. "Star Clusters." In *Astrophysik Iv: Sternsysteme / Astrophysics Iv: Stellar Systems*, edited by S. Flügge, 53:129–207. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-45932-0_4.
Serio, G. F., L. Indorato, and P. Nastasi. 1985. "G. B. Hodierna's observations of nebulae and his cosmology." *Journal for the History of Astronomy* 16 (45): 1–36. https://doi.org/10.1177/002182868501600101.
Shapley, Harlow. 1930. *Star Clusters*. Vol. 2.
Smith, Burke, and Otto Struve. 1944. "The Radial Velocities of the Pleiades." 100 (November): 360. https://doi.org/10.1086/144677.
Smyth, W. H. 1864. *Sidereal Chromatics*.
Steinicke, Wolfgang. 2010. *Observing and Cataloguing Nebulae and Star Clusters*.
Struve, O. 1944. "Radial Velocities of Twenty Stars of Early Type in and Near the Galactic Cluster NGC 6231." 100 (September): 189. https://doi.org/10.1086/144657.
Trumpler, R. J. 1935. "Observational Evidence of a Relativity Red Shift in Class O Stars" 47 (279): 249. https://doi.org/10.1086/124604.
Vogel, H. 1873. "Versuche, die Bewegung von Sternen durch spectroskopische Beobachtungen zu ermitteln. Von Dr. H. Vogel." *Astronomische Nachrichten* 82 (November): 291.
Vogel, H. C. 1889. "Über die auf dem Potsdamer Observatorium unternommenen Untersuchungen über die Bewegung der Sterne im Visionsradius vermittelst der spectrographischen Methode." *Astronomische Nachrichten* 121 (16): 241. https://doi.org/10.1002/asna.18891211602.
Wilson, O. C., and Mary F. Coffeen. 1954. "The Mass of the Globular Cluster M92." 119 (January): 197. https://doi.org/10.1086/145810.
Winlock, Joseph, and L. Trouvelot. 1876. "Astronomical engravings from the Observatory of Harvard College." *Annals of Harvard College Observatory* 8 (January): P1.1–P35.
Zik, Yaakov, Giora Hon, and Ilan Manulis. 2020. "Did Simon Marius observe Jupiter's satellites on January 8, 1610? An exercise in computation." *arXiv E-Prints*, February, arXiv:2002.04643. http://arxiv.org/abs/2002.04643.

Nineteenth Century Amateur Searches for Vulcan

Bill Barton

Six documented amateur searches for the supposed inter-Mercurial planet Vulcan were carried out in the second half of the nineteenth century. Two were carried out by the short lived *Observing Astronomical Society,* organised by W F Denning (1848-1931). Further lone searches were carried out by T W Backhouse (1842-1920). The final search was carried out by the *Liverpool Astronomical Society* under Elizabeth Brown (1830-1899).

The first search involved T P Barkas, James Cook, Chas. Hill, Philip Vallance, (unknown?) Watson, and nine others (total fourteen observers) and took place from 14 March to 14 April 1869. The second involved T W Backhouse, T P Barkas, J Birmingham, W R Birt, James Cook, T G E Elger, A P Holden, H W Hollis, E B Knobel, H Ormesher, Henry Pratt, P Vallance, G J Walker, Jno. Watson, T Wilson and around ten others (total twenty-five observers) and ran the following year from from 20 March to 10 April 1870 . [Astronomical Register, vol. 7 (1869), p.89-90 and vol. 8 (1870), 77-78]

And there the project lay for over a decade.....

Calculations by U J J Leverrier (1811-1877) showed that Vulcan could have been expected to transit the Sun between March 25 and April 10 (descending node) or September 27 and October 14 (ascending node) from the year 1883. T W Backhouse reported Leverrier's calculations and the opportunity to search for Vulcan in *The Observatory* vol. 7 (1884), p. 171. Later that year he reported his own search of 1884 September 22 to 1884 October 14, a period of 23 days with only two days when observations were missed. [*Astronomical Register* vol. 22 (1884), p.273] In the spring of 1885 he repeated his search observing from March 15 to April 18 with only seven days missed. [*Astronomical Register* vol. 23 (1885), p.144]

A third search was carried out by Backhouse between September 22 and October 15 1885. [*LAS Journal* vol. 4, pt, 6 (1886 April), p. 41]

Elizabeth Brown joined the LAS on 21 January 1884 and directed both the LAS and BAA Solar Sections (which she later joined as an *Original Member*) and enters the search scene with an appeal for observers and directions for best results. As LAS Solar Section Director she noted that members in South America would provide valuable observations due to their tropical latitude and westerly longitude. "Those observers who are willing to take part in the search are requested to keep a record of the dates and times of their observations, (these should be taken, if possible, at regular intervals of two hours), and to send their names previously, specifying where practicable, the hours which are most likely to suit them best, to Miss E. Brown, Further Barton, Cirencester, England." [*LAS Journal* vol. 5, pt. 4 (1887 February 1), p. 146] Reviewing the 1887 membership list, 77 members were part of the Pernambuco Branch, and 301 were on the General List, thus 20% of the total membership lived in South America. Whether this proportion of members residing at a great distance from the home town of the LAS places a financial burden upon the society this author can't say.

312 observations from six observers working during the 25 day period from 1887 March 17 to April 10 were received T W Backhouse, Sunderland (report not to hand), J Bartlett, Woking (81), E Brown, Cirencester (79), G L Brown, Stirling (44), R Cross, Oxford (42), J

Gordon (Gordan?) Forfar (35), and T Radmore, Portsmouth (31) [*LAS Journal* vol. 5, pt. 7 (1887 May 2), p. 197] Thus no one in South America took part in this project.

