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Patenting University Research

Harry Steenbock and the Wisconsin Alumni Research Foundation

*By Rima D. Apple**

"To protect the interest of the public"

ON 12 AUGUST 1924 Harry Steenbock, professor of biochemistry at the University of Wisconsin, received an unexpected telegram from a former colleague, Dr. Amy L. Daniels of the Iowa Child Welfare Research Station of the State University of Iowa. The wire insisted, "PUBLISH VITAMIN D WORK AT ONCE, DON'T DELAY." In the letter that followed Daniels explained: "I learned this morning that others are working on irradiated fats. And the person who mentioned it led me to believe that this other individual is a 'pirate.' . . . no names were mentioned, and I don't even know the section of the country where the work is being done."[1] Daniels was referring to an article she knew Steenbock had submitted to the *Journal of Biological Chemistry* in April of that year, an article in which he described his research on the so-called antirachitic vitamine. Steenbock had observed that if he took various fats normally inactive in preventing rickets and exposed them to ultraviolet light, he could induce in them "growth-promoting and calcifying properties." However, since Steenbock was filing a patent for the irradiation process, he had requested that the journal withhold publication of the article. After receiving Daniels's warning, Steenbock immediately released the paper for publication and also sent a short note about irradiation to *Science,* which published the announcement in the September 5th issue.[2]

Clearly the need to establish priority prodded Steenbock to release his research earlier than he had planned.[3] But while priority issues had necessitated

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I wish to thank James Liebig, archivist, University of Wisconsin–Madison, and Else Arnold and John R. Pike, Wisconsin Alumni Research Foundation, for their help in locating records cited in this paper.

[1] Robert Taylor, "The Birth of the Wisconsin Alumni Research Foundation," typescript dated 1956, Wisconsin Alumni Research Foundation files (hereafter **WARF files**).

[2] Harry Steenbock and A. Black, "Fat-soluble Vitamins: The Induction of Growth-Promoting and Calcifying Properties in a Ration by Exposure to Ultra-Violet Light," *Journal of Biological Chemistry,* 1924, *61*:405–422; and Steenbock, "The Induction of Growth Promoting and Calcifying Properties in a Ration by Exposure to Light," *Science,* 1924, *60*:224–225.

[3] See Steenbock's letter to the editor, *Journal of the American Medical Association,* 19 July 1930, *95*:220; and [Harry Steenbock], "Excerpts from Publications and Copies of Correspondence Relating to the Priority of the Discovery of Antirachitic Activation and the Reactions of Dr. Hess to Patent Application: A Reply to the Comments of Mr. Auerbacher on an Article by Paul DeKruif Published in the *Ladies Home Journal,* May 1935," University of Wisconsin Archives, Harry Steenbock General Subject Files, 9/11/13/3, Box 15. To a large extent, conflicting priority claims resulted from different

early publication, another consideration had counseled delay. Premature announcement, the biochemist had feared, would ultimately harm rather than help the public. He would have preferred to establish a patent before publishing. Both his journal article and the *Science* announcement noted, "To protect the interest of the public in the possible commercial use of these and other findings soon to be published, applications for Letters Patent, both as to processes and products, have been filed with the United States Patent Office." In his eyes, a patent could insure the public against unscrupulous merchants and could encourage reputable manufacturers to develop vitamin-D-enriched products. At the same time, royalties generated by the patent could support further research, both his own and that of others at the University of Wisconsin. The controversy surrounding Steenbock's efforts to patent the irradiation process and the subsequent development of the Wisconsin Alumni Research Foundation to manage the patents, their licenses, and their royalties provide a significant case study of the tensions and conflicts that arise at the intersection of university research and commercial enterprise. It demonstrates both the ways in which the work of academic laboratories can influence manufacturing and how the needs of the marketplace can shape the interests of academic scientists.

I. STEENBOCK'S BACKGROUND

Steenbock's decision to patent reflected concerns and interests that had shaped his life from childhood.[4] Brought up on a family farm in Wisconsin, he understood the importance of agriculture, particularly dairy farming, to the state's economy. And early in his scientific career he recognized the commercial significance of university research in farming.

