Cincinnati Chemists

IV. Thomas Herbert Norton (1851-1941)

William B. Jensen
University of Cincinnati

Thomas Herbert Norton (figure 1) was born on 30 June 1851 in the village of Rushford, NY, the son of Robert Norton and Julia Ann Horsford. Originally the proprietor of a cheese factory, the father decided in 1856 to become a minister and moved the family to Auburn, NY, in order to study at the local Theological Seminary. Following graduation the next year, the family moved first to Lockport, NY, and finally, in late 1860, to St. Catherines in Ontario, Canada, where the father became pastor of the local Presbyterian Church (1).

In later life Norton reported that he had first studied chemistry at the age of 12 under the guidance of his father, though he apparently didn't decide to pursue it as a career until later. Following a brief flirtation with the military, during which he enlisted in the Canadian Voluntary Militia in response to an adolescent infatuation with the American Civil War, and a year as a reporter and editor for a local newspaper, Norton entered Hamilton College in 1869, graduating four years later as class valedictorian and holder of the Phi Beta Kappa Key.

Figure 1. Thomas Herbert Norton (1851-1941).

Graduate and Postgraduate Study in Europe

Having finally decided on a career as a chemist, Norton departed for Europe in the summer of 1873 to pursue graduate work in chemistry under Robert Bunsen at the University of Heidelberg, though he first stopped in Scotland, as he later wrote, in order to "assuage" his romantic tastes "by reading all of the longer poems of Scott and some of his novels amid the scenes where the action was laid" – a yearning which, needless to say, is difficult for the 20th-century mind to comprehend (2).

At least three mementos of Norton's two-year stay at Heidelberg are still in the Oesper Collections at the University of Cincinnati. These include the textbook which he used (the 1869 edition of Adolf Strecker's *Kurzes Lehrbuch der anorganischen Chemie*), a carefully bound set of handwritten notes for Bunsen's introductory lectures on "Experimental Chemistry," and a set of framed photographs of Norton's Ph.D. committee, which consisted of Robert Bunsen and Hermann Kopp in chemistry, Gustav Kirchhoff in physics, and Johann Blum in mineralogy. On 4 March 1875 this committee granted Norton a Ph.D. *summa cum laude* (3).

Following graduation, Norton pursued postdoctoral work under August Hofmann at Berlin (1875-1876), where he was an Assistant, and under Adolphe Wurtz at Paris (1876-1877), acting at the same time as a foreign correspondent for the British weekly journals *Nature* and *The Chemical News*. During his summers, he also continued his "romantic" wandering through Europe and Asia, later claiming to have walked more than 12,000 miles and to have been the first to demonstrate "the feasibility of traveling on foot alone over Greece and Palestine," or – to put it in more characteristic Nortonese – to be the first "Occidental to essay pedestrianism in Peloponnesus."

In 1878 Norton accepted a position as chemist, and later as plant manager, with the *Compagnie Generale des Cyanures* at St. Denis near Paris, where he was involved in developing methods for the synthesis of thiocyanates and their conversion into ferrocya-

nides. Finally, in 1883, after nearly a decade in Europe, he returned to the United States to accept the Chair in Chemistry at the University of Cincinnati, which had been suddenly vacated by its first occupant, Frank Wigglesworth Clarke, and to marry his fiancee of many years, Edith Eliza Ames.

Professorship at Cincinnati

The University of Cincinnati had been in active operation for little more than nine years when Norton arrived with his new bride and set up house at 41 Albion Place in Mount Auburn. It had a student population of only 89 undergraduates and five graduate students and was housed in a single red-brick building located on the old Charles McMicken Estate on the side of the Vine Street Hill (figure 2). However, despite its small

Figure 2. A colorized postcard showing the original University building on Vine Street hill and giving a clear view of the windows to the chemistry laboratory in the basement.

size, the Department of Chemistry, under Norton's predecessor, Frank Wigglesworth Clarke, had already produced more than 91 publications, eight B.S. degrees and one M.S. degree in chemistry, and could boast of a 38-student laboratory located in the basement of the University building (4). Two years after Norton's arrival this laboratory caught fire, nearly destroying the entire building (figure 3), and Norton had to design a

Figure 3. A photograph of the original University building taken from the same angle as figure 2, showing the building after the laboratory fire of November 1885.

new facility. This was located in the attic rather than the basement of the newly renovated University building (figure 4) – apparently on the theory that any future fires or explosions would endanger only the top of the building instead of the entire structure – and could accommodate 60 students or nearly a third more that of the original (5).

