

Microbiology Milestone: Herbert W. Conn, Lifetime Achievements

A keen observer, moralist, and humanist, Conn focused on dairy microbiology but also cared about broader issues of public health

Kenneth M. Noll, Maria L. Marco, and Bruce J. Cochrane

ASM honored microbiologist Herbert W. Conn (1859–1917) last year, designating the University of Connecticut its 8th Milestones in Microbiology site. The October 2013 dedication ceremony included a symposium highlighting Conn's many achievements in microbiology research and teaching, while also recognizing his many contributions to ASM, including his role as a cofounder and, later in 1902, as a president of the Society of American Bacteriologists (SAB), the forerunner of ASM.

Before the ceremony, the Honorable Dannel P. Malloy, Governor of Connecticut, issued an official statement recognizing Conn and the new ASM Milestones site (Fig. 1). During the ceremony, Stanley Maloy of San Diego State University, a past President of ASM, presented the commemorative ASM Milestones plaque to Provost Mun Choi, who accepted it on behalf of the University of Connecticut (UConn) and the wider university community. The Milestones plaque is now prominently displayed near where Conn once worked on the UConn campus.

Ceremony Honors Conn

Speakers at the October ceremony as well as posters and collections of Conn books that were displayed by the Department of Molecular and Cell Biology (MCB) provided overviews of Conn's life and works. Also featured was a version of Mark Twain's satirical short story from that era, "3,000 Years Among the Microbes," which refers directly to Conn.

Among those participating in the ceremony were several descendants of Herbert Conn, including Bruce Cochrane and Berta Jo Bolick. Cochrane, Conn's great-grandson, is a biology professor at Miami University of Ohio. He spoke

about Conn and his son, Harold J. Conn, basing some of his remarks on materials that Harold had gathered as part of a biography of his father, "A Religious Scientist at the Turn of the Century, Herbert William Conn of Wesleyan University." Harold J. Conn, also a distinguished microbiologist, served as president of SAB in 1948.

Bolick is a great-granddaughter of Herbert Conn through his daughter, Bertha. Bertha's daughters Bettina Greaves, Phyllida Walker, and Julia Conn generously donated Conn's Seibert compound microscope to UConn. The microscope, displayed during the ceremony (Fig. 2), is now on permanent display in the MCB, home of the Microbiology program that Conn founded.

The symposium portion of the ceremony, "H. W. Conn's Golden Age of Bacteriology becomes the New Golden Age of Microbial Biology," featured presentations by microbiologists familiar with his many contributions to microbiology and to society, and also of later developments that he helped to inspire. Those speakers included Maria Marco, of the University of California, Davis; Frederick Cohan of nearby Wesleyan University;

SUMMARY

- In designating the University of Connecticut its eighth Milestones in Microbiology site in 2013, ASM honored the microbiologist Herbert W. Conn (1859–1917).
- Conn's world view was one shaped by the piety of New England Protestantism, but tempered by introspection.
- Although Conn's first publications about bacteriology were about the slow acceptance of germ theory by medical schools, his major contributions were in dairy bacteriology, including ideas that led to current interest in probiotics.
- Other members of Conn's family contributed to the development of microbiology, including his son Harold, who also served as a president of the Society of American Bacteriologists, as well as Harold's daughter Jean.

FIGURE 1



Reading the Official Statement from the Governor of Connecticut, the Honorable Dannel P. Malloy, honoring and recognizing Professor William H. Conn and the ASM Milestones in Microbiology designation for the University of Connecticut at the Milestones dedication ceremony. Left to right: front, Bruce Cochrane, Kenneth Noll, Berta Jo Bolick, Allen Bolick; rear, James A. Poupard, Chair, Center for the History of Microbiology/ASM Archives, Mun Choi, Provost and Executive Vice President for Academic Affairs, University of Connecticut, and Stanley Maloy, Dean, College of Sciences, San Diego State University, former ASM President.

Joseph Petrosino of Baylor College of Medicine; and Kenneth Noll of UConn (Fig. 3).

Conn: Considerate Teacher and “Religious” Scientist

In his 1948 SAB presidential address, Harold J. Conn described his father’s role during the early years of the SAB, drawing on his own recollections and on his father’s unpublished diaries and autobiographical materials. Those accounts are notable, demonstrating his prodigious memory while also documenting the importance of religion in his upbringing and revealing the serious health problems that he faced early in his life and that kept him from attending school and enjoying the social world of young children. They also describe his love of the outdoors.

Harold Conn divided his father’s career into three segments. The first was as a teacher of evolution and biology. The second traces back to his studies in biology at Johns Hopkins University with Theobald Smith, experiences that helped to kindle his later interest in microbiology. During the third, from the beginning of the 20th century,

he turned more of his attentions to issues of public health, both as a researcher and, perhaps more importantly, as a public scientist.