Steenbock graduated from the University of Wisconsin in 1908 and was immediately hired as a research assistant by E. B. Hart, chair of the Department of Agricultural Chemistry. This employment put him in close contact with some of the most creative researchers in biochemistry, including Stephen Babcock and Elmer Verner McCollum. Steenbock's name first appeared on a scientific publication in 1911, for research conducted under Hart and McCollum. In this innovative study, the "single grain ration experiment," four groups of cows were fed carefully controlled diets: one of corn, one of wheat, one of oats, and one a combination of the three. The researchers constructed each ration to supply all the known components necessary for healthful growth. As near as contemporary chemistry could determine, each ration was analytically identical with the others. Nonetheless the groups of cows differed markedly in their development. Though the researchers were unable to determine the cause of these differences, this path-breaking experiment established Steenbock's interest in nutrition research, an interest that later led to his important vitamin discoveries.

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definitions of what constituted the "discovery" of ultraviolet effects. For a study of an analogous situation in research on another vitamin see Naomi Aronson, "Resistance to Discovery: Vitamins, History, and Careers," *Isis*, 1986, *77*:630–646.

[4] Information about Steenbock's life has been drawn from two primary sources: Howard Schneider, "Harry Steenbock (1886–1967)—a Biographical Sketch," *Journal of Nutrition*, 1973, *103*:1233–1247; and an interview with Aaron Ihde, professor emeritus, University of Wisconsin, and former student of Steenbock's, conducted 5 Feb. 1988. I thank Professor Ihde for the time he took to discuss Steenbock's life and work with me. See also Mark H. Ingraham, *Charles Sumner Slichter: The Golden Vector* (Madison: Univ. Wisconsin Press, 1972), pp. 176–179.

As a research assistant Steenbock was in a position to observe closely a department that, under the tutelage of Hart and Babcock and with the support of Harry L. Russell, formidable dean of the College of Agriculture, had successfully turned university research into practical applications appreciated by the state's farmers.[5] The most visible of these successes was the invention of the Babcock tester. In 1890 Babcock announced his invention for quickly and accurately measuring the butterfat content of milk. Farmers and cheese makers had long recognized the need for such a device: many of the state's dairy farmers sold their milk directly to cheese factories, where the milk's butterfat content set the price. The Babcock tester eliminated the need for highly sophisticated chemical tests or guesswork. With the tester the farmer and the manufacturer had an on-site, authoritative gauge of butterfat content. Following Babcock's announcement many companies quickly began to manufacture a Babcock tester.

II. THE DECISION TO PATENT

Three and a half decades later, during his earliest vitamin-D studies, Steenbock recognized the commercial potential of his work. From that time on he claimed humanitarian reasons for patenting the irradiation process. For one thing, he sought to protect the public from the "patent pirate." That is, he feared that someone else would file patent claims for the practical applications and then charge industry exorbitant sums for their use. However, if he, Steenbock, did the patenting, he could ensure the safest, most healthful dissemination of the patent's applications. To bolster his argument, the biochemist offered the case of insulin, whose researchers used the control inherent in patenting rights to make sure that "the public is protected against the manufacture of poor preparations and is also protected against extortionate charges and to avoid the possibilities of misusing their discovery which not only would have retarded the further development and use of this product, but would also have resulted in causing untold suffering among diabetic patients." Moreover, Steenbock was "unwilling to give unscrupulous food and drug venders [*sic*] the freedom of marketing this or that irradiated product on the basis of preposterous indefensible claims."[6] With a patent he believed that he could supervise licensees and oversee their advertising material. In addition, the payment of royalties could bring much-needed research funding to the University of Wisconsin: the results of research would help fund further research.

Steenbock had another, highly significant, reason for deciding to patent: to keep the irradiation process out of the hands of the oleomargarine manufacturers. Margarine had been invented in the nineteenth century, but this cheap butter substitute composed of animal and vegetable fats did not seriously challenge the dairy industry until World War I, when butter was in short supply.

[5] On the relationship between "pure" and "applied" science in schools of agriculture and agricultural experiment stations at this time see Charles E. Rosenberg, "Science Pure and Science Applied: Two Studies in the Social Origin of Scientific Research," in *No Other Gods: On Science and American Social Thought* (Baltimore: Johns Hopkins Univ. Press, 1976), pp. 185–195.