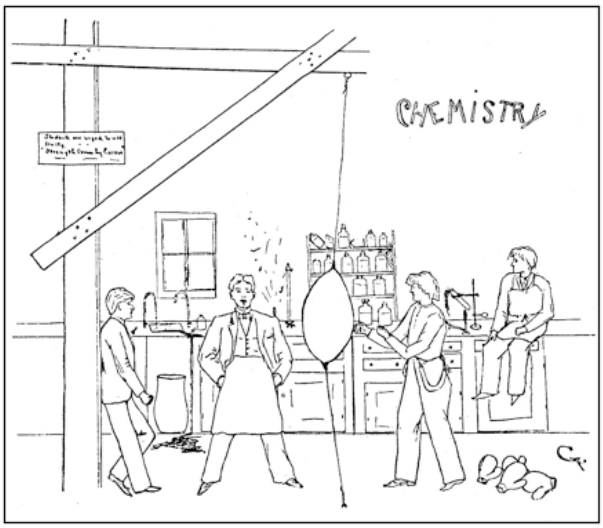


Figure 4. A student drawing of 1895 showing the temporary laboratory accommodations in the attic of the original University building (Note the attic beams and the small window).

Figure 5. The architect's drawing of the new university buildings in Burnet Wood, circa 1896. The central building is the original McMicken Hall, the extension on the right is Cunningham Hall, and that on the left is Hanna Hall, with Hanna Annex just visible behind it.

This incident did not end Norton's involvement in laboratory construction as the University's move from the McMicken Estate to its current location in Burnet Woods during the years 1895-1896 required that he design yet a second laboratory (figures 5-8), this one occupying the first and basement floors of Hanna Hall and all of Hanna Annex (33). This original version of Hanna Hall was torn down in 1949 to make room for the present structure. However, Hanna Annex, now renamed the Basic Science Building, is still standing, though it is scheduled to be torn down this year upon completion of the new Geology-Physics complex (6).

Apparently the fire of 1885 had destroyed so much of the department's chemical apparatus that Norton had very little to take with him to the new location, as indicated by the fact that the total bill for the move to Hanna Hall was only $9.30 (34). This initial scarcity of

Figure 6. Hanna Hall (right) and the Hanna Chemical Laboratory Annex (left) viewed from the north. Chemistry was located in these building from 1896-1916 in facilities designed by Norton.

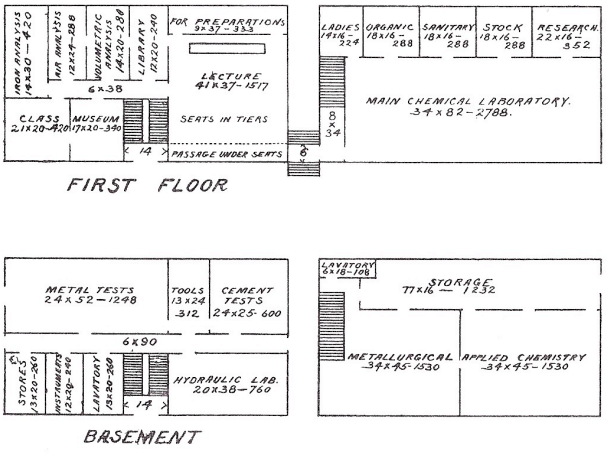


Figure 7. Floor plans to Hanna Hall and the Hanna Chemical Laboratory Annex. North corresponds to the top of the diagram.

resources was also commented upon by John Uri Lloyd many years later (34):

At that time I was very close to Norton. I knew what he was struggling to accomplish, and time and time again spent afternoons and Sundays at his home when the new chemical department was being planned. I comprehend what he and Mrs. Norton did to found that department. Together they made charts for atomic and molecular weights, Together they worked on models to exhibit problems in stereochemistry. In other ways Mrs. Norton helped, preparing demonstration maps for chemical lectures explanatory of experiments. Professor Norton and his assistants had little in the way of

Figure 8. A typical UC Freshman working in the new general chemistry laboratory in Hanna Annex.

apparatus, but with that little and what they added, they did their work well.

Indeed, Norton is reported to have been so overwhelmed by the vast amounts of space he had suddenly acquired that he actually despaired of ever being able to fill it. However, so rapid was the growth of the University from this point on, that by 1910 – just 14 years after the building of Hanna Hall – there would be serious talk of the necessity of building yet another chemistry building.

During his first five years at Cincinnati, Norton carried full responsibility for the entire chemistry program. However, from 1888 on, he was given an assistant, a position held by a variety of persons, usually for periods of one to two years. Norton also revised the curriculum to reflect his interest in industrial chemistry. This was done by dropping most of the advanced courses introduced by Clarke, by devoting most of the second year course in quantitative analysis to the analysis of commercial and industrial products, and by extending the chemical technology course so that it occupied most of the third year. According to the catalog, this last course was specifically designed to prepare students "for positions in dyeing, bleaching, sugar-refining and similar establishments and chemical works." It featured exhibits of actual products, the study of miniaturized production processes, field trips "to the leading chemical works of Cincinnati, and occasional lectures delivered to the class by industrial chemists on their special branches" (7). In short, the program was specifically tailored to meet the needs of local chemical industry, and between 1883 and Norton's departure in 1900, it produced 24 B.S. and three M.S. degrees in chemistry.

