

Notes from the Oesper Collections

Stanley Rossiter Benedict

William B. Jensen

*Department of Chemistry, University of Cincinnati
Cincinnati, OH 53706*

Stanley Rossiter Benedict (figure 1) was born on 17 March 1884 in Cincinnati Ohio, the fifth of six children born to Wayland Richardson Benedict and Anne Kendrick Benedict (1). The elder Benedict (figure 2), after graduation from the University of Rochester in 1865, had served as the principal of several secondary schools in the east before entering and graduating from the Rochester Theological Seminary in 1871. Two years later he was appointed minister of the Mount Auburn Baptist Church in Cincinnati, followed in 1875 by his appointment as the first Professor of Philosophy and Psychology at the newly organized University of Cincinnati, where he remained until his retirement in 1907 (2).

Professor Benedict's job at the University not only entailed teaching the two subjects listed in his title, but also courses in logic, ethics, history, political economy, the history of education, and the Bible (3). Indeed, the latter course, as well as both his former occupation and the titles of several of his published books (4), strongly suggest that he was careful to impose a proper Chris-

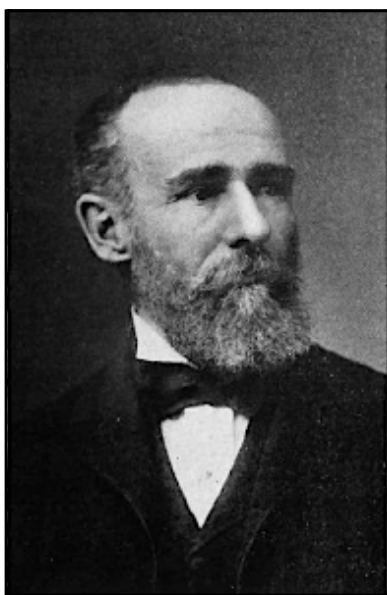


Figure 2. Professor Wayland Richardson Benedict (1846-1915)



Figure 1. Stanley Rossiter Benedict (1884-1936)

tian interpretation on his subject matter. This approach became an issue in 1881 as part of a confrontation between Benedict and the University Rector, Thomas Vickers. Described by the student newspaper as “a German infidel and scoffer at things religious,” Vickers was accused of harboring a “very pronounced” hatred of Professor Benedict (3):

The indignities – nay the open insults – to which Professor Benedict has been subjected are topics of current remark among students. Professor Benedict is probably the most popular professor among the students. It may be that this fact only increases Mr. Vickers' dislike. Certain it is that he is always casting aspersions upon Professor Benedict, either directly or indirectly, and endeavors in every way to undermine his popularity among the students.

The Vickers affair created a great deal of negative publicity for the new university but did not end in Vickers' dismissal. However, luckily for Benedict, Vickers would voluntarily resign three years later. If anything, the incident revealed that – contrary to public belief – a professor's lot is not always a happy one.

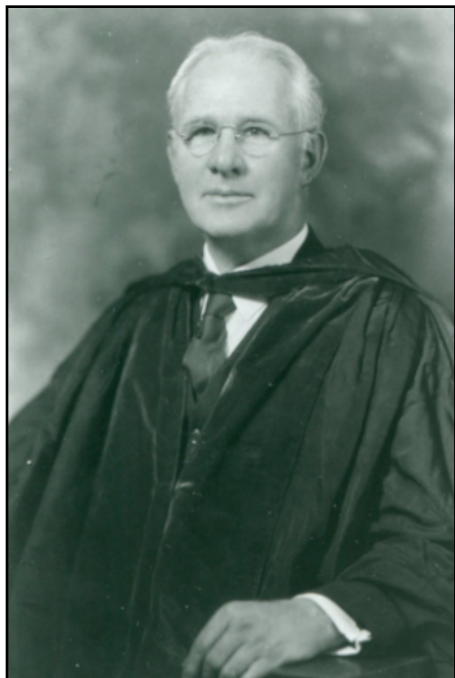


Figure 3. John Ferguson Snell
(1870-1953)

Like his siblings, young Stanley was educated in the public schools of Cincinnati and entered the University of Cincinnati in 1902. At the time the family was living in Clifton in a house on Brookline Avenue and thus within easy walking distance of the University (2). Benedict originally intended to study medicine and, with this goal in mind, he majored in biology, taking his A.B. in 1906, the year before his father's retirement. Unhappily no student yearbook was published that year so we have no graduation photo. Likewise, though the yearbook for his junior year lists him as a member of the "Blue Hydra Biology Club," he unfortunately failed to make an appearance for the club photograph.

