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Front Cover — Lynn Hilborn seeks out the unusual and has focused on an area of the sky that seldom gets much attention—the region around Polaris, the North Star. This image, captured with an ML 8300 camera using a 135-mm lens at f/2.5, shows the star and its background of galactic cirrus. Galactic cirrus is the filamentary material seen throughout this image and is the visible-light traces of tenuous dust and gas within the Milky Way. Lynn used exposures of 38×4 minutes in L, 18×10 m in R, and 12×10 m in B for this 7½ hour image.

Towards an Intellectual Genealogy of Canadian Astronomers

Richard A. Jarrell, York University [deceased][1]

Abstract

We present an overview of the Astronomy Genealogy Project (AstroGen), which is being undertaken by the Historical Astronomy Division of the American Astronomical Society. Examples from Canada are used to illustrate some of the opportunities and pitfalls.

Résumé

Nous présentons un aperçu du projet Généalogie astronomique (AstroGen) entrepris par la Division d'astronomie historique de l'American Astronomical Society. Des exemples provenant du Canada en illustrent quelques possibilités et embûches.

Introduction

Early in 2013, the Historical Astronomy Division (HAD) of the American Astronomical Society agreed to create an astronomy genealogical project (AstroGen; http://had.aas.org/astrogen/) with the ambitious goal of obtaining educational information about astronomers worldwide and as far back in time as possible. With this information, it will be possible to show in a graphic way a particular astronomer's intellectual "forebears" and his or her intellectual "progeny" in much the same way genealogists construct family trees. The HAD plan is based upon the successful Mathematics Genealogy Project (MGP) of the American Mathematical Society, hosted at North Dakota State University (http://genealogy.math.ndsu.nodak.edu/). This program has been underway since 1996 and now has more than 180,000 records. By being inclusive and interpreting mathematics broadly, the MGP captures a sizable number of astronomers, particularly before the 20th century, when an astronomer was more likely to be trained by a mathematician than by another astronomer or a physicist. It also has a great many physicists.

Following the MGP's lead, we will create a Web site in which one can search for a particular astronomer and find who were his or her supervisor(s) or mentor(s), the type of degree, year, and institution, and title of dissertation. We can also see the astronomer's students. Where we can, we want also to be able to provide more information, such as years of birth and death. This extra information will help distinguish between astronomers with identical or near-identical names.

Anyone who has dealt with real genealogy knows how difficult it can be to obtain solid information earlier than two generations in the past. It is unlikely that many readers of this journal could even name all sixteen of their great-great-grandparents, much less their dates and where they were born. Some people find genealogy utterly fascinating, others have complete indifference to it. For some, genealogy is a means of identifying genetic heritage. Suppose your great-great grandmother was a member of the Dutch royal family. While you might take great pride in this fact, you share only 1/16 of the genes of your noble ancestor. Does such watered-down genetic heritage mean very much? In most cases, no, although in highly inbred families such as the Spanish Hapsburgs, genetic traits (the Hapsburg chin) did survive many generations, with a tragic ending. More important in most families—unless we are talking about passing on noble titles or vast fortunes—are the cultural characteristics of a family such as religion, class, social linkages, and habits that might persist for many generations. It is this latter kind of inheritance that the MGP and AstroGen highlight. How long do characteristic attitudes about science and academic behaviour survive? Are there particular approaches to scientific problem solving that persist over generations? Are certain research domains handed down from supervisor to student and to the student's students?