Despite his 17 years of service to the University, Norton's departure in 1900 was not a happy one. For most of his stay the University had been without a President, the leadership rotating instead among the various departments and faculty. The resulting abuses and "lack of cohesion and discipline" had become so great by 1899 that the Board of Trustees felt compelled to appoint a President based on an external search in the person of Howard Ayers. After first determining that it was impossible to get many of the faculty to even talk with one another, let alone function as a single organization, Ayers requested the resignation of nine faculty members (75% of the tenured faculty in Academic Department), including Norton. All but Norton refused and had to be removed through forced retirement or abolishment of their chairs (8).

Norton's willingness to accommodate Ayers was due to the fact that he had just been appointed as U.S. Consul to Harput, Turkey, by President McKinley, but before his departure he rendered the department a final service by leaving it with his 900-volume chemical library (9). To be more accurate, Norton actually sold his library to William A. Proctor, who then proceeded to donate it to the department (figure 9). Proctor had recently purchased and donated several other valuable private libraries to the University, which had just com-

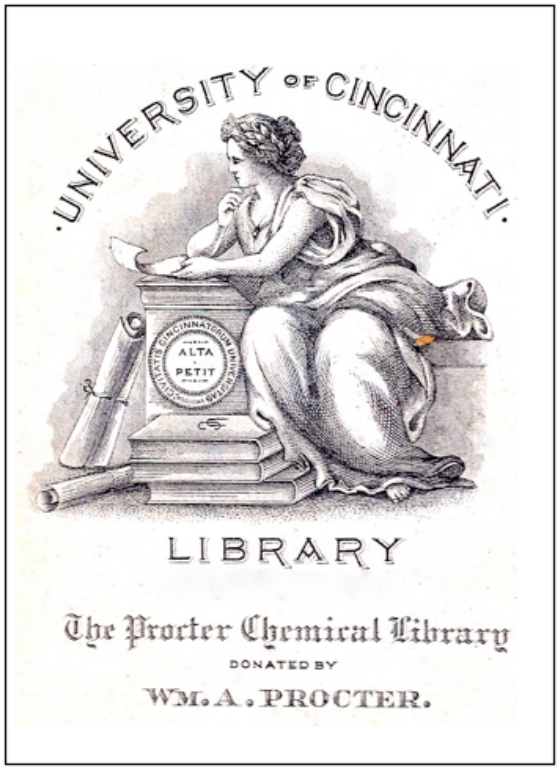


Figure 9. Bookplate for the original Procter Chemical Library which was based on Norton's personal library.

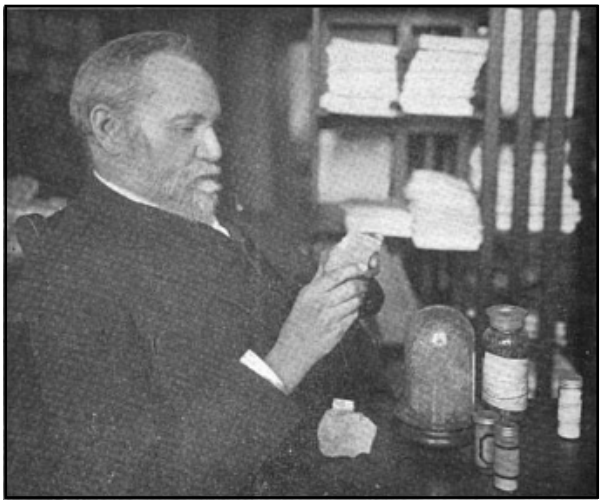


Figure 10. Norton at age 68.

pleted the Van Wormer library and was in the process of rapidly expanding its holdings. Most of these donations had been named in honor of the original collectors. However, since it was something of an embarrassment for the University to name its new chemical library after a professor it had just fired, Norton's collection was called the Proctor Chemical Library instead. This name was retained until the 1920s and many of the older chemical journals still contain the original book plates (10).

Naturally, Norton never made reference to the circumstances surrounding his departure, and the only comment suggesting any bitterness appeared in a biographical sketch which he wrote for the *National Cyclopedia of American Biography* six years later, where, with characteristic modesty, he noted that "in his professorship he [had] given no little fame to the University of Cincinnati" – with the obvious implication that his successors had not done likewise (11).

Later Career

Norton (figure 10) remained as U.S. Council at Harput until 1905, carrying out a special investigation of the Armenian Massacres for the United States government in 1904 and going on a special mission to Persia to investigate the murder of an American missionary the next year. In 1905 he was transferred to Smyrna, Turkey, and in 1906 to Chemnitz, Germany, where he remained until the outbreak of the First World War.

Returning to the United States in 1914, Norton spent the next three years preparing special reports for the Department of Commerce on different European chemical industries. In 1917 he became editor of *The Chemical Engineer* (1917-1918) and a consultant on dyestuff patents for Du Pont (1917-1920), though he was let go from the latter position when it was discovered that his knowledge of the practical and preparative details of industrial dye synthesis was "too limited to be of help to Du Pont" (32). From 1920-1929 he was co-editor of the *Chemical Color and Oil Daily* (later called *Chemicals*), and in 1930 he went to work as a research chemist for American Cyanamid, where he remained until his death from pneumonia on 02 December 1941 in White Plains, NY, at the age of 90.