Perhaps his absence is explained by other activities stemming from the fact that, soon after entering the University, he had come under the influence of a member of the UC chemistry faculty by the name of John Ferguson Snell (figure 3), who would play a decisive roll in changing the course of Benedict's life. A Canadian by birth, Snell was interested in the chemistry of nutrition and food – an interest which he shared with Benedict. After earning his B.S. at Toronto in 1894 and a Ph.D in physical chemistry from Cornell in 1898 under the guidance of Wilder D. Bancroft, Snell worked as a research assistant in nutritional chemistry

under W. O. Atwater at Wesleyan University. In 1901 he became an Instructor in Inorganic and Analytical Chemistry at the University of Cincinnati, where he remained until 1907, when he returned home to Canada to head the Department of Chemistry in the newly established Macdonald College of McGill University. There he combined his chemical interests with the national interest by specializing in the chemistry of maple syrup (5, 6).

Benedict's undergraduate association with Snell not only resulted in a shifting of his primary interest from medicine to the biochemistry of nutrition, but also introduced him to the subject of chemical analysis and exposed him to the experience of laboratory research. His first two scientific papers were published in collaboration with Snell while still a sophomore at Cincinnati. Both were entitled "A Method for the Estimation of Chlorides, Bromides, and Iodides," and both appeared in the *Journal of the American Chemical Society (JACS)* for 1903 (7).

Over the remaining three years of his undergraduate career, Benedict would publish at least eight more articles dealing with various aspects of the qualitative and quantitative analysis of ions in aqueous solution in both *JACS* and the *American Chemical Journal* – some coauthored with Snell and some by himself alone (8). All of these listed the Chemical Laboratory of the University of Cincinnati as his affiliation, save one on the effect of various ions on heart rate which was published in the *Journal of Physiology* and listed the UC Department of Biology instead. Indeed, during these



Figure 4. Lafayette Benedict Mendel
(1872-1935)

years Benedict's rate of publication exceeded that of the entire UC chemistry faculty.

Now thoroughly imbued with a passion for laboratory research, Benedict deserted his plans for medical school and instead entered the graduate program at Yale in the fall of 1906 in order to study physiological chemistry under Lafayette B. Mendel (figure 4) in the famous laboratory established by Russell H. Chittenden in 1882 (9). In his first year of graduate school he would publish three more papers, this time dealing with the chemical detection of reducing sugars rather than detection of the aqueous ions of conventional inorganic analysis that had occupied him during his undergraduate years at Cincinnati.

The clinical detection and estimation of sugar is, of course, of great importance in diagnosing and monitoring diabetes. In these papers Benedict attempted to improve upon the conventional test for sugar (figure 5) based on use of a copper tartrate complex in a sodium hydroxide solution first introduced by the German chemist, Hermann von Fehling, in 1849 (10). Two years later this interest would lead to his discovery of an alternative sugar test based on the use of a copper citrate complex dissolved in a mildly alkaline sodium carbonate solution, now universally known as *Benedict's Solution* (11). Whereas Fehling's original solution was unstable and had to be freshly prepared



Figure 5. An early 20th-century physician's office kit for testing urine for sugar using Fehling's solution (Jensen-Thomas Apparatus Collection). The two bottles on the left contained the dilute acids required to hydrolyze any sucrose present to glucose and fructose. The two bottles on the right, labelled Fehling's solution, contained the copper tartrate complex and the sodium hydroxide solution, respectively, that had to be freshly mixed before performing the actual test.



Figure 6. A circa 1928 Bock-Benedict colorimeter (Jensen-Thomas Apparatus Collection).

before each test, Benedict's alternative was stable and could be prepared and stored ahead of time.

