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A History of Physics at Otterbein University

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Contents

1 Introduction

This project aims to document what was ultimately achieved in and by the Otterbein Physics Department. I had had in in mind for several years, inspired by a set of handwritten notes and photos in the department files, written by Phil Barnhart and outlining roughly the period 1959-1970 [1]. Barnhart chaired the department for 23 years in the period 1961-1991. Also in this file were excerpts from two general histories of the university, W. W. Bartlett, *Education for Humanity, The Story of Otterbein College* [2] and H. B. Hancock, *The History of Otterbein College, 1930-1972* [3]. Later I discovered the early history written by Garst [4], which covers the period 1847-1907.

My own recollections and files covered the period from 2002 to the present, and in addition I had access to old program reviews, course catalogs, and other materials from the departmental files.

I started writing in the summer of 2020 and quickly had a skeleton of the story. I filled in many details after further interviews with Lou Arnold (Chair 1991-2005), John Muster (student 1959-63; faculty member 1967-1972), and Stephen Grinch, the university Archivist. Grinch was especially helpful in providing material for the early period, roughly from the founding to the late 1950s.

Otterbein Towers magazine provided many stories of alumni, including detailed profiles of numerous winners of Otterbein's alumni awards, but also lots

of shorter notes of careers, graduate study, etc. I have incorporated most of the stories I could find, but certainly there are many distinguished alumni who are not represented here. If any of you wish to add your own stories, or have anecdotes regarding your experiences or the faculty members you encountered, I would be happy to hear from you!

By the early fall I had fleshed things out a great deal, though there remains a stubborn lack of detail for the period (roughly) 1908-1958. Kay Hedges, granddaughter of James H. McCloy (member of the physics faculty from 1913-60) provided a remarkable selection of student and faculty tributes to McCloy written at the time of his retirement. A lot of the color from this period was gleaned from these letters.

In general I think it is a proud and colorful history, although on a modest scale, of course. Naturally the fortunes of Physics (and the other sciences) are correlated with those of the university generally. There is an initial period of struggle, where the new institution is trying to establish itself and become financially viable.[1] There are periods of relative plenty, marked by growth and expansion. And there are periods of challenge, whether due to war, economics, or demographics.

The Department itself was created in 1908, and the first BS degree in Physics was awarded in 1923. The quality of a program can be measured by the success of its graduates, and from the beginning Otterbein Physics grads were successful in many endeavors, some earning advanced degrees in physics, engineering, or applied mathematics, and going on to illustrious industrial or

[1] Actually, it is possible to view the entire history of the university as reflecting this general struggle.

university teaching careers, others working in technical areas of engineering and research, still others teaching in the high schools.

The Department and its curriculum continued to evolve, in an effort to insure the continued success of its students. Sometimes this progress was slower than ideal, or would even stall for a time, due to external factors, sudden personnel changes, or wavering institutional support. Often the momentum was regained only under new leadership (not necessarily a single person). This cyclical pattern is an interesting aspect of the history, which I believe reflects mainly the general struggles Otterbein has faced throughout its history to achieve financial stability.

Nevertheless, progress was made, and, in my opinion, by about 2015 the Physics Department at Otterbein was as good as that at any comparable institution, and better than most. I will not make the case for that claim here; the reader can follow the story and make their own judgment. Of course, this was the continuation of, and dependent on, a long history of development by dedicated faculty members (and others). There is a well-known quote of Isaac Newton: "If I have seen further it is by standing on the sholders [sic] of Giants." That sentiment certainly applies here.

Notes

When departmental faculty members are listed, the Chair is given first with the remainder in order of seniority.

The institution's name changed from Otterbein University of Ohio to Otterbein College in 1917, and then back to Otterbein University in 2010. In

this document we generally refer to it as "the university," rather than using the technically correct name for each era.

Abbreviations used:

AAAS = American Association for the Advancement of Science

AAPT = American Association of Physics Teachers

AMO = Atomic, Molecular, and Optical

APS = American Physical Society

AY = Academic Year

NSF = National Science Foundation

PER = Physics Education Research

PI = Principal Investigator

SLS = Science Lecture Series

VPAA = Vice President for Academic Affairs

2 The Sciences at Otterbein: Early History

Two outstanding faculty members were responsible for instruction in the natural sciences and mathematics in the early history of the university: John Haywood and Thomas McFadden. Close friends as well as faculty colleagues, each served the institution for many years, helping to establish it as it struggled to find its footing in the early days. The story of the sciences at Otterbein begins with their story.

Haywood was a graduate of Oberlin College and came to Otterbein in 1851, succeeding Sylvester S. Dillman as Professor of Mathematics and Natural Sciences. Dillman was also an Oberlin graduate, and had been appointed in 1849, the third instructor to be hired by the institution. The first two were W. R. Gri th, who held the title of Principal, and Ms. C. Murray, at the opening in 1847. With the appointment of Dillman, Gri th became professor of languages.

Haywood was born in Stockton, New York, one of nine children [5]. He learned the trade of blacksmithing from his father, but came west to study at Oberlin after a traveler showed Haywood a catalog for the new university and sparked his enthusiasm for learning. His four years at Oberlin were transformative, and he came to Otterbein committed to education and firm in the belief that, "while knowledge was not the only key to a good life, it was of sure value to honest men in this world" [5].

In 1852 he married Sylvia Carpenter, briefly principal of the Ladies' Department at Otterbein. The couple had six children, although this part of their lives was marked by tragedy: three of the children died in infancy, one at age nine, and son Joseph at age 22, shortly after graduating from Otterbein in the Class of 1880. Only daughter Lida survived to full maturity.

Haywood's influence on the fledgling institution would be profound:

> Coming to the university at so early a period, his service was unique in character and importance. Associated with those largely who were inexperienced in the work of higher education, he was given a free hand in giving it shape and direction, not simply in the university, but in the United Brethren Church. [4]

Haywood also quickly became a prominent figure in Westerville, and in 1857 he served on a committee to work toward the incorporation of the village. This was accomplished in 1858, and Haywood was elected its first Mayor by a vote of 116 to 3. As a surveyor, he laid out many of Westerville's streets.

Also in 1858, the Department of Mathematics and Natural Sciences was split into a Department of Natural Sciences and a Department of Mathematics. Haywood took over Mathematics, and in the sciences Thomas G. McFadden M.D. was appointed to the faculty, with the title Professor of Natural Sciences and Scientific Agriculture and Horticulture.[1]

McFadden was born in Rushville, Ohio, which lay on a newly opened pikeway running between the National Road and Cincinnati [6]. His mother was

[1]The "and Scientific Agriculture and Horticulture" was a spontaneous addition of the Board, made just before they adjourned the meeting in which McFadden was appointed. The reasons for this are discussed below.

Figure 2.1: The Otterbein faculty in 1859. Haywood is back row, center; McFadden is on his left.

killed in a stage coach accident when he was ten years old, and in the aftermath he and his family became especially close with the family of the Rev. William Hanby, who were neighbors. At age fourteen he was sent to a Methodist academy in Augusta, KY. He then attended Dickinson College in Carlisle, PA, graduating in the class of 1845, and the Medical College of the University of Maryland, graduating in 1848. He returned to Rushville to practice medicine, and in 1849 he married Rebecca Hartley. The couple would eventually have four children, Louis, Agnes, Thomas, and Cora.

In this period, William Hanby was closely involved with the effort of the United Brethren Church to establish Otterbein, its first institution of higher learning. In 1854 the Hanby family moved to Westerville to take a more active role in this work, and they convinced the McFaddens to join them. Thomas and his family followed in the spring of 1855.

He quickly established a medical practice in collaboration with Dr. A. G. Stevenson, but almost immediately he became involved in the work of the university. He was asked that June to give a course of lectures on physiology, and the Board of Trustees appointed him to the Visiting Committee on Examinations. He was also appointed to the Executive Committee of the University on June 21, 1855. In 1857 he was named the Treasurer of the University, a position he held until the Civil War. He joined the faculty full time in 1858, as noted previously.

Also in that year, as Westerville was being incorporated, he was elected town clerk by a vote of 119 to 1. He was thus a very busy man, as he maintained his medical practice up until the start of the Civil War.

The Board's late addition of "and Scientific Agriculture and Horticulture" to McFadden's title was a reference to the Manual Labor movement at Otterbein, which had been a contentious issue and was a critical problem for the institution in 1858. This was a progressive initiative in which students performed work, usually agricultural or mechanical, as a supplement to their academic endeavors. The work itself was seen as healthful and morally beneficial, and the program also aimed to make college more accessible to students of limited means and to support the institutions themselves.

The idea had been tried at a number of other institutions, most energetically and "in circumstances...most favorable to success" [4] at Oberlin College. But these programs had largely failed by the time Otterbein took up the cause. In answer to the obvious question, why "an attempt which had so generally failed elsewhere should be made in Otterbein University," Garst wrote [4]

> The explanation is not far to seek. As already stated, the members of the United Brethren Church, at the time, were largely rural and engaged in agricultural pursuits. They knew far more about manual labor than higher education. Manual labor seemed to them just about the most practicable thing in the world, and in their very limited knowledge of the conditions of carrying forward the educational work successfully, it is not strange that they failed to appreciate the di culties of carrying forward the two together. The failures which had occurred along this line were not denied, but they were attributed to the disinclination of professors and students to work, and not to any inherent di culties in the problem itself.

At Otterbein, a plot of 18 acres was acquired in 1854 for use as a university garden,[2] and students were offered the opportunity to work in that garden; it was never compulsory.

This was a deeply contentious issue for the University, which came to a head during a severe financial crisis. The program consistently lost money, and there was a division among the trustees between those who wanted to go "all in" and make the program compulsory, and others who wanted to abolish the program and sell the land to offset the debt of the university, which was by then reaching alarming levels. The appointment of McFadden with the baroque title previously mentioned was an attempt to mollify the pro-manual labor contingent, by appointing a faculty member to oversee the program.

At the 1859 session of the Board, however, McFadden reported on its many

[2]This was in the area north of Home Street and between West and Grove Streets, including the site of the current athletic stadium.

problems, noting that "not a ghost of a system exists" and there was a "lack of definiteness – lack of cooperation – lack of equipment." The meeting was contentious, lasting until almost 2am, and at the end McFadden was tasked with overseeing the "liquidation" of the program. The "and Scientific Agriculture and Horticulture" was dropped from his title in 1860.[3]

Haywood and McFadden were close friends and faculty associates throughout their careers. They built a telegraphic "intercom" linking their homes, the first such line constructed in Westerville. By all accounts, however, the children of the two families used the telegraph more than did the two professors.

Acquiring equipment for the new science department was a challenge. There was some material already on hand; the Catalog of 1852 mentions a "new and extensive philosophical and chemical apparatus," and the next catalog speaks of "apparatus appraised at $900, plus surveying instruments, $25." In February 1857 Haywood was authorized to purchase a pair of globes, terrestrial and celestial, but by June the trustees had decided that the state of university finances would not permit this acquisition. Significant new equipment for the teaching of science would not be forthcoming until after the Civil War.

The Civil War disrupted the lives of many at Otterbein. Many students left to join the army, and both McFadden and Haywood departed in 1862,

[3]The demise of the manual labor movement at Otterbein contributed to the failure of another program, that of selling "scholarships" to raise endowment funds for the University. This had been underway for some time, on the promise that Otterbein was committed to the manual labor movement. When the program was discontinued, many who had pledged to purchase the scholarships revoked their pledges, and this program also collapsed. In hindsight, that was probably a good thing for the University, as the scholarships "were sold at a ruinously low price." [4]

although for different reasons. Both men returned to Otterbein after the war, however, and remained there for the rest of their careers.

McFadden went into the army and joined the 46th Ohio Volunteer Infantry as regimental surgeon in 1861 [6]. He and his regiment were present at the Battle of Shiloh in April, 1862, where he worked for three days and two nights straight treating hundreds of badly wounded soldiers aboard the steamship *Memphis*. This experience devastated him. After the battle he was granted an honorable discharge to have time to recover. He was examined by a board of surgeons who pronounced, "hypertrophy of left ventrical [sic] and diseases of the valves of the heart – no hope – unfit for duty," but by the fall of 1862 he was feeling stronger and in 1863 he returned to army service. His weakened heart would not permit service at the front, and he spent the rest of the war at Camp Chase near Columbus, initially as Post Surgeon and eventually as Head of the General Hospital. He returned to Otterbein in 1865 but his health did not permit him to resume his medical practice.