Research Activities

In his 1906 biographical sketch, Norton claimed that "his work [had] been of such an original character as to command attention and his name [was] well known in scientific circles in Europe" (11). Although Norton's appearance among the starred names in the first edition of *American Men of Science* lends some credence to this claim, in general posterity hasn't been as charitable in its evaluation of his research activities (12). During his studies in Germany, Norton did not write a formal Ph.D. thesis (a not uncommon practice) (13) but rather published two papers in *Poggendorff's Annalen* in collaboration with a fellow American student named William F. Hillenbrand (who would later become a famous analytical chemist) dealing with the electrochemical separation and isolation of cerium, lanthanum and didymium (14), which would earn him at least a passing mention in Mary Elvira Weeks' famous study of the discovery and isolation of the chemical elements (15).

During his postdoctoral period, he coauthored two papers on organic chemistry in the *Berichte* with Arthur Michael, another American student who would later gain fame as an organic chemist, and during his five-year stint as an industrial chemist in Paris, he published seven more on the preparation of various organic glycols and sulfocyanates in the the *Bulletin societie chimique* and in *Comptes rendus* in collaboration with a Russian-born chemist named Joseph Tcherniak (1851-1928). Tcherniak had been a fellow student at Heidelberg in 1875 and was now the acting administrator of the *Compagnie Generale des Cyanures* (16, 31).

After coming to Cincinnati, Norton's publication habits changed. He switched from publishing in German and French journals to American journals and developed the habit of allowing results to accumulate for periods of five to ten years and then publishing them *en masse*. Thus, of the 24 papers he published while at Cincinnati, eleven were published virtually back to back in the 1888 volume of the *American Chemical Journal* and nine back to back in the 1897 volume of the *Journal of the American Chemical Society*. The vast majority of these were the result of either

student research projects or consulting work for local industry and are roughly divided half and half between organic and inorganic subjects. Many are little more than short observational notes and no overall research theme is apparent. Several also deal with new forms of chemical apparatus, including fractionating columns, gas generators (figure 11), and aluminum condensers (16).

Perhaps the most interesting piece of work was Norton's attempt to prepare solid orthosilicic acid [$H_4(SiO_4)$] by rapid mechanical drying of freshly precipitated silica, made via the hydrolysis of silicon tetrafluoride (17). Norton reported the product, which consistently gave the proper water to silica ratio for orthosilicic acid, to be "an amorphous white powder, perfectly dry to the touch, which may be preserved indefinitely in hermetically closed vessels, but loses its water of hydration steadily on exposure to air." Current wisdom denies the existence of $H_4(SiO_4)$, save as minor species in solution, and Norton's claims to the contrary have never received any attention in the reference literature (18).

There is also evidence that Norton rented laboratory space to local industrial chemists who lacked adequate research facilities, as he included several papers in the bound volumes of the department's *Research Contributions* which were either not written by members of the department or by students who had since graduated and were working for local industry. These included Ernst Twitchell's famous paper on the estimation of rosin in soap and several papers on high-temperature chemistry by a German Ph.D. named Sigmund Waldbott, who was apparently working with a consulting chemist named Karl Langenbeck on the development of the local tile and ceramics industry (19).

In addition, Norton was adept at soliciting donations of equipment from local industry. The 1889 catalog reveals that he convinced the manager of the Christian Moerlein Brewery to run a free electrical line over to the University laboratory (the brewery was located across the street from original campus) so that the students could do electrolytic determinations. In 1891 he obtained a donation of ore crushing machines for the Chemical Technology course from the Lane and Bodley Co. of Cincinnati, in 1893 a collection of blast furnace products, and in 1894 he got John Uri Lloyd to buy the department a new polariscope and a reflecting goniometer (20).

Though he ceased to do active laboratory research after leaving Cincinnati, Norton did continue to publish articles related to the economic and statistical aspects of industrial chemistry. As early as 1879, while working in Paris, he was commissioned by the U.S. government to write a report on the Chemical Exhibits at the Paris Exposition of 1878, and in 1911, while still a Consul in Germany, he was lent by the State Department to the Department of Commerce to prepare a series of studies on the chemical industries of Europe. This resulted in two lengthy reports – one on the *Utilization of Atmospheric Nitrogen* (1912), and one on *The Chemical Industries of Belgium, Holland, Norway and Sweden* (1913) – both of which were later translated into German and published in book form (figure 12) (29). Continuing this activity upon his return to the United States, Norton wrote lengthy reports on *American Sources of Potash* (1915), *Dyestuffs for American Textile and Other Industries* (1915), *Foreign Markets for American Cottonseed Products* (1915), *Census of Artificial Dyestuffs Used in the United States* (1916), and *Tanning Materials of Latin America* (1917). Based on these reports, he also wrote numerous shorter articles for various trade journals, as well as several privately printed biographical and genealogical sketches (16).

