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A HISTORY OF DRAKE MUNICIPAL OBSERVATORY, DES MOINES, USA: FROM RICHES, TO RAGS, TO RESTORATION

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Abstract: In this paper we discuss the history of Drake Municipal Observatory in Des Moines, Iowa (USA), and identify three phases of its history: the early building stage, a period of decline, and the restoration. We also cover the initial purchase of the 8.25-in Warner & Swasey/Brashear refractor and its installation on the main Drake campus and introduce Daniel Walter Morehouse, the principal driving force behind the creation of Drake Municipal Observatory in 1920 as a joint initiative of Drake University and the City of Des Moines. Following Professor Morehouse's death in 1941, the observatory endured decades of decline until late twentieth-century efforts to restore the Observatory. We conclude this paper by discussing the educational role of the Observatory, the remarkable comet (C/1908 R1) discovered by Daniel Morehouse, and his research output while based at Drake Observatory.

Keywords: Drake University, George Carpenter, Francis Marion Drake, Warner & Swasey mountings, Brashear objectives, Daniel Morehouse, Drake Municipal Observatory, restoration

1 INTRODUCTION

This paper focuses on the Drake Municipal Observatory, located in Des Moines, Iowa. Des Moines started in May 1843, when Fort Des Moines was constructed at the junction of the Des Moines and Raccoon Rivers (for US localities mentioned in the text see Figure 1). Although the Fort was abandoned in 1846, settlers occupied the site and in September 1851 it was recognized as a city. Six years later Fort Des Moines was renamed Des Moines and it became the new state capital of Iowa. The population swelled after 1866, when railroads connected Des Moines to cities in the east. By 1880 Des Moines was Iowa's largest city, with a population of 22,408 (Henning and Beam, 2003). Soon after, Drake University was established.

Figure 1: USA localities mentioned in the text (base map: 800px-Map_of_USA_with_state_names.svg.png; map modifications: Wayne Orchiston).

Figure 2: G.T. Carpenter (after Bryngelson, 2010).

Two miles west of the University, Drake Municipal Observatory stands as a monument to the vision and dedication of founding Drake University astronomer Daniel Morehouse. The Observatory is located in the middle of Waveland Golf Course, the oldest golf course established west of the Mississippi River. In 2001, one of the authors of this paper (JW) researched the history of this Observatory as part of her part-time off-campus internet-based Master of Astronomy degree at what was then the University of Western Sydney (in Sydney, Australia). More recently, the first author (KW) investigated the establishment of early university observatories in the United States, including Harvard University Observatory and Yerkes Observatory (Williams Bay). Wresch's work also involved archival investigation of Drake Municipal Observatory that complemented the late Janis Winter's earlier work. This paper is mainly based on a combination of these two projects.

The genesis and continuation of Drake Municipal Observatory parallels other university-associated observatories established in the U.S. in the late nineteenth and early twentieth centuries (Bond, 1856; Donnelly, 1973; Osterbrock, 1999). More recently, it is a testament to late twentieth-century joint effort by Drake University and the City of Des Moines to revitalize the Observatory so that it can be used effectively by Drake University astronomy students and for public outreach.

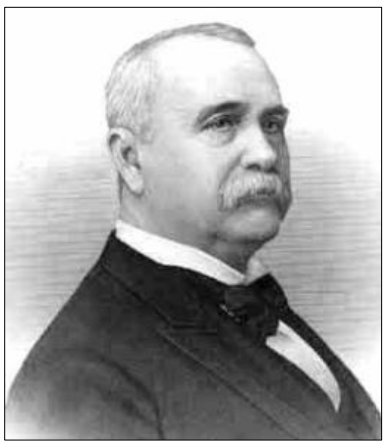


Figure 3: F.M. Drake (https://www.iowasuvcw.org/iowa-department-of-the-g-a-r/).

2 RICHES: THE FOUNDING OF DRAKE UNIVERSITY AND ITS OBSERVATORY

2.1 Introduction

George Thomas Carpenter, Edmund N. Curl, Francis Marion Drake, Corydon Eustathius Fuller, and Daniel Robertson Lucas each played key roles in the founding of Drake University in March 1881 and its subsequent early development. Carpenter, Curl, Drake, Fuller, and Lucas were all active members of the Disciples of Christ Church—now known as the Christian Church. This church emphasized "… intellectual philosophy and education as a means of perpetuating church ideals … [and consequently] establishing schools and colleges was a natural part of the church's ministry." (James, 2011: 86). So, as members of the church participated in the western expansion of the United States, "… they established a number of secondary-school academies and colleges." (ibid.). In Iowa, this mission motivated the foundation of Oskaloosa College and Drake University. Brief biographies of the latter's founders are given below.

George Thomas Carpenter (Figure 2) was born in Nelson County, Kentucky, on 3 March 1834. Soon after his father died, and seven year later his mother remarried and the family moved to Illinois. Described as an "… energy filled, happy boy." (Bryngelson, 2010), George Carpenter attended Princeton Academy (Princeton, Illinois) and Abingdon College (Abingdon, Illinois), graduating from the latter institution in 1859. After teaching and preaching in Winterset, Illinois, for two years, George Carpenter joined his brother W.J. Carpenter in Oskaloosa, Iowa, where George served as first President of Oskaloosa College which was founded in 1861. In 1863, he married Miss Henrietta T. Drake from Drakesville, Iowa. This union made Carpenter the brother-in-law of Francis Marion Drake, namesake of the university they would both play a key role in founding. Carpenter was the first Chancellor of Drake University and he also was Vice-President of the University's Board of Trustees. He retired in 1892, and died on 5 August 1893 (ibid.).

Little has been published about Edmund N. Curl, who was a successful Des Moines lawyer and businessman, and a partner in Carter, Hussey & Curl, a printing, binding and book publishing company (James, 2011: 91).

Francis Marion Drake (Figure 3) was born in Rushville, Illinois, on 30 December 1830. In 1837, he moved with his parents to Fort Madison (Iowa). They moved again in 1846, first founding Drakesville before settling permanently in Centerville in 1876 (Myers, 2011). Accounts describe Drake as well-educated and 'a natural' in business and entrepreneurial ventures. He served with distinction in the American Civil War until seriously injured on 24 April 1864 (for details, see Hamersley, 1905). Discharged from the Army as a Brigadier-General in 1865, Drake enjoyed a very successful post-war career as a banker and railroad builder. He became one of Iowa's richest and most influential citizens. After helping to found Drake University, he would go on to serve as the Governor of Iowa for one session (1896–1898). Francis Marion Drake died in Centerville on 20 November 1903. He was so admired that "… a special train was added from Des Moines to Centerville to transport all the mourners." (Myers, 2011).

Corydon E. Fuller (Figure 4) was born on 2 November 1830 in Ohio, but when he was 15 the Fuller family moved to Grand Rapids, Michigan. In 1851 he went to Ohio and enrolled at Hiram College, another institution affiliated with the Disciples of Christ. There Fuller befriended Francis Marion Drake, a connection that would continue for decades. Likewise, "… both Drake and Fuller maintained a friendship with another college mate, U.S. President James A. Garfield." (James, 2011: 92).

After graduation, Fuller settled in Mishawaka, Indiana. In the years leading up to the American Civil War, he made a living as an itinerant bookseller in Arkansas, and neighboring areas of Louisiana and Mississippi (Cox, 1996). In 1861 he moved to Rochester, Indiana, where he published the *Rochester Chronicle* before relocating to Washington D.C. Fuller moved again in 1865, this time to South Bend, Indiana. Two years later, he settled in Des Moines (Anonymous, 1880). There, his talents in banking and land developments as Secretary of the Iowa Loan & Trust Company and Cashier of the Iowa Loan & Trust Bank would prove invaluable in the early development of Drake University. Corydon Fuller died on 12 November 1886 at age 55 (ibid.).

Daniel Robertson Lucas (Figure 5; Cauble, 1930) was born in Belvidere, Illinois, on 14 January 1840. In 1858, the Lucas family moved to Burnettsville, Indiana, where Daniel began preaching at the local Christian church. In 1862, soon after marrying Mary E. Longley, Lucas joined Company C Ninety-Ninth Indiana Volunteer Infantry as a Second Lieutenant and chaplain of the regiment. After the Civil War, Lucas

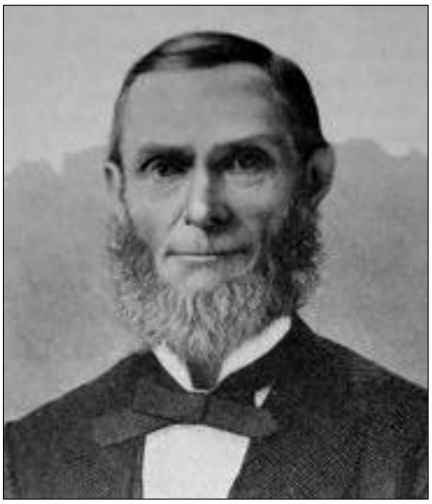


Figure 4: C.E. Fuller (https://www. findagrave.com/memorial/28088929/corydon-e-fuller).

pursued formal clerical training. In 1876, he assumed the pulpit at the Central Christian Church in Des Moines. After helping to found Drake University, "… in 1888, he returned to Indiana to pastor the Central Christian Church of Indianapolis." (Cauble, 1930). Lucas died in Indianapolis on 11 March 1907.

2.2 The Founding of Drake University

The financial footing of Oskaloosa College had never been particularly solid, so in the late 1870s, George Carpenter and his brother began discussing the option of moving the College from Oskaloosa to the state capital, Des Moines. According to one source, neither the College's stockholders nor the Church nor the courts supported the move.[2] Consequently, Carpenter and a group of 17 other prominent Des Moines businessman and Disciples of Christ Church leaders formed the University Land Company in May 1881 to finance the new university.

Figure 5: Chaplain D.R. Lucas in 1899 (http://www.therestorationmovement.com/_states/indiana/lucas.htm).