Conn’s successes in adulthood are rooted in his childhood experiences. He was a keen observer of his surroundings, manifested later in his exquisite, detailed sketches of marine invertebrates dating to his years at Johns Hopkins (Fig. 4). A summer spent working on a farm led to his later focus on agricultural microbiology. “The caring for and the milking of the cows, the handling of the milk, the making of the butter and even the making of the cheese became to me actualities and have remained such through the years,” he wrote. Additionally, health problems during his childhood, combined with his strong memories of health problems that others had faced, contributed to his interest in public health.

However, no portrait of Conn would be complete without a consideration of morality and

FIGURE 2



Herbert Conn’s Seibert compound microscope with lenses generously donated to UConn by his granddaughters Bettina Greaves, Phyllida Walker, and Julia Conn. Professor Conn is shown in the background photo.

FIGURE 3



Speakers at the Milestones symposium. Left to right, Kenneth Noll, Maria Marco, Frederick Cohan, and Joseph Petrosino. Marco and Petrosino are ASM Distinguished Lecturers.

religion in his life. He grew up in an atmosphere of stern New England Protestantism. “I still feel a little of the oppression that I experienced in that strict New England home, where amusement was hardly tolerated and the reading of a story was deprecated at any time and quite forbidden on a Sunday,” he noted later in life.

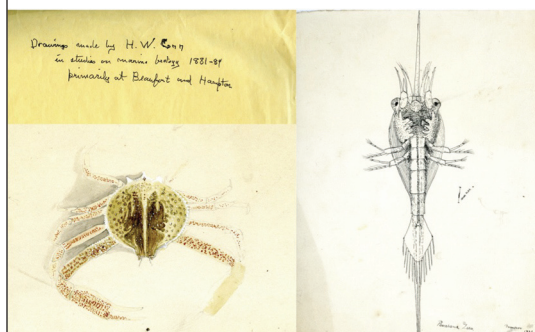
Conn wrote much about his formal religious experiences, including how his worldview was affected by the lives of his childhood peers. Two examples stand out, the first involving Charles Hayden, a childhood acquaintance. Hayden, who went to college with plans to become a preacher, later was arrested for but subsequently acquitted of poisoning his parents and sister in 1879. Of Hayden, Conn wrote: “Whatever may have been the real cause, the course to destruction was a rapid one. He has over and over come to my mind . . . A ruined life it was, and the road to the ruin led through just the little evils that the young man is so apt to think and the many vices [that] are giving him freedom from the rigid life of what he feels was a too-puritanical home.”

Yet, Conn also appreciated the positive side of humanity. He described an awkward young man who was asked to speak at school. “I have been thinking over the subject of evolution,” Conn wrote, recapitulating part of the young man’s speech. “Now I don’t believe in evolution. But I have been thinking that Mr. Darwin has been spending his life studying just this subject. And it seems to me that he probably knows more about it than I do, and if he says it is true, I had better not say much about it until I know as much as he does on the subject.”

These and other examples provide a flavor of Conn’s world view, one shaped by the piety of New England Protestantism, but tempered by introspection. We see its impact in his book, *Social Heredity and Social Evolution* (1914), his last effort to reconcile science and religion. In it, he separates the development of “virtue,” something he viewed as unique to humans, from biological evolution, of which *Homo sapiens* is a physical product like any other species. One could speculate that, were he alive today, Conn would have little affection for evolutionary psychology. For him, the development of humans as moral individuals lay completely outside the realm of evolution.

Conn taught Sunday school and wrote articles about science and religion for the *Methodist Review*. In “Natural Selection and Christianity” (1891), he argued that, in forming tribes, prehistoric humans were subjected to selective forces acting on the group rather than the individual, and that the members of these groups were then selected for intellectual rather than physical abilities. When Jesus told people to love one another, the “selective force,” from a religious standpoint favored individuals who used peaceful means to coexist, and this “force” is unique to man, Conn wrote. In this manner, he addressed the questions of group selection and altruism, questions that continue today. Conn’s article was respectful to

FIGURE 4



Sketches of marine invertebrates made by Herbert Conn while a graduate student at Johns Hopkins assisting his advisor, W. K. Brooks at the Chesapeake Zoological Laboratory summer program. Left panel: unidentified crab species, Hampton, Va., 1883. Right panel: member of the crustacean genus *Zoea*, Beaufort, N.C., 1882.

those of religious faith, an approach that might warrant reconsideration when discussing evolution today.

Conn: Dairy Science Emphasis in Bacteriology

Although Conn's first publications about bacteriology were about the slow acceptance of germ theory by medical schools, his major contributions were in dairy bacteriology. In 1888 he joined the recently established Storrs Agricultural School Experimental Station. "Under the direction of Dr. H. W. Conn, Professor of biology at Wesleyan University, an investigation of the microorganisms that have to do with fermentation and other changes that take place in milk and during the ripening of cream, has been undertaken," noted the Station's Annual Report. He was paid \$50 for "labor" that year. He worked there for the next 19 years, publishing more than 50 reports about dairy bacteriology. Among his three presentations at the first meeting of the SAB in December 1899 was a talk entitled "Certain Practical Applications of Bacteriology in Dairying."