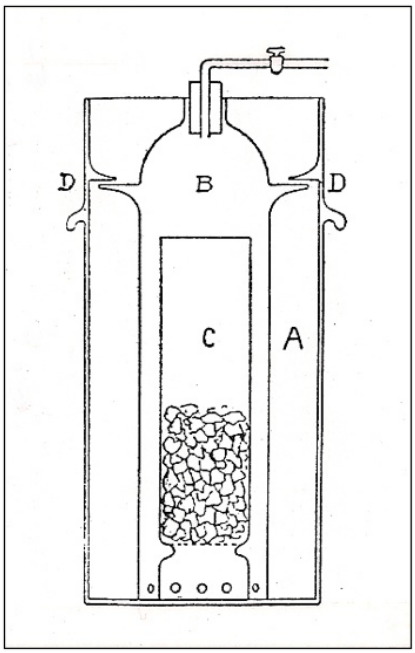
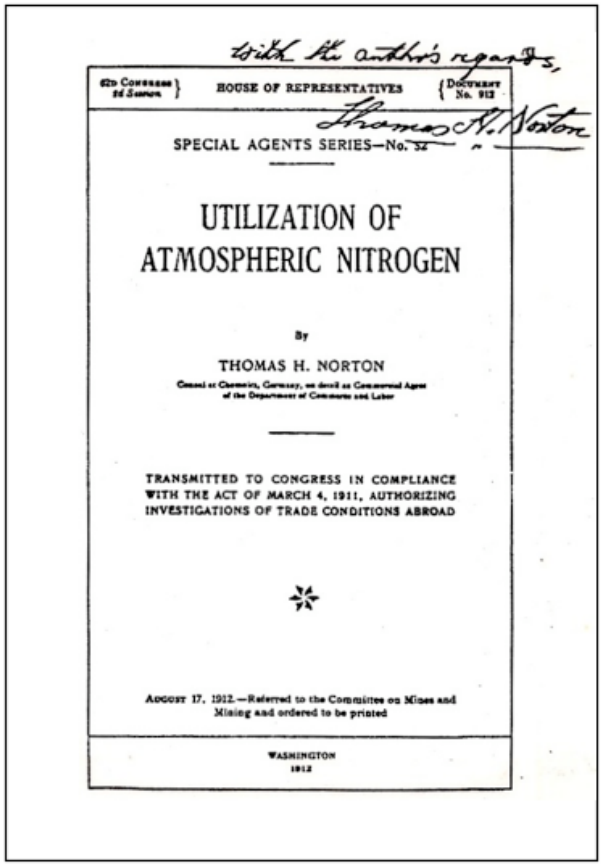


Figure 11. Norton's design for a hydrogen sulfide generator. Made from glazed earthenware, the outer chamber (A) was filled with acid and the inner chamber (C) with iron sulfide. Rotation of the middle chamber (B) until its shoulders (DD) caught on those of the outer chamber, held everything in place. The working principle was the same as that of a Kipp generator and Norton reported that it had "rendered excellent service in the laboratories of the University of Cincinnati."

The Dyestuff Census

The most controversial of these writings was Norton's *Census of Artificial Dyestuffs Used in the United States*


With the author's regards,
Thomas N. Norton

62d Congress, 2d Session. HOUSE OF REPRESENTATIVES Document No. 912

SPECIAL AGENTS SERIES—No. 52

UTILIZATION OF ATMOSPHERIC NITROGEN

By

THOMAS H. NORTON

Consul at Chemnitz, Germany, on detail as Commercial Agent of the Department of Commerce and Labor

TRANSMITTED TO CONGRESS IN COMPLIANCE WITH THE ACT OF MARCH 4, 1911, AUTHORIZING INVESTIGATIONS OF TRADE CONDITIONS ABROAD

AUGUST 17, 1912.—Referred to the Committee on Mines and Mining and ordered to be printed

WASHINGTON 1912

Figure 12. The cover of an autographed copy of Norton's 1912 report on nitrogen fixation, which he described as "the most complete and exhaustive treatise on the subject in any language," though it does not appear to have been cited by later reference works on the same subject.

or the *Dyestuff Census,* as it was popularly known. This grew out of a movement to foster the development of the fledgling American dye industry by imposing a tariff on imported dyestuffs. Leading the support for the tariff was I. Frank Stone, President of the National Aniline Co., and opposing it, U.S. Congressman Herman A. Metz, who also happened to be an importer of German dyestuffs. In order to determine the actual needs of American industry for dyes and the current state of its dependency on foreign imports, the Secretary of Commerce, William C. Redfield, commissioned Norton to write a report.