In 1862 Haywood received an offer to become headmaster at Kingston Academy in Ross County, Ohio, which he accepted.[4] The reasons for Haywood's move are unknown, but presumably stem from the declining enrollments at Otterbein, the absence of his friend McFadden, and a desire to further his career [5]. In 1867 he returned to Westerville and resumed his position on the faculty at Otterbein.

With the departure of both McFadden and Haywood, Henry A. Thompson was appointed Professor of Natural Science and Mathematics in 1862. Thomp-

[4]In fact, the minutes of the June, 1862 trustees meeting indicate that the entire faculty of the institution – five persons – resigned at this time.

son was a graduate of Jefferson (now Washington and Jefferson) College, in Jefferson, PA, and also studied at the Western Theological Seminary in Allegheny, PA. He moved to Professor of Mathematics after McFadden's return, and retired in 1867 after Haywood's return.[5]

Equipment was still a problem for the science department, and in 1868 Haywood was arranging a series of literary entertainments in order to raise money for a chronometer and sextant. By 1870 the trustees had authorized $1,000 for McFadden to secure "apparatus, specimens, minerals, rocks, fossils, charts, etc." But the money was not forthcoming due to financial constraints. In 1875 McFadden finally wrote to the trustees:

> I venture once more to call your attention to the condition of the department of Natural Science as respects apparatus and means of illustration. I have, with some regularity for several years past, been asking the board for an appropriation to supply some of our most urgent needs, without so far realizing anything... It is not my wish that undue prominence be given to Natural Science, but only that means be provided for properly teaching some of the most important facts and theories... It would be di cult to name an institution pretending to give college instruction, whose facilities in these respects are not tenfold greater than ours...

This appeal was successful and the board appropriated $3,000 for the purchase of new equipment.

[5]Following this, after serving four years as superintendent of schools in Troy, OH, and one year as professor of mathematics in Westfield College, IL, he was elected President of Otterbein University in 1872, in which position he served until 1886.

Figure 2.2: Science equipment in the late 1870s.

In order to make the most of these funds, McFadden traveled to New York, and eventually Glasgow, Edinburgh, and London, where he visited universities, talked with scientists, and met with manufacturers of scientific apparatus. Upon his return he ordered the equipment, some of the most modern then available. Included were a pneumatic apparatus, acoustic apparatus, galvanic batteries, a balance and weights, mirrors, prisms, and lenses, an induction coil, and barometers. Some of this historical equipment is still in the Department, on display in the foyer of the Science Center.

He also acquired a human skeleton, that in later years "was destined to blossom almost like a perennial from campus trees, the victim of student pranks." [6]

Haywood was interested in many areas of science and applied mathematics, but perhaps his greatest passion was astronomy. The mid-late 1800s was an exciting time in this area with many notable developments. In 1845-46 Adams

and Leverrier independently inferred the existence of a new planet, based on discrepancies between the observed motion of Uranus and calculations based on Newton's theory of universal gravitation. Neptune was subsequently discovered on September 23, 1846, within half a degree of the predicted location.

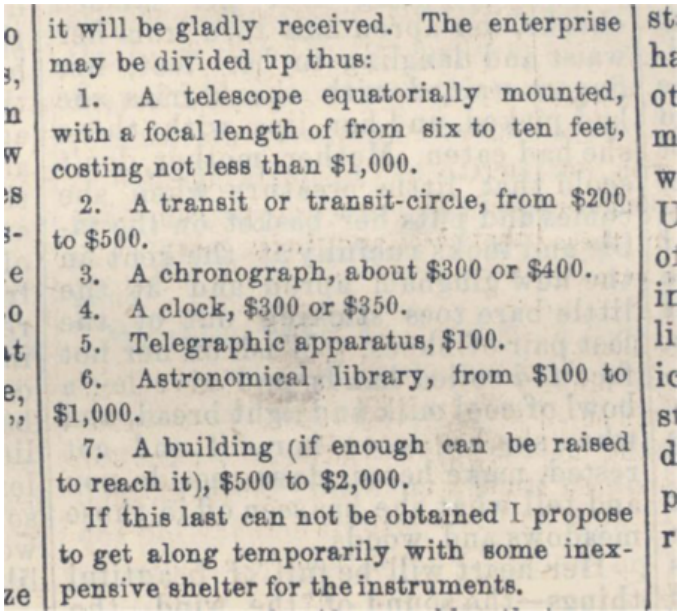
The major outstanding astronomical problem of the day was to determine the size of the solar system. The *relative* sizes of planetary orbits were well known, but the overall scale was known only to an accuracy of about 5%. To improve the situation, one can triangulate a known planet from two different locations on the Earth, as accurately as possible. The greatest accuracy was expected to be achieved in observations of Venus as it transited the Sun in 1874 and 1882, and Haywood set out to join in the measurements of 1882.[6]

For this he would need some equipment, in particular a good telescope. This and the other needed items would cost about $1,000. A proposal to the Trustees of the University for funding in 1877 was met with wholehearted rhetorical support but no actual money. He then appealed in 1878 to the then 253 alumni of the university for funding (of not less than $2,000) to establish a university observatory. In his request he made an impassioned plea:[7]

> Barely four years hence the great astronomical event of three centuries, the transit of Venus, will occur under conditions favorable for observation here... If I live to that time and am in the service of Otterbein University, and am not furnished with suitable instru-

[6] Transits of Venus, where Venus passes directly between Earth and the sun, are among the rarest phenomena that can be reliably predicted. They occur in a regular pattern that generally repeats about every 243 years, in which pairs of transits eight years apart are separated by gaps of 121.5 years and 105.5 years.

[7] In some documents this statement is attributed to President Thompson, but as Phil Barnhart first pointed out, the remarks are Haywood's.



it will be gladly received. The enterprise may be divided up thus:

1. A telescope equatorially mounted, with a focal length of from six to ten feet, costing not less than $1,000.
2. A transit or transit-circle, from $200 to $500.
3. A chronograph, about $300 or $400.
4. A clock, $300 or $350.
5. Telegraphic apparatus, $100.
6. Astronomical library, from $100 to $1,000.
7. A building (if enough can be raised to reach it), $500 to $2,000.

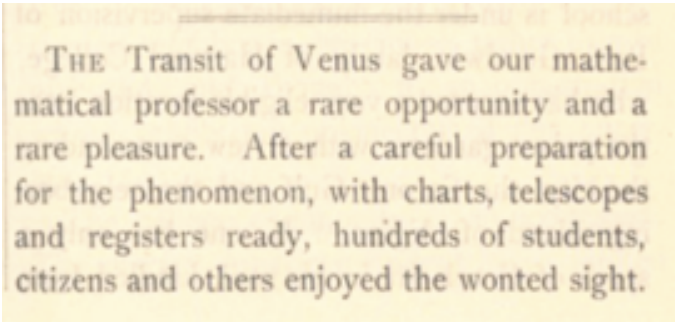
If this last can not be obtained I propose to get along temporarily with some inexpensive shelter for the instruments.

Figure 2.3: John Haywood's wish list for the university observatory campaign, as detailed in *The Religious Telescope*, July 24, 1878.

> ments for its observation I should be compelled to feel that I had wasted my life in the service of the United Brethren Church.

Haywood got his funding and successfully observed the 1882 transit. As described by T.J. Sanders, a student who eventually became President and was afterwards Professor of Philosophy [7]:

> The year that I studied astronomy under [Haywood], the Planet Venus was to make a transit across the sun's face – a rare phenomenon – occurring only once in about 300 years. Professor Haywood said to the class, "If any of you would like to know how an astronomer calculates such an event, I will gladly guide you through." Four of us decided to undertake the work. After several days we came through and our work tallied with the astronomers.



THE Transit of Venus gave our mathematical professor a rare opportunity and a rare pleasure. After a careful preparation for the phenomenon, with charts, telescopes and registers ready, hundreds of students, citizens and others enjoyed the wonted sight.

Figure 2.4: Description of the transit event published in the December 1882 edition of *Otterbein Record*.

> When the time came, there was Venus, touching the Sun's edge at about 3 P.M. and for nearly an hour passed across the Sun's face, as a black spot the size of a walnut.

This was surely one of the first student-faculty research projects undertaken at the university.[8]

Haywood also maintained continuous meteorological records (temperature, barometric pressure, rainfall, wind speed, humidity) for 36 years, until the formation of the United States Weather Bureau in 1891 [5]. Much of our knowledge of weather patterns in the 1800s came from the observations of such independent scientists. In 1885, the trustees of the university passed a resolution:

> Resolved by the Board of Trustees of Otterbein University that we very highly appreciate the observations made in Meteorology and other original scientific work performed by Prof. John Haywood during the last quarter of a century.

[8] Otterbein physics faculty members would lead public observations of the next set of Venus transits, in June 2004 and June 2012.

After Towers Hall was built and occupied in 1871, science classes were taught in the large room at the southeast corner of the first floor. There were no laboratories, however; all instruction was by way of lecture and demonstration. This was typical of science education up until the end of the nineteenth century. By around 1880, a small basement room had been equipped with home-made lockers, and laboratory courses were offered for the first time [8]. The space was ill-suited to the purpose and without ventilation, however.

This situation persisted until 1898, when the pressure of regulations from the Ohio College Association became too great to resist. At this point Saum Hall, which had originally been built in 1854 as a men's dormitory, was renovated for science teaching.[9] President Sanders personally raised the money for this project. The first floor was equipped for Biology, the second for Physics, and the third for Chemistry. As reported in *Otterbein Aegis*, September 1898:

> The building has been fitted throughout with water. Improved machinery for the preparation of gasoline vapor [!] has been purchased. For biology new microscopes will be secured. Modern apparatus has been added for chemistry and physics. ... Students in science can now anticipate well equipped laboratories.

Of course, teaching was not the only activity that occupied the faculty. There was much administrative work to be done as well, and Haywood and McFadden did their share. The faculty minutes from this period offer an engaging look at some of the issues that occupied their attention [5]:

[9] Saum Hall was located on the site of the current Courtright Memorial Library.

Figure 2.5: Saum Hall, home of the sciences from 1898-1920. Image from the January 1927 *Otterbein College Bulletin*.

Sep 3, 1877:	Prof. Haywood was designated a committee to draft rules for the use of college grounds for ball playing.
Sep 24:	(Prof. Haywood in the chair) On motion it was agreed that a knowledge of the metric system of weights and measures be made a prerequisite for admission to the Freshman Class. Agreed to request Prof. Haywood to lecture to the students on the metric system, on Thursday next.
Mar 11, 1878:	Haywood, Guitner and Garst were appointed a committee of supervision of the Senior class on a proposition to finish the walls of the chapel in fresco painting.
May 27:	Prof. Haywood was appointed a committee to secure a su cient quantity of sawdust for commencement day.
Nov 7, 1881:	On account of the death of Joseph Haywood, son of Prof. Haywood and a member of the class of '80, it was resolved to suspend recitations tomorrow, Tuesday, November 8.
May 7, 1883:	Prof. Haywood to represent the University at Oberlin's semi-centennial celebration July 4, 1883.

Jan. 14, 1884:	Prof. Haywood was appointed to put the clock in good running order.
Sep 18:	Prof. Haywood was appointed a committee on erasers. He was asked to provide erasers as soon as possible.
Mar 1, 1886:	Profs. Haywood and McFadden were appointed a committee to decide what shall be done in case of the use of the chapel for funeral services by secret orders.[10]

Haywood was a particularly important member of the faculty in the early history of the university. According to President Bookwalter:

> During his service in the early history of the institution [Haywood] was in fact the man who gave it the real form and standing of a college, and throughout all his long career his high scholarship and eminent ability as a teacher were to the college a tower of strength. Professor Haywood was a stirring example of what the higher Christian education and the Christian graces together can produce. His pure, beautiful private life and his distinguished, unselfish public services have left their impress and fruits as an abiding benediction to thousands and perpetual enrichment to the college.