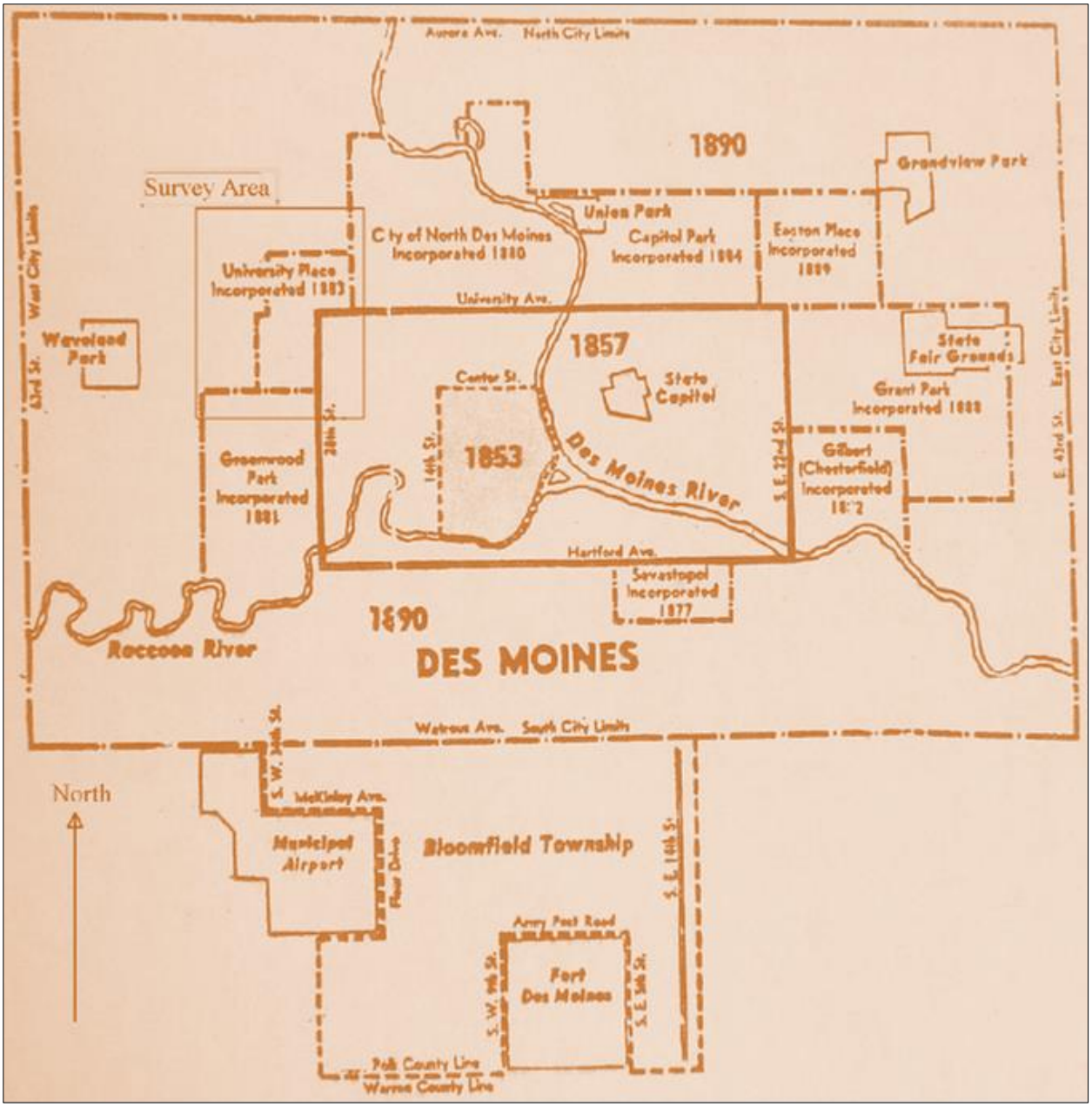


Figure 6: Map showing the location of the original city of Des Moines in 1853, and the location of Drake University on the northwestern corner of the city limits (solid rectangle) in 1881. By 1890 the city had expanded to include a number of former townships, including University Place, to the north, east, south and west. Waveland Park, the site of Drake Municipal Observatory is close to the western boundary of the enlarged city (after Jacobsen, 2011: 21).

Instead of siting the university in downtown flood-prone Des Moines, they selected gently undulating partly-wooded land on the north-western boundary of the city (see Figure 6). Their plan was to purchase local blocks of land that they could subdivide (plat) and sell off at a profit.

The University Land Company "… was capitalized at $100,000." The original stockholders were Central Iowa leaders with "… depth of experience in law, real estate and banking." They put up $20,650 to buy land with "… mortgages making up the difference." The board of seven managing directors determined that "… indebtedness was not to exceed one-fourth of the capital stock." (James, 2011: 90).

Edmund N. Curl served as first President of the Land Company. He was paid to oversee "… the platting and upkeep of the land during the first year of the land company." (James, 2011: 91). Table 1 summarizes the investment and roles of Curl and other leading citizens involved in both the Land Company and Drake University.

When the University Land Company purchased 139 acres of land that formed the heart of the original University Place area, about 65% of that land lay outside of the city limits (James, 2011: 90). The Land Company

Table 1: Leading citizens involved in the University Land Company and Drake University (after James, 2001; Jacobsen, 2011).

Name	University Land Company			University Position
	Position	Investment	Stock Issue	
George T. Carpenter	Vice-President	$2000	$5000	Chancellor, and Vice-President, Board of Trustees
Edmund N. Curl	President	$2000	$5000	Member, Board of Trustees
Francis Marion Drake	Major benefactor	$2000	$5000	President, Board of Trustees
Corydon E. Fuller	Treasurer	$200	$500	Secretary, Board of Trustees
Daniel R. Lucas	Secretary	$1000	$2500	Member, Board of Trustees

gave the University a five-acre parcel of land for the campus as well as one-quarter of all proceeds from land sales. This immediately put the University in a strong financial position, from which it also began making its own land purchases and sales.

Members of the University Land Company also persuaded Francis Marion Drake to donate $20,000 toward the founding of the University. In due appreciation, Drake University was named after him. Over the years, General Drake would provide further financial support for the University. By the time Drake died in 1903, his various contributions totalled $232,000 (Jacobsen, 2011: 61).

2.3 The Early Development of Drake University

The Trustees of Drake University, Iowa's first private university, issued the following 'mission statement':

> This university has been designed upon a broad, liberal and modern basis. The articles of incorporation provide that all its departments shall be open to all without distinction of sex, religion, or race. (Cited by Jacobsen, 2011: 60).

When Drake started, all but one staff member from Oskaloosa College decided to join the new university in Des Moines. A number of students also moved and classes commenced in rented premises in September 1881.

Scholars have subdivided the history of Drake University into four or five different phases of development (see Jacobsen, 2011: 59). This paper will adopt the following periodization:

(1) The Early Years, 1881–1893
(2) The Consolidation Years, 1894–1902
(3) The Progressive Years, 1903–1922
(4) The Consolidation Years, 1922–1941
(5) The Modern Era, 1941–present day

During phases (1) and (4) astronomy flourished as George Carpenter and Daniel Morehouse respectively served as the University Chancellor.

After Carpenter's experience at Oskaloosa College, where shareholders controlled the institution's destiny, he ensured that Drake University's financial affairs were controlled by a Board of Trustees (with General Drake and prominent members of the University Land Company listed in Table 1 playing key roles). James (2011: 85) sees this oversight as central to the early success of Drake University.

Carpenter worked strategically during the Early Years to stabilize the institution. He made an effort

> … to actualize the "university" part of the school title, by affiliating with the off-campus Iowa College of Law and the Iowa Eclectic Medical College. The university otherwise first consisted of the Literature and Arts College on campus and it offered seven separate degrees (read colleges). The degrees list included civil engineering, an acknowledgement that practical training had a role within the liberal arts. (Jacobsen, 2011: 60).

By consolidating with Calanan College in 1884, Drake acquired buildings downtown that it used for teacher education. This off-campus Normal School took the total number of colleges to seven. (Jacobsen, 2011: 60). Significantly, by 1887, Carpenter accomplished the separation of "… faculty salaries from being solely dependent upon tuition." (Ibid.)

Carpenter also oversaw the erection of the University's first two buildings. Stately 'Main Building' (Figure 7) was constructed during 1881–1883, while the nearby Science Hall was completed in 1891 and included a tower with an astronomical observatory (see Figure 8). Between 1881 and 1904 there was considerable suburban development near the University as a result of the University Land Company and the University selling off land holdings to consolidate the University's financial situation and fund further on-campus developments (see Jacobsen, 2011: 32–36, 41–42, 48–54). In June 1890 the University sold off 'Smith's First Addition' specifically to fund construction of Science Hall. Jacobsen (2011: 58) notes that "The concept of using real estate to support the university was not a new one but was very successful …"

An 1890 portrait of Carpenter emphasized the novelty of his business acumen among academics:

> It is often said that college professors know not enough about business affairs to furnish their own tables, but if this be true, Chancellor Carpenter is a marked exception to the general rule, as he can analyze business propositions as accurately as he can a sentence in Greek.

Figure 7: Main Building, completed in 1883 (after Jacobsen, 2011: 63).

Figure 8: Science Hall, completed in 1891 (courtesy: Drake University Archives and Special Collections).

Table 2: Examples of telescopes with equatorial mountings manufactured by Warner & Swasey for American observatories.

Year*	Telescope Objective		Observatory
	Aperture (inches)	Manufacturer	
1881	9.5	Alvan Clark & Sons	Smith Observatory, Beloit College, Beloit, Wisconsin
1884	9.53	Alvan Clark & Sons	McKim Observatory, De Pauw University, Greencastle, Indiana
1886	36	Alvan Clark & Sons	Lick Observatory, University of California, Mount Hamilton, California
1887	8	Alvan Clark & Sons	Durfee High School Observatory, Fall River, Massachusetts
1893	12	John Brashear	Dudley Observatory, Albany, New York
(1883)	26	Alvan Clark & Sons	U.S. Naval Observatory, Washington DC
1895	6	John Brashear	Theodor Jacobsen Observatory, University of Washington, Seattle
1896	12	John Brashear	University of Illinois Observatory, Urbana, Illinois
(1896)	18	John Brashear	Flower Observatory, University of Pennsylvania, Upper Darby, Pennsylvania
1897	40	Alvan Clark & Sons	Yerkes Observatory, University of Chicago, Williams Bay, Wisconsin
1901	9	John Brashear	Stephen's Memorial Observatory, Hiram College, Hiram, Ohio
1901	11	John Brashear	Kirkwood Observatory, Indiana University, Bloomington, Indiana
1914	20	John Brashear	Chabot Observatory, Oakland, California
1922	12	John Brashear	Fuertes Observatory, Cornell University, Ithaca, New York
* Dates in brackets refer to remounted telescopes (the objectives were completed earlier).			

Carpenter did business as President of Des Moines' Merchants and Bankers Insurance Co. in addition to his University commitments.

The location of Drake University in a rich agricultural center in the Midwest allowed for rapid growth, and within ten years it had experienced a tenfold increase in students and faculty (see Jacobsen, 2011; James, 2011).

The Early Years ended in 1893 with the death of Carpenter, who had rapidly achieved a great deal to ensure the long-term survival of Drake University. In 1895, old University Avenue was renamed Carpenter Avenue in his honor, and several years later a small park was named Carpenter Square (James, 2011: 94).

2.4 A Telescope and an Observatory

In 1890 Professor William Alfred Crusinberry (1850–1929), a Masters graduate from Oskaloosa College, began teaching Mathematics and Astronomy at Drake University (Find a Grave).

The new Science Hall included an observatory to house a telescope that could be used by students for practical assignments (see Figure 8). General Drake generously funded the purchase of an 8.25-in (21-cm) refracting telescope to fill that need. Drake University accounts of the telescope state that it was manufactured by the well-known Cleveland (Ohio) firm of Warner & Swasey, but this is only partially correct. Worcester Reed Warner (1846–1929) and Ambrose Swasey (1846–1937) were justly famous for their precision equatorial mountings and robust telescope tube assemblies (e.g. see Figure 9), they did not manufacture the optics, leaving the objectives to America's most accomplished astronomical optical practitioners of the day, Alvan Clark and Sons of Cambridgeport, Massachusetts (Warner and Ariail, 1995) or Pittsburgh's John Brashear (1840–1920; Figure 10; Brashear and Scaife, 1925).

Based on a variety of published sources, Table 2 shows that Warner & Swasey used lenses from Alvan Clark & Sons for telescopes that they made in the 1880s, beginning with their very first telescope, destined for Smith Observatory at Beloit College (Anonymous, 1930). Thereafter, Brashear lenses predominated although Warner & Swasey used only Alvan Clark & Sons objectives for their most ambitious telescopes (including the 40-inch Yerkes Observatory telescope, which is still the largest operational refractor in the world). Morehouse's (1918) account of the 6 June 1918 total solar eclipse confirms that Warner & Swasey used a Brashear objective for the Drake University telescope.

The original plan was to install the Drake University telescope in the Science Hall observatory so that it would be available to students starting in the fall of 1893. However, the Drake University student newspaper, the *Drake Delphic*, reported a disappointing delay in September 1893:

Figure 9: A close-up of the Drake University telescope's distinctive Warner & Swasey equatorial mounting (photograph: Deborah Kent).