Conn's main research focus was the bacteriology of butter manufacture, particularly the complexity of the microbial ecosystem involved in cream ripening. That complexity was necessary to give butter its particular flavors. Americans then favored strongly flavored butters, which were produced locally and therefore highly variable in quality.

To provide a more consistent product, Conn sought to identify bacteria that could be added to cream to reproducibly produce consistently good flavors. When he hosted the dairy bacteriology exhibit at the 1893 Chicago World's Fair, a shipment of butter from Uruguay was found to have a particularly pleasant taste. He isolated a bacillus from this butter, called *Bacillus* No. 41, that was later commercialized by the Conn Butter Culture Company. Although this product was aggressively marketed, it did not catch on with American dairymen and was widely criticized. That foray into commercial enterprise proved embarrassing but did not tarnish his reputation as a scientist.

Conn's investigations on milk and its fermentation products led him to study both beneficial and detrimental microorganisms affecting these and other foods. Of course, he appreciated the strain-specific attributes of bacteria involved in

the ripening of butter. However, during this period, other microbiologists were identifying starter cultures to better control beer and bread fermentations. Much later, genetic and biochemical comparisons among the *Lactococcus* and *Lactobacillus* strains and species essential for dairy fermentations revealed more of the remarkable genetic and phenotypic diversity that accounts for the variations found in Conn's butter products. Investigations of dairy-associated lactic acid bacteria also continue to provide basic knowledge on the cellular pathways resulting in those transformations of milk and have also served as model organisms for investigating concepts in microbial evolution and ecology.

With their focus on dairy-associated bacteria, Conn and his contemporaries fostered not only dairy microbiology, but also the study of intestinal microbiology. In 1908, Russian microbiologist and later Nobel Laureate Elie Metchnikoff published his hypothesis that bacteria in yogurt promote human health and longevity. The term "probiotic" originated with Metchnikoff's ideas about beneficial bacteria, and renewed activity in this area of research now holds promise to promote health and prevent disease.

The microbial digestion of lactose in milk is one benefit of dairy fermentations among lactose-intolerant populations. More broadly, probiotics may provide health benefits not only in terms of the digestive system but also systemically, and may include preventing antibiotic-associated diarrhea and also reducing the frequency and duration of respiratory infections.

Conn's Legacy

Other members of Conn's family also contributed greatly to the development of microbiology. In addition to serving as president of SAB, his son Harold was the driving force behind the Biological Stain Commission in the early 1920s. Jean Conn, Harold's daughter, was born on April 18, 1917, the day that Herbert died, a coincidence that affected the family deeply. Jean later pursued a career in microbiology and married Vincent Cochrane, author of *The Physiology of Fungi*, who was appointed Daniel B. Ayres Professor and Chair of the Department of Biology at Wesleyan University, the very department Herbert Conn founded and chaired almost a century earlier.

The evolving fields of dairy fermentations and probiotics and the public's growing awareness of

the importance of microbes to human and environmental health are milestone developments. Herbert Conn's accomplishments provided a foundation for these developments, and they are part of his large and lasting contribution to human welfare.

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More information on the Milestones in Microbiology Program, administered by the Center for the History of Microbiology ASM Archives (CHOMA), can be found at www.asm.org/milestones-in-microbiology or www.asm.org/choma.

Suggested Reading

- Conn, H. J.** A religious scientist at the turn of the century. Herbert William Conn of Wesleyan University. Wesleyan University Archives.
- Conn, H. J.** 1948. Professor Herbert William Conn and the founding of the society. *Bacteriol. Rev.* **12**:275–296.
- Erkus, O., V. C. de Jager, M. Spus, I. J. van Alen-Boerigter, I. M. van Rijswijck, L. Hazelwood, P. W. Janssen, S. A. van Hijum, M. Kleerebezem, and E. J. Smid.** 2013. Multifactorial diversity sustains microbial community stability. *ISME J.* **7**:2126–2136.
- Leisner, J. J.** 2005. Weeds, heat and pure cultures—on the differential success of new technologies in the Danish and American creamery industries in the 1890s. *Food Policy* **30**:419–433.
- Marco, M. L., and S. Tachon.** 2013. Environmental factors influencing the efficacy of probiotic bacteria. *Curr. Opin. Biotechnol.* **24**:207–213.
- Marco, M. L., and M. H. J. Wells-Bennik.** 2008. Impact of bacterial genomics on determining quality and safety in the dairy production chain. *Int. Dairy J.* **18**:486–495.
- Sanders, M. E., F. Guarner, R. Guerrant, P. R. Holt, E. M. Quigley, R. B. Sartor, P. M. Sherman, and E. A. Mayer.** 2013. An update on the use and investigation of probiotics in health and disease. *Gut* **62**:787–796.