He retired in 1893 and was known then and afterwards as the "Grand Old Man of Otterbein."

Professor McFadden was also a revered member of the Otterbein and Westerville communities, having served as town doctor and first town clerk of Westerville, as well as the first librarian, treasurer, and a trustee of the university.

[10]The "secret orders" in question are presumably the Freemasons, against which there was a strong feeling in the UBC church.

Figure 2.6: Haywood (left) and McFadden (right), in later life.

He led a significant expansion and modernization of the science curriculum in the years following the Civil War. By 1880 the Natural Science Department was offering a diverse array of courses in natural history, chemistry, physics, botany, physiology, zoology, mineralogy, geology, and geography.

Thomas McFadden died in 1883, and was succeeded as head of the Department of Natural Science by his son, Louis H. McFadden (a graduate in the class of 1874), who had been named Adjunct Professor of Natural Science the year before.

In 1885 the Department of Natural Sciences was further divided into a Department of Chemistry and Physics and a Department of Biology and Geology. Louis McFadden was named Merchant Professor of Physics and Chemistry at this time.[11] He was also a member and secretary of the executive committee, librarian, and vice-president. He served until 1907, when he resigned to

[11]The endowment of this faculty chair was the gift of Mrs. Caroline Merchant, for a number of years the Matron of Ladies' Hall.

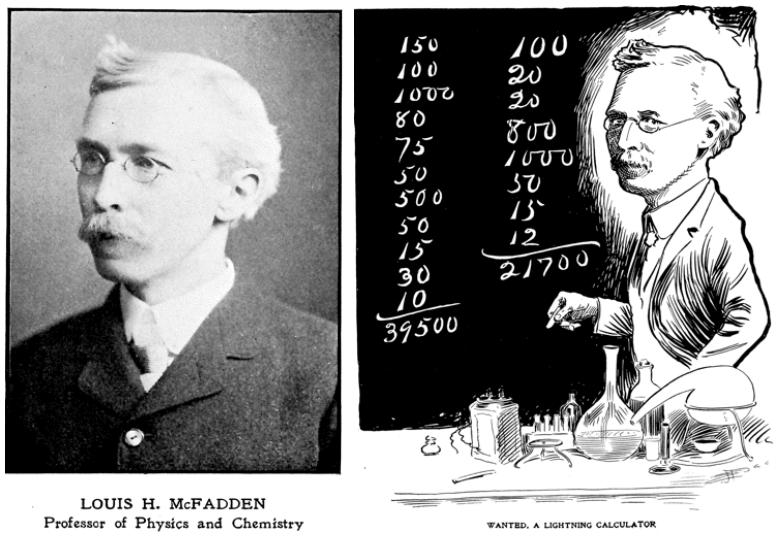


Figure 2.7: Louis H. McFadden, Merchant Professor of Physics and Chemistry, in 1903. Photo and caricature from the 1903 *Sibyl*.

become the chief chemist of a manufacturing company in Dayton, Ohio.

Other members of the McFadden family also served the university ably. In 1898 the senior McFadden's other son, Thomas G. McFadden, was appointed Professor of Natural Sciences in the Department of Biology and Geology. He served until 1900. His sister, Cora A. McFadden, taught English for a year in the 1880s, then returned in 1916 as Dean of Women, a post she held for 12 years. Altogether, members of this family served Otterbein for a total of 62 years.

3 Founding and Early History (1908-1958)

The Department of Physics was created in 1908, along with the Department of Chemistry, by splitting the previous Department of Chemistry and Physics. At the same time, Willington O. Mills '06 was appointed Merchant Professor of Physics and Astronomy and Louis A. Wineland became Professor of Chemistry.

Mills died unexpectedly in 1913, and was succeeded as Merchant Professor by James H. McCloy (BS, Purdue University; later MS, The Ohio State University). McCloy would serve the university until 1960, and would lay the foundation for the study of physics at Otterbein.

At the start of his career the university curriculum was based on a "Group System." Students selected one of six groups in which to focus their studies, of which one, Group IV, was titled Mathematics and Physics. Each group required a specific number of courses in different areas, though within the areas student had some freedom in choosing specific courses. For Group IV, a year of general physics was required, taught from Henry S. Carhart's *Physics for University Students*. The laboratory manual was that of Ames and Bliss.

By 1915 elective courses in Electricity and Light had been added to the curriculum. McCloy was also teaching courses in Surveying and Mechanical Drawing under the catalog heading of Civil Engineering, as well as Astronomy.

In 1918 the university adopted a system of awarding degrees based on

Figure 3.1: Professor James McCloy (1913-1960).

fulfilling requirements for majors and minors, and at this point a fully fledged (for the time) physics program emerged. The standard system of accounting for semester credit hours (sh) was also adopted.[1] The system retained a set of groups, though these were modified and reduced in number to four: Languages and Literature (I), Natural Sciences (II), Mathematics and Philosophy (III), and Social Sciences (IV). A student selected a major in one group (18-32 sh) and had additionally to complete four minors (12 sh each), one in each of the groups. This accounted for 66-80 sh out of a total of 128 required to graduate. For physics, a year of Advanced Laboratory was added to round out the major.

The university awarded the A.B. degree, the Mus.B. for music students, and the B.F.A. for art students. However, students with majors in Group II could elect to receive the B.S. degree instead of the A.B.

In 1919-20, the McFadden Science Hall was constructed (this is the east

[1]This is the "Carnegie" rule: one hour in class per week over the course of a semester was equal to one semester credit hour.

Figure 3.2: Construccction of McFadden Science Hall in 1919-20.

end of the current Science Center). This building was dedicated "in honor of the distinguished services of the three professors of that name who served the college in their time." [8]

By 1922 the graduation requirements had been modified to a major and one minor (in a group different from the major), or two majors (from different groups). In 1923 the sizes of the majors and minors were altered to 24-32 sh and 16 sh, respectively. This necessitated the addition of two new courses to the physics program: Theoretical Mechanics and Advanced Heat. These were offered in alternate years to Electricity and Light. In 1925 a second year-long course in general physics was instituted, "for those who have not had High School Physics," as well as a course in physics teaching methods for secondary education.

In 1937-38 a detailed plan for a pre-engineering option appeared for the first time. It was designed to accommodate students planning to transfer to an engineering school after any number of years at Otterbein. In this year the minor requirement was also dropped and replaced with a standard distribution requirement.

In 1942-43 a new course on Radio Electronics was introduced (two semesters, 3+3 sh). Pre-engineering became a specific 2-year curriculum after which the student would transfer to the engineering school.

Like the Civil War, World War II affected many at Otterbein profoundly. Again the number of students declined significantly as young men were called to war or other service. McCloy went on leave from 1943-45 to serve as Professor of Physics in the Navy V-12 Program at Denison University. This was a wartime program to quickly boost the number of commissioned naval o cers beyond what could be provided by the US Naval Academy.

When he returned to campus courses were revised, new laboratory equipment was purchased, and Walter R. Bailey (BS Otterbein, graduate work at Ohio State) was added to the staff as Assistant Professor of Mathematics and Physics. Bailey transitioned to Mathematics full time in 1948 and was succeeded in Physics that year by Frank K. Harman as Assistant Professor. Harman had a BA and BSc in Education from Ohio State, an MSc in Physics from Ohio State, and underwent Naval Electronics O cer training at Harvard and MIT. He remained at Otterbein through 1950. For the 1950-51 academic year, Calvin Holtkamp (BS, Otterbein) was appointed Departmental Assistant. Holtkamp was at the same time pursuing graduate study in physics at

Ohio State.

Starting in 1946 a general requirement of 6 sh of mathematics and 6 sh of physics for any BS degree was instituted. The physics portion of the requirement was expanded to 8 sh starting in 1958.

In 1950, a formal "3-2" agreement was established with the Carnegie Institute of Technology (now the Carnegie Mellon University College of Engineering), to allow students to pursue the study of engineering. In this program the student would spend three years at Otterbein and two years at Carnegie, earning a BA in Physics from Otterbein and a BS in Engineering from the Institute. In 1960 this program was modified so that the student spent two years at Otterbein and three at the engineering school, and the partners were expanded to include Ohio State University and Case Institute of Technology (now the Case Western Reserve University School of Engineering). In this later version, the student did not receive a degree from Otterbein, but only the BS in Engineering from the partner school.

In 1955 the Weitkamp Observatory and Planetarium was established on top of the McFadden Science Building, adding a significant facility for both teaching and the enjoyment of the community. This was the gift of Dr. Alfred H. Weitkamp '04, in memory of his wife Mary Geeding Weitkamp '09. Originally conceived as a single dome, the project eventually became a pair of domes, one for the telescope and another for a planetarium, with a classroom between and joining them. Much of the design was done locally, and students helped with the construction. The telescope was a 16-inch Newtonian made by Cave Optical of California, and a Spitz A-1 projector was installed in the

Figure 3.3: The completed McFadden Science Building showing Observatory dome (R) and Planetarium (L), with a small complex of o ces and labs between them.

planetarium. This was at the time the largest free-standing console projector made, and one of only three in Ohio. It is still in the possession of the Department, and is a real museum piece.

At this time the name of the department was changed to the Department of Physics and Astronomy. Leon Zechiel (1955-59; BS, De Pauw University; MS, Ohio State University), who was connected with the staff of the Perkins Observatory at Ohio Wesleyan University, became the first director of the Weitkamp Observatory.

In 1958 Mendell E. Rimmel (BS, Mount Union College; MS, University of Akron) was appointed Assistant Professor of Physics. His teaching was regarded poorly by the students, however, and he departed after a single year.

Jimmy McCloy built a fine physics program that served its graduates well and was a solid foundation for the future. He led it through di cult times

Participants in the Dedication Service of the Weitkamp Observatory and Planetarium at Otterbein were: First Row, Left to Right—Prof. James H. McCloy, Chairman, Department of Physics and Astronomy, Dr. Alfred H. Weitkamp, Los Angeles, Calif.—donor of the Observatory and Planetarium in memory of his wife, Mary Geeding Weitkamp, Mr. Leon N. Zechiel, Instructor in Astronomy and Director of Weitkamp Observatory.

Second Row, Left to Right—Bishop Fred L. Dennis, Dayton, Ohio, the Dedicating Official, Mr. Sanders A. Frye, Otterbein College Business Manager, Dr. J. Gordon Howard, President, Otterbein College, Dr. Armand N. Spitz, Yorklyn, Delaware, inventor of the Spitz Planetarium who delivered the Address at the Dedication.

Figure 3.4: Dedication of the Weitkamp Observatory and Planetarium, 1956. The apparatus on the right is the Spitz A-1 projector.

during the Depression and World War II, and afterwards strengthened it by modernizing the curriculum and laboratories. He was a sympathetic, kindly teacher, with a fine, dry, sense of humor. The many letters written by former students and colleagues on the occasion of his retirement in 1960 are touching in their regard for him. The students (most of them *not* physics majors) comment repeatedly on his kindness, patience, and generosity.

Among many examples, here is George W. White '21, who in 1960 was Professor and Chair of the Department of Geology at the University of Illinois:

> I should like you to know that your influence has not only extended to your own students, but also to your students' students. I know I have tried to act to my own students in that spirit so evident in your own teaching; I mean your quality of fairness, helpfulness, and above all your insistence on the highest quality of performance of which you thought the student capable.