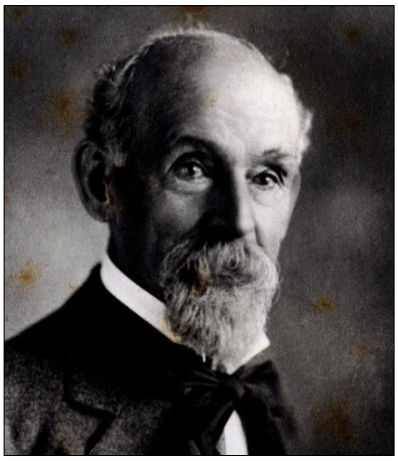


Figure 10: John Brashear (after Brashear and Scaife, 1925).

> Prof. Cruisenberry's recent talk explained the matter fully. The telescope is now making at Warner & Swazy's [*sic*] establishment, Cleveland, O. Several delays have occurred but six months will doubtless find the instrument in place. It is of the latest construction and will be an object of much pride to all. The money for erecting the dome is also secured and next spring our students will begin to measure sidereal distances.

When the telescope finally arrived at Drake University, the Astronomy Department welcomed it as a valuable addition.

3 DRAKE UNIVERSITY AND THE DEVELOPMENT OF ASTRONOMY DURING THE PROGRESSIVE AND CONSOLIDATION YEARS (1903–1941)

3.1 The Role of Daniel Walter Morehouse

Three years after the Drake University telescope was installed, a student named Daniel Morehouse would be its first beneficiary, and later he would be the passionate force behind the founding of the Drake University Municipal Observatory.

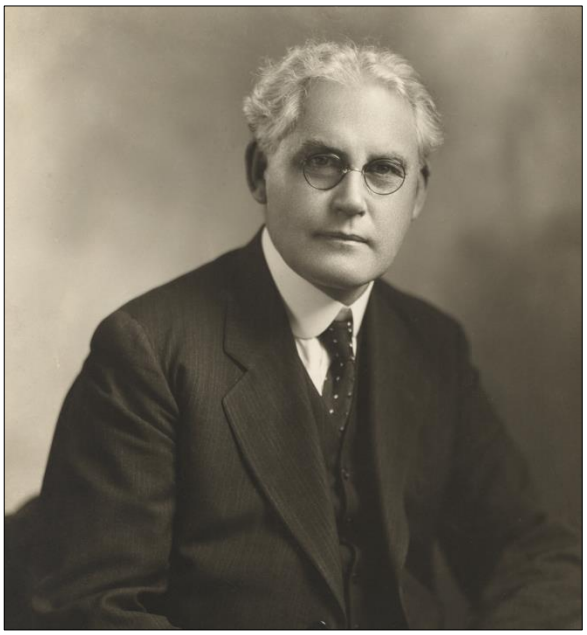


Figure 11: Daniel Morehouse (courtesy: Drake University Archives and Special Collections).

Daniel Walter Morehouse (Figure 11; Fox, 1941) was born in Mankato, Minnesota, on 22 February 1876. After spending his childhood in South Dakota. he spent two years at Northwestern Christian College in Excelsior, Minnesota, before transferring to Drake University in 1897. Likely at that time he "… little dreamed … that he would be associated with that institution during the remainder of his life." (Wilson, 1942: 338). Morehouse was a dapper and well-liked student who participated in the literary society and played on a championship football team. He graduated in the spring of 1900 and the next fall began teaching Physics and Astronomy at Drake University. In 1902, he earned a second Bachelor's degree, from the University of Chicago, and that same year was awarded an MSc by Drake University and "… promoted to the rank of professor of physics and astronomy." (Wilson, 1942, 341). Thus assured of "… a successful career[,] he married Myrtle Slayton of Des Moines on June 9, 1903." (ibid.)

Morehouse then spent successive summers pursuing graduate work at the University of Chicago, using facilities at Yerkes Observatory. There, he was one of only a handful of visiting astronomers permitted to use the Bruce Telescope, and in 1908 he discovered a comet that eventually was named after him. This is discussed further below, in Section 8.1.

Morehouse served as an instructor in astronomy at the University of California during the 1911–1912 academic year. Afterwards, he completed his PhD, in 1914, with a thesis titled "The Orbit of the Seventh Satellite of Jupiter." (Morehouse, 1914).[3]

Back at Drake University, he then balanced observing activities with a heavy teaching load that included courses in mathematics, astronomy, and physics. His approach was to teach astronomy

> … in such a way as to fascinate students, avoiding the highly mathematical and theoretical aspects of the subject that would interest only specialists. (Wilson, 1942: 343).

In 1919 Morehouse was appointed Dean of Men and Acting President, starting a deep involvement with University administration. This only intensified in 1923 when he became President of Drake University—a role that continued until his death in 1941. Even with a taxing administrative load, Morehouse never completely abandoned teaching. He was "…at heart primarily interested in astronomy and teaching, which were ever his foremost joys."

(Wilson, 1942: 340).

As both an educator and an administrator Morehouse extended himself tirelessly. He was a dedicated and hard-working Drake University President, during what historian Jacobson (2011: 72) calls an "… era of great plans." Overall, the vision was to launch "… a comprehensive campus plan….for a modern university …" with fundraising efforts to match (Ibid.). Both the John D. Rockefeller Fund and the Carnegie Foundation provided Drake University with money on the condition "… that the university had to become strictly secular." (ibid.). In early 1925

> A six-year fund raising campaign was launched … to raise $1.3 million. A 1929 drive to raise $10 million for an interest bearing endowment followed, half of these funds were for campus enlargement … (ibid.).

These fund-raising efforts produced considerable on-campus construction, including a new stadium, field house, women's and men's dormitories, the Cowles Library, and a student union. Wilson (1942: 344) has described how

> The completion of each new building was in turn a proud and happy moment in the life of President Morehouse. Each is a substantial testimonial of the time and energy spent in behalf of the University by its courageous and tireless leader. Each is also the evidence of his ability as a business man in building up the physical resources of his institution.

The campus impact of Daniel Morehouse's business savvy parallels that of George Carpenter.

Beyond the University, Morehouse served as President of the Iowa State Academy of Science in 1921–1922. While engaged with statewide and national boards and councils of educators, he was also a member of the American Astronomical Society, the British Astronomical Association and the Royal Astronomical Society. The American Association for the Advancement of Science also elected him Chair of its Astronomical Division. One summer Morehouse served as guest Director of the Adler Planetarium in Chicago, where he had been invited numerous times as a popular guest lecturer. Morehouse was on location in New York at Corning Glass in March of 1934 for the pouring of the 200-inch telescope mirror intended for the world's largest telescope at Palomar Mountain in California (Wilson, 1942).

Daniel Morehouse built a legacy as a comet discoverer, as a brilliant administrator, as an inspirational teacher, and as the builder and Director of Drake Municipal Observatory. His productive life ended on 21 January 1941 after several years of heart problems. Wilson (1942: 337–338) remembered him as

> … a distinguished scientist and educator, as well as a sincere and devout churchman and a true Christian gentleman. The nobility of his character was widely recognized, and he was ever a loyal friend, confidant, and adviser of the many who knew and loved him well ...

3.2 Observational Astronomy at Drake Observatory

On 4 April 1909, the *Drake Delphic* reported an enhancement for the telescope (A generous gift, 1909): five generous alumni donated $500 to purchase a photographic doublet lens for the instrument.[4] Later documentation mentions that this objective was made by John Brashear (Morehouse, 1918).

The *Drake Delphic* continued to report ongoing telescope use by staff, students and interested members of the public during the early decades of the twentieth century. For example, an article published on 21 September 1911 describes a new comet:

> Mr. Whisler of the Department of Physics and Astronomy in the University has been studying this new appearance and has succeeded in securing several photographs of it. While it is in sight he will be glad to make arrangements for those interested to view it from the big telescope in the Observatory any time in the evening. (Another comet is discovered,1911).

Percy Frazy Whisler had received a Bachelor of Science from Drake University in 1909 (University of Illinois, 1911). He taught Physics and Astronomy at Drake University while Morehouse conducted his doctoral work at the University of California, Berkeley. (see Additions to Drake Faculty …, 1911). Whisler received his graduate astronomy training at the University of Illinois (Urbana), and was the first Master's student of Joel Stebbins. Stebbins (1876–1966; Whitford, 1978) was one of the pioneers of photoelectric photometry (Hearnshaw, 1996), and Whisler participated in many of his early experiments (History of the Observatory …, n.d.). Since they used the University of Illinois' 12-in Brashear refractor (see Stebbins, 1911) listed here in Table 2, Whisler would have been familiar with early techniques in photoelectric photometry. Hence, he would have realized that the Drake Observatory 8.25-in refractor lacked the required light-grasp for such experiments.

Due to Professor Whisler's experience and dedication, Drake University remained up-to-date with new astronomical developments despite being a small Midwestern educational facility. For example, when what is now known as Nova Geminorum 1912 (DN Gem) appeared on 13 March 1912, Drake Observatory was

notified of the discovery. As the *Drake Delphic* reported:

> Professor Percy Whisler has received a telegram from E.C. Pickering, professor of Astronomy at Harvard University, that a new star has appeared in the heavens. This new star is of the fourth magnitude and is near Theta Geminorium. The star can be seen without the telescope if you know where to look for it. It has been observed here with and without telescope by Prof. Whisler. (Another new star …, 1912).

3.3 In Search of a New Observatory Site

Daniel Morehouse's experience at Yerkes Observatory in Wisconsin and later at Lick Observatory in California impressed on him the pedagogical, scholarly, and community-building value of locating a new university observatory away from streetcar vibrations and the light-pollution from suburbs growing around Drake University. Figure 12 illustrates that local housing construction between April 1919 and April 1924 was booming to the south and southwest of the campus. The north arrow on the map is over Glendale Cemetery and Waveland Golf Course, which "… formed a boundary to westward residential growth." (Jacobson, 2011: 22).

After his work at the University of California, Morehouse returned to Des Moines increasingly motivated to find a new home for the Drake Observatory 8.25-in telescope. Consequently, he contacted astronomers at established observatories, to solicit information about the recommended location, financing and layout of a new observatory.

3.4 Drake University Municipal Observatory

3.4.1 The Location

Other universities had grappled with the central concern of locating an observatory somewhere that reconciled proximity to the university with distance from the light and noise pollution of urbanization. In the early 1800s when Harvard College originally planned its observatory, the chosen site was a peaceful location just minutes from the heart of campus.

