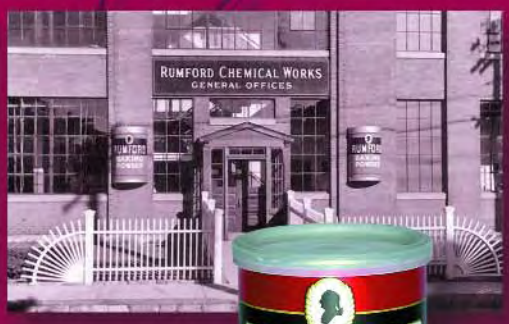
Rumford Baking Powder
June 12, 2006

A National Historic Chemical Landmark

Eben Horsford



AMERICAN CHEMICAL SOCIETY
SCIENCE THAT MATTERS

"[My] method [is one] which, by providing agents of known qualities and strength, reduces the measure of skill required to a minimum; and secures, with a very small degree of care and moderate expenditure of time, uniformly excellent bread."

Eben Norton Horsford, *The Theory and Art of Bread-Making: A New Process Without the Use of Ferment* (Cambridge, Mass: Welsh Bigelow & Co., 1861), p. 27.

Baking Powder

For more than three millennia, the method of preparing bread by means of fermentation did not change substantially; that is, until the 1830s when bakers began adding sodium bicarbonate (bicarbonate of soda) and sour milk to their dough. The lactic acid in the sour milk reacted with the sodium bicarbonate to produce carbon dioxide, which, trapped in the dough, resulted in the desired lightness of the baked bread. The introduction of sodium bicarbonate with an acid marked a significant advance in baking technique, proving especially useful in the baking of cakes, biscuits, and quick breads.

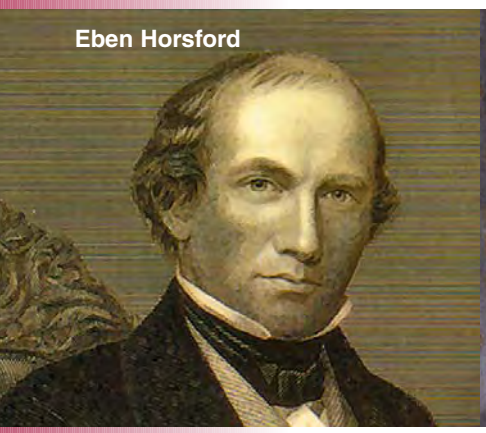
The use of sour milk presented a problem: the chemical reaction depended on its acidity. The replacement of the sour milk with cream of tartar (potassium hydrogen tartrate), a by-product of wine fermentation, solved this problem. Cream of tartar greatly improved and regularized the baking process since the uniformity of both sodium bicarbonate and cream of tartar from batch to batch offered bakers better control of the leavening process, allowing for predictable results.

The mixing of sodium bicarbonate and cream of tartar marked the introduction of baking powder. The action of the two chemicals began as soon as they were added to wet dough or batter; therefore, they had to be kept separate to prevent a premature acid-base reaction. This required the extra step of measuring. And since cream of tartar was imported from Europe there was the additional problem of supply and price fluctuations, depending on the grape harvest. These two factors—the marketing of the components in separate packages and the uncertain availability of cream of tartar—fueled the search for a more efficient and economical baking powder.

A German-educated, Harvard chemist, Eben Horsford, suggested replacing cream of tartar with calcium acid phosphate, also known as mono-calcium phosphate. Horsford and his business partner, George Wilson, established the Rumford Chemical Works in Rhode Island for the manufacture of calcium acid phosphate. In the early years of production the source for calcium was bones, which were digested with sulfuric acid. This resulted in a mixture of phosphoric acid, superphosphates, and calcium sulfate which was laboriously fractionated to yield calcium acid phosphate, which Horsford called "pulverulent (powdered) phosphoric acid."

The first packaged products from the Rumford Chemical Works were appropriately measured proportions of calcium acid phosphate and sodium bicarbonate, marketed as "Horsford's Bread Preparation." While the introduction of calcium acid phosphate satisfied the supply problem presented by cream of tartar, the baker still had to mix two products to get a satisfactory leavening agent. Since it was the presence of water which began the reaction process, Horsford took careful precautions to dry the ingredients, and, to keep them dry, he added starch to the mixture as the vital third ingredient.