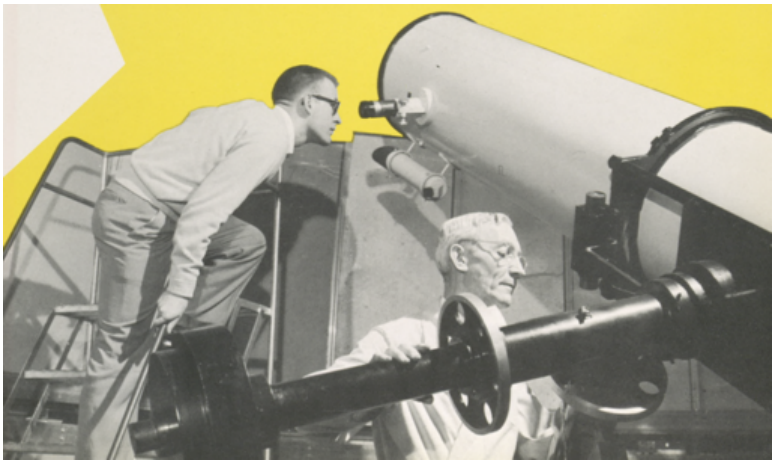


Figure 3.5: Professor McCloy and unknown student at the 16-inch reflector in the Weitkamp Observatory. Image from *Otterbein Towers*, April 1958.

And Leonard J. Newell '24 relates one of several anecdotes that illustrate McCloy's fundamental kindness and regard for his students:

> One afternoon in class, at about 1:30, I fell asleep. You were about to make an important explanation, and you did not want me to miss it. You quietly spoke to the boy next to me and said, "This point is important. Will you please nudge Mr. Newell and awaken him so that he will not miss it. I don't want to embarrass him because he has to work day and night."

One of the most amusing tributes came from Al Elliott '23, reproduced here exactly as it appears in the letter:

> Once
> along time ago
> I wuz a sort uv
> a student in
> Prof. Jimmie's

Geometry class,
An I had a
Roommate by the
Name uv Joe Hendrix
who wuz purty good
at Geometry.
(I wuzn't)
So whenever I
would volunteer
to put a
Geometry theorem
on the blackboard,
Jimmy would slyly
say,
"Well, I see
Hendrix has been
bizzy again.

Darn Jimmy!
(Parady on Darn Bill!
Tan & Cardinal, 1921-23)

He developed lifelong friendships with many of his students. Among them was George Heitz '23, an early physics graduate. He came from a poor background and McCloy invited him to live with his family in addition to employing him as a laboratory assistant. In 1960 Heitz wrote:

> Your keen sense of humor, your interest in young people, your patience with the slow ones, your deep understanding, and your willingness to give of yourself has, to many of us, made Otterbein and Jimmy McCloy synonymous.

This extraordinary generosity of spirit was evident in McCloy's personal life as well. His granddaughter, Kay Hedges, says:

> My mother Jean has often related her memories from growing up during the Great Depression. She remembers waking up frequently at their home on W. Broadway and finding strange men sleeping on the screened porch along the width of the back of the house. These were unfortunate people, out-of-work and destitute, who had hopped the train and jumped off in Westerville, hoping to find someone who would give them shelter. Grandpa always did and often paid them to do small jobs around the house. I'm sure their home was marked in some way, as Mom says this was such a common occurrence.

McCloy also had a love of music, and wrote songs for his church and as tributes to Otterbein. For his wife, who was a graduate of Otterbein's music conservatory, he composed one of the university's beloved songs, "Sweetheart Serenade."

Already, graduates across the sciences had an excellent record of success in the professions and in graduate school. A 1939 study[2] examined the fraction of graduates of 337 universities that went on to graduate school (understood broadly to include medical, dental, and other professional schools). It found that within Ohio, only Ohio State and Western Reserve (now Case Western Reserve) Universities outperformed Otterbein on this metric. One finds numerous other references in *Otterbein Towers* and *Sybil* from this era describing the success of Otterbein grads in top post-graduate programs.

The earliest graduate of which we have record is Fenton V. Stearns '21,

[2]Carried out by one Prof. Kunkle of Lafayette University.

who majored in chemistry, mathematics, and physics. He received an MSc in Physics from the University of Pittsburgh, and also studied physics at the University of Chicago, where he earned the LaVerne Noyes Scholarship and was elected to the Gamma Alpha graduate scientific fraternity, and Sigma Xi. He had a long career as an engineer with the Western Electric Company in Chicago. In his retirement letter to Jimmy McCloy, Stearns wrote:

> This letter conveys my sincere appreciation for the direction of my life's work resulting from the many enjoyable and profitable hours spent in your physics and astronomy classes.

Among other notable alumni from this period, Dr. Gerald A. Rosselot '29 earned a PhD in Physics from Ohio State before moving to the Georgia Institute of Technology, where he served as professor of physics from 1934-53. From 1941-52 he was Director of the institute's Engineering Experiment Station (now the Georgia Tech Research Institute). He was a co-founder of Scientific Atlanta in 1951, and in 1953 he joined the Bendix Corporation as Director of Engineering. He also served as Director of Bendix's Research Laboratories Division, and was later vice president. He retired in 1972.

Dr. Francis P. Bundy '31 was part of the four-person team at General Electric that first succeeded in making synthetic diamonds in December, 1954. Bundy graduated with a BS in Physics from Otterbein, and obtained an MSc and PhD in Physics from Ohio State before joining the GE Research Department in 1946. He was elected a Fellow of the American Physical Society in 1953, and in October 1969 he was awarded the Roozeboom Gold Medal by the Royal Netherlands Academy of Sciences, for "his very important work in

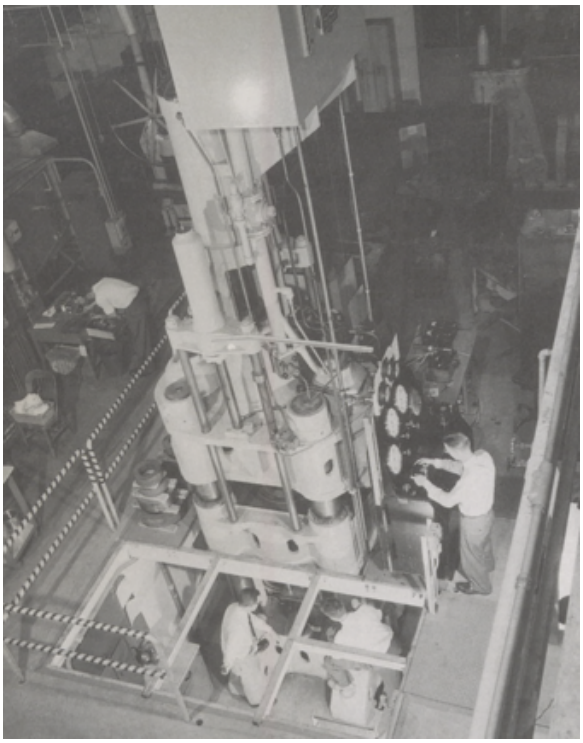


Figure 3.6: Bundy at the control station (right) of General Electric's 1000-ton Birdsboro "Diamond Press" in 1955. (Photo courtesy of General Electric Research and Development Center, via Francis Bundy.)

particular on the phase diagram of carbon under extreme circumstances of temperature and pressure." He was named Distinguished Alumnus in 1956.

Dr. Frank M. Van Sickle '41 graduated from the Boeing School of Aeronautics after earning a degree in physics from Otterbein. Starting as a civil airlines meteorologist in WWII, he ended as a chief engineer in the space program in New Orleans, LA, working for the Chrysler Corporation Missile and Space Divisions.

He was member of the Chrysler ground support teams that worked on the booster for the first US satellite in 1958; lifted astronaut Alan Shepard into

America's first space flight in 1961; built a series of Saturn rocket boosters as predecessors to the landing of astronauts on the moon; launched the SKYLAB on its space related experimental missions; and in 1975 boosted the US Apollo spacecraft to join its Russian counterpart in the Apollo-Soyuz vehicle test project. He was awarded an honorary Doctor of Science degree from Otterbein University in 1967, and named Distinguished Alumnus in 1981.

Dr. Albert A. Bartlett '44 earned a PhD in Physics from Harvard University and joined the physics faculty of the University of Colorado at Boulder in 1950.[3] He was a Fellow of the American Physical Society and of the American Association for the Advancement of Science, and President of the AAPT in 1978 and 1981. He received numerous awards over his long career, including the 1972 Thomas Jefferson Award of the University of Colorado, established in recognition of Jefferson's "total influence on present-day conceptions of the benefits of general education, of intellectual freedom, and of the conditions for social progress...a person contributing to 'the advance of those high ideals exemplified by Thomas Jefferson' will demonstrate humane qualities beyond those of scholarly distinction, important as they are." He won the Robert A. Millikan award of the AAPT in 1981.

Bartlett became well known for his efforts to educate the public on the nature of exponential growth and its implications for energy, population growth, and sustainability. He famously gave a one-hour lecture, "Arithmetic, Population and Energy: Sustainability 101" a total of 1,742 times to audiences ranging from students to corporate executives and scientists and to congressional

[3]Bartlett's father, Dr. Willard W. Bartlett, was chair of the Education Department at Otterbein from 1926-1936.

staffs. He first gave the talk in September 1969, and subsequently presented it an average of once every 8.5 days for 36 years (!).

Calvin J. Holtkamp '50 was a veteran of the US Air Force and served in World War II in the European Theater. He received an MS in Physics at Ohio State and worked as an engineer for Westinghouse. In his career he received 38 patent awards, and submitted over 120 invention disclosures.

After graduating from Otterbein, Thomas R. Bromeley '51 earned an MS in industrial administration from Carnegie Mellon University and served in the US Navy. He then enjoyed a long career as a publisher, manufacturer and financier whose business interests involved newspaper publishing, radio broadcasting, stainless steel fabrication and utilization, and information technology. He was CEO and chairman of Top Line Corporation and Allegheny Bradford Corporation. He served on the executive committees of the University of Pittsburgh, Bradford Hospital and the Chautauqua Institution, and was a member of the Otterbein Board of Trustees for many years, serving as Chairman from 1995-2005. He was named Distinguished Alumnus in 2002.

4 Modernization and Growth (1959-1979)

This period saw the expansion and modernization of the department and the physics curriculum.

Philip Barnhart (astronomy; MA, Indiana University; later PhD The Ohio State University) was appointed Lecturer (part time) in February 1959, and also became Director of the Weitkamp Observatory, succeeding Zechiel. Barnhart was then working for the OSU Research Foundation on infrared astronomy, and pursuing his PhD.

In fall 1959, E. Paul Matthews (BA, Ohio Wesleyan University; MA, Ohio State University) was hired to succeed McCloy. Donald Molyneux (MA, University of Buffalo) was then hired in 1960 in a "package deal" with the Evangelical United Brethren Church – "three ministers to liven up the faculty" [1]. According to Phil Barnhart, Molyneaux

> had a master's degree in physics dated 1940, no physics experience since, and a lassitude toward advancement, improvement, and cooperation that was to prove intolerable to those of us trying to build a department.

The departmental faculty was thus entirely new to Otterbein: Matthews (Chair), Molyneux, and Barnhart (part time).

Barnhart became a full-time faculty member in the fall of 1961. However, at the end of that academic year Matthews departed Otterbein to return to rocket

Figure 4.1: Physics faculty in 1961-62: (L to R) Matthews, Molyneaux, and Barnhart. Image from 1962 *Sibyl.*

development at North American Aviation. Barnhart was offered the Chair by Dean David Waas, and he accepted on the conditions that the department would be maintained at three full-time faculty members and that its budget would be increased to allow the buildup of modern laboratory equipment. These conditions were agreed, and Barnhart set about hiring a new full-time faculty member to replace Matthews.

This hire (fall 1962) was Charles Cook, a graduate of Grinnell College (MA, University of Rochester). However, Cooke departed after one year, and in 1963 Donald C. Bulthaup (experimental nuclear physics; MS, Michigan State University; later PhD The Ohio State University) joined the faculty, which thus consisted of: Barnhart (Chair), Molyneux, Bulthaup.

At this time the Department substantially revised its curriculum to meet the needs of the student population, and also raised its standards (in the description of Phil Barnhart). Emphasis in training was placed on preparation

Figure 4.2: Don Bulthaup in 1979, as Vice President for Academic Affairs.

for secondary teaching, graduate school, and industry. A year-long course in elementary modern physics was a central feature of the new curriculum. This was the first course offered in the Department that treated the revolutionary developments in physics of the early 20th century, namely (special) relativity and quantum theory.