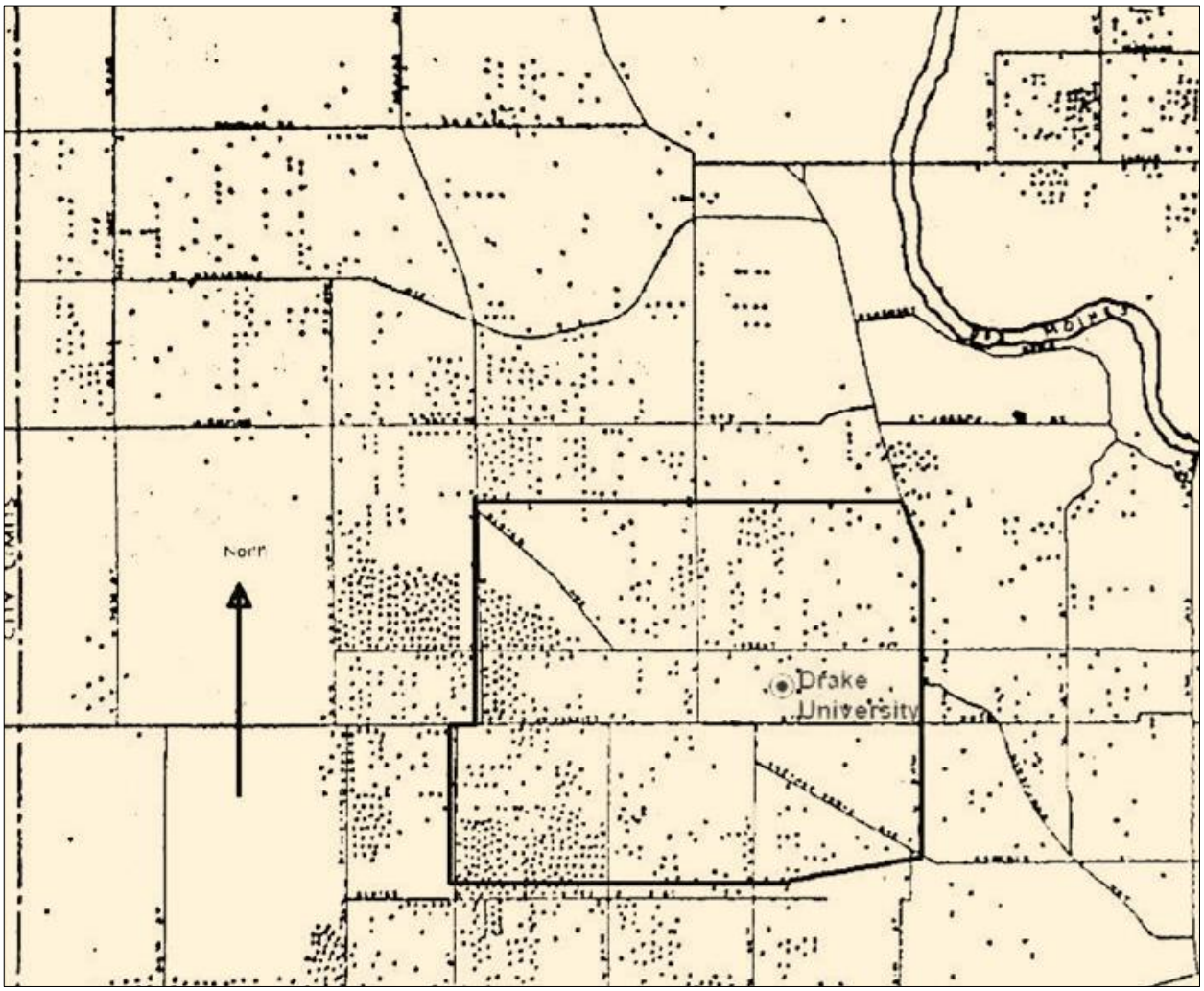


Figure 12: Map showing new houses constructed near the Drake University campus, 1919–1924. The empty land at the bottom of the large arrow is Waveland Golf Course, the eventual site of the new Drake University Municipal Observatory (base map after Jacobsen, 2011: 22; map modifications: Wayne Orchiston).

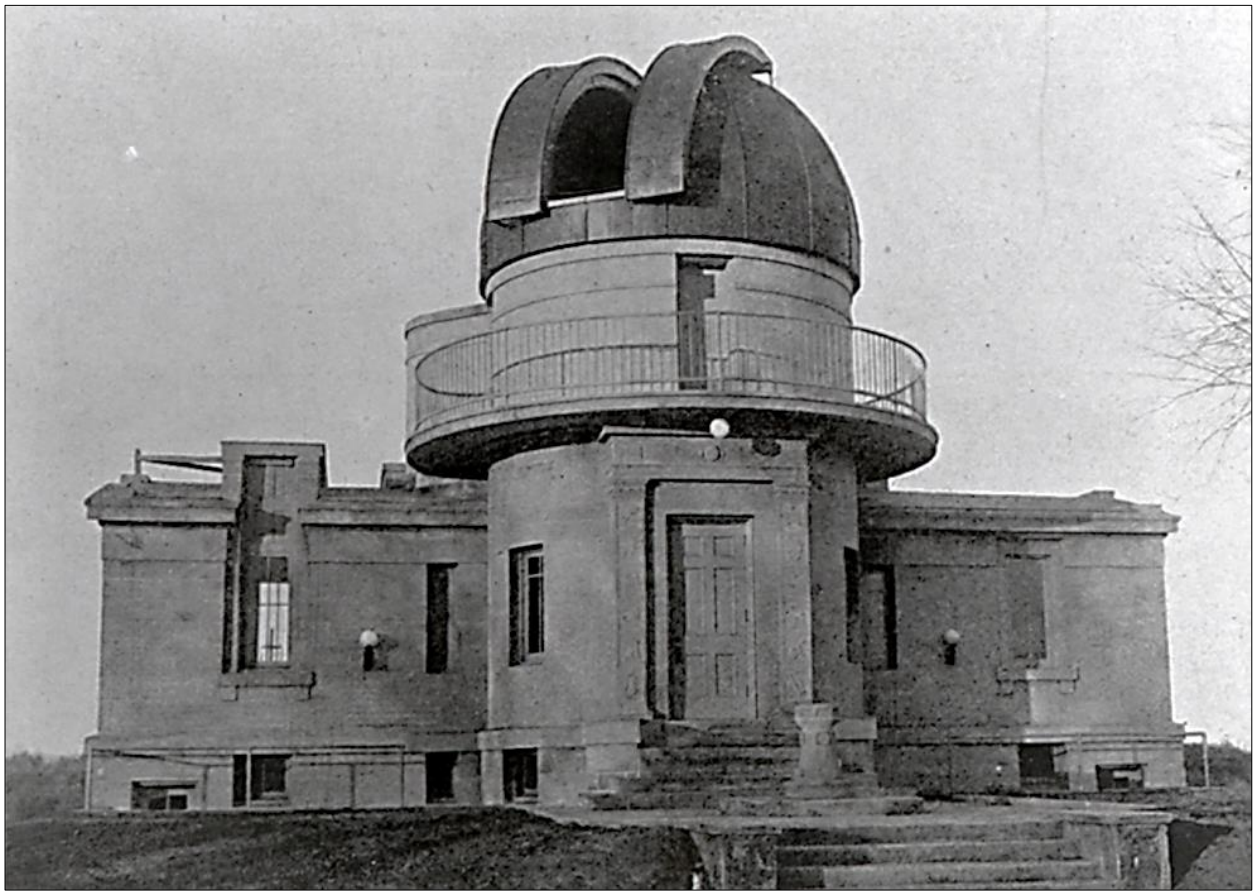


Figure 13: Drake University Municipal Observatory soon after construction, showing the transit room (left), the central entrance doorway leading to the rotunda, and above that the dome room with the 8.25-in refractor (courtesy: Drake University Archives and Special Collections).).

Figure 14: Another view of the Drake University Municipal Observatory, showing the transit wing (right), the main dome housing the 8.25-in refractor, and in the foreground the lecture room (courtesy: Drake University Archives and Special Collections).

However, an urban area quickly sprang up, creating a dilemma by the time of construction. In the end, integrating the observatory with student life was top priority, so the observatory went ahead near campus—as originally planned. Great care was taken to mount equipment properly to minimize any outside disturbances (Bond, 1856). In contrast, the University of Chicago chose observational clarity over proximity to campus. They opted to establish Yerkes Observatory at Lake Geneva in Williams Bay, Wisconsin, far from a major urban area (Osterbrock, 1995).

Morehouse's aim was to locate the observatory within easy access of Drake University, for the benefit of faculty and students, but he also wanted a location that would bring astronomy to the people of Des Moines. Thus, Morehouse began a collaboration with city administrators to determine a workable solution for an improved observatory facility. The City of Des Moines and Drake University eventually reached an agreement: the city would provide a site in the city's golf course at Waveland Park, build an observatory and maintain the outside of the building, if Drake University would agree to supply the necessary astronomical instruments, maintain them and the interior of the building, and offer public programs (see Morehouse, 1922a; 1922b).

Drake University Municipal Observatory (Figures 13 and 14) was built in 1920–1921 "…

Figure 15 (left): An aerial photograph showing Waveland Park, with Drake University Municipal Observatory located in the middle of the golf course (after Morehouse, 1922b: Plate 1).
Figure 16 (right): Drake University Municipal Observatory occupies the highest point in the Waveland Golf Course and Des Moines (http://kristaziogolf.blogspot.com/2011/04/review-waveland-golf-course-des-moines.html).

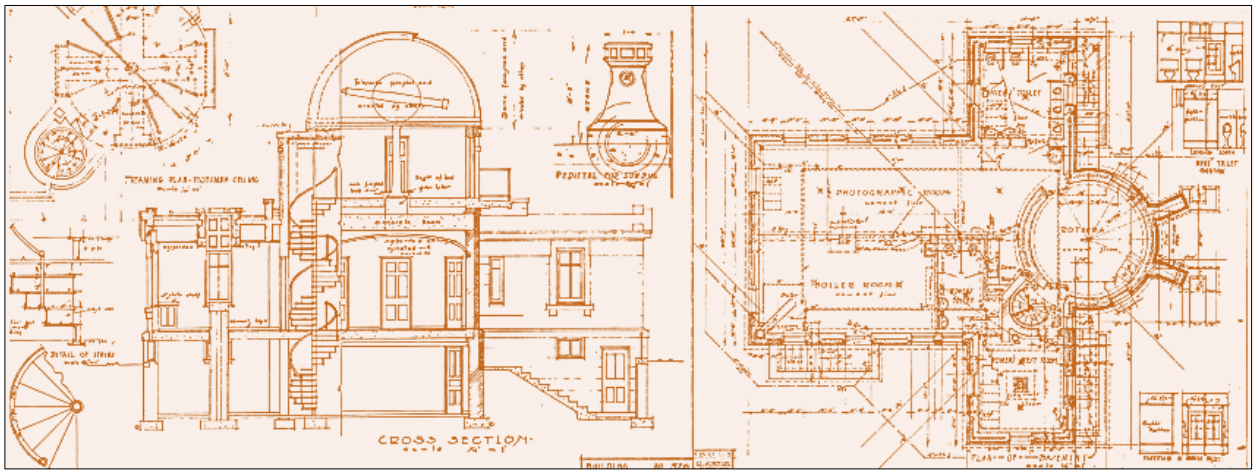


Figure 17: The floor plan (right) and cross-section (left) of Drake University Municipal Observatory (courtesy: Drake University Archives and Special Collections).

in the center of a ninety-acre park which is kept as a golf course." (Morehouse, 1922c: 223). Waveland Park (Figure 15) is the oldest golf course west of the Mississippi River, and the Observatory site marks the highest ground in the City of Des Moines (see Figure 16). It is less than two miles from Drake University and, at the time of construction, was on the outskirts of the city.

Twenty years after the fact, Morehouse fondly recalled a stroll—about the time he first graduated from Drake University—during which his youthful self had serendipitously

> … walked over the Waveland park grounds and said to himself that the sightly knoll in the middle of that beautiful public park was the place for an astronomical observatory … (cited in Morehouse, 1921: 327).

3.4.2 The Layout

The information Morehouse learned from his exchanges with other astronomers resulted in plans for Drake University Municipal Observatory that reflected standard practices of the time (see Donnelly, 1973). Harvard established one of the first American collegiate observatories in 1839. With the development of larger and more precise telescopes came the practice of building an observatory with a central insulated dome to protect the telescope and facilitate its proper mounting. Director, William Cranch Bond (1789–1859; Turner, 2014) advised such a design for Harvard to house a telescope and other stationary mounted equipment. Two straight wings extended from either side of the central dome and connected to the Director's living quarters (Bond, 1856). Yerkes Observatory followed a similar blueprint. A central dome housed first-rate mounted astronomical equipment donated from the personal collection of George Ellery Hale (2008). Yerkes also features a single extending straight wing, which housed the library and offices (Osterbrock, 1999).