Problems with Building a Database

The advantage we will have in AstroGen is that we have let the mathematicians discover the problems and pitfalls, which we can hopefully avoid. At the beginning, the MGP founders had to decide upon the software, the temporal and geographical limitations (if any), and conventions for what data was to be

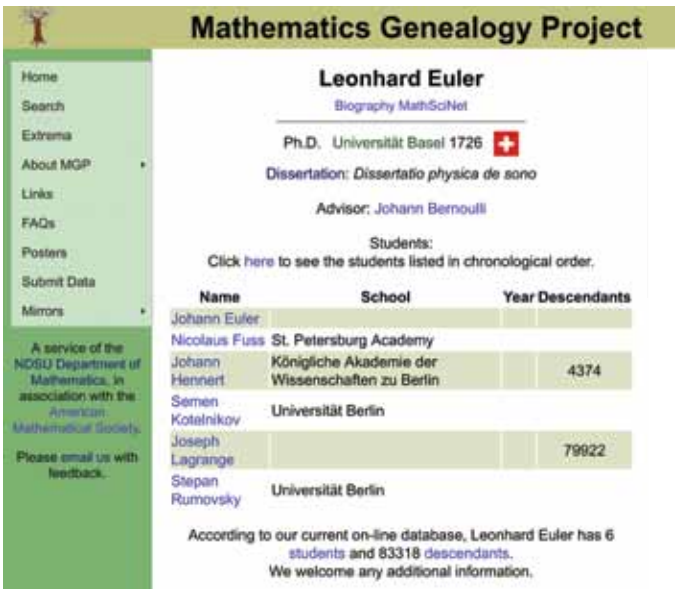

Figure 1 — Leonhard Euler's entry in the Mathematical Genealogy Project. http://genealogy.math.ndsu.nodak.edu/id.php?id=38586.

sought and verified. An example of a typical page, that of the mathematician and astronomer Leonhard Euler, is shown in Figure 1.

As the MGP's Web site notes, a full entry would contain:

1) the complete name of the degree recipient,

2) the name of the university which awarded the degree,

3) the year in which the degree was awarded,

4) the complete title of the dissertation, and

5) the complete name(s) of the advisor(s).

In the 20th and 21st centuries, the degree would usually be a doctorate (Ph.D., D.Sc., *etc.*) and the advisor would be the dissertation supervisor. As we probe earlier and earlier, types of degrees will change. There were no doctorates in the modern sense in the 18th century; dissertations were quite unlike what we recognize today, and the term supervisor did not have the modern meaning. In some cases, the term "mentor" might be preferable, particularly when an astronomer's key influence might have been an undergraduate teacher or an observatory director who was not a teacher *per se.*

Geography is always an issue. On MGP pages, a flag of the modern nation is displayed. For instance, on Carl Friedrich Gauss's page, a modern German flag is shown, although Germany did not exist in his time. MGP staff also found that there were difficulties in spelling of names, titles of theses, and correct dates. The AstroGen team, which is wrestling with a number of decisions as to what to include, has already decided that there will be no flags.

Once decisions are made regarding the information to put in the database, the single greatest problem will be data collection. Neither the MGP nor, presumably, AstroGen, will have a paid team of researchers. Volunteers build and maintain the MGP site, and data are sent in by individuals. Data are only as good as what individuals provide, and not all data can be verified in a timely manner. Donations, small grants, and a sympathetic Web site host allow for the MGP's continued existence. In a way, such a project is something like a shoestring Wikipedia operation.

Tracking the Early Canadian Astronomers

In contemporary astronomy, we know what an astronomer is in terms of training and professional position. During the 19th century, these are not so obvious. Take, for example, Canada's three first professional government astronomers: William F. King (1854–1916); Otto Julius Klotz (1852–1923); and Édouard-Gaston Daniel Deville (1849–1924). They were all involved in astronomy primarily through surveying—King and Klotz became Chief Astronomers and Deville was Surveyor-General—and they were professional in the sense that they earned a living through their science. King was an early student of John Bradford Cherriman (1823-1908) at the University of Toronto. Cherriman was a mathematician, although he did direct the Toronto Magnetic and Meteorological Observatory for a short time. However, Cherriman is not in the MGP database despite having been 6th wrangler in the mathematical tripos at Cambridge in 1845, which was no small feat. He was trained at St. John's College, Cambridge, and one would have to search college records to discover who Cherriman's mathematics mentor or tutor was. Thus, from King, we can go back only one step.