The baking powder devised by Horsford first carried his name, only later becoming Rumford Baking Powder. As such it was marketed for decades and contained the same three ingredients—calcium acid phosphate, sodium bicarbonate, and corn starch—in the same proportions as in Horsford's day. The only significant change came in the source of the calcium acid phosphate; in the late 1880s, the introduction of calcium phosphate mining eliminated the need for beef bones.



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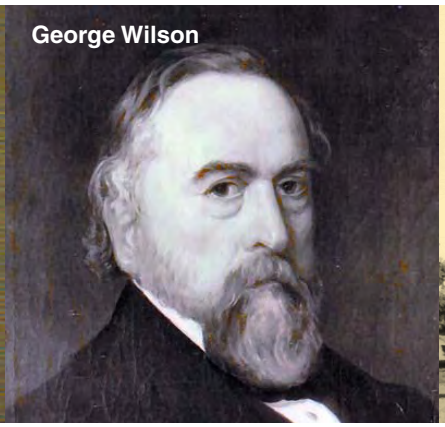


George Wilson

Old factory, restored

Eben Horsford

Eben Norton Horsford was born in Moscow (now Livonia), New York, on July 27, 1818. In 1837 Horsford entered the Rensselaer School (now Rensselaer Polytechnic Institute), graduating a year later with a B.S. in civil engineering. Horsford's associates in New York urged him to go to Giessen, Germany, to study with Justus von Liebig. Horsford—according to his diary—had read Liebig's book, *Organic Chemistry and Its Application to*

Agriculture and Physiology the year after it appeared in English. Horsford departed for Germany in 1844, for what would be his only formal education in chemistry. This expensive venture abroad was made possible by Horsford's friends, who paid for part of the trip and loaned him money to cover the rest.

Horsford spent two years in Giessen, studying mainly organic chemistry, but his laboratory investigations included analyses of a wide variety of substances. While still in Germany, he was nominated for the Rumford chair at Harvard University. With the strong support of Liebig and John Webster, Professor of Medicine at Harvard and editor of Liebig's book, Horsford was formally offered the professorship in February 1847, with an annual salary of $1,500.

At Harvard, Horsford developed a laboratory for chemical analysis modeled on Liebig's facility in Giessen, and he became dean of the university's Lawrence Scientific School. His research displayed the interest in practical chemistry learned in Germany. For example, he studied the Boston water supply with emphasis on the effect of water on lead and iron pipes. He analyzed a sample of guano for William Marcy, the Secretary of State. After 1854, his main preoccupation was to discover a substitute for yeast in baking bread. With the introduction of baking powder Horsford became less interested in teaching and university administration, and, in 1861, he resigned as dean of the Lawrence Scientific School, and two years later, he retired from the Rumford chair.

In 1861 Horsford published *The Theory and Art of Breadmaking*. After the Civil War he largely abandoned science in favor of other avocations, including trying to prove the Vikings established a settlement near Boston. He could indulge his hobbies since he had prospered from the chemical works. As the father of five girls, Horsford spent part of his wealth supplying Wellesley College with books and apparatus. He lived in Cambridge, Massachusetts, until his death on January 1, 1893.

Rumford Chemical Works

The Rumford Chemical Works began when George Wilson—a school teacher with a flair for business—sought Horsford's cooperation in the development of chemical products which Wilson would manufacture. After the site they chose for their first factory had to be abandoned because of complaints from nearby residents about gas emissions, Wilson opened a facility in 1856 in East Seekonk, Massachusetts.

That same year Horsford received a patent for "pulverulent phosphoric acid." Although chemists were familiar with phosphoric acid, it had not been produced on a commercial scale. So Horsford and Wilson needed to develop a manufacturing process based on then available raw materials, either bones or spent bone black from sugar refining. By the beginning of the Civil War, Horsford and Wilson had solved the supply problem and were producing sufficient amounts of calcium acid phosphate to satisfy production needs for baking powder.