The layout for the Drake University Municipal Observatory (Figure 17) likewise features

a central rotunda and telescope dome with adjacent rooms for work, meetings or lectures and instruments. The architectural style is Grecian, with a sundial outside the main entrance. The building is made of buff-colored 'Bedford stone', a high-quality limestone also known as Indiana Limestone that was quarried mainly between the cities of Bloomington and Bedford in Indiana.[5]

Surrounding the entrance doorway are raised panels with carvings of the twelve signs of the zodiac (see Figure 18), surmounted on either side by Greek Corinthian columns, reminding visitors of "… the contributions which Greece made to the arts and sciences." (Morehouse, 1922a: 172). DRAKE UNIVERSITY MUNICIPAL OBSERVATORY is carved in Roman letters on a lintel above the doorway, and above this "… is the familiar bas relief of the winged sun with attendant cobras, used so frequently by the Egyptians on their architectural monuments." (ibid.), and representing the infinitely small point or individuality in relationship to the vastness of the Universe. On either side of this bas relief is carved the date of the construction of the Observatory: AD 1920 and the Julian Date 6633. Morehouse (ibid.) explains the logic:

> Thus in review before our minds passes the ancient Chaldean, Persian, Egyptian, Greek and Roman civilizations, each of which contributed its part to the science to which this building is dedicated.

In addition, marble used in the Observatory originates from various countries, once again reflecting the global nature of astronomy (Names of the marble …).

The main door accesses a rotunda that is directly below the Dome Room with the historic Warner & Swasey/Brashear telescope. The sky-blue marble floor of the rotunda is tiled with an inlaid mosaic not-to-scale map of the Solar System (Figure 19) that does not include Pluto—a reflection of its later discovery, in 1930 (not to mention its demotion in 2006). Drake Municipal Observatory Lecturer Herb Schwartz has dated the planetary configuration shown in the Solar System map to 1 October 1921, which was within two weeks of the building's dedication ceremony (pers. comm., 2001).

From the rotunda, a doorway leads directly to the public lecture room, which is designed to hold up to 150 people. A raised dais at the far end provides an excellent lecture platform. Along the walls of the room are photographs of other observatories, as well as many different astronomical objects such as nebulae and comets. On either side of the raised dais is a series of photographs honoring Professor Daniel Morehouse, included seven images of

Figure 18: The attractive entrance doorway to the Observatory (photograph: Deborah Kent).

Comet C/1908 R1 (Morehouse) that were taken at the Royal Observatory, Greenwich (England), shortly after the comet's discovery in early September 1908 (see Figure 20).

Figure 19: The floor of the entrance Rotunda, showing the inlaid mosaic Solar System (photograph: Deborah Kent).

Figure 20: Photographs of Comet C/1908 R1 (Morehouse), taken at the Royal Observatory, Greenwich, in 1908 (ohotograph: Deborah Kent).

Figure 21: The 8.25-in Brasheat/Warner & Swasey refractor (photograph: Deborah Kent).

There are two other doors off the rotunda. The one on the right accesses an office, while the one on the left leads to the Transit Room. When the Observatory opened, this room housed a transit telescope to provide official time for the City of Des Moines, and a telegraph line from the Observatory provided time directly to the railroad.

A spiral staircase leads directly to the Dome Room on the second floor. The 8¼-inch refractor (Figure 21) is mounted on reinforced concrete beams (Morehouse, 1922a). The dome is 18 feet (5.5 meters) in diameter, and a balcony runs around the exterior of the observing tower thus providing a wider view of the sky. Four doors exit the Dome Room and three of these lead to the balcony. The fourth door leads directly to the roof of the lecture hall which serves as an Observing Deck. This area has space for a large group of people to observe the sky. In the daytime it also provides a good view of the dome, which is liberally pock-marked with dents (see Figure 22), courtesy of its intrusive location on a golf course!

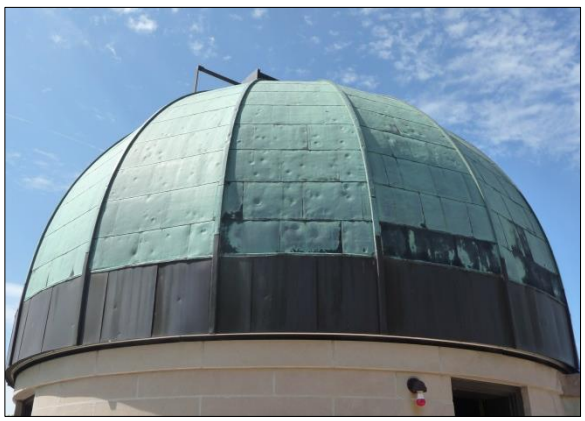


Figure 22: The pock-marked dome, 'decorated' by stray golf balls (photograph: Deborah Kent).

3.4.3 The Equatorial Telescope

It is clear from one of Morehouse's four accounts of the Observatory's founding and from photographs of the astronomical instruments installed there that they came from the original Drake University Observatory in Science Hall, including the 8.25-in refractor with its distinctive Warney & Swasey equatorial mounting and objective worked by John Brashear (Morehouse, 1922c). Given Morehouse's attention to detail, it seems strange that he lists the aperture of the objective as 8.5 inches in another account (Morehouse, 1921), and as 9 inches in the two other largely-duplicated accounts (Morehouse, 1922a; 1922b).

Other astronomical equipment provided by

Drake University were "… transit instruments, clocks, chronometers and portable instruments." (Morehouse, 1921: 328).

3.4.4 The Dedication Ceremony

The Dedication Ceremony was held on Saturday 5 November 1921 (Morehouse, 1921), and was a grand event "… of more than local importance." (Morehouse, 1921: 327). It also marked the culmination of an investment of $53,000 by the City. (ibid.). The program (Figure 23) included the dedication of Drake University Municipal Observatory by Des Moines City Councilman Harry B. Frase (1875–1927) who presented the keys to the founding Director, Professor Daniel Morehouse for "… permanent care forevermore, with the well wishes of the city." (Dedication Program, 1921: 19). Morehouse responded that

> This observatory is a physical proof of a principle, which I have been giving to my classes, that astronomy is the greatest example of cooperation in the world. (Dedication Program, 1921: 20).

Furthermore, the Observatory was deemed to be unique as

> … the only one built and owned jointly by a [US] city and an independent university and dedicated at once to the work of research, student instruction and the enlightenment and entertainment of the general public. (Morehouse, 1921: 328).

The 'Dedicatory Address' was presented by Professor Forest Ray Moulton (1872–1952; Gasteyer, 1970) from the University of Chicago, who spoke on "Larger Worlds". Moulton was well known for his astronomy text books and as a champion of the 'Chamberlin-Moulton Planetesimal Hypothesis'—that the planets of our Solar System formed by coalescing from smaller bodies termed 'planetesimals' (see Brush, 1978).

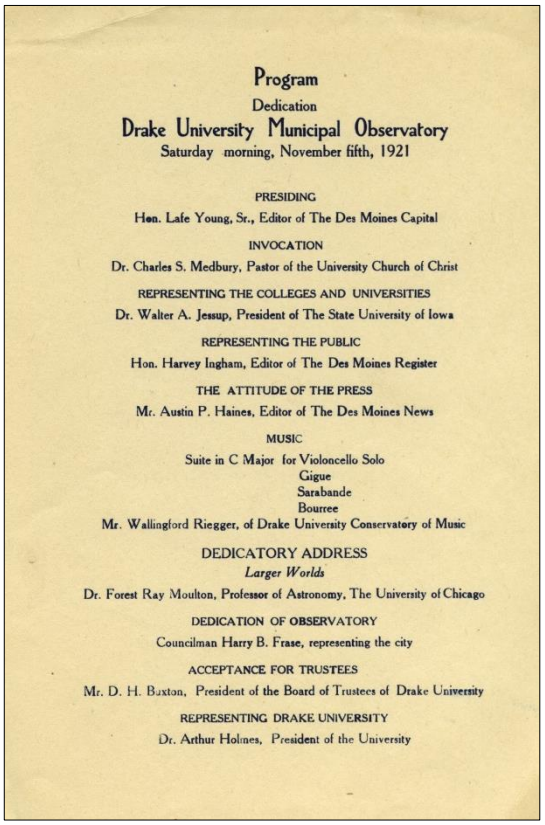
4 MAINTENANCE OF DRAKE UNIVERSITY MUNICIPAL OBSERVATORY

After the Municipal Observatory was completed, Drake University continued to add new equipment and refurbish the old as had been agreed upon. As President of Drake University, Morehouse continued to make headlines and bring prestige to the institution. Thus, after his paper, "A Ring Nebula (Dark) in Cygnus", appeared in the February 1927 issue of *Popular Astronomy*, the Iowa Academy of Science rewarded this work with funds to add a guiding telescope to attach to the camera at the Observatory (Equipment Added to Observatory, 1928). Then in 1930, a new stainless steel worm gear replaced the original very worn and pitted one (Repairs made …, 1930).

Meanwhile, Drake University's commitment to the community continued. In the same issue of the *Drake Delphic* announcing the new worm gear, the following information was provided

> Drake students, and any others who wish to visit the observatory, are welcome to come on any Monday or Friday night, and will have the opportunity of viewing the man in the moon at close range. (ibid.).

In 1937, the telescope was scraped and repainted (Drake Observatory Telescope Repaired, 1937) and in 1940 Theodore Mehlin (1906–1971), the Professor of Astronomy at Drake University, designed a new mounting for the Observatory. All manufacturing was done in Des Moines. The new mounting was needed



Program
Dedication
Drake University Municipal Observatory
Saturday morning, November fifth, 1921

PRESIDING
Hon. Lafe Young, Sr., Editor of The Des Moines Capital

INVOCATION
Dr. Charles S. Medbury, Pastor of the University Church of Christ

REPRESENTING THE COLLEGES AND UNIVERSITIES
Dr. Walter A. Jessup, President of The State University of Iowa

REPRESENTING THE PUBLIC
Hon. Harvey Ingham, Editor of The Des Moines Register

THE ATTITUDE OF THE PRESS
Mr. Austin P. Haines, Editor of The Des Moines News

MUSIC
Suite in C Major for Violoncello Solo
Gigue
Sarabande
Bourree
Mr. Wallingford Riegger, of Drake University Conservatory of Music

DEDICATORY ADDRESS
Larger Worlds
Dr. Forest Ray Moulton, Professor of Astronomy, The University of Chicago

DEDICATION OF OBSERVATORY
Councilman Harry B. Frase, representing the city

ACCEPTANCE FOR TRUSTEES
Mr. D. H. Buxton, President of the Board of Trustees of Drake University

REPRESENTING DRAKE UNIVERSITY
Dr. Arthur Holmes, President of the University

Figure 23: The program used during the Dedication of Drake University Municipal Observatory on 5 November 1921 (courtesy: Drake University Archives and Special Col-lections).

because formerly, when the camera and telescope were all on one mounting, only one person at a time could use it. The 16 February 1940 *Drake Delphic* article that discussed the new mounting also stated that the camera's 5-in (12.7 cm) telescope was a gift from William Dunn in memory of his son Maurice who was killed in France during World War I (Drake Observatory telescope …, 1940).

When Daniel Morehouse died in January 1941, both Drake University and the State of Iowa lost an outstanding leader. Through the Drake Municipal Observatory his dream of bring-

ing astronomy to the people of Des Moines had been realized. Whether this dream remained a reality would be a challenge for the future.

5 RAGS: DETERIORATION OF DRAKE MUNICIPAL OBSERVATORY IN THE POST-MOREHOUSE ERA

5.1 Introduction

Following Professor Morehouse's death, Drake University Municipal Observatory slowly began to deteriorate. Brief periods of growth did not keep pace with ongoing decline, some of which resulted from natural wear as the building and its equipment aged. Social and economic factors also contributed. Thus, low Astronomy enrollments at the University, limited budgets from both Drake University and the City of Des Moines, and vandalism all contributed to the deterioration.