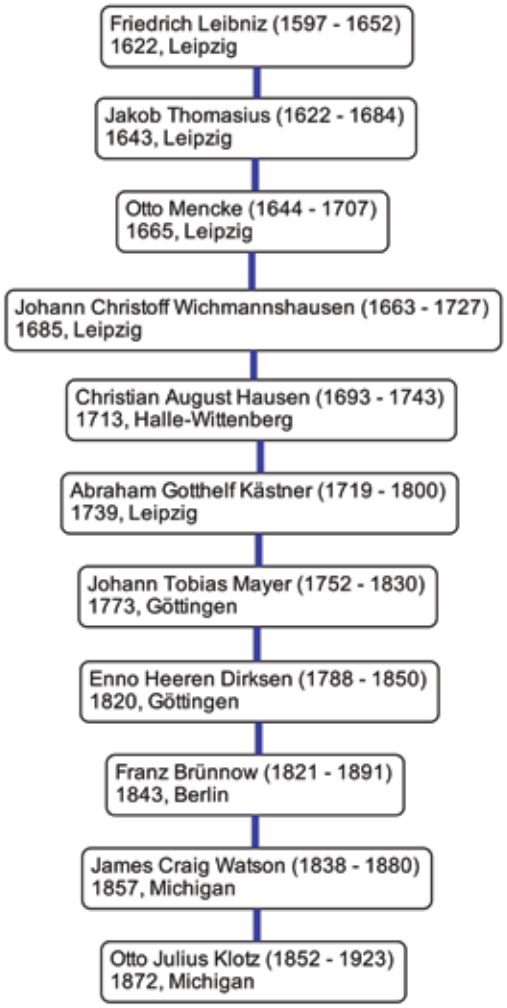

Figure 2 — Klotz's academic ancestry (graphic by J.S. Tenn).

Deville's education was at the French Naval Academy in Brest (École navale), which would not likely lead to a notable astronomer or mathematician. It would take some digging to discover who his instructors were. In Klotz's case, he *was* trained by an astronomer, Canadian-born James Craig Watson (1838–1880), at the University of Michigan. Watson is listed in the MGP as receiving a Dr.Phil. from the University of Leipzig in 1870 for a dissertation entitled "Theoretical Astronomy relating to the motion of heavenly bodies." The page states "advisor unknown" and "no known students." Here is the problem of too little information. The Dr.Phil. was, in

Figure 3 — Otto Julius Klotz (William James Topley/Library and Archives Canada)

fact, a honorary degree for his textbook, *Theoretical Astronomy* (published in 1868) and his asteroid discoveries. Apart from Klotz, he had at least two noteworthy students: John M. Schaeberle; and C.G. Comstock. Watson's teacher was Franz Brünnow (1821–1891), the first director of the Detroit Observatory in Ann Arbor. Brünnow is in the MGP and from his page we can construct Klotz's intellectual family tree with each generation of teacher, where and when they graduated (Figure 2).

We can trace Klotz's intellectual ancestry back ten generations to Friedrich Leibniz, the father of the great mathematician Gottfried Leibniz, before we reach a dead end. Klotz (Figure 3) would probably have been pleased if he had known any of this. But, Klotz, like his colleagues King and Deville, was not a professor and thus had no intellectual "offspring" in the ordinary sense. This might be a hint that we need to broaden our sense of intellectual genealogy, because all three of these men, but especially King, had an influence upon younger colleagues and co-workers and acted as mentors.