[6] Harry Steenbock, "The Relations of the Writer to the Wisconsin Alumni Research Foundation," Jan. 1926, p. 4, University of Wisconsin Archives, Harry Steenbock WARF Special Files, 9/11/13/1 (hereafter **Steenbock WARF**), Box 1. On the patenting of insulin see Michael Bliss, *The Discovery of Insulin* (Chicago: Univ. Chicago Press, 1982), esp. pp. 131–133, 137–139, 174–181.

Nutrition research quickly demonstrated that oleo lacked vitamin A, an important nutritional element found in butter, but it soon became possible to correct this deficiency by adding vitamin A during the manufacturing process. A few years later researchers discovered that butter contained vitamin D, which was also missing from oleo. If manufacturers could add vitamin D to margarine, they could claim that oleo was at least nutritionally equal to butter. Steenbock, concerned about protecting Wisconsin's dairy industry, wanted to deny the oleo industry access to an inexpensive source of vitamin D. As he used the oleo question to justify his patent:

> In its broad humanitarian aspects it must be granted that any process which can be used to improve our food and thus improve our health should not be encumbered by restrictions of any kind. But there is another aspect to this matter and that is the effect which such a laissez faire policy would have upon the prosperity of that industry which has contributed most to our nutritional welfare, namely, the dairy industry. With the dairy industry the improvement of oleomargarine is a factor which not only would concern the production of butter but the economic status of dairying as a whole. This seemed too big a risk to take especially when considered in relation to the possible reaction of the dairy interests to research at the University.[7]

According to a colleague, Steenbock's "primary reason for securing the patent . . . was so that license might be withheld from the oleo interests, to protect Wisconsin's dairy industry."[8]

Many disagreed with Steenbock and felt it inappropriate for university researchers, particularly those employed at land-grant colleges such as the University of Wisconsin, to patent their discoveries. They claimed that inventions and discoveries of faculty and staff at state-financed institutions belonged to the public. A. J. Glover, influential editor of *Hoard's Dairyman* and a leading spokesperson for the Wisconsin dairy industry, was furious that Steenbock would consider patenting. "Why should the public devote money to discovering new truths only to permit them to be patented and their use determined by some corporations? It seems to me that information discovered by the use of public money belongs to the public and it is difficult for me to understand how such discoveries can be patented and some private corporation determine how they shall be used." He firmly believed that the university had no moral or legal right to take out patents.[9]

Glover's position received support from key faculty members, most vocally Hart, F. B. Morrison, and Kirk L. Hatch. In the early years of the century, Babcock had brought Hart out to Wisconsin from the Agricultural Experiment Station in Geneva, New York, to become chair of the Department of Agricultural Chemistry and thus relieve him, Babcock, of administrative chores. A tireless researcher as well as a very able administrator, Hart quickly became a disciple of Babcock's. Morrison was a nationally renowned professor of animal husbandry, coauthor of the principal text in the field, and also a disciple of Babcock's. Hart and Morrison, as well as Babcock himself, believed that the results of university research should be available openly and without restriction to all who need them.

[7] Steenbock, "Relations to WARF," pp. 1–5, quotation on p. 5; see also interview with Ihde; and Schneider, "Harry Steenbock" (both cit. n. 4).

[8] F. B. Morrison to Harry L. Russell, 14 Dec. 1925, WARF files.

[9] A. J. Glover to Russell, 22 Oct. 1925; Morrison to Russell, 14 Dec. 1925; WARF files.

Similarly, Hatch, the first director of the university's agricultural extension service, saw university research as an unrestricted contribution to the state's citizens. Consequently he too vehemently opposed Steenbock's patenting plans.[10]

Morrison generally opposed patenting but did foresee special circumstances in which research "should be patented if a patent were necessary to protect the discovery against unwise and fraudulent use."[11] Yet he worried that if university researchers were allowed to patent, they might be attracted to commercially feasible projects instead of to pure, noncommercial research. Thus, patent opponents feared, both the university and scientific research would be tainted with commercialism.[12] Some faculty also saw a difference between receiving royalties from books and from patents, but Steenbock believed researchers should be able to protect their findings in the same way that authors copyrighted their ideas.