Meanwhile, the City of Des Moines experienced rapid population growth, and the once-quiet and peaceful golf course on the edge of town soon was swallowed up by the expanding city. A new freeway was constructed along one side of Waveland Park, leaving only a small hill and a few trees separating the Observatory from the noise and lights of passing traffic. However, the growing community would also become an integral part in saving the Observatory, and a factor in keeping the Observatory vital during this period of decline. Except for a short period in the 1970s, the lecture series continued to bring astronomy to a growing and interested public.

5.2 Astronomy Enrollments at Drake University

During his lifetime, Daniel Morehouse was the heart and soul of the Astronomy program at Drake University. From all accounts, he was a gifted lecturer (Fox, 1941; Wilson, 1942). His passion invigorated the Astronomy program, which dwindled with his death. Other factors, such as World War II, may also have played a role in the dropping Astronomy enrollments during the 1940s. Consequently, academic use of the Observatory also declined.

On 3 April 1951 the *Drake Delphic* ran an article about the Astronomy Department, reporting that there were only thirteen students enrolled in the program. Professor Mehlin had moved to Williams College in 1942 (see Pasachoff, 1998: 72), and by 1951 Caltech and University of California (Berkeley) graduate Philip S. Riggs (1906–1994) was Professor of Astronomy at Drake University. Riggs apparently took over where Morehouse left off at Drake University Memorial Observatory "… as an inspiring teacher and popular lecturer …" (Obituary …, 1996), but he lacked a distinguished research record, and he was less successful in attracting students to his Astronomy. Riggs explained in a 1951 *Drake Delphic* article that Astronomy was "… a field that cannot absorb many people." He also stressed that despite low enrollments, passion was high, and that some former Drake University students who had used the Observatory facilities to launch successful astronomical careers. He specifically mentioned Dr Seth B. Nicholson, who "… has for many years been at the Mt. Wilson and Palomar observatories in California and has discoveries to his credit." (Manion, 1951). Riggs also highlighted W.F. Meyer, who, though deceased, had "… spent the greater part of his life as professor of astronomy at the University of California at Berkley [*sic*]." (Ibid.)

But even with such successful graduates the program was dwindling. The University had less use for the Observatory, and at the same time the University and the City struggled to attend to its upkeep.

5.3 Vandalism

Vandalism became a problem for the Observatory during the decades of the 1960s, 1970s, and even into the 1980s.

The costliest and most devastating was the break-in that occurred in March 1970 (A Brief Account …, 1970; Lytton, 1970; $10,000 damage …, 1970). Vandals broke into the Observatory and smashed many of the displays and instruments, leaving only the main telescope unharmed. The estimated damage was $10,000, a considerable sum at that time. Most significant was the damage to material inside the lecture hall. Books, many more than 100 years old and out of print, were stolen or destroyed. Transparencies were ruined and cases holding meteorite samples were smashed and the samples scattered on the floor. Fire extinguisher foam was sprayed on everything in the lecture hall. Luckily, the lock on the door to the Dome Room kept the main telescope and its accessories safe and untouched.

Another break-in occurred in November 1980, and resulted in the theft of five auxiliary telescopes valued at $5,000 (Telescopes stolen …, 1980).

5.4 Budget Cuts

By 1973, the need for repairs to the Drake Municipal Observatory had become urgent, and Professor Riggs stated: "It is struggling with the problem of existence." In the 13 April 1973 issue of the *Drake Delphic* Riggs listed problems relating mainly to city lights, smog, the age of the Observatory and its up-keep. The article also quoted Jack Muller from the Des

Moines Parks Department: “Because of recent cut backs, the most the city can do for the observatory [at the moment] is minimum repairs.” (Freimoth, 1973)

Emergency repairs were made to the building in 1983, and “Although only a few leaks were apparent in the observatory, the ceiling began to cave in.” (Peterson, 1983). The 4 November 1983 issue of the *Drake Delphic* also reported that the public lectures, which had been such a vital part of the Observatory’s history (e.g. see Public Lecture Series, 1970; Public Nights, 1969; Public Nights Schedule, 1969), henceforth would only be held in the fall and spring. Lack of both interest and funds was the reason given for not conducting a winter lecture series (Peterson, 1983).

5.5 On-Going Community Support

Over the years, the Drake University Municipal Observatory faced a succession of challenges and obstacles, but each time the community rallied behind it. With the passage of time, the Observatory suffered quite a lot of weather damage, not to mention the break-ins and vandalism. There was vast public outcry over the vandalism, and many community members wrote letters to Drake University administrators to inquire about fixing the damage. When these issues were not addressed by the City of Des Moines further complaints were made, and Professor Riggs (1970) then reached out to a city representative, Dean Johnson, and asked him to act as an advocate for the Observatory. The Observatory was badly damaged and in desperate need of repairs, which were estimated to cost $225,000. However, the city was not willing to pay for the repairs, and the University was ready to abandon the Observatory. Des Moines citizens from the neighborhood then came together to support keeping the Observatory, and many people and businesses donated money for the necessary repairs.

But this was only a stop-gap measure (‘Too little, too late’), and by the 1990s the Observatory had reached a sorry state. Any visitor to the Observatory would be discouraged by its rundown appearance (Suk, 1999). Restoration would likely exceed $700,000, and it was now time for both Drake University and the City of Des Moines to decide the fate of its once proud Municipal Observatory. Would it be restored, or would it continue to deteriorate?

6 RESTORATION: A NEW LIFE AT LAST

6.1 The Role of the City of Des Moines

The Observatory had been neglected for many years, so the City of Des Moines faced an extensive list of required repairs in 1999. (Suk, 1999).

The major concerns were repairing the copper dome and replacing interior fixtures. The roof over both the east and west wings would need to be replaced within six years. The City of Des Moines designated $127,000 for exterior repairs, but help from the city did not stop with municipal funds. Businesses came forward to do what Iowans are known for—neighbor helping neighbor. Mid-Iowa Environmental Group Inc. paid for asbestos removal. Waldinger Corporation donated a new heating, ventilation and air-conditioning system to eliminate the need for a boiler. Mid-American Energy donated a gas line, and ABC Electric offered to update the electrical system at cost. The list grew as more and more people and companies came forward to help. Then came a potentially devastating blow. Drake University announced budget cuts that would prevent it from upholding its end of the agreement: the public lecture series and the University’s commitment to the Observatory would cease.

6.2 The Role of Drake University

When Drake University announced that it would phase out support for the Observatory, more than 300 people attended an open house at the facility. The Waveland Park Neighborhood Association circulated a petition requesting continued University support for the Observatory. Letters to the Editor of the *Des Moines Register* newspaper overwhelmingly supported the facility, and Iowans fully expected the University to uphold its end of the 80-year-old ‘gentleman’s agreement’.

Supporters of the Observatory sighed in relief to read an article on page 5 of the 18 November 2000 issue of the *Des Moines Register*: Madelyn Levitt (Figure 24), a Drake University booster, offered to donate $150,000 towards the renovation of the crumbling Observatory. Levitt said:

> I’ve always been a dreamer … Dreamers look to the stars. When I heard that we were having trouble finding help for the observatory, I knew I had to help. (Finney, 2000).

With these and other resources Drake University re-committed itself to the restoration of the Observatory (Waldman, 2000).

6.3 Renovation – at Long Last

On 4 May 2001 Drake Municipal Observatory held an Open House. This ‘Walkthrough Tour’ gave the public an opportunity to see the progress that had been made with the Observatory Restoration Project. The Open House

Brochure (2001) that was given to guests listed extensive renovations.

Visitors could now see a brand-new side to the Observatory; it was no longer the 'dilapidated old tomb' they had come to know (Boone, 2001). In the basement, foundation walls had been excavated and waterproofed, drainage tiles were installed and plaster damage had been repaired. New natural gas lines replaced oil as a heat source, and a furnace replaced the old boiler. The whole building had been rewired and all asbestos had been removed. There were new exterior doors, and the restrooms had been renovated.

On the first floor, extensive plaster damage from water entering through leaks in the roof and around the dome was repaired; walls were repainted; and new carpet had been laid. A new security system was installed to deter further vandalism. In addition, a former storage closet had been converted into a wheelchair-accessible restroom.

Figure 24: Madelyn Levitt (https://drakeapedia.library.drake.edu/wiki/File:1stphoto.JPG

Structural improvements were made on the second floor, where the dome houses the telescope. The base of the dome had been repaired, and the structural ring that keeps the dome circular had been replaced. The deteriorating lower section of the dome had also been replaced with new wooden framing and copper sheets. Repairs were also made to the exterior walkways and railings. Weather stripping was repaired and improved to prevent animals from gaining entry to the building. New shutter doors were built and clad in copper, then rehung using the original hardware.

In addition to these structural improvements there were new designs and revamped amenities. And although the name on the entrance doorway was not changed and Drake University maintained its association, the refurbished facility quickly became known simply as the 'Drake Municipal Observatory'.

The Observatory now stands as a testament to what a community can accomplish by supporting restoration and astronomical science.

7 DRAKE MUNICIPAL OBSERVATORY IN THE TWENTY-FIRST CENTURY

Today the Observatory still stands proudly in Waveland Park (Figure 25). It is still home to the very same 125-yr old 8¼-in refracting telescope, but its years of hardship are long gone. The Astronomy program at Drake University once again is flourishing, and students in every new Introductory Astronomy class take trips to the Observatory to foster a deeper appreciation for this oldest of sciences.

There is now a long list of Observatory supporters. In addition to co-owners Drake University and the City of Des Moines, there are countless companies that donate their time and resources to ensure the high-quality upkeep of the building and its equipment.

Finally, Daniel Morehouse's dream of bringing astronomy to the community is being realized though vibrant public programs. When Drake University first began inviting community members to the Observatory, a variety of programs were designed to incite public interest. From these, the two main programs that remain are Friday Public Nights and the Lecture Series.

Public Nights allow visitors to view celestial wonders through the telescope every Friday evening, provided the sky is clear. People of all ages are encouraged to attend and learn about the fascination of the Universe. The Observatory has recently acquired a Meade 16" Starfinder Reflecting Telescope. Starting in Fall 2019, this will be available outside at ground-level for accessible viewing during Public Nights.

The Observatory's Lecture Series (Figure 26) began in 1970 and runs annually during the summer months. The aim is to teach about specific astronomical topics, such as planets in our Solar System or space travel. This is an effective way directly to engage community members and it also provides lecturers with opportunities to discuss important new discoveries.

These public initiatives expand the Observatory's influence beyond Drake University Astronomy students, and also bring the community together to share in a learning opportunity that otherwise would not exist.

Figure 25: Drake Municipal Observatory on 15 March 2016 (courtesy: Dr Scott Kardell).

Figure 26: People at the last Public Lecture in 2018 voting to have Drake Municipal Observatory introduce a Winter Series of Public Lectures in 2019 (courtesy: Drake Municipal Observatory).

8 DISCUSSION

8.1 Comet C/1908 R1 (Morehouse)

For many present-day astronomers the name "Morehouse" immediately brings to mind the remarkable comet that bears his name.

The circumstances of its discovery are recounted by Phillip Fox (1878–1944, Aitken, 1944), a PhD student who was present at the time. Morehouse discovered the comet in 1908, when he was helping Yerkes Observatory Director Professor Edward Emerson Barnard (1857–1923; Sheehan, 1995) conduct a photographic survey of the Milky Way using the Bruce Telescope. On the evening of 1 September, Morehouse photographed a region along the fringe of the Milky Way, and Fox (1941: 290–291) recalls that

> In mid-morning on 2 September 1908, as I came down from the 40-inch dome where I had been working with the spectroheliograph, I met Morehouse as he came up from his dark room. There was excitement in his manner and voice so much so that he scarcely whispered as he spoke: "Fox, I think I've found a comet." When I asked him if it appeared on both plates he rushed down to the dark room and in a moment returned to report the confirmation. It may be added that two nights later, 3 September, Borrelly independently discovered this comet.