The resulting "census," in which Norton strongly favored the tariff and other measures which would allow the country "to emancipate itself from almost complete dependence upon foreign nations – chiefly Germany – for its chemicals and especially its dyes, and to create in security its own well-rounded comprehensive chemical industry," was not favorably received. Protests from New York importers and the German companies themselves resulted in Redfield withdrawing the proof sheets of the report from publication and ordering the cancellation of a talk by Norton on the same subject at New York City College (21, 30). Norton, however, persisted. In late 1915 he presented a talk on the subject in Cincinnati as part of the 25th anniversary celebration of the Cincinnati Section of the ACS, and in 1916 a summary of the report was published in the *Journal of Industrial and Engineering Chemistry* (22). Numerous articles in *The New York Times* also gave support to Norton's position, and in late 1916 the tariff was finally enacted.

Professional Activities and Honors

Questions of research reputation aside, there is little doubt that Norton (figure 13) did enjoy an extensive contemporary reputation as a result of his professional political and social activities. Described by one of his contemporaries as having "an intense interest in life [and] human nature," he was unquestionably a joiner and an organizer. His various biographical accounts indicate that, from his college days on, he was quite active in various fraternities. His interest in chess led to his organization of the Mt. Auburn Chess Club while living in Cincinnati and to the organization of the Brandywine Chess Club of Wilmington while working at Dupont. It was work on his family genealogy that led to membership in the Ohio Society of the Sons of the American Revolution, The Society of the War of 1812, and the Society of Colonial Wars, as well as to

Figure 13. Norton in later life.

an acquaintance with William McKinley, and to his eventual appointment as U.S. Consul at Harput. Lists of his memberships in churches, and the boards of directors for hospitals, schools, and other civic organizations also abound (23).

Professionally, Norton belonged to the chemical societies of England, France, Germany, and Russia, as well as to the New York Academy of Science, the Washington Academy of Science, the Society of Chemical Industry, the National Institute of Social Science, and the International Institute of China. He also served as General Secretary (1893) and Vice-President (1894) of the American Association for the Advancement of Science.

Norton joined the American Chemical Society shortly after its organization in 1876, while still working as a chemist in Paris, but like many others let his membership lapse when it became apparent that the Society was little more than a local organization for chemists centered around New York City. In 1890 Norton and his wife built a house at the corner of Lorraine and Brookline Avenues in Clifton, and the same year he invited local chemists to his new home in order to organize a local Chemical Society (2). Unlike its two predecessors, this third attempt at a Cincinnati Chemical Society succeeded and in 1892, when the now failing American Chemical Society announced an amended constitution allowing for the organization of local sections and the establishment of rotating national meetings, Norton petitioned to bring the 29-member Cincinnati Society in as a local section. This petition was formally granted on 29 March 1892, making the Cincinnati Section the third oldest in the Society (following Rhode Island and New York) (24). Norton also served as an ACS councilor from 1897-1899.

As a consequence of these many activities Norton was awarded an honorary doctorate by Hamilton College in 1895. In 1936 he received a honorary degree from the University of Heidelberg as part of its 550th anniversary celebration (25), and in 1937 he received the Lavoisier medal from the French Chemical Society (26), though it must be confessed that these awards had as much to do with Norton's longevity (he was in his mid-eighties at the time) as with his reputation.

Personality and Teaching Style

Developing some feel for Norton's personality is perhaps the most difficult task at this late date, given the absence of both personal documents and first-hand impressions written by his contemporaries. However, as many of the above quotations show, in his autobiographical statements he displayed a persistent lack of modesty and a compulsion to clothe even the most mundane events of his life with romantic and historical significance – not to mention ponderous prose. Thus we find that his father had owned, not just any cheese factory, but the "first" of its kind in the United States. He had not just walked on foot through Europe and Asia, but had been the "first" Occidental to do so. His report on the *Utilization of Atmospheric Nitrogen* had not only been translated, but was the "first" United States government report to ever be translated into a foreign language, etc., etc. References to the illustriousness of his Anglo-Saxon ancestors also abound and account for his membership in everything from the Sons of the Revolution to the Society of the War of 1812. His most extensive autobiographical document, *Reflections: Retrospective, Introspective and Prospective*, is as long on name dropping, when it comes to prominent politicians, as it is brief when it comes to his fellow scientists. In short, Norton loved both the limelight and the pleasures of associating with those having political power.

Norton also seems to have been something of an exhibitionist, who actively sought out novel and adventurous situations. While U.S. Consul at Harput he terrorized the local inhabitants by tearing up and down the streets of the ancient city on a bicycle, and he nearly cut his diplomatic career short by shooting down the Euphrates River on a raft of inflated goat skins. Even his passion for chess took on romantic significance when described in typical Nortonese, not to mention never-ending sentences, and supposedly included (2):

... a game with living chessmen in gorgeous costumes; two days of continuous play with the genial monks of the famous old Benedictine Monastery of Monte Cassino in Italy; games on horseback for a couple of days while riding through Mesopotamia with Dr. Shepard, the celebrated surgeon of Anatolia; games while floating down the Tigris; others with the Archbishop of Baghdad at Ninevah; some very diplomatic encounters with the envoy of the Shah of Persia; a simultaneous series against the picked players of Tabriz; a charming defeat at the hands of Capablanca, the present world's champion; a more strenuous struggle with Marshall, the American champion; very delightful encounters with the champion lady player of New York City; and a host of other souvenirs – picturesque and romantic.