Molyneux departed Otterbein at the end of AY 1966-67 (after he "reached a nadir of ineffectiveness" [1]) and was replaced in 1967 by John Muster '63 (astronomy; MA, The Ohio State University) in a temporary appointment. Muster had been a physics student at Otterbein and was employed as a teaching assistant in the Department in 1963-64; he returned to the Department after earning his Masters degree and teaching high school physics for two years.

Then, in fall 1968 John A. (Jack) Taylor (PhD, Massachusetts Institute of

Figure 4.3: (L to R) Taylor, Barnhart, and Muster around 1970.

Technology) was hired into a permanent line. With Barnhart on leave in AY 1968-69 (to continue work on his PhD) the departmental personnel included: Bulthaup (Chair), Taylor, and Muster.

Barnhart returned from leave in 1969, at which point Bulthaup went on leave, also to finish his PhD. From 1969 the departmental faculty members were thus: Barnhart (Chair), Taylor, and Muster. Bulthaup completed his PhD in 1972, and Barnhart finished his in 1974.

Also in 1968 the University switched from semesters to a quarter-based academic calendar known as the "3/3 Plan," so called because there were three 10-week terms and students normally took three courses per term. The entire curriculum was reorganized, including general education. The credit

hour was abolished; requirements were reckoned simply in courses. Thirty-two courses were required to graduate, of which a major could be at most nine (in a single department). Only the BA degree would be awarded, in addition to the BMusEd and BSEd for students in Education.

Grade point averages were also abolished; instead, students could have at most four Ds, and these had to be offset by an equal number of As or Bs.

Finally, a set of Common Courses was created. Certain courses were prescribed for freshmen, others for sophomores, and so on. All members of a given class would take their Common Courses at the same time. Where possible, these would be offered in a single large section (there were exceptions, for example English and foreign language courses). Substitutions were not allowed.

One of Muster's main projects was the development of the Physical Sciences Common Course, supported by grants from the Lubrizol Corporation and the Marathon Oil Foundation. This innovative course involved the use of tape recordings, films, and individually designed study programs. Many of the recordings were secured by his own efforts in interviews of well-known scientists in the US and Europe, including an in-person interview in Germany with Nobel laureate Werner Heisenberg.

It is outside the main story line, but I will digress here to note that many of these curricular changes would be undone in the coming years – there would be a return to credit hours and GPAs, majors would be revised and expanded, and in 1980 the BS degree would be reinstated for programs in the Science and Mathematics Division. (Other degrees were also added in other areas.) The

history of this transition and its aftermath is very interesting. The o cial documents provide a fairly bloodless description of reports and meetings, stripped of what must have been (having lived through a couple of these transitions myself) a great deal of turmoil. Dave Deever '61, Professor of Mathematics from 1971-2001, has written his reflections on the episode [9] that capture some of this missing flavor.[1] Writing in 1998, he comments that:

> The turbulence involved in making these changes is hard to exaggerate... Faculty distrust of each other must have been at an all-time high. There are stories of secret faculty caucuses held off campus (in the band shell in the park). There is the story that certain faculty managed to persuade Mrs. Clements, *the* big financial giver at the time, of the folly of the plan so that when President Turner refused to listen to her demand that he abort the idea she placed in her will the provision that though her house was to go to the college, President Turner was never to live in it.

Regarding the aftermath, he writes:

> Looking back over the last thirty years or so, the thing that strikes me is how very little difference there really is between then and now. Most of what was put in place at so great a cost is gone, especially in the curricular area. We tried a "one size fits all" approach to education. As long as we could get plenty of students who fit that size, it worked. However, when we needed again, as

[1] Deever had been a student at Otterbein under the old semester calendar, then returned as a faculty member just after the 3/3 Plan was instituted.

> we had through most of Otterbein's history, to attract as many students as we could, a variety of sizes was required.

There are echoes of these comments in the transitions of the future.

Returning to the story of Physics, over the period from roughly 1960-70, the acquisition of modern laboratory equipment accelerated greatly, made possible by grants from the National Science Foundation in 1962 and 1967, and gifts from Ohio Bell Telephone Labs, General Motors, Tektronix Corporation, the Hiram College Department of Physics, and the estates of Lawson Johnson and Prof. Cedric Hesthal,[2] in addition to significant support from the university. Altogether about $85,000 of equipment was added, at a cost of only $35,000 to Otterbein. The department also obtained a license from the Atomic Energy Commission for a high intensity "neutron howitzer" funded, along with other nuclear physics equipment, by the 1967 NSF grant. An X-ray diffraction system was also acquired, and was in joint use with the Department of Chemistry.

In 1970 the McFadden Science Building was expanded significantly, becoming the Schear-McFadden Science Building. At this point the department finally acquired su cient laboratory space; before this, it had operated in cramped quarters of less than 3500 total square feet (including observatory and planetarium) in McFadden Hall.

However, a rooftop fire in fall of 1971 destroyed the observatory and several laboratories. As noted previously, there was at that time a planetarium, an observatory, and a cluster of small labs and o ces in between (see Fig. 3.3).

[2]Professor of Physics at OSU.

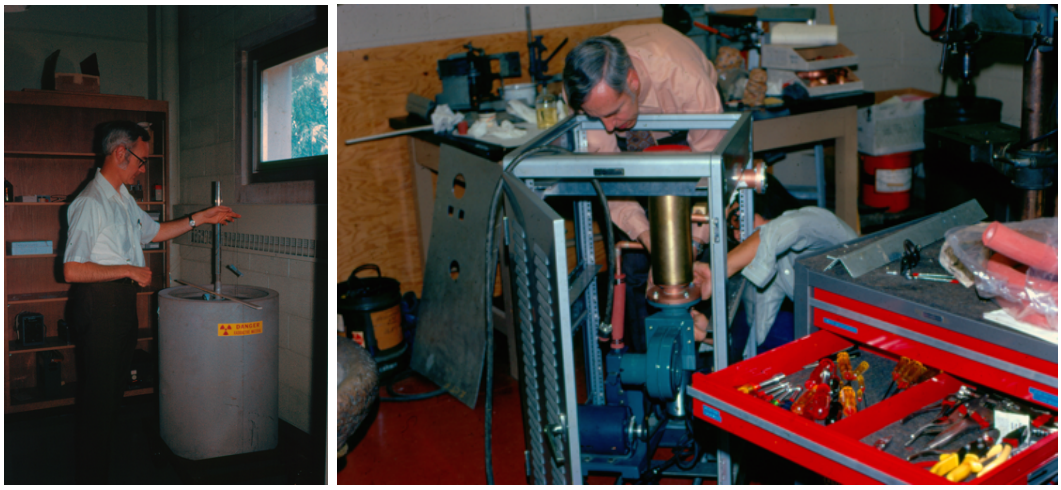


Figure 4.4: (L) Jack Taylor and the neutron howitzer; (R) Don Bulthaup and student building a pumping station used for creating thin films by sputtering. Pictures from 1971.

The fire was perhaps caused by a faulty lighting fixture, and spread quickly to the roof of the rest of the building, a roof made up of tar and gravel. Fortunately, few people were in the building.

The tar made the fire particularly di cult to extinguish. Westerville's ladder wagon would position itself on one side of the building, and as they sprayed water the fire would simply move to the other side. It took the assistance of the Sharon Township ladder wagon so that the fire could be attacked from both sides before it could be put out.

As soon as the fire was out, since there was no structural damage to the main part of the building, persons with o ces in the building were allowed in to try to recover what they could. There was no actual burning below the roof, and little smoke damage. However, even after the fire had been out for a while the stairs still looked like a mountain stream with water tumbling down the rapids [10].

Figure 4.5: (L) Fire on the roof of McFadden Hall on the night of November 16, 1971; (R) the charred mount for the 16" reflecting telescope that was destroyed.

The planetarium was repairable and remains to the present day. The observatory was eventually replaced in the early 1980s with a storage shed with retractable roof. This held a modern, smaller telescope with approximately the resolving power of the earlier 16-inch Newtonian.

Also in 1970, Jack Taylor published his two-part workbook, "Programmed Study Aid for Introductory Physics" (Addison-Wesley). This was designed to bridge the gap between textbook theory and practical problem solving, providing step-by-step explanations of representative problems. Much of the testing and development for this was carried out in Otterbein classrooms.

Bulthaup returned from leave in fall 1971, and at this point the departmental faculty consisted of Barnhart (Chair), Bulthaup, Taylor, and Muster. Muster departed Otterbein after the 1971-72 academic year. He later earned a

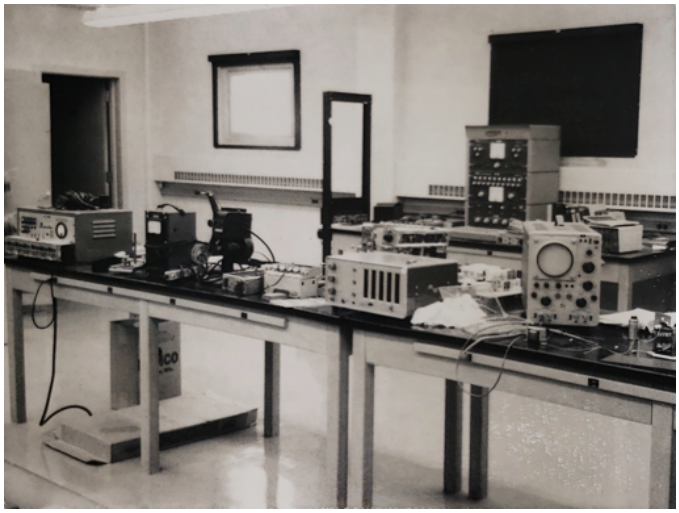


Figure 4.6: Advanced laboratory circa 1970.

PhD, and taught at Austin Peay State University and the University of California, Berkeley before founding the Mentoring Academy in Oakland, California.

Jack Taylor succeeded Barnhart as Chair starting in 1974. He would lead the Department until his departure from Otterbein in 1980.

In 1976 the Common Courses were expanded and restructured, becoming the Integrative Studies Program. Phil Barnhart played a central role in developing this signature program, and the Department has always maintained a close and supportive relationship to it.

In 1977, Don Bulthaup moved to Academic Affairs as VPAA, succeeding Roy Turley of the Department of Chemistry. He would serve in this role until 1988.

This period saw the development of the Physics Department into a fully modern entity, with an updated, relevant curriculum, su cient space, and modern laboratory equipment. Barnhart and Bulthaup share most of the

Figure 4.7: Physics students and faculty around 1970.

credit for the vision and energy that underlay this progress. The result was a solid foundation on which to continue building. It is clear that the faculty in those days (by, say, the early 1970s) was justifiably proud of what they had accomplished. Barnhart's commentary on this period, written in early 1971:

> Our greatest satisfaction – our graduates are succeeding.

Among the notable alumni of this period, Allen L. Manson '60 completed flight training in the US Navy in 1962 and the Navy Test Pilot School in 1966. He was selected to the Society of Experimental Test Pilots in 1968. He joined NASA in 1969 and was promoted to Head of Research Pilots at the Johnson Space Center in Houston, TX. He eventually served NASA for 42 years as a test pilot and aerospace manager, rising to become Chief of Aircraft Engineering and Maintenance. He conducted flight tests of NASA and Navy airplanes and

provided flight instruction to astronauts who landed on the moon and flew the Space Shuttle. Manson received the NASA Exceptional Service Award and the NASA Space Flight Award for his service. He retired from NASA in 2003 and received Otterbein's Special Achievement Award in 2005.

Brian K. Hajek '66 had a long career as Professor of Nuclear Engineering at Ohio State University. He was named Distinguished Alumnus in 2012.

Dr. Thomas Deever '68[3] received the President's Citation as outstanding senior upon graduation. He studied optics at the University of Rochester, earning an MS and eventually an MBA there, and worked for 30 years at Eastman Kodak. He then became involved in a series of aid projects in Nigeria and Sierra Leone, beginning with a project in 2000 to bring clean drinking water to the village of Uboegbelu, Nigeria. Later projects included building schools and hospital facilities in the two countries. These projects eventually involved several schools in Rochester, NY as well as the Nigerian government. Tom received the Alumni Community Service Award in 2006.