Reference above to "… both plates …" refers to the special nature of the Bruce Photographic Telescope. The instrument, which is shown in Figure 27, actually comprised

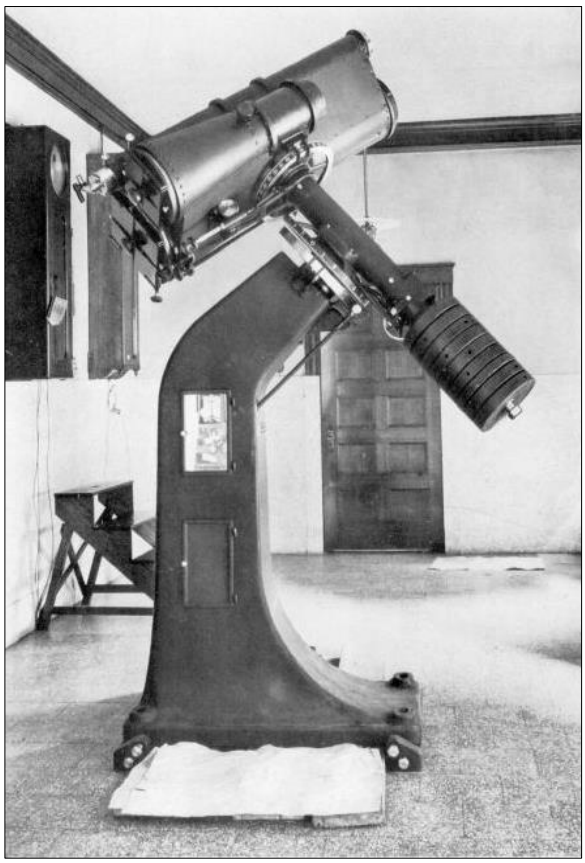


Figure 27: The Bruce Photographic Telescope (after Barnard, 1905: Plate I).

> … a five-inch guiding telescope and two photographic doublets of 10 and 6¼ inches aperture, rigidly bound together on the same mounting. (Barnard, 1905: 37).[6]

The distinguished Belgian-American astronomer Georges Van Biesbroeck (1880–1974; Hockey and Williams, 2014) has described how Morehouse's discovery plate was exposed for six hours, from 15^h35^m to 21^h40^m Greenwich Astronomical Time. At this time,

> Both the 10-inch and 6-inch lenses were used simultaneously as part of Barnard's program of Milky Way studies. The nucleus of the comet made a long trail and the tail was spread out in a wide band. The exposure being centered at 2^h20^m and 60° the comet was so far from the center that only the 6-inch plate showed the object completely, while on the 10-inch plate the nucleus was out of the field and only the blurred image of the tail appeared. (Van Biesbroeck, 1943: 139).

In fact, in 1908 the Bruce Telescope acquired a third portrait lens, of just 3.4-in aperture, mounted in a wooden box. The new comet was successfully photographed with all three lenses. Barnard explained (1908: 296) that

> The smaller lens, while showing practically everything obtained with the larger ones but on a smaller scale, gave the full extent of the tail, which sometimes extended beyond the edges of the larger plates.

Regular observations of the comet started on 3 September. Many astronomers followed it, but what quickly set Comet C/1908 R1 (Morehouse) aside from all previously observed comets was "… the most bizarre, most whimsical, most unpredictable …" nature of its tail (Fox, 1941: 291). It would change markedly over the course of only a few hours—as revealed in many photographs. At times the tail would split into several separate tails, and at other times the tail would detach from the head of the comet (these are now known as 'disconnection events'). These on-going changes in the tail were reported by many astronomers (e.g. see Barnard, 1908; Glancy, 1909; Miller, 1908; Motherwell, 1909; Wilson, 1908).

After discussing her Lick Observatory photographs, Estelle Glancy (1883–1975) comments:

> Photography finds an important usefulness in comet work, and Comet Morehouse is a remarkably favorable subject for two reasons. In the first place, the orbit plane could scarcely be better situated with respect to the Earth … Perihelion passage occurred on December 26th. Hence, from September 1st to December the comet was visible in the northern hemisphere, and during the early part of this period it was a circumpolar object. Five weeks after its disappearance below our horizon it became visible to the southern observers under almost as favourable circumstances, and it can be followed for several months more. Though visually fainter than Comet Daniel 1907, Comet Morehouse photographed more readily. This is due to the fact established by spectroscopic observations here and elsewhere, that the radiations lying in the visual regions of the spectrum (red, orange, yellow, green) are weak and those in the photographic regions (blue and violet) are remarkably strong. Hence this comet, which appears in the visual telescope as an object

> of little interest, has secured the continuous attention of numerous observers. (Glancy, 1909: 76–77).

In his paper on the definitive orbital elements of Comet C/1908 R1 (Morehouse), Van Biesbroeck (1943: 152–153) lists in Table 2 the published photographic observations he utilized in his analysis. These reveal the intentional interest shown in this unique comet, and derive from observatories in the following (present-day) countries: Algeria, Austria, Belgium, Chile, China, Denmark, England, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, Poland, Russia, South Africa, Ukraine and the USA. In Figure 28 we show a representative selection of photographs.

Apart from its ever-changing tail, the spectrum of the comet's nucleus also attracted attention, as several unidentified emission lines were reported by observers (e.g. see Campbell, 1908; Campbell and Albrecht, 1909; Frost and Parkhurst, 1908).[7]

Soon after the 1 September 1908 discovery, Daniel Morehouse returned to Des Moines, and he made micrometric observations of the position of the comet's nucleus on September 28; October 1, 6, 11, 13, 29; and November 2, 8, 10 and 11 using the Warner & Swasey filar micrometer that came with the 8.25-in Drake Observatory telescope (Morehouse, 1909b). Subsequently, some of these measurements were used by others to derive the orbital elements of the comet.

In November, Morehouse (1909a) also took photographs of the comet with a 3-in portrait lens supplied by E.E. Barnard, and attached to the tube assembly of the 8.25-in refractor. Like others before him he commented on the ever-changing tail, but noted that "Outside of this the comet seems perfectly normal. The head is bright and small giving off a few short spurs."

As was customary at the time, Daniel Morehouse received the Donohoe Medal from the Astronomical Society of the Pacific for his comet discovery (Fox, 1941).

8.2 Morehouse's Record as a Research Astronomer

In spite of his busy life at Drake University, Professor Morehouse still found time to carry out some astronomical research, but Wilson's claim (1942: 346) that "… his contributions to the literature were many and varied." is perhaps an over-statement given that his list of astronomy publications totals less than two dozen—a very modest full-career tally

Moreover, most of Morehouse's 'papers' are actually short notes of less than one page,

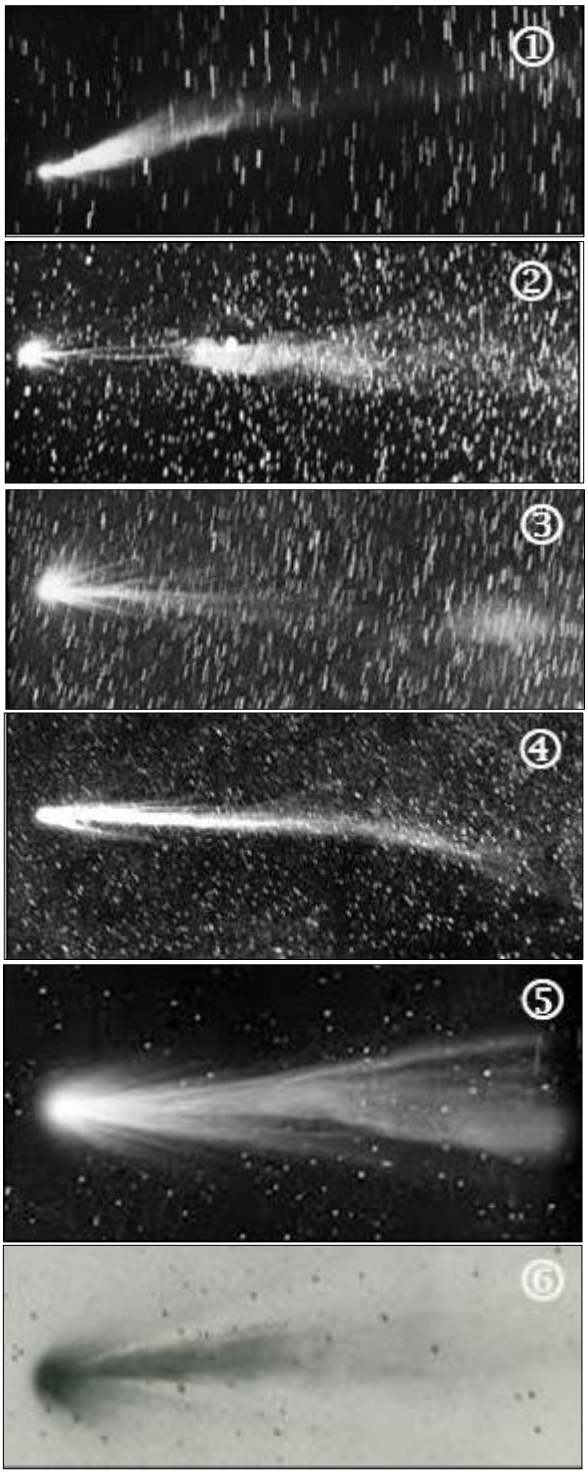


Figure 28: 1908 photographs of Comet C/1908 R1 (Morehouse)in chronological order. Key: ① = 20 September, Yerkes Observatory (https:// retrofutureground.tumblr.com/post/102874019742/yerkes-observatory-morehouses-comet-c1908-r1; accessed 20 July 2019); ② = 1 October, Yerkes Observatory (https:// retrofutureground.tumblr.com/post/102874019742/yerkes-observatory-morehouses-comet-c1908-r1; accessed 20 July 2019); ③ = 2 October, Yerkes Observatory (https://retrofutureground.tumblr.com/post/102874019742/yerkes-observatory-morehouses-comet-c1908-r1; accessed 20 July 2019); ④ = 15 November, Lick Observatory (after Doolittle, 1910: 21); ⑤ = 16 November, Heidelberg (https://www.facebook.com/140234731687/photos/ comet-c1908-r1-morehouse-was-photographed-by-max-wolf-at-heidelberg-koenigstuhl-/10154992834691688/ ; accessed 20 July 2019); ⑥ = 22 November, Royal Observatory Greenwich negative (after Buczynski, 2018: 15).

or 1–2 page 'short communications'. Only four contributions equal or exceed 5 pages, and his longest paper is only ten pages.

Most of Morehouse's publications are descriptive accounts of his own visual, photographic or micrometric observations (although Morehouse et al. (1911) and Morehouse (1922) deal with the work of his students). But, as Wilson (1942) reflects, Morehouse's papers do show his wide-ranging astronomical interests. Thus, there are papers about solar eclipses and the chromosphere (Morehouse, 1918c; Morehouse and Fox, 1933); the planets Mars, Jupiter and Pluto (Morehouse, 1922d; 1930); asteroids 8 Flora, 21 Letetia and 1909 JA (Morehouse, 1910a, 1912; Morehouse et al., 1911); some of the Jovian satellites (Morehouse and Myer, 1912); aurorae (Morehouse, 1918a, 1925); meteors and possible meteorites (Morehouse, 1907, 1918b), comets (Morehouse, 1910b, 1910c, 1919), and a dark nebula (Morehouse, 1927). Non-observational papers are about the longitude of Drake Observatory (Morehouse, 1915) and "Astronomy's contribution to the stream of human thought" (Morehouse, 1932). This latter paper is primarily about the sociology of astronomy, and is based on the address that Morehouse gave when elected Chairman of the Astronomical Division of the American Association for the Advancement of Science. This was his only paper published in the prestigious international journal, *Science*. Finally, one book review rounds out Morehouse's list of publications.