The romanticism which had led him at the age of 22 to Scotland to "assuage" his interest in the poems and novels of Scott was still apparent at the age of 70, when he summarized his feelings about the future in his autobiography (2):

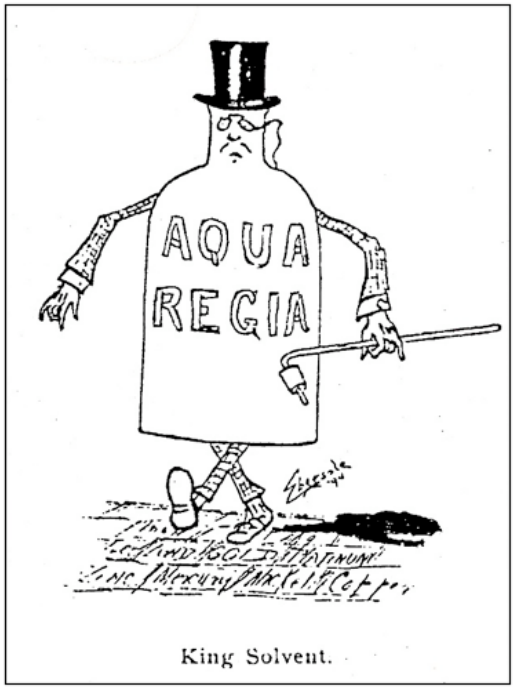


Figure 14. Student "chemical humor" inspired by Norton's lectures in introductory chemistry, circa 1895.

I still revel in a hike with the same zest as when rambling afoot 12,000 miles over Europe and Asia. The lure of my bicycle is ever keen along the sylvan pathways of the dewy morn. The call of "Boots and Saddles" is still as fascinating as when my coal-black Arab steed bore me over the trails followed by Abraham, Alexander and Tamerlane. To send or capture a baseball on its curved flight still keeps the nerves tingling. The mimic warfare of knights and rooks with their comrades gains in charm with each added year.

and upon receiving the Lavoisier medal at age 86, he could not resist claiming that (26):

Since those days on the banks of the Seine I have never attacked a problem in inorganic, organic, or industrial chemistry without trying to fancy how Lavoisier would have faced it.

As appropriate as all of this pompous phraseology may have been for the formalities of official dinners and diplomatic functions, it must have been deadening in the classroom, especially since – if we are to believe the student yearbooks – Norton seems to have combined it with a never-ending collection of bad chemical jokes and puns (figures 14-15). Thus the 1898 Yearbook warned incoming freshman that (27):

Professor Norton is one of the wittiest men we ever met. He has a large supply of stock jokes on hand, with which he entertains the chemistry classes every year. The freshman especially are in a position to appreciate this entertainment, for they are hearing all these jokes for the first time. Lest, however, the continual repetition of the jokes should become wearisome to any student, the Professor has this year added a new one to his list, for the especial delight of his seniors.

Indeed, the yearbook for the previous year had carried a four-page satire of one of Norton's lectures as part of its series "Off Hours with Great Men" and also included a satirical title page and preface for a chemistry text based on his lectures. Upon his death in 1941, his obituary in *The New York Times* characterized him as "A Noted Chemist" and as an "Authority on Synthetic Resins and Dyes." The mock preface penned by his students 44 years earlier provides a slightly different, but nonetheless appropriate, epitaph (28):

This volume represents a laborious account of the lectures in chemistry delivered at the University of Cincinnati to the class of 1900. The object of having it appear in this form is that it may impart to the world the brilliancy of its gems of knowledge, and at the same time to allow the public to read between the rays of reflected light; first, the miseries undergone while

Figure 15. Student "chemical humor" inspired by Norton's lectures in introductory chemistry, circa 1895.

compelled to listen and copy for two hours at a time without daring to move or speak; second, the cruelty imposed by the laboratory work necessary to confirm the statements made during the lectures; and last, but not least, that the public may have an insight into the inhuman treatment to which the pupils of the scientific course at the University of Cincinnati are subjected.

Chemistry, O Science dear,
Costing thirty-nine a year,
Though thy joys are manifold
Griefs like thine can ne'er be told.

References and Notes

1. In addition to reference 2, which is Norton's most extensive biographical document, the following were also helpful, especially in establishing dates subsequent to 1921:

a) "Norton, Thomas Herbert," *The National Cyclopedia of American Biography*, **1906,** *13*, 478.

b) "Norton, Thomas Herbert," *Who Was Who in America*, **1950**, *2*, 400.

c) C. E. Munroe, "Thomas Herbert Norton," *Ind. Eng. Chem.,* **1935**, *13*, 318.

d) "Norton Celebrates 90th Birthday," *Ind. Eng. Chem. (News Ed.)*, **1941**, *19*, 795.

e) "Necrology for Thomas Herbert Norton," *Ind. Eng. Chem. (News Ed.)*, **1941**, *19*, 1474.

f) "Norton, U.S. Consul, T. H.," *American Men of Science*, **1906**, *1*, 236 and subsequent editions.

g) "Thomas H. Norton," *The Cincinnatian* (University of Cincinnati Yearbook), **1894**, *1*, 16.

h) D. H. Wilcox Jr., "Thomas Herbert Norton." in W. D. Miles, Ed., *American Chemists and Chemical Engineers,* ACS, Washington, DC, 1976, pp. 369-370.

i) "Obituary of Thomas H. Norton," *New York Times*, 3 Dec. 1941.