Dr. Thomas W. Crane '68 earned a PhD in Physics from Yale University in 1974. He worked briefly at the Los Alamos Meson Physics Facility before beginning work at Los Alamos National Laboratory in 1976. An avid bicyclist, he competed in the annual Los Alamos Triathlon, the Tour de Los Alamos, and the Iron Horse Race in Durango, Colorado, before multiple sclerosis forced him to forgo physical activities.

Dr. Karl G. Kempf '69 attended graduate school at Stanford University and the University of Akron, where he earned a PhD in Applied Mathemat-

[3]Brother of Dr. David Deever '61, also a mathematics and physics major who was Professor of Mathematics at Otterbein from 1971-2001.

ics in 1974. He has been a pioneer in the application of microcomputers to the automotive, entertainment, and aerospace industries. He worked with Goodyear and the Ferrari Grand Prix racing team, implementing the first onboard computer systems and co-inventing active suspension. These innovations helped Ferrari with three consecutive Formula One World Championships in the 1970s. He also worked at Pinewood Studios, UK on computer-driven special effects for three *Superman* movies. Returning to the US, he joined McDonnell Douglas where he worked on control and automation systems for factories and for the Space Station. In 1987 he joined Intel Corporation, where he is currently a Senior Fellow. He was elected to the National Academy of Engineering in 2003, and received the Otterbein Alumni Special Achievement Award in the same year.

Dr. Michael G. Ziegler '72 earned a PhD in Physics at Ohio State, and works as a clinical faculty member in the OSU Physics Department.

Nate Van Wey '72 taught physics at Perry High School in Stark County for 44 years. He was awarded the Tandy Technology Scholar Award as well as the Ashland Oil Teacher Achievement Award. He was also a member of an NSF research team in Antartica in 1995.

Dennis Mammana '73 went on to earn an MS in Astronomy from Vanderbilt University. He held positions at Strasenburgh Planetarium in Rochester, New York, the Smithsonian's National Air and Space Museum, the University of Arizona, and San Diego's Reuben H. Fleet Science Center. He is the author of six books on popular astronomy, hundreds of magazine and encyclopedia articles, and numerous planetarium scripts. Since 1992, he has written *Stargazers*,

the only nationally-syndicated weekly newspaper column on astronomy. He has merged art with science as a noted and accomplished sky photographer, whose images have appeared in many electronic and print media, as well as in art exhibitions. He won the Alumni Special Achievement Award in 2008.

Dr. Myron Campbell '77, received a PhD in Physics from Yale University. After a postdoctoral appointment at the Enrico Fermi Institute of the University of Chicago, he joined the physics faculty of the University of Michigan, where he remains today. He has also served as Associate Dean for Natural Sciences. He is a Fellow of the American Physical Society, and received the Alumni Special Achievement award in 2000.

William H. Rickels '77 worked for 37 years in systems engineering and intelligence analysis, retiring as Chief Systems Engineer for the Ball Aerospace & Technologies Corp in Fairborn, OH. Among other projects, he worked with the Advanced Technical Exploitation Program for the National Air & Space Intelligence Center at Wright-Patterson Air Force Base in Dayton, OH.

5 Passing the Torch (1980-2000)

Over the next two decades the department continued to develop, in particular building strength in research. The many benefits of research experiences for undergraduate students were being increasingly recognized, and in addition the university benefitted generally from the oversupply of PhDs in many fields that developed in the 1990s. The junior faculty hired in this period were generally accomplished scholars, often with postdoctoral experience (at least in the sciences, where this is common), and who wanted to stay active in their scholarly work and bring the excitement of research to students. However, the start of this period was marked by some challenges, which required new leadership to overcome.

With Bulthaup in Academic Affairs, the Department was down to two full-time faculty members in 1980, Taylor (Chair) and Barnhart. Jack Taylor departed Otterbein mid-way through AY 1980-81, leaving Barnhart to run the department with only adjunct faculty. The resulting quality of teaching was not good, especially in the general physics course which is taken by students in a variety of programs.

Louis G. Arnold (theoretical nuclear physics; PhD, University of Kentucky) was appointed as successor to Taylor in 1983. He came from OSU, where he had been a Research Assistant Professor for several years. At this point the departmental personnel were: Barnhart (Chair) and Arnold, with Bulthaup

Figure 5.1: Lou Arnold, Chair of the department from 1991 to 2005.

on leave. By now the effects of the reduced and fluctuating faculty were being felt: in particular, the number of majors was declining, and the ongoing maintenance and development of the introductory laboratory had stalled. This was "a disaster of broken equipment," in Lou Arnold's description.

Arnold set about rebuilding the introductory courses, and by 1988 he had completely revised these courses and their labs, including implementing computerized data acquisition systems in the lab. He also received an NSF grant that allowed the purchase of microcomputers for the Advanced Lab.

In 1982 the Weitkamp Observatory was finally rebuilt following the rooftop fire of 1971. Phil Barnhart supervised the construction, designing a shed with a retractable roof to house a 14-inch Celestron telescope on a permanent mount.[1]

In 1983, Otterbein became the first member of the North American As-

[1]This project was not without its hiccups. Barnhart had designed the shed with an aluminum frame and heavy duty wheels on the movable roof, of the kind used for aircraft hangar doors. The Service Department instead bought cheaper wheels, and built the rooftop frame out of iron. The cheap wheels collapsed under the excessive weight, and even after this was repaired, the electric motor that moved the roof – sized for aluminum rather than iron – would burn out every few years under the strain. This problem would not be corrected until a new shed was constructed in 2017.

Figure 5.2: Rebuilding of the rooftop observatory in 1982.

Figure 5.3: Phil Barnhart on the restored Weitkamp Observatory deck, 1982. The Planetarium dome is behind him.

troPhysical Observatory (NAAPO), a consortium of colleges and universities created to operate the 110-meter "Big Ear" radio telescope in Delaware, OH. Phil Barnhart took a leadership role in the organization and served as its first Director. Other consortium members were Denison University, Ohio University, Oberlin College, the College of Wooster, Manchester College (IN), and St. Mary's University of Halifax, Nova Scotia.

The Big Ear telescope – o cially the Ohio State University Radio Observatory (OSURO) – was constructed from 1956-61 and began collecting data in 1963. The observatory completed the Ohio Sky Survey in 1971, and from 1973-1995 it was engaged in the search for extraterrestrial radio signals, making it the longest running SETI project in history. In 1977, Big Ear recorded the famous "Wow!" signal, a strong radio signal that appeared to come from the direction of the constellation Sagittarius and that had certain features expected of signals from an advanced civilization. The signal was never detected

again, and its ultimate origin is still unclear.

In addition to the consortium members, many local volunteers donated time and funding to support NAAPO. According to Barnhart,

> Important contributions were made by an ever-evolving team consisting of eighth grade middle school students; secondary teachers and students; college research and teaching faculty and staff; undergraduate physics and engineering students; business, industry and professional people, (self-employed and organization-employed); retired technicians, engineers and scientists.

The facility provided a unique opportunity for student research projects, and over the years student interns participated in data analysis as well as maintenance and hardware upgrades.

The land on which Big Ear was constructed was owned by Ohio Wesleyan University, and in 1982 they sold it to commercial developers.[2] Under NAAPO, the land was leased from the developers and the telescope continued to operate from 1985-1997 as an educational and research facility. The lease was terminated at the end of 1997 and the telescope was dismantled in early 1998.

In 1987 the Science Lecture Series (initially called Science 2000) was established on the initiative of Phil Barnhart and Professor Jerry Jenkins of the Department of Chemistry. The George W. and Mildred K. White Science Seminar Fund sponsors this annual program in which a scholar of stature is

[2]These planned to build houses and expand a neighboring 9-hole golf course, prompting Barnhart's quip that Big Ear was the world's only par 72 radio telescope.

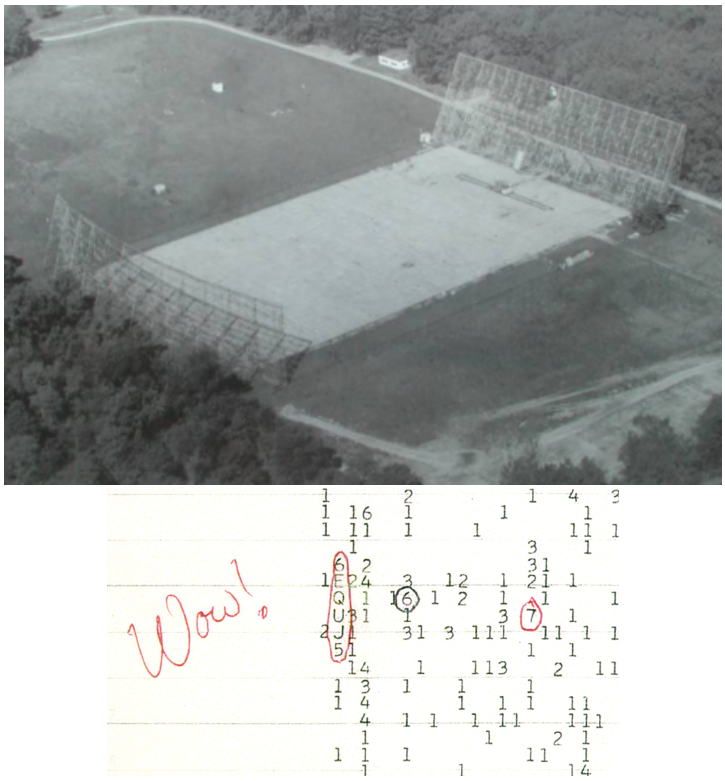


Figure 5.4: (Top) "Big Ear" as seen from the air; (Bottom) The famous "Wow Signal," received in 1977.

brought to campus for a public lecture and interactions with students. Over the years many notable scholars have participated, including several Nobel Prize winners.

Bulthaup returned from Academic Affairs to the Department in 1988 after a new VPAA was hired in an external search. The Departmental faculty thus returned to its normal level: Barnhart (Chair), Bulthaup, and Arnold. In 1991 Arnold took over as Chair, to provide continuity in the anticipated retirements of his more senior colleagues.

The first of these was Bulthaup, who retired in 1993. Michael Pettersen

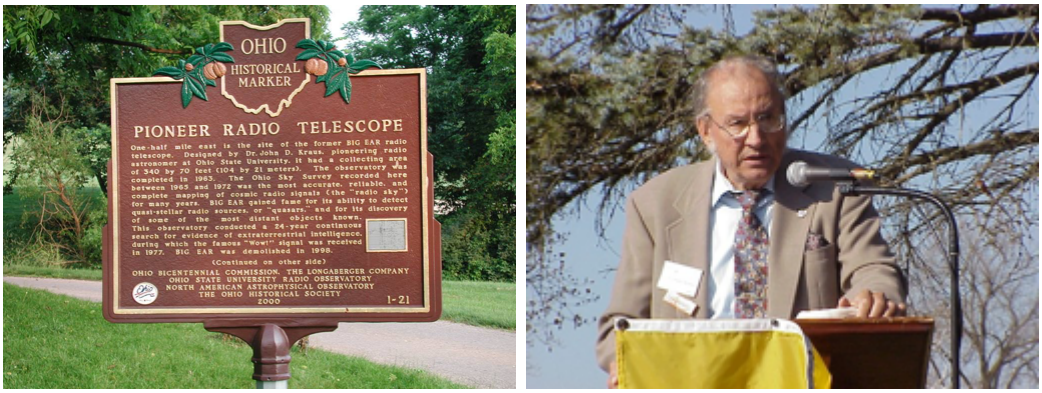


Figure 5.5: (L) Historical marker for the "Big Ear" radio telescope, dedicated in 2000, (R) Barnhart as Master of Ceremonies at the dedication.

(experimental condensed matter physics; PhD, California Institute of Technology) was appointed as his successor.

Barnhart then retired in 1995. His line was filled for 1995-96 by James Castiglione (PhD, Ohio State University), and then permanently in 1996 by Eric Werwa (materials science and engineering; PhD, Massachusetts Institute of Technology). At this point, the departmental personnel were thus: Arnold (Chair), Pettersen, and Werwa.