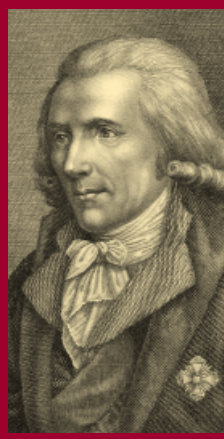
Success dictated the need for a formal corporate structure; as such, the Rumford Chemical Works was incorporated in 1859 in Massachusetts with capital of $10,000. Horsford chose the corporate name which recognized the scientific achievements of Benjamin Thompson, Count Rumford, who had endowed the Harvard chair he occupied. In 1861 the boundary between Massachusetts and Rhode Island was adjusted with the result that East Seekonk, Massachusetts, became part of East Providence, Rhode Island.

Baking powder was the main output of the Rumford Chemical Works. By the mid-1860s "Horsford's Yeast Powder" was on the market as a premixed leavening agent. It was packaged in bottles, but Horsford wanted to use metal cans for packing, which meant the mixture had to be more moisture resistant. This was accomplished by the addition of starch, and in 1869 the Rumford plant began the manufacture of what can truly be considered baking powder.

Count Rumford

Benjamin Thompson was born in Woburn, Massachusetts, in 1753. As a young man he ran afoul of his more patriotic neighbors and was arrested on the charge of "being inimical to the liberties of this country." He was released but never received a public hearing. In late 1775 Thompson sent British General Howe a lengthy report on the numbers, disposition, and equipment of American forces surrounding Boston. When Howe evacuated Boston in March, 1776, Thompson sailed to England.

Thompson entered the British Colonial Office, serving under Lord Germain, the Secretary of State for North America. His status in England became precarious after Germain was drummed out of the colonial service by critics who accused him of incompetence in prosecuting the war with the rebellious colonies. Thompson, heeding the warning signs, left for travel on the continent.



After several months wandering Europe, Thompson entered the service of the Elector of Bavaria, who made him a Count of the Holy Roman Empire. Thompson was allowed to choose his own title; he selected Rumford, the early name of Concord, New Hampshire, where he had taught school and where his first wife had been born. Throughout his wanderings in Europe, Rumford conducted scientific research on a variety of topics, including gunpowder, light, and mechanics. His major focus was on heat, which he believed was a form of motion.

Rumford spent the last dozen years of his life in Paris. His first wife died in 1792; in 1805 he married the widow of the famous French chemist, Antoine Lavoisier. It was not a happy marriage; the couple separated in 1809, and Rumford moved to Auteuil, where he died in 1814. In his will he left Harvard University an annuity of $1,000 to establish a professorship "to teach… the utility of the physical and mathematical sciences for the improvement of the useful arts, and for the extension of industry, prosperity, happiness, and well-being of Society."

National Historic Chemical Landmark

The American Chemical Society designated the development of baking powder by Eben Horsford at the Rumford Chemical Works as a National Historic Chemical Landmark in a ceremony in East Providence, Rhode Island, on June 12, 2006. The commemorative plaque reads:

In the mid-19th century, Eben Horsford, Rumford Professor at Harvard University, devised a unique mixture for baking, which he named "yeast powder" and later called baking powder. The acid component, calcium acid phosphate, originally manufactured from bones, replaced cream of tartar, an expensive byproduct of the European wine industry. The mixture of acid with sodium bicarbonate was stabilized by the addition of starch and marketed in one package. In the presence of moisture carbon dioxide is released, leavening biscuits, cookies, or other quick baking products. As a result of Horsford's work, baking became easier, quicker, and more reliable.

About the National Historic Chemical Landmarks Program

The American Chemical Society, the world's largest scientific society with more than 158,000 members, has designated landmarks in the history of chemistry for more than a decade. The process begins at the local level. Members identify milestones in their cities or regions, document their importance, and nominate them for landmark designation. An international committee of chemists, chemical engineers, museum curators, and historians evaluates each nomination. For more information, please call the Office of Communications at 202-872-6274 or 800-227-5558, e-mail us at nhclp@acs.org, or visit our web site: www.chemistry.org/landmarks.

A nonprofit organization, the American Chemical Society publishes scientific journals and databases, convenes major research conferences, and provides educational, science policy, and career programs in chemistry. Its main offices are in Washington, DC, and Columbus, Ohio.

Acknowledgments:

Written by Judah Ginsberg

Photo Credits: Rumford Collection, East Providence Historical Society.

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