Both sides of the controversy cited the case of the Babcock tester to justify their respective positions. Babcock had refused to patent his invention in order to ensure its broad application—in other words, for the good of the public. Subsequently, in order to undersell their competitors, manufacturers produced cheaply constructed equipment labeled as the Babcock tester but in which the test bottles, so carefully calibrated by Babcock, were often carelessly fabricated. As a result, this important test was discredited and fell into disuse until states established laboratories to check and standardize the equipment before its sale.[13] Years later Morrison used the Babcock tester as an example of the benefits to be derived from not patenting, pointing out that it "is still used universally when anyone wants to show the value of University research to the State and the monetary savings made possible by such research to our people."[14] Steenbock, however, focused on the problems that had developed during the early years of the tester and insisted that patenting was for the protection of the public.

To some extent Steenbock's fears of "unscrupulous food and drug venders" using his vitamin-D discoveries were warranted. For example, shortly after his announcement, the Ultra-Vol Co. attempted to sell an oil that was "activated by a violet ray." A Mr. T. J. Brume claimed to have invented a "superior type" of lamp he wanted to sell to irradiate milk at home. Another enterprising manufacturer, Goodall's Laboratories, produced Bottled Sunshine, supposedly olive oil exposed to ultraviolet rays. In its advertising the company ascribed quotations to satisfied customers and even experts, such as Steenbock himself. Goodall's sold its product out of the window of a Chicago drugstore for $1.25 a bottle (see Fig. 1). And then there was Joseph P. Sereda, who claimed that his "violet-ray machine" cured some eighty different diseases—from abscess through brain fag and nervousness to whooping cough and writer's cramp. Cosmetics companies touted the benefits of vitamin-D soap. One such product, Cosray, promised to

[10] Morrison to Russell, 28 Oct. 1925, WARF files; and Edward H. Beardsley, *Harry L. Russell and Agricultural Science in Wisconsin* (Madison: Univ. Wisconsin Press, 1969), p. 160; and interview with Ihde (cit. n. 4).

[11] Morrison to Russell, 28 Oct. 1925, WARF files.

[12] For more on the role of scientists at public institutions and the tension between the push of research and the pull of social and commercial considerations see Rosenberg, *No Other Gods* (cit. n. 5), esp. Part 2; and Charles Weiner, "Universities, Professors and Patents: A Continuing Controversy," *Technology Review*, Feb./Mar. 1986, *89*(2):33–43.

[13] Harry L. Russell, "The Wisconsin Alumni Research Foundation: Its Purpose," typescript dated Feb. 1931, WARF files; and Beardsley, *Harry L. Russell* (cit. n. 10), p. 157.

[14] Morrison to Russell, 28 Oct. 1925, WARF files.

smooth wrinkles, reduce enlarged pores, and eliminate blackheads and pimples.[15]

Dean Russell described the scene that convinced him that the public welfare required patenting of the Steenbock process.

> Shortly after the early public announcement by Dr. Harry Steenbock of his discovery . . . the writer was passing a drug store window in Chicago where a curious crowd was watching a demonstration.
>
> A mazda lamp was shining on a rotating glass plate which was covered with a film of oil that was dripping in a tiny stream from a reservoir above and was being collected in a trough that caught the oil as it flowed off the edge of the rotating plate. The oil was being bottled and the demonstrator was busily engaged in disposing of his cotton seed product to the side walk crowd at a handsome price, making the claim that this product was imbued with wonderful healing properties derived from the electric lamp.[16]

The existence of a patent would not prevent all fraudulent use of the process or its name. Yet Steenbock continued to believe he should patent his work. Only with a patent, the professor insisted, could he exert some control over ethical manufacturers and at least partly protect the public.

