

Daniel Kirkwood

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Kirkwood Avenue, Kirkwood Hall and Kirkwood Observatory are visible memorials to Daniel Kirkwood. He must have been an important person to merit such recognition, but very few people today know why he was important. This symposium gives me an opportunity to do something to revive public appreciation for this man.

This talk will have four major parts: 1) Indiana University prior to Kirkwood's arrival, 2) Chronology of Kirkwood's life, 3) Daniel Kirkwood at Indiana University and his work as a scientist, and 4) Daniel Kirkwood and the Indiana Academy of Science.

I.U. had three faculty members after Andrew Wylie became President in 1829, and one of them offered instruction in Astronomy. Daniel Kirkwood was 15 years old at this time. The faculty had grown to about half a dozen by the time Kirkwood arrived and numbered about a dozen when he retired. Astronomy was listed in the course of instruction as a Senior Year Course in both the Regular and Scientific Courses in 1856. In 1880 it was listed in all three curricula: Ancient Classics, Modern Classics, and Science.

Daniel Kirkwood was six years old when the Indiana State Seminary was founded in 1820. He was 42 years old when he joined the I.U. faculty in 1856. *Table I* gives selected dates and events in his life. His first U.S. demonstration of the Foucault Pendulum in 1851 only a few months after it was demonstrated in Paris is an example of his pioneering spirit, inquiring mind, and knowledge of contemporary science in Europe. The honorary degree from the University of Pennsylvania a year later recognized this. He was Professor of Mathematics and Astronomy at Delaware College, and also its President, when he was called to Indiana University in 1856. He served under five I.U. Presidents and retired in 1886 at the age of 72. Kirkwood Hall was dedicated a year before he died in 1895 at the age of 81. The Kirkwood Observatory was dedicated five years after his death.

TABLE I. DANIEL KIRKWOOD

1814,	Sept. 27 Born in Harford Co., Maryland.
1820	INDIANA STATE SEMINARY founded.
1829	Andrew Wylie became the first President of INDIANA COLLEGE.
1833	Took charge of a country school at Hopewell, York County, Pennsylvania.
1834	Entered York County Academy, York, Pa.
1838	"First assistant and mathematical instructor", York County Academy.
1838	Name changed to INDIANA UNIVERSITY.
1843-48	Principal, Lancaster City High School
1848	Teacher and Principal at Pottsville Academy.
1849	M.A. from Washington College.
1851	Andrew Wylie died.
1851	Foucault Pendulum, Pantheon, Paris.
1851,	May 15 & June 7 Kirkwood gave first public demonstration of Foucault Pendulum in U.S. at Schuylkill Haven, Pa. Repeated June 14 at Pottsville Court House.
1851	Elected a Member of the American Philosophical Society, Philadelphia. Member, A.A.A.S
1851	Professor of Mathematics, Delaware College.
1852	LL. D. from Univ. of Pennsylvania.
1854-56	President of Delaware College.
1856-86	Professor of Mathematics, Indiana University (at Washington and Jefferson College 1866-67).

TABLE I—(continued)

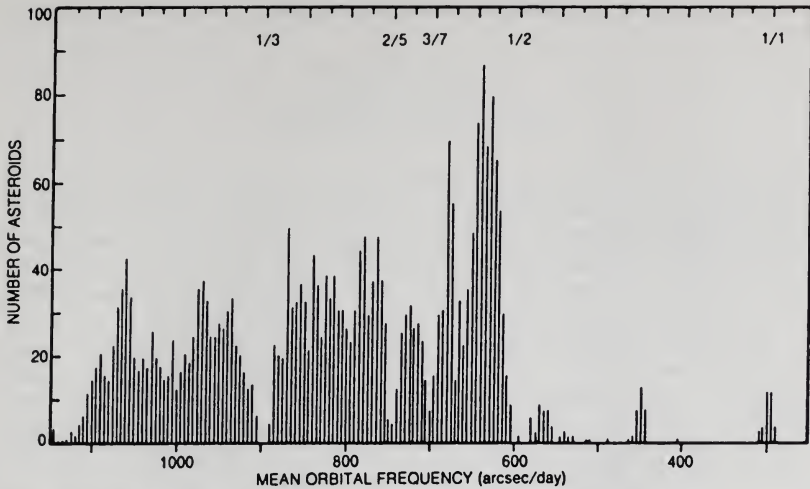
<i>Indiana University Presidents</i>	
1853-58	William M. Daily
1859-60	John H. Lathrop
1860-75	Cyrus Nutt
1875-84	Lemuel Moss
1885-91	David Starr Jordan (Prof. of Biology 1879-85).
1889	Moved to Riverside, California to live with a nephew. At opening of Stanford University he was appointed Non-resident Lecturer in Astronomy.
1894	Kirkwood Hall was erected.
1895	Died. Buried in Rose Hill Cemetery, Bloomington. His wife and daughter are also buried there.