Academic astronomers were relatively rare in the 19th century, particularly in Canada. William Brydone Jack (1817–1886), who built one of Canada's earliest observatories, at the University of New Brunswick, was a student of the noted physicist David Brewster at St. Andrew's University. But, Brewster was effectively self-taught in science, so we meet another dead end. At Queen's University, James Williamson (1806–1895) taught astronomy and directed the observatory; he was an Edinburgh graduate and a student of mathematician Walter Nichol. Williamson's successor was his student Nathan F. Dupuis (1836–1916), whose best-known student was Samuel Alfred Mitchell (1874–1960) of the University of Virginia. Some diligent footwork could probably extend the lines from Williamson in both directions.[2]

C.A. Chant's Many Children

Figure 4 — Clarence Augustus Chant (University of Toronto)

The modern era of Canadian astronomical education commenced with Clarence Augustus Chant (1865–1956; Figure 4) at the University of Toronto. His training was in the traditional mathematics and physics courses. His mathematics instructor, who taught a course on astronomy, was Alfred Baker (1848–1942). In physics, James Loudon (1841–1916), later president of the university, was his instructor. J.S. Plaskett had the same teachers. Both Baker (B.A. 1875) and Loudon (B.A. 1862) were students of Cherriman, so we are back to the brick wall for now. Chant launched astrophysics at the university in the first decade of the 20th century and began turning out a long string of students, some co-taught by his later assistant and former student Reynold K. Young (1886–1977).

Chant had an impressive list of students over a nearly 40-year teaching career. At least 14 students became astronomers (Table 1). Young would also be involved with any students from 1924, when he arrived from the Dominion Astrophysical Observatory (DAO). This list shows where the students spent their astronomical career. Many of Chant's students formed the early core of the staff at the Dominion Observatory (DO) in Ottawa.

Students of Clarence Augustus Chant
H.F. Balmer (Buffalo Science Museum)
J.B. Cannon (DO)
W.E. Harper (DO, DAO)
J.P. Henderson (DO)
Ernest Hodgson (DO)
F.S. Hogg (DAO, Toronto)
R.J. McDiarmid (DO)
Peter Millman (Toronto, DO, NRC)
Robert M. Motherwell (DO)
Ruth J. Northcott (Toronto)
T.H. Parker (DO)
J.A. Pearce (DAO)
H.H. Plaskett (DAO, Oxford)
R.K. Young (Kansas, DAO, Toronto)

Table 1

There was no graduate program until right at the end of Chant's tenure, so almost all of these students took a bachelor's degree. Some went on for a Ph.D. elsewhere: Hogg and Millman to Harvard, Young and Pearce to California, McDiarmid to Princeton. That would add another layer of mentors. Toronto's Department of Astronomy launched in the 1930s, but staff was small, graduate students few, and they studied only for the M.A. degree. With the 1950s, the Ph.D. program was created, and the list of graduates since then is quite impressive. As the university's astronomy and astrophysics library has a reasonably complete collection of theses and dissertations, a few days' research would provide data to create a number of lines of descent from Chant and Young.[3]

Despite this impressive list of offspring, only four were directly involved in teaching astronomy. Young taught 22 years, Millman 7, and Northcott 25 at the University of Toronto. Millman moved into the civil service after World War II, and Northcott taught mostly undergraduates. She certainly would be considered a mentor to many students but not the supervisor, which underscores one problem in the methodology. Plaskett taught 32 years at Harvard and Oxford.

Is Astronomy in Canada Different?

Universities are involved in production—research and publication—and in reproduction, the formation of new generations of researchers and teachers. Each science has its own distinctive pattern. Astronomy is very different from chemistry, for example; reproduction for chemistry means a significant annual cohort of Ph.D.s destined for teaching posts in colleges and universities as virtually every institution that teaches science teaches chemistry. Still, most of chemistry's reproduction goes into graduating research chemists for industry and government as it has for many decades. Astronomers have far fewer academic posts available to them at any time, nor do they have many opportunities in industry or government. Until the 1970s, the number of jobs open to astronomers in North America was very limited.

Looking at Chant's list of graduates, we can see that few went directly into academic careers. Only Frank Hogg went directly to the Ph.D. and then to Toronto after a short sojourn at the DAO. Young had a brief teaching stint at the University of Kansas but spent several years in Victoria before an opening was available as Chant's assistant. Millman taught at Toronto only seven years before war service and a move to the civil service. Harry Plaskett ended up in Oxford after detours through the DAO and Harvard. Balmer worked in a science museum. All the rest went into government service, either at the DO or the DAO, or both. In fact, if we follow the MGP scheme, Chant would have only four academic descendants in the next generation, if we discount Millman's brief teaching career.