III. PATENT MANAGEMENT AND THE CREATION OF THE WISCONSIN ALUMNI RESEARCH FOUNDATION (WARF)

A series of perplexing problems faced Steenbock once he had decided to patent. First came the complicated process of applying for the patent itself. The application process, begun in 1924, was extremely time-consuming and frustrating: the Patent Office raised objection after objection, necessitating numerous revisions and resubmissions. Having eventually acquired his four patents (in 1928, 1932 [two patents], and 1936[17]), Steenbock's next worry concerned patent management—how "to administer the results of research as well as to protect research."[18] Someone had to evaluate license applications, supervise licensees, defend against patent infringements, and manage the funds generated from the royalties. Even before the first patent was granted, Steenbock knew he could not handle all these administrative details himself. Moreover, he felt that as a scientist he needed to distance himself from the commercial, profit-making aspects of the patent.

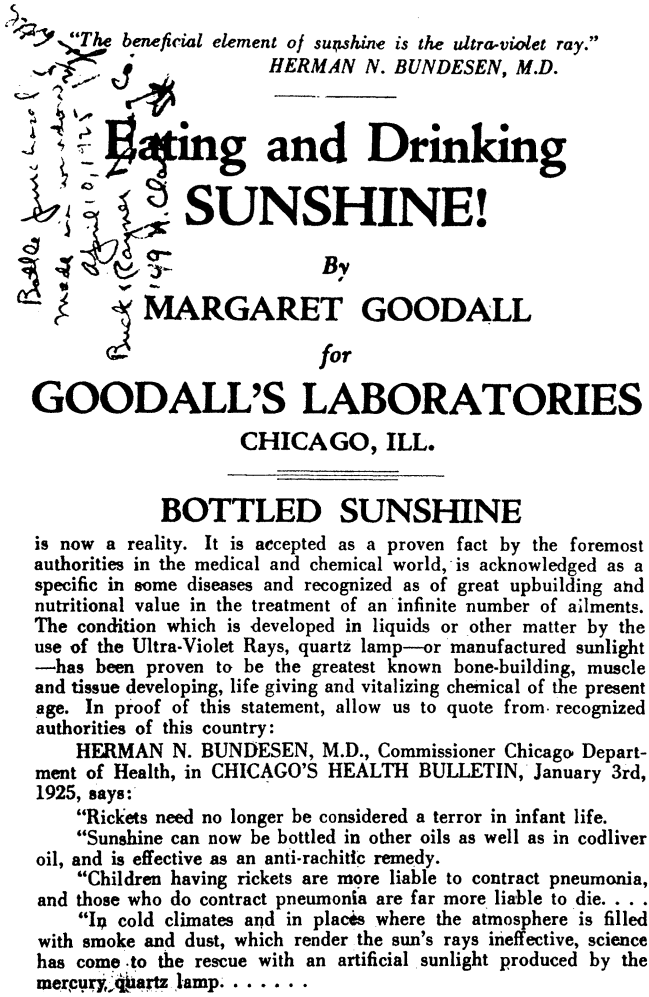
His first thought was to assign the patents to the university. Such an arrangement, he believed, could profit the public, the manufacturing sector, and the university research community. Eager to benefit the public, the university would be liberal in granting licenses; anxious to avoid costly litigation, industry would be willing to pay royalties, monies that in turn would fund research on the campus. Under this system, Steenbock wrote, the "public can be served ade-

[15] M. K. Hobbs to Steenbock, 9 Feb. 1929, Steenbock WARF, Box 1; H. E. Gunn to Steenbock, 24 Apr. 1929, *ibid.;* "Eating and Drinking Sunshine!" clipping in Steenbock General Subject Files (cit. n. 3), Box 15; Joseph P. Sereda, trading under the name of Health Violet Products, Docket 1695, *Federal Trade Commission Decisions,* Vol. XIII, pp. 134–140; and "Vitamin Aids under Fire," *Business Week,* 27 Dec. 1937, pp. 49–50.

[16] Russell, "WARF's Purpose" (cit. n. 13).

[17] Steenbock antirachitic product and process (basic) 1,680,818 8/14/28; antirachitic product and process (cereals) 1,871,135 8/9/32; antirachitic product and process (essence) 1,871,136 8/9/32; and antirachitic product and process (yeast) 2,057,399 10/13/36.

[18] Steenbock, "Relations to WARF" (cit. n. 6), p. 3.