Of all Morehouse's publication, we would single out his account of the 1918 total solar eclipse and his investigation of the longitude of Drake Observatory as being of greatest international importance. And it is telling that they, and the afore-mentioned paper published in *Science*, were his longest research papers.

It is noticeable that Morehouse did not publish any papers on astrophysics. It is equally interesting that at no time did he seek to replace the 8.25-in Warner & Swasey/Brashear refractor with a much larger reflecting telescope that could have been used effectively for astrophysical research. Morehouse appears to have been a classical astronomer at heart.

With the exception of his solar eclipse reports, all of Morehouse's observational papers were based on observations that he carried out at Drake's on-campus observatory and later at the Drake University Municipal Observatory in Waveland Park. This is interesting because Morehouse had close friends at Lick and Yerkes Observatories and he could have applied successfully for observing time at both institutions—and at other observatories with instrumentation that was far superior to that found at Drake Observatory.

Furthermore, it is significant that the great majority of Morehouse's papers were published in *Popular Astronomy*—a journal with a wide amateur astronomy following[8]—while only a solitary paper (and a short one at that) appeared in one of the leading journals of the day, *Astronomische Nachrichten*. Morehouse published nothing in the other leading journals, namely the *Astronomical Journal*, the *Astrophysical Journal*, *Monthly Notices of the Royal Astronomical Society* and *Publications of the Astronomical Society of the Pacific*.

In spite of Morehouse's administrative and teaching loads at Drake University, he still found time to conduct the short-term projects mentioned above. Had he revised his research priorities, then he could also have addressed some of the following 'lost opportunities'.

Firstly, Morehouse chose not to follow up his University of California (Berkeley) PhD research, which his thesis supervisor Professor Armin O. Leuschner (1868–1953; Herget, 1978), described as unfinished. Here was the perfect opportunity to carry out research that did not require observing time, and that Morehouse could have pursued at Drake University had he wished to do so.

Although the research that Morehouse carried out for his PhD was unfinished, Leuschner did point out that

> … the first two objects: the proof of the advantages of Leuschner's closed expressions for correcting satellite orbits and of the accuracy of the directions for taking full account of the aberration, had been achieved …

Thus, there was a body of research that could have been shared with colleagues worldwide, and it is telling that Morehouse never wrote up this work in full (although see Morehouse and Meyer, 1912). Here, it would seem, was another 'lost opportunity'.

Yet another such project also comes to mind. It is clear from his all-too-brief accounts of Comets C/1908 R1 (Morehouse), 1P/Halley and 23P/Brorsen-Metcalf that Morehouse had a more than passing interest in comets, and he also had the mathematical acumen to compute their orbital elements. Given the wealth of published material available about his own 1908 comet, it is strange that Morehouse never chose to investigate its orbit. Instead, we had to wait 35 years for its definitive orbital elements to be published by Van Biesbroeck (1943).

However, we should not let the foregoing

comments cloud our judgement. As Wilson, (1942: 342) reminds us,

> Though he was not primarily a research astronomer, Dr. Morehouse served astronomy well by creating among his students and friends a deep and abiding interest in the subject.

Furthermore, had Professor Morehouse

> … been able to devote his life entirely to astronomy, the products of his research would have been much more extensive. (Wilson, 1942: 346).

We wholeheartedly agree with this assessment.

9 CONCLUDING REMARKS

Although George T. Carpenter and Francis Marion Drake were largely responsible for founding Drake University's original observatory and stocking it with instruments, Daniel Walter Morehouse soon emerged as the single most important factor in its continuation and survival. Drawing on the fame that he acquired through discovering the remarkable comet in 1908 that now bears his name, Professor Morehouse understood that an Observatory was not just a telescope or a building—or even a famous astronomer. It was also about a community, and his dream was to bring astronomy to the people of Des Moines and the surrounding region. Morehouse finally achieved this in November 1921 when Drake University Municipal Observatory opened at Waveland Park at what was then the outskirts of Des Moines, two miles west of the University campus, and the instruments in the original observatory were transferred there. Then, for the next twenty years he was the driving force behind the Municipal Observatory, despite a heavy administrative load at Drake University and continuing teaching commitment. Understandably, these conspired to impact negatively on his research, and consequently his list of astronomy publications was modest.

After Morehouse's passing in 1941 Drake University Municipal Observatory went into decline, and it was only rescued from obscurity in 2000 when a benefactor and the city of Des Moines and Drake University teamed up to attend to its restoration. Some Iowans felt that the restoration funds could have been better spent on a new facility away from city lights, but the current location keeps the refurbished (and renamed) Drake Municipal Observatory within easy access of the people, just as Morehouse wanted. Thus, it remains in the middle of a golf course near the middle of the city, and is home to an historic refracting telescope that now has a 125-year pedigree.

Some believe that it is also home to the spirits of Daniel Morehouse and his wife Myrtle, whose ashes were buried in the wall of the rotunda. Since the restoration occurred there have been reports of strange sounds and experiences that suggest to some that the Observatory is haunted. Rather, we would like to think that the spirit of Daniel Morehouse's dream is very much alive in the eyes of a new generation of Drake University Astronomy students and fascinated members of the general public when they sit on the old wooden chairs in the lecture hall at Drake Municipal Observatory, surrounded by beautiful photographs of famous observatories, nebula and comets—including images of Comet C/1908 R1 (Morehouse), which is surely one of the most remarkable comets in the annals of astronomy.

10 NOTES

1. Janis Winter (1951–2018) is a posthumous author of this paper. Wayne Orchiston supervised her graduate work in 2001 and then in 2019 connected with Deborah Kent, who had recently supervised Kaley Wresch's research about Drake Observatory. With the permission of Winter's surviving sons, William Loos and Anthony Loos, Kent, Wresch and Orchiston merged these two streams of research and conducted additional research to produce this paper.
2. After Drake University was founded, Oskaloosa College struggled to survive, and it finally closed in 1900 (James, 2011: 86).
3. Professor Leuschner (1914: 214–215) described Morehouse's thesis project:

   > The original determination of the elements of the orbit of the seventh satellite of *Jupiter* presented an unusually difficult problem—designated almost impossible by some investigators—on account of the large and irregular solar perturbations during the time from January 3 to March 6, 1905, over which the discovery observations extended. Solutions, which took account of the perturbations, were accomplished by Dr. F.E. Ross by a general satellite theory and by Dr. R.T. Crawford and Mr. A.J. Champreux by Leuschner's method of direct solution of the orbits of disturbed bodies.
   >
   > Both solutions require improvement … [and Daniel Morehouse] undertook the task of deriving an accurate set of osculating elements by a further application of Leuschner's method, partly for the purpose of testing the advantages of certain closed expressions, partly in order to test the accuracy of certain directions for taking full account of the aberration, and, finally, in order to provide a set of osculating elements of sufficient accuracy to serve as the basis of any future rigid satellite theory.

4. Unfortunately, blurry microfilm renders illegible the benefactors' names. $500 in

1909 is equivalent to about $315,000 in 2018 dollars, based on the following web site: www. measuringworth.com (accessed 4 June, 2019).

5. Indiana Limestone was a quality building product. It was used extensively for university and major public buildings across the USA, and for such landmarks as the Empire State Building in New York (Indiana Limestone).
6. Photographic doublets used short-focus wide-field portrait lenses, which were excellent for detecting comets, minor planets and variable stars. Construction of the Bruce Photographic Telescope was funded by astronomy philanthropist, Miss Catherine Wolfe Bruce (1816–1900). The mounting was manufactured by Warner & Swasey, and John Brashear was responsible for the 10-in portrait lens (Barnard, 1905).
7. We now know that CO^+ ions were largely responsible for these unidentified lines. The spatial distribution of these ions is

> … elongated in the antisolar direction … The ion tail structure becomes more and more diffuse at larger and larger distances from the nucleus … (Ip, 2004: 606).

8. Jordan D. Marche II has written a fascinating research paper about the three astronomical journals published by Carleton College's William W. Payne. *Popular Astronomy*, launched in 1893, was the most prominent of these, and although it was designed "… for amateur astronomers, teachers, students and popular readers." (Marché, 2005: 53), it quickly appealed also to professional astronomers, especially those, like Daniel Morehouse, who were not involved in astrophysical research.

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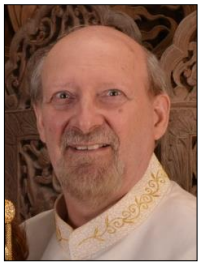
Janis Winter (1951–2018) earned a Master of Astronomy degree from the Western Sydney University. She went on to become a member of the Des Moines Astronomical Society (DMAS) in 2006, and worked as an instructor at Des Moines Area Community College (DMACC). She was elected DMAS President first in 2011 and was re-elected through 2016, when health concerns prevented her continuance. Winter retired from DMACC in 2014. She was elected again to the DMAS Board of Directors in 2018 and served until her death in August of that year. Greg Woolever, DMAS Ashton Observatory Director described Jan as "… durable and heroic in her pursuit of her passion for astronomy." while Herb Schwartz, Professor of Astronomy at Drake University, remembered her as a "…gentle soul with a sharp mind, an insatiable curiosity, and a can-do attitude."



Professor Wayne Orchiston was born in Auckland (New Zealand) in 1943, and has BA Honours and PhD degrees from the University of Sydney. He formerly worked in optical and radio astronomy in Australia and New Zealand. He is now at the National Astronomical Research Institute of Thailand in Chiang Mai, and is an Adjunct Professor of Astronomy in the Centre for Astrophysics at the University of Southern Queensland in Australia. Wayne has supervised a

large pool of graduate students in history of astronomy, including the late Janis Winter. He has wide-ranging research interests, and has published on aspects of Australian, Chinese, English, French, German, Georgian, Indian, Indonesian, Iraqi, Italian, Japanese, Korean, New Zealand, South African, Thai, Turkish and US astronomy.

Wayne's recent books include *Eclipses, Transits, and Comets of the Nineteenth Century: How America's Perception of the Skies Changed* (2015, Springer, co-authored by Stella Cottam); *New Insights from Recent Studies in Historical Astronomy: Following in the Footsteps of F. Richard Stephenson …* (2015, Springer, co-edited by David A. Green and Richard Strom); *Exploring the History of New Zealand Astronomy: Trials, Tribulations, Telescopes and Transits* (2016, Springer); *John Tebbutt*: *Rebuilding and Strengthening the Foundations Australian Astronomy of* (2017, Springer), *The Emergence of Astrophysics in Asia: Opening a New Window on the Universe* (2017, Springer, co-edited by Tsuko Nakamura); *The History of World Calendars and Calendar-making ...* (2017, Yonsei University Press, co-edited by Nha Il-Seong and Richard Stephenson); and *Growth and Development of Astronomy and Astrophysics in India and the Asia-Pacific Region.* (2019, Springer, co-edited by Aniket Sule and Mayank Vahia).

Wayne has been very active in the IAU for several decades, and was responsible for founding the Transits of Venus and Historic Radio Astronomy Working Groups. In August 2018 he became President of Commission C3 (History of Astronomy). He co-founded the *Journal of Astronomical History and Heritage* in 1998, and is the current Editor. He also serves as an Editor of Springer's Series on Historical and Cultural Astronomy. In 2013 the IAU named minor planet 48471 'Orchiston' after him.