"IT has been suggested that some explanation is necessary for the rather sudden abandonment of the "Search for Vulcan" which was undertaken last year, on a systematic plan, and carried out with much zeal by some members of the of Solar Section. The reasons for coming to this decision were based upon an exhaustive paper in the *Astronomische Nachrichten*, by Dr C H Peters, to which allusion has been already made in the L.A.S. *Journal* (Vol. V., Part 6)#. in which he criticises the observations upon which LeVerrier founded his computations for the orbit of the so-called intra-Mercurial planet. After thoroughly sifting and discussing them he sums up his remarks in the following words: "Always admiring the ingenious way in which LeVerrier attacked the problem, we are forced in the same time to conclude that the pillars of his calculations, the data given by observations, have upon closer examination slipped away entirely" -E. BROWN. [LAS Journal vol. 6, pt. 6 (1888 April 2), p. 224]

p. 182, see also *English Mechanic* 1884 September 12, Sadler. [vol. 40?]

Further information on the observers noted above:-

Thomas William Backhouse of West Hendon House, Sunderland joined 16/08/1884 and was later an *Original Member* of the BAA in the autumn of 1890.
J. Bartlett, Rosslyn House, Ripley, Woking, joined 10/11/1885
G. L. Brown, 22 Nelson Place, Stirling, joined 09/03/1885
Robert Cross, 32 St. Aldates Street, Oxford, joined 16/08/1884. 1881 census, 45 year old (born circa 1836), married with three sons and four daughters, joiner and carver employing two boys.
James Gordon, Whinnydrum, Aberlemno, Forfar, joined 10/01/1887. (ca. 1844-??)
Thomas Radmore, Rossiter Cottage, Buckland, Portsmouth, joined 21/01/1884. (1843-1918, BAA OM)

The contributions from C H Peters (1813-1890) are:-
1, Some critical remarks on so-called intra-mercurial planet observations, *Astronomische Nachrichten*, vol. 94 (1879), issue 21, p.321
2, Some critical remarks on so-called intra-mercurial planet observations (Schluss), *Astronomische Nachrichten*, vol. 94 (1879), issue 22, p.337

In order to account for the lack of visibility of Vulcan it was even suggested that it wasn't a single planet, but a group of very small members somewhat akin to the flying gravel bank model of comets.

The only sightings of Vulcan were made by Lewis Swift (1820-1913) and James Craig Watson (1838-1880)

Discovery of Vulcan, Lewis Swift, *Nature* vol 18 (1878), p. 539
The Intra-Mercurial Planets, Lewis Swift, *Nature* vol 19 (1878), p.96

You Have to Start Somewhere!

Ron Palgrave

In 1956 I was 12 years old and had built a telescope from simple lenses and cardboard tube. I fashioned an equatorial mount from some bits of wood and mounted it all on an upturned ironing board. The counter weight was a Nescafe coffee tin filled with nuts and bolts.

This instrument introduced me to chromatic aberration, but I was amazed at what such a crude arrangement revealed. I gained some sense of the feelings that Galileo must have experienced. A lifelong interest in astronomy was thus sparked. Sometime later, I got my first “real” telescope, a 4 inch Newtonian reflector from W Ottway. It was a gift from an uncle who had a shared interest in astronomy. This came as a kit of mostly wooden parts and included a pair of mirror blanks. The wooden components were chiefly of a material which, in the day, was called “chipboard”. During the construction and assembly phase, my father substituted much of this with oak.

The mirror blank had to be ground to shape and the kit include all the necessary materials to do this, including pitch, carborundum and rouge. I recall that the grinding

took a very long time. But in an era where the standard amateur telescope was a 6 inch, the prospect of 4 inch felt very respectable and so the motivation was strong.

Eventually, the mirror was finished, though I do not recall doing a great deal of testing! Then, as instructed, I sent the figured mirror back to Ottways. After a little time, I got a

letter back from them asking what I wanted done with it? I explained that the kit instruction asked me to do this, so it could be aluminised. They replied that "…. so few of these kits had been sold, and even fewer completed, that this obligation on their part had been overlooked".

When assembled, the first light produced views that, compared to my earlier cardboard tube refractor, were astounding. After about 12 months use, I found I leant towards lunar and planetary sketching. Accordingly, I saved up for the high power eyepiece option. This increased the magnification from X32 to X78. I suspect that these were standard microscope items.

A little later, I was undergoing industrial/practical training for a career in design engineering. In conclusion I had to design and build a mechanical device, so I chose to produce an equatorial head for the 4 inch. This made operation much easier. For my efforts I received the “Apprentice of the Year” award.

I used this 4 inch intensively for maybe 8 years. Later it was supplanted by a 10 inch, which I housed in a home-made glass fibre dome. But, as so often seems the case, life then got in the way. A string of relocations around the country obviated any serious astronomy. These days I am retired and fortunate to have a 14 inch Schmidt Cassegrain in an observatory equipped with a nice warm room. The finder for the 14 inch is probably more useful than the 4 inch Ottway, which presently sits sulking in our spare room. But nothing could replace the affection I have for my first “real” telescope.

For many years, I had tried in vain to find any reference at all to the 4 inch Ottway kit. I suspect that they were not very proud of them. I began to think mine was the only one that they had sold. Then quite by chance I stumbled across reference to what is probably “the other” kit that they produced! This was in the BAA historical section, the owner being member Dr Alan Thomas. [Perhaps the 4 inch Ottway Owners Club could meet in a phone-box someday!] I was interested to find that, in the day, the kits cost a little over £5. Cheap thrills?

From the Deep Sky Section Archive

Nick Hewitt has sent us some snaps from a section meeting, c.1988, organised by his predecessor Bernard Abrams. Do you recognise the youthful attendees?

Maurice Gavin

Nick Hewitt

Bernard Abrams and Rob Mosely

Bernard Abrams