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is now a reality. It is accepted as a proven fact by the foremost authorities in the medical and chemical world, is acknowledged as a specific in some diseases and recognized as of great upbuilding and nutritional value in the treatment of an infinite number of ailments. The condition which is developed in liquids or other matter by the use of the Ultra-Violet Rays, quartz lamp—or manufactured sunlight —has been proven to be the greatest known bone-building, muscle and tissue developing, life giving and vitalizing chemical of the present age. In proof of this statement, allow us to quote from recognized authorities of this country:

HERMAN N. BUNDESEN, M.D., Commissioner Chicago Department of Health, in CHICAGO'S HEALTH BULLETIN, January 3rd, 1925, says:

"Rickets need no longer be considered a terror in infant life.

"Sunshine can now be bottled in other oils as well as in codliver oil, and is effective as an anti-rachitic remedy.

"Children having rickets are more liable to contract pneumonia, and those who do contract pneumonia are far more liable to die. . . .

"In cold climates and in places where the atmosphere is filled with smoke and dust, which render the sun's rays ineffective, science has come to the rescue with an artificial sunlight produced by the mercury quartz lamp. . . . . .

Figure 1. *Bottled Sunshine advertisement, front page. Penciled note reads, "Bottle purchased, made in window, April 10, 1925, Buck and Rayner Drug Co., 149 N. Clark St., $1.25 for bottle." Courtesy of University of Wisconsin Archives.*

quately without exploitation and automatically such grants will, to a large extent, protect the public against the charlatan who is always sure to appear with impossible and unwarranted claims."[19]

Despite these remarks Steenbock had reservations about offering the University of Wisconsin his patents, reservations stemming from his experiences several years earlier after his development of a chemical process to produce a highly concentrated form of vitamin A. Steenbock, recognizing the commercial potential of this substance for infant foods and medicinals, had been concerned that the oleomargarine industry also might use it to manufacture a more attractive butter substitute. Steenbock offered the vitamin-A process to the university's board of regents, which then engaged a law firm to draw up the patent claims. Arba B. Marvin, the attorney who initially investigated the issue of vitamin patents, eagerly assured Steenbock that "after the applications have been lodged in

[19] Harry Steenbock, "The Administration of the Results of Research," undated typescript, pp. 6–7, Steenbock WARF, Box 1.

the patent office I will have some suggestions to offer concerning the sale of fractional rights under these applications as a means of raising money for more research work in your department."[20] Evidently, neither the board nor the law firm saw any urgency, and so matters moved slowly. At about the same time, though, the oleo interests established a fellowship to study the vitamin-A process, and, believing that these researchers would apply for a patent themselves, those pursuing the Wisconsin claim abandoned their efforts. Steenbock was extremely disappointed. Several years later, Dean Russell sent a package from Japan, to which the professor replied: "I have received preparation of vitamin A capsules for which accept my thanks as I was glad to get it. However, when I see these chaps making money on what to a considerable extent represents the results of my work, I cannot help but regret the Marvin incident."[21]

Though frustrated by this experience, Steenbock still felt that he should offer the irradiation process to the university. As he knew, other universities were becoming involved in patenting research. For instance, T. Brailsford Robertson, a biochemist, gave the University of California several of his patents in 1917. The regents there accepted his offer and created a patent-management corporation with themselves as trustees. Similarly, the University of Minnesota named its board of regents to process any patents developed on its campus. Columbia University used a different structure. In 1924 Columbia established University Patents, Inc., a patent-holding corporation wholly owned by the university. University Patents, in turn, entered into agreements with the Research Corporation, a nonprofit foundation that handled patentable discoveries for institutions and their faculties. Several New York business people had created the Research Corporation at the request of the Smithsonian Institution. A scientist, F. G. Cottrell, had donated the rights to his electrical precipitation process to the Smithsonian. Since the Institution's trustees were unwilling to direct a commercial enterprise, the Research Corporation had been designed to handle the matter and pass the earnings on to the Smithsonian.[22]

However, once again the University of Wisconsin Board of Regents was slow to act and, as Steenbock recalled later, "I had to admit that I lost an opportunity to patent my vitamin A discoveries by the dilatory action of the Regents, and that again I could see little or no progress to my request for action [on the vitamin-D patent]."[23] Evidently, the board was, at least in part, reluctant for a public institution to enter into a "speculative venture" unless Steenbock guaranteed repayment of any university funds invested.[24] The biochemist was in no financial posi-

[20] Arba B. Marvin to Steenbock, 17 Mar. 1923, Steenbock WARF, Box 2.