In 1991 the Arch B. Tripler Solar Observing Facility was established. Tripler had long been a friend of Barnhart, and on his death in fall 1990 he bequeathed a variety of astronomical equipment and books to the Weitkamp Observatory. Among the equipment was a unique telescope dedicated to solar observing.

In 1993 the modern 3+2 Dual Degree Program was established, a partnership with Washington University in St. Louis and Case Western Reserve University. This program provided a way for students to pursue the study of

Figure 5.6: Mike Pettersen and unknown student.

engineering at Otterbein, and was similar to the program from the 1950s. The student would spend three years at Otterbein and two at the partner institution, earning a BA in Physics from Otterbein and a BS from the partner in whatever flavor of engineering they chose to pursue.

In 1994, the Science Education Discovery Center was opened in the Schear-McFadden Science Building. This was a joint initiative of Lou Arnold, Paula Knight of the Department of Education, and Alison Prindle of Integrative Studies, and provided a state-of-the-art facility for the training of pre-service and in-service science teachers. Generous support from Battelle Memorial Institute and the Harry C. Moores Foundation was instrumental in creating this modern learning space.

Figure 5.7: Physics faculty in 1998: (L to R) Eric Werwa, Lou Arnold, and Mike Pettersen. Image from 1998 *Sibyl*.

Pettersen was awarded an NSF research grant in 1995, the first such award[3] at Otterbein: *Molecular Dynamics of Rough Surfaces in Adsorbed Films* (RUI program, $95,000 awarded). Like those that would follow, this grant was aimed at building laboratory infrastructure and supporting undergraduate student-faculty research.

By the end of the century, the Department had thus weathered some di - cult times and returned to a position of strength under the energetic leadership of Lou Arnold. With an excellent young faculty focused increasingly on building opportunities for student-faculty research, it was well positioned for the future.

[3]I.e., a grant awarded under the regular research directorates of the NSF, as opposed to grants for educational initiatives or equipment.

Figure 5.8: Paula Knight gets some help cutting the ribbon on the new Science Education Discovery Center. Looking on are (L) Doug Oleson of Battelle Memorial Institute and (R) Otterbein President C. Brent DeVore.

Figure 5.9: The Science Education Discovery Center in action.

6 The New Millennium (2001-present)

However, at the start of the millennium, the Department again underwent significant personnel changes and found itself in a period of transition.

Eric Werwa departed Otterbein in 2001 for a position in governmental science policy. His position was filled initially by Krysztof Gorny (PhD, Ohio State University), who however resigned after a single term. The line was then filled starting in January 2002 by David G. Robertson (theoretical particle physics; PhD, University of California at Santa Barbara), initially on a visiting basis and then full time starting with the 2002-03 academic year.

Then, in the spring of 2002, Mike Pettersen announced he was leaving Otterbein to take a faculty position at Washington and Jefferson College in Pennsylvania.[1] A search was conducted in the fall, and in January 2003 Uwe Trittmann (theoretical particle physics; Dr. rer. nat., University of Heidelberg, Germany) was appointed to this position. He also took over as Director of the Weitkamp Observatory.

At this point the departmental personnel were: Arnold (Chair), Robertson, and Trittmann.

Robertson and Trittmann each won (separate) Cottrell Science Scholar Awards from Research Corporation in support of student-faculty research. Robertson also had grants from the Ohio Supercomputer Center, including a

[1] Pettersen hoped to find an institution with a more robust student-faculty research culture.

Cluster Ohio grant that established a 16-processor parallel computing system (an early "Beowulf cluster") on campus for student/faculty use.

Arnold stepped down as Chair in December 2004, after he was informed that the projector bulb in the old LeMay Auditorium, which failed early in autumn quarter, would not be replaced for the remainder of the academic year. Robertson then became Chair, although he was not yet tenured.

Trittmann was elected Chair of the Ohio-Region Section of the American Physical Society (OSAPS) for 2005-06.

In the general history of the university, VPAA Patti Frick was succeeded in Fall 2006 by Abíódún "G-P" Gòkè-Paríolá. The new leadership initiated a strategic planning process which would result eventually in the conversion from the quarter-based academic calendar back to a semester calendar. This work was begun around 2008, with the first term on semesters being fall 2011.

G-P also approved an expansion of the department to four full-time faculty members, and Brian C. Sell (experimental condensed matter physics; PhD, University of California at Davis) was hired into the new line in the fall of 2007.

Lou Arnold retired in December 2008 after 25 years of service, and was succeeded by Nathaniel J. Tagg (experimental particle physics; PhD, University of Guelph). Tagg arrived at Otterbein in the fall of 2008, and so at the end of the 2008-09 academic year the departmental personnel were: Robertson (Chair), Trittmann, Sell, and Tagg.

By this time the university was starting to move beyond mere rhetorical support for faculty scholarship. Startup packages in the sciences were very

Figure 6.1: Public observation of the 2004 transit of Venus led by Otterbein faculty members Uwe Trittmann and David Robertson, who were at the time unaware of the history of John Haywood and his observation. Top: Robertson (with raised arm) explains things. Bottom: 10TV News and NPR cover the event. Trittmann is taking the pictures.

small but not actually zero,[2] and new faculty across the university received course releases in their first two years to help establish their research. In 2007-08 all departments produced revised and expanded statements on scholarship requirements for tenure and promotion. There was a definite feeling that the bar was being raised somewhat on scholarly expectations. This was accompanied by an explicit focus on research and other high-impact practices in the form of the Five Cardinal Experiences initiative, which began with the shift to semesters in 2011.

Teaching loads under the quarter system were actually rather friendly to research: faculty members taught seven courses per year on a 2/2/3 pattern, hence teaching only two courses at a time for most of the year. The conversion to semesters did affect teaching loads, but not catastrophically. We adopted a model where the standard course was 4 credits, and a faculty member taught six total courses per year, about equal in total credits per year to the quarter system. This was done explicitly to maintain space in faculty workload for scholarship and creative work. It was fewer overall courses, and they met for less time each week than did the old quarter courses, but one taught three classes per term as an ongoing proposition. In general this was not felt to be a serious setback on the scholarship front.

Tagg was immediately successful in winning research funding from the NSF, starting in 2009: *Neutrino Experiments with the NuMI Beam* (RUI program, $113,000 awarded); this grant fully funded two research students each summer,

[2]Robertson and Trittmann each received $5k, which was adequate given that they were theorists. Sell received $15k and Tagg $10k, the difference reflecting that Sell was engaged in building an on-campus lab while Tagg was involved in large-scale experiments at the Fermi National Accelerator Laboratory.

the creation of a remote operations center where the Fermilab experiments of which he was a member could be monitored, and other activities. He would win three more such grants, most recently in 2020. Tagg thus had continuous NSF research funding for the period 2009-2021.

An extensive expansion and renovation of the Schear-McFadden Science Center was undertaken from 2007-09, and the Department moved to temporary quarters, with faculty o ces in the "Mold House" across Main Street from the Science Center. and teaching labs in the eastern wing of the building, which had been renovated first. Physics moved in to its permanent space in the western wing over Spring Break 2009.[3]

In roughly the period 2009-2010 the faculty also completely redesigned the physics curriculum for a semester-based calendar. Physics faculty members were also heavily involved in the re-design of Integrative Studies, given the Department's deep historic ties and commitment to this program.

In other grant-related activities, Robertson won an NSF grant in collaboration with Prof. Dean H. Johnston of the Department of Chemistry: *Nanotechnology Education – A Multidisciplinary Approach to Attracting and Retaining Students in Science* (National Science Foundation, NUE Program, $193,000 awarded (2005-2007)). He also participated in *Development and Dissemina-*

[3]This project echoed earlier struggles to provide adequate facilities and equipment for the sciences. The Science Center had been identified as a priority for renovation and modernization by the late 1980s, but nothing could be done until around 2006, after it had been mentioned in two accreditation reports as a problem for the university. The building was expanded significantly and had space for faculty research as well as modern teaching laboratories. But it was full upon completion – there was no room for growth – and the planned endowment for equipment did not materialize. Indeed, the overall fundraising for the project was disappointing, and the university had to finance a significant portion of the cost.

tion of Computational Science Educational Materials and Curricula at the Undergraduate Level (National Science Foundation, DUE Program, $25,000 of $480,020 awarded (2007-2011)).

Sell was co-PI on the grant *Cardinal Science Scholars: Enhancing Student Opportunities and Retention in Biochemistry, Chemistry and Physics* (National Science Foundation, S-STEM Program, $482,992 awarded (2009-2013)). This was again a collaboration with Chemistry (Prof. Joan Esson). He also participated in *OP2: Operation Physics for Middle Grades Science Teachers* (Ohio Board of Regents, TQE Program, $108,733 awarded (2010-2011)), in collaboration with Prof. Wendy Sherman Heckler of the Department of Education. This grant funded an intensive graduate-level course on physics for middle school science teachers, with a strong focus on active learning and conceptual understanding.

Our students were small in number – we have averaged a little over three graduates per year for most of our history – but generally excellent, with many going on to graduate study in physics, engineering, or applied mathematics. Others pursued successful careers in industry, engineering, secondary teaching, computing, business, law, and finance. Among many accomplishments that could be listed, Brandi McVety '09 was admitted to the highly competitive REU program at the University of Michigan, and spent a summer working at the Large Hadron Collider in Geneva, Switzerland. Justin Young '10 won a Goldwater Fellowship, still the only Otterbein student to have accomplished this.

Regarding teaching, the Department made an early and total commit-

Figure 6.2: Brandi McVety '09 with the ATLAS detector at the Large Hadron Collider.

ment to modern, research-based teaching methods.[4] This policy began under Arnold's leadership and was continued and expanded by Robertson, and so may be said to have started around 2000. All new faculty were sent to the AAPT New Faculty Workshop in their first few years of service, to learn about teaching methods developed by the PER community. The Department developed a real culture of talking about teaching and trying new things. The introductory courses were brought to a modern standard, with active learning components like Peer Instruction, Just in Time Teaching, and interactive lecture demonstrations. Some faculty would also attend the AAPT Experienced Faculty Workshop. In this period, multiple junior faculty in the Department were nominated for the university's New Teacher of the Year award.

Regarding the intellectual life of the university, the Department was also

[4]Starting in the 1970s, physicists began studying how people best learn physics, and developing pedagogical approaches based on this research as well as general cognitive science. By now some Physics Departments have established research groups devoted to this subject, known generally as Physics Education Research (PER).

Figure 6.3: Frank Wilczek lectures in LeMay Auditorium.

very active. It hosted Nobel laureates Frank Wilczek in the spring of 2005, and Sir Anthony Leggett in the fall of 2008 as part of that year's Science Lecture Series. In the fall of 2005 we also organized the SLS program "Big Bang Boom: Einstein's Theory in the 21st Century," featuring Michael Turner (University of Chicago) and Robert Kirshner (Harvard University). This was a joint project with the Pack Lecture Series that year, for which we hosted physicist and author Alan Lightman (MIT).

Physics Coffee Hour was also instituted in 2004; this regularly attracted faculty and students from other departments to talk about recent developments in physics, hear student or faculty research presentations, or for external speakers.

Also in 2004, Trittmann created the Starry Mondays series of public lectures on astronomy, followed by rooftop observing. This program has continued to the present day and is quite popular.

Towards the end of the decade, the wider university context underwent

Figure 6.4: Physics Coffee Hour circa 2009. (Top) Robertson and Tagg at left; Trittmann is seated to the right. (Bottom) In foreground are Brian Sell (L) and Prof. David Dennis of the Department of Business, Accounting and Economics.

some significant changes. Kathy Krendl was installed as President of the University in 2009, succeeding C. Brent DeVore. In 2010 G-P was replaced as VPAA by Amy Jessen-Marshall in an interim appointment. This was the start of a period of serious instability in the Academic Affairs leadership – from 2005 through 2019 we would see eight different VPAAs, counting interim appointments (Frick, Gòkè-Paríolá, Jessen-Marshall (interim), McGillin, Prindle (interim), Martinez-Saenz, Sherman Heckler (interim 2017-19, then permanent starting in 2019)[5]).