Elisha Ballantine had been appointed Professor of Mathematics in 1854. He was transferred to the Professorship of Languages in 1856, and Daniel Kirkwood was elected Professor of Mathematics by the Trustees by a vote of 5 to 2 on Sept. 5th. He was not able to arrive in Bloomington for the opening of classes and a Faculty meeting on September 26. Henry W. Ballantine was appointed to fill the vacancy until his arrival. He was presented to the Faculty at a Faculty Meeting on October 31st.

Kirkwood was a teacher-researcher in the tradition of the present day. As a teacher and person he was beloved by students and townspeople alike. Two quotations from a biographical sketch in the *American Mathematical Monthly* for May 1894 illustrate this. "The admiration, almost reverence they have for him is admirably illustrated in this statement made by one of his students years ago, "When I die I want to go where Dr. Kirkwood goes." "The writer well remembers his first visit to Bloomington. He went into a barber shop . . . By chance the conversation turned to men. Every man present found his ideal in Daniel Kirkwood. No man ever received a higher tribute of praise." As a research scientist he was the first I.U. faculty member to achieve a significant international reputation. Two other quotations from the above mentioned article illustrate this. "Proctor was making a lecture tour of the United States, he lectured in Indianapolis. After the lecture he was approached by a delegation from Greencastle requesting him to lecture there the next evening. He said, "no I cannot do so. I came from England to America to see Daniel Kirkwood. Tomorrow is my opportunity and I am going to Bloomington to see him." "His is truly a great name in science, with a world wide renown." So wrote Professor P. Piazzi Smyth, Astronomer Royal for Scotland in 1885. He who knows Dr. Kirkwood either personally or through his contributions to science, gladly gives assent to the Astronomer Royal's eulogy."

His bibliography lists 109 publications, including three books. One of the books and 25 articles were published after he retired in 1886 at the age of 72. His last paper was published when he was 79, two years before he died. His publications reflect his strong interest in comets, meteors, and asteroids. Five years after he came to I.U. he suggested that periodic meteors are the debris of disintegrated comets, an idea that is universally accepted today.

Daniel Kirkwood's scientific immortality comes from his discovery of the gaps in the distances of asteroids from the sun corresponding to periods of $\frac{1}{2}$, $\frac{1}{3}$, etc. of the period of Jupiter. This was a major, basic discovery, and the "Kirkwood Gaps" are frequently referred to by that name in textbooks and in present day asteroid research literature (i.e. *Physics Today*, Sept. 1985, p. 17-20). Only four asteroids had been discovered at the time of Kirkwood's birth, and 42 had been discovered by the time he came to I.U. His discovery of the "Kirkwood Gaps" (Figure 1) was based on the data for the first 50 asteroids. His book "The Asteroids" was published in 1888, two years after he retired.



Kirkwood gaps are clearly seen in this distribution of orbital frequencies for several thousand cataloged asteroids in the asteroid belt. The fractions above the histogram indicate frequencies that correspond to simple fractions of Jupiter's 11.9 year orbital period. These commensurable periods are clearly depopulated by some sort of resonant interaction with Jupiter. The prominent "3/1 Kirkwood gap," for example, is labeled $\frac{1}{3}$ here to indicate that its orbital period is $\frac{1}{3}$ that of Jupiter.

FIGURE 1. Kirkwood Gaps (used by permission from *PHYSICS TODAY* / September 1985, page. 17.

Daniel Kirkwood was one of the 71 Charter Members of the Indiana Academy of Science. His name is one of nine listed in the Dedication and Foreword of the "History of the Indiana Academy of Sciences 1885-1984" as those "without whose enthusiastic support the endeavor would have failed." He retired the year after the founding of the Academy, but remained in Bloomington for another three years before moving to California. He was the first to be given the status of Honorary Member. "There were giants in those days" and Daniel Kirkwood was a "giant among giants."