References a) and c) depend heavily on accounts written by Norton himself, including their actual wording.

2. T. H. Norton, *Reflections: Retrospective, Introspective, and Prospective*, The Chemical, Color, and Oil Record: New York, 1921. All quotations, unless otherwise indicated, are from this reference.

3. Information from the archives of the University of Heidelberg. Supplied in a private communication by Dr. P. R. Jones, Department of Chemistry, University of New Hampshire.

4. Addresses and statistics on student population and graduates are from the *Catalogue of the Academic Department*, *University of Cincinnati, 1883-1900*. Publication statistics are from W. B. Jensen, "Bibliography of the Publications of the Department of Chemistry of the University of Cincinnati," Oesper Collections: University of Cincinnati, 1986.

5. *Catalogue of the Academic Department*, *University of Cincinnati, 1886-1887*, pp. 12, 17.

6. *Ibid., 1895-1896*, pp. 12 - 13, 40.

7. *Ibid., 1887-1888,* p. 52.

8. Letter of Howard Ayers, dated 16 January 1900, and letter of Thomas H. Norton, dated 12 January 1900, University of Cincinnati Archives. See also R. C. McGrane, *The University of Cincinnati: A Success Story in Urban Higher Education*, Harper: New York, 1963, pp. 175-179.

9. Letter of W. A. Procter, dated 07 December 1900, University of Cincinnati Archives. Also McGrane, p. 151.

10. *Catalogue of the Academic Department, University of Cincinnati, 1900-1901*, p. 58.

11. See reference 1a.

12. See reference 1f.

13. P. R. Jones, *Bibliographie der Dissertationen amerikanischer und britischer Chemiker an deutschen Universitäten: 1840-1914*, Deutschen Museums: München, 1983, p. 74.

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16. For a complete listing, see W. B. Jensen, "Bibliography for Thomas Herbert Norton," Oesper Collections, University of Cincinnati, 1986.

17. T. H. Norton, D. M. Roth, "On the Existence of Orthosilicic Acid," *J. Am. Chem. Soc.*, **1897**, *19*, 832.

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19. *Contributions from the Chemical Laboratory of the University of Cincinnati,* Vol. 1, Oesper Collection, University of Cincinnati, 1877-1907, papers 42, 45, 46.

20. *Catalogue of the Academic Department, University of Cincinnati, 1889-1890,* p. 61; *Ibid.*, *1891-1892*, p. 45; *Ibid.*, *1893-1894*, p. 51; and *Ibid., 1894-1895*, p. 47.

21. See reference 1h for details.

22. T. H. Norton, "Dyestuff Situation in the United States at the Close of 1915," *J. Ind. Eng. Chem.*, **1916**, *8*, 166. See also, *Ibid.,* **1916**, *8*, 287, 1039, 117l.

23. It should be noted that Norton also served as Professor of Chemistry at the Cincinnati College of Pharmacy from 1889-1891 and as University Librarian from 1896-1900.

24. C. A. Browne, M. E. Weeks, *A History of the American Chemical Society*, ACS: Washington DC, 1952, p. 39.

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28. *Ibid*., **1897,** *4*, 194.

29. T. A. Norton, *Die chemische Industrie in Belgien, Holland, Norwegen und Schweden*, Vieweg: Braunschweig, 1914. I have not been able to find a listing for the German edition of the book on nitrogen fixation.

30. W. Haynes, *American Chemical Industry: A History*, Vol. III, Van Nostrand: New York, NY, 1945, Chapters 16-18.

31. T. Norton, "Joseph Tcherniak," *J. Chem. Soc.,* **1929**, 297- 298.

32. D. A. Hounshell, J. K. Smith, *Science and Corporate Strategy: Du Pont R&D: 1902-1980*, Cambridge University Press: Cambridge, 1988, pp. 90-91. Interestingly Norton is not even mentioned in P. J. Wingate, *The Colorful Du Pont Company*, Serendipity Press: Wilmington, DE, 1982, which deals specifically with Du Pont's entry into the dyestuff business after World War I.

33. The new chemistry facilities in Hanna Hall and Hanna Annex were described in some detail in S. Waldbott, "Das chemische Laboratorium der neuen Universität von Cincinnati," *Chem. Zeit*., **1897**, *21*, 562-563.

34. Speeches by L. W. Jones and J. U. Lloyd as reported in "Formal Opening of New Chemical Laboratory, University of Cincinnati," *J. Ind. Eng. Chem*., **1917**, *9*, 604-612.

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