Of course, the economic downturn in 2008 also affected the university seriously. Later, demographic trends would add to the challenges.

Nevertheless, at the end of this decade the Department – with its name restored to the original "Department of Physics" in 2010[6] – was in a very strong position.

Brian Sell departed the university after the 2010-11 academic year for a position in private industry. His line was filled for 2011-12 by Christopher Porter (PhD, The Ohio State University) on a visiting basis, after which Aaron W. Reinhard was hired permanently, starting in fall 2012. Reinhard was an experimental AMO physicist (PhD, University of Michigan) who commenced the development of an on-campus atomic physics lab. VPAA Vicki McGillin and Dean of Arts and Sciences Paul Eisenstein were instrumental in making

[5]This is seven different people, but we are counting Sherman Heckler twice since she was initially an interim appointment, hence not acting with the full autonomy of a regular Provost.

[6]The "and Astronomy" was dropped since there were no longer any astronomers among the faculty, and no astronomy courses were offered outside of the Integrative Studies program.

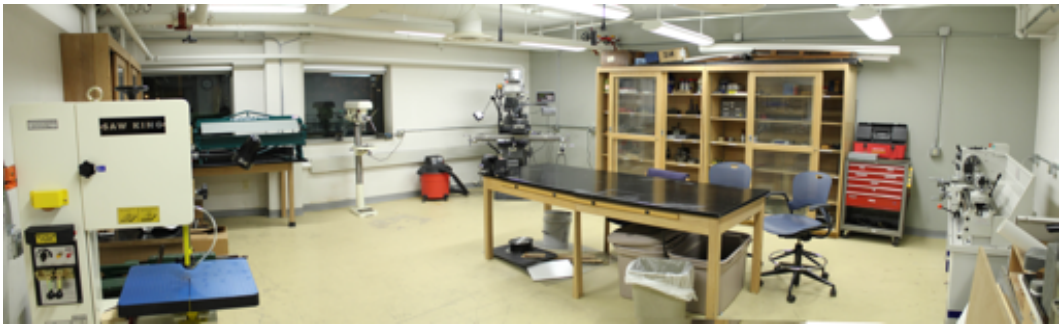


Figure 6.5: Department machine shop, October 2012.

this hire possible by pulling together a (barely!) adequate startup package.[7]

At this point the departmental personnel consisted of: Robertson (Chair), Trittmann, Tagg, Reinhard. One of Reinhard's first projects was to rebuild the department Machine Shop, which had been decommissioned during the building renovation. This was completed in fall 2012 with funding from Academic Affairs and the Department in roughly equal proportions.

In late 2010, a bequest in the name of Arthur A. Wiese came to the University. This gift (about $2M) was designated to support students with an interest in engineering, and was thus assigned to Physics, as the department running the 3+2 Dual Degree Program. In the coming years we used these funds to offer scholarships to talented students.[8]

The Department continued to build its reputation for excellent teaching, research, and service. Reinhard won the university New Teacher of the Year award in 2014 and Robertson was Master Teacher of the Year in 2017. Stephan

[7]There were three hires in the sciences that year, one each in Physics, Chemistry, and Biology. Each received a significantly larger startup package than had previously been offered, marking a welcome shift in the university's support for faculty scholarship.

[8]Wiese had no real connection to Otterbein other than a friend on the Board of Trustees; he was an alumnus of Ohio State. But this friend apparently convinced Wiese that the gift would have greater impact at Otterbein than at Ohio State.

Figure 6.6: AMO lab under construction: (L) optical table being brought into the Science Center; (R) installed and ready for use.

Frank, a long-serving adjunct faculty member, won the Part Time Faculty Teaching award in 2019 for general education. In the Department's 2014 Long Range Review, Dean of Arts and Sciences Paul Eisenstein wrote:

> My sense is that their commitment to new pedagogical practices, and just the level of discourse they maintain about effective teaching, is a model for other departments in the School.

In 2015 Reinhard was awarded a prestigious NSF CAREER grant in support of his research: *The Effect of State-Mixing Interactions on the Rydberg Excitation Blockade* ($400,000 awarded), allowing him to rapidly develop his lab capabilities. As before, the grant included lots of support for students; he typically supported two each summer, including taking them to professional conferences. A number of publications were produced that included student co-authors.

At this point every member of the department either had, or had had, external grant support for student-faculty research. The strong culture of research in the department led, among other things, to a period of five con-

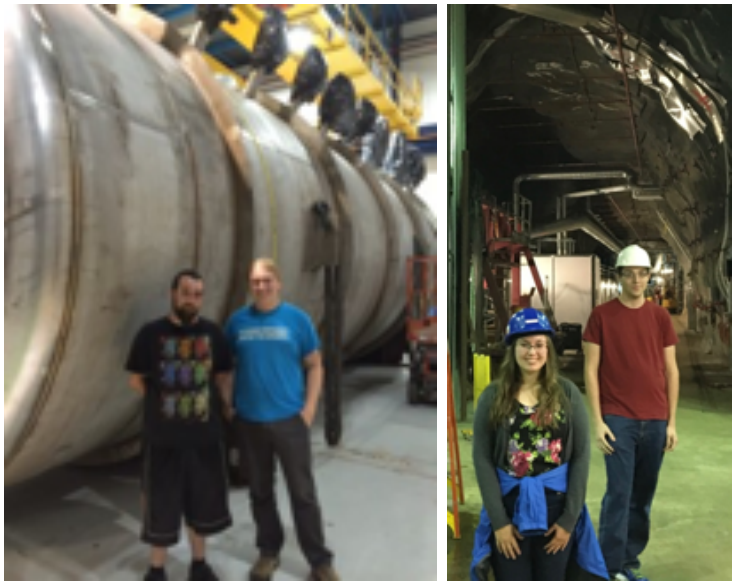


Figure 6.7: Neutrino research: (L) Peter Watkins '17 and Phillip Kellogg '15 visit the Minerva detector at Fermilab, 2014; (R) Heather Tanner '20 and Brad Goff '19 at MicroBoone, 2018.

secutive years (2015-2019) in which physics Honors students won an annual award for best thesis.

In other grant-related activities, Robertson took over for Sell on the S-STEM and Operation Physics grants after Sell's departure. Both of these grants were renewed with Robertson as co-PI, S-STEM in 2013 ($629,133 awarded) and Operation Physics continuously each year through 2018 (awards averaging slightly over $100,000 per year for a grand total of roughly $850,000). As mentioned previously, Tagg maintained continuous research support from NSF up until 2021.

In total, over a roughly 15 year period up until 2020, Physics faculty members were PIs or co-PIs on external grants totaling about $2.8 million.[9]

[9]This does not include a third NSF S-STEM grant (total award $1M), on which Trittmann was co-PI and which was awarded in Fall 2020. A further $1M grant for student

Figure 6.8: Operation Physics in full swing: (Top) Investigating Newton's Second Law on the go-kart; (Middle) Golf ball trebuchets; and (Bottom) Robertson rides the leaf-blower hovercraft.

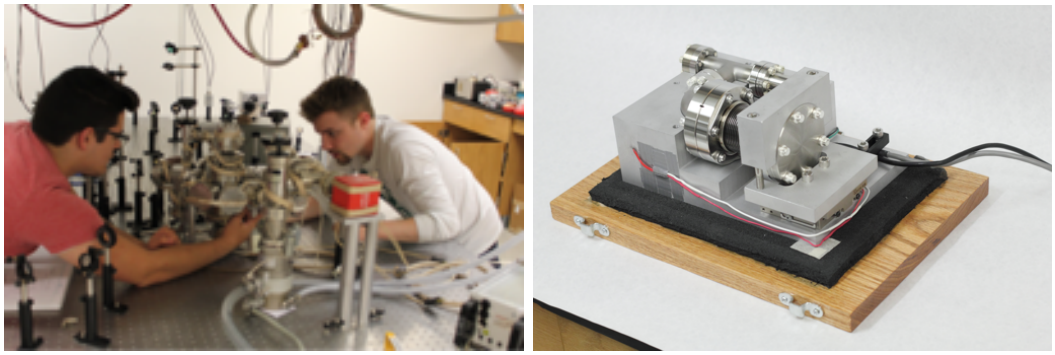


Figure 6.9: AMO research: (L) Michael Highman '17 and Keegan Orr '18 working in the lab, 2016; (R) Fabry-Pérot interferometer for laser tuning designed and built by Orr and Reinhard, 2018.

Tagg also shared the 2016 Breakthrough Prize in Fundamental Physics as part of the Sudbury Neutrino Observatory experiment, on which he worked as a graduate student. This experiment was recognized with the 2015 Nobel Prize for Physics along with the Super-Kamiokande experiment.

In February 2016 the Department hosted another Nobel laureate, William D. Phillips, as part of the Science Lecture Series ("Time, Einstein, and the Coldest Stuff in the Universe"). The 2011 SLS organized by Physics ("The Beating Heart of the Galaxy") featured astronomer Andrea Ghez of UCLA, winner of numerous awards including a MacArthur Fellowship.[10]

Regarding service, starting in early 2013 the Department became involved in discussions about creating a program in Systems Engineering at Otterbein. This idea arose from a proposal of Gary Maul, Professor Emeritus of Engineering at OSU, which he had presented informally to President Krendl. A working

scholarships, Choose Ohio First, was awarded by the state of Ohio in spring 2021. Robertson was a co-PI on this grant.

[10]Ghez would later share the 2020 Nobel Prize in Physics, for the work she talked about at Otterbein.

Figure 6.10: Science Lecture Series 2016. L to R: Robertson, Reinhard, Phillips, Tagg, Trittmann.

group was convened consisting of Robertson, Reinhard, and Maul, and in the summer of 2013 they developed a full curriculum as well as cost estimates, facilities plans, and other materials. The curriculum was innovative, involving a blend of mechanical, electrical, and industrial engineering, and geared to leverage Otterbein's focus on integration and inter-disciplinarity. Robertson and Reinhard shepherded the proposal through the university governance system that fall. It was passed by the University Senate in November 2013, and Reinhard was named interim Director (in only his second year at Otterbein!). He led a press conference announcing the new program on February 6, 2014, at TechColumbus.

Later that spring, Gary Maul was hired as Chair of Engineering, and the program accepted its first cohort of students in fall 2015. Robertson continued

Figure 6.11: Aaron Reinhard announces the new program in Systems Engineering, with President Krendl looking on.

to work on this program through 2018, serving on search committees for faculty and later directors, helping determine scholarship requirements for tenure and promotion, etc.

In 2014, after the department's most recent Long Range Review, the university finally committed to renovating the Weitkamp Observatory. This had been left out of the 2007-09 Science Center project, as a cost savings measure. By 2017 a new shed had been constructed, capable of housing two telescopes, although the second mount was not installed. At that point the project faltered due to a lack of leadership and funds, so the deck and planetarium remain untouched to the present day.[11] In 2018, a donor offer to renovate the Planetarium was completely ignored by the O ce of Advancement.

[11] In 2015, during the "Where We Stand Matters" campaign for Otterbein, a student put their leg though the rotting deck, sustaining a minor injury. (Really, you can't make this stuff up.) Minor repairs to the worst parts of the deck were performed at that time, but it remains dilapidated and dangerous, with nails regularly pulled up by the flexing of the weakened boards.

Figure 6.12: In 2017 a group of students led by Profs. Robertson and Trittmann from Physics, and Hal Lescinsky from Biology and Earth Science, trekked to White House, TN to observe the total solar eclipse on August 21. On the way down they also explored Mammoth Cave (Lescinsky is a geologist) and camped in Kentucky with dark sky observing.

Robertson stepped down as Chair of Physics after 10 years in 2015, and was succeeded in the position by Tagg. Robertson became Director of Undergraduate Research and Creative Work, a position he held from 2015-19.

Figure 6.13: Polaroid photos of students and faculty on the Advanced Lab fridge, taken by Jiyu Li '19.

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