In 1908, after only two years of graduate school, Benedict was granted a Ph.D. This was followed by one-year appointments at both Syracuse University and Columbia University. Finally, in 1910, at age 26, he was appointed Assistant Professor of Chemical Pathology at Cornell University Medical College in New York City, where he remained until his demise from a heart attack on 21 December 1936 at age 52. Though his career was cut short by his premature death, it must be remembered that he had begun publishing research papers at age 19 and, in the end, the final count would total almost 100 publications and result in his election to the National Academy of Sciences.

Though he would do research on the metabolism of carbohydrates, uric acid, phenols, creatine, creatinine, and cancer, Benedict is perhaps best remembered for his work in critically appraising and modifying various clinical tests for important metabolic products found in the blood and urine, of which his early work on refining Fehling's test for sugars was a prototype. Many of these tests were colorimetric in nature and had been proposed by the Harvard clinical chemist, Otto Folin, leading to a friendly competition between the two (12).

Not only did Benedict modify the chemistry of many of these tests, he also modified the apparatus,

leading to his invention in 1918 of an improved clinical colorimeter that both downsized and improved upon the conventional Duboscq colorimeter by replacing its expensive prism system, used to create a split optical field, with a simple system of 45° mirrors (13). A surviving example of Benedict's colorimeter is among the artifacts to be found in the Oesper Museum of Chemical Apparatus at the University of Cincinnati (figure 6).

Benedict was also an active member of the American Society of Biological Chemists, serving as its President for both 1919 and 1920 and as managing editor of its publication, *The Journal of Biological Chemistry*, from 1920 until his death. Much of his own research was also published in this journal (14).

References and Notes

1. For biographical background on Benedict see E. V. McCollum, "Stanley Rossiter Benedict, 1884-1936," *Nat. Acad. Sci. Biog. Mem.*, **1952**, 27, 155-177; C. J. Steinberg, "Stanley Rossiter Benedict" in W. D. Miles, *American Chemists and Chemical Engineers*, ACS: Washington, DC, 1976, pp. 21-22 and other references cited therein.

2. *The Cincinnati*, University of Cincinnati: Cincinnati, OH, 1895, p. 11, 1905, p. 165, 1907, p. 35.

3. R. C. McGrane, *The University of Cincinnati; A Success Story in Urban Education*, Harper & Row: New York, NY, 1963, pp. 74, 98, 99, 108.

4. The elder Benedict's books include *Theism and Evolution*, Houghton-Mifflin: New York, NY, 1886; *New Studies in the Beatitudes and the Lord's Prayer: Lectures*

Given at the University of Cincinnati during the Winter of 1893-1894, Earhart & Richerson: Cincinnati, OH 1894; and *World Views and their Ethical Implications*, University Press: Cincinnati, OH, 1902.

5. J. F. Snell, "Food Chemistry at Macdonald College, 1907-1936," Typewritten manuscript. Copy on file in the Oesper Collections.

6. Anon, "Fathers and Sons in Chemistry: The Snells – Two Johns and One Arthur," *Ind. Eng. Chem. News Ed.*, **1939**, 17(April 20), 243.

7. S. R. Benedict, J. F. Snell, "A Method for the Estimation of Chlorides, Bromides, and Iodides," *J. Am. Chem. Soc.*, **1903**, 25, 807-814; *Ibid.* 1138-1141.

8. Many of these papers are missing from the bibliography assembled by McCollum in reference 1.

9. R. H. Chittenden, *The Development of Physiological Chemistry in the United States*, Chemical Catalog Co: New York, NY, 1930.

10. H. Fehling, "Die quantitative Bestimmung von Zucker und Stärkmehl mittelst Kupfervitriol," *Ann. Chem. Pharm.*, **1849**, 72, 106-113.

11. S. R. Benedict, "A Reagent for Detection of Reducing Sugars," *J. Biol. Chem.*, **1909**, 5, 485-487.

12. For background on the impact of the colorimeter on physiological and clinical chemistry and the importance of Folin, see L. Rosenfeld, *Four Centuries of Clinical Chemistry*, Gordon & Beach: Amsterdam, 1999.

13. J. C. Bock, S. R. Benedict, "A New Form of Colorimeter," *J. Biol. Chem.*, **1918**, 25, 227-230.

14. R. H. Chittenden, *The First Twenty-five Years of the American Society of Biological Chemists*, Waverly Press: Baltimore, MD, 1945, pp. 68-69.