What this suggests is that there are real national differences in the employment patterns of astronomers. Before the 1960s, Canadian astronomers were far more likely to be employed by government agencies than by universities. Few Canadian universities even taught astronomy and only Toronto had a department. Emigration was the only other option if a graduate wanted to remain in astronomy. By contrast, American universities had long taught astronomy and a number of universities maintained departments and observatories. However, apart from the U.S. Naval Observatory, government positions in pre-NASA times were very rare. The pattern in pre-1960 France and the Soviet Union would likely be similar to Canada's. A genealogical reconstruction could show national patterns and how they have changed over time.

We can also see this pattern in sub-disciplines. As radio astronomy expanded in Canada, almost all positions were at the National Research Council or at the Dominion Observatory. Radio astronomers at universities were a rarity until relatively recently.

Given this pattern in Canada, we can see that reproduction was long biased towards producing government scientists, not professors. This meant a much smaller core of teaching staff educated the following generations. Traditionally, students are attracted to supervisors because of the research interests of the latter. A smaller teaching core might then translate into a narrower range of research production. Using the genealogy, one could quickly track the subject matter of dissertations to see whether that has been the case. We would expect the American pattern to be different given the much larger core of teaching professionals. Another test of student interest would be to track Canadian-born students who took their degrees outside Canada.

Next Steps

Mathematicians have probably always outnumbered astronomers by a considerable factor, but if HAD hopes to encompass as many astronomers as possible, it has a daunting task ahead of it if we consider it even to be a fraction of the size of the MGP's large database. And, it is clear by just a bit of searching that there are many, many gaps in the MGP database. The publication of the *Biographical Encyclopedia of Astronomers* (BEA), with the second electronic edition now online and the second print version due soon) provides us with about 1700 entries that can act as a first pass at names along with birth and death places and dates. However, one would not expect to be able to reconstruct genealogies for more than a handful of astronomers who worked before the 16th century. Another limitation is that the first edition of the BEA includes only astronomers born before 1918. Given the dictum that more scientists are alive today than in all of history before them, we will have a very significant number of additions to make to the database beyond the BEA list. We clearly need to enlist the interest of working astronomers to provide their own—presumably accurate—information to the database. For deceased astronomers who were missed by the BEA and other scientific biographical dictionaries, we do have a few useful sources. We have a solid series of obituaries, unfortunately going back only to 1991, in the *Bulletin of the American Astronomical Society*. Other obituaries have appeared in national society publications and in journals. These can be easily searched with the NASA ADS or the Web of Science.

The scope of the Canadian portion of AstroGen is much more tractable. This is in part due to the sheer weight of the University of Toronto's contribution to reproduction and the limited number of institutions offering specifically astronomical training. The most significant fraction of working astronomers are members of CASCA and can be identified easily. ✶

Endnotes

1 This paper was written in early December 2013. Tragically, the author died on the 28th of that month before he could complete it. (For an obituary, see http://cstha-ahstc.ca/tag/richard-adrian-jarrell/.) Final editing and the writing of the abstract have been done by the Director of the AstroGen project, Joseph S. Tenn. Prof. Tenn is actively seeking additional members for the AstroGen team and welcomes correspondence (joe.tenn@sonoma.edu).

2 Actually, Dupuis, who taught Mitchell mathematics when the latter was an undergraduate at Queen's, would be listed as Mitchell's mentor, not his supervisor. Mitchell later earned his Ph.D. at Johns Hopkins University under Charles Lane Poor—JST.

3 Nearly all who have earned Ph.D.'s in astronomy at Canadian universities have now been entered into the AstroGen database, thanks to the work of Peter Broughton and myself—JST.