[21] Steenbock to Russell, 17 Dec. 1925, WARF files.

[22] Archie M. Palmer, *Survey of University Patent Policies: Preliminary Report* (Washington, D.C.: National Research Council, 1948); Palmer, *University Patent Policies and Practices* (Washington, D.C.: National Research Council, National Academy of Sciences, 1952); Beardsley, *Harry L. Russell* (cit. n. 10), pp. 155–158; Steenbock, "Relations to WARF" (cit. n. 6), pp. 3–4; Schneider, "Harry Steenbock," p. 1244; and Ingraham, *Charles Sumner Slichter* (both cit. n. 4), pp. 178–179. See also William Alan Richardson, "Research: Self-Supporting," *Medical Economics,* 1935, *13*(3):15–18.

[23] Steenbock to WARF trustee George Haight, 7 Dec. 1929, University of Wisconsin Archives, E. B. Fred Files, 4/16/4, Box 50.

[24] Beardsley, *Harry L. Russell,* pp. 157–158 (cit. n. 10), citing university business manager James Phillips, quoted in *Capital Times* (Madison, Wis.), 8 Mar. 1938. For more on Steenbock's experiences with the board of regents and the vitamin-A patent see Steenbock, "Relations to WARF" (cit. n. 6); Marvin to Steenbock, 17 Mar. 1923, Steenbock WARF, Box 2; Steenbock to C. A. Dykstra, 1 Dec. 1942, *ibid.;* E. B. Fred, "The Years of Decision: The Early Years of the Wisconsin Alumni

tion to make such a pledge, but he continued to believe that patenting was essential.

Thwarted by the inaction of the board, Steenbock adopted a different solution to the sticky problem of patent management. In 1921 two Chicagoans, William Hoskins, a consulting chemist, and Russell Wiles, a patent lawyer, proposed a corporation plan similar to that developed in California and Minnesota but with a significant difference: the commercial and the academic aspects were completely separate. Hoskins and Wiles felt strongly that no educational institution could run a successful, efficient business. Instead there should be an independent organization, directed by friends of the university. With this structure, business matters would not concern or distract the university from its educational mandate; yet academe could reap the rewards of a well-managed patent whose royalties would pay for other scientific work. Steenbock never specifically credited Hoskins and Wiles for their idea, but his correspondence strongly suggests that their plan influenced him. In the spring of 1924 Steenbock visited Carl Miner, also a Chicago consulting chemist, about pending patent problems. Miner knew Hoskins and Wiles and evidently told Steenbock about their proposal. When the Wisconsin board of regents made it clear that it was not interested in handling the Steenbock patents, Steenbock discussed the Hoskins and Wiles plan with Dean Russell and Charles Slichter, dean of the Graduate School. Both men were excited about the idea. Slichter contacted several alumni who he knew were interested in the future of the school and persuaded them to create a separate corporation to handle university patents, the Wisconsin Alumni Research Foundation (WARF).[25]

WARF was created to administer patents for the university's faculty and staff, starting with the Steenbock patents. The foundation was independent of the university, the connection between the two being the transfer of funds from WARF to the university's already-established Research Committee. The committee then selected the projects to be funded. WARF acted as an interface between research, a function of the university, and commerce, a function of industry. WARF, not the professor, granted licenses under the so-called Steenbock patents; the foundations' emblem, not the professor's signature, graced advertisements announcing the vitamin-D potency of irradiated products. The foundation also constructed a laboratory to test the potency of irradiated products to ensure that items using the WARF logo met the standards outlined in their contracts. However, Steenbock worked very closely with WARF, especially during its

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Research Foundation," typescript history dated Mar. 1960, archive copy in University of Wisconsin Archives; and Steenbock to Russell, 17 Dec. 1925, WARF files.

[25] Steenbock to WARF Trustees, 13 June 1928, Steenbock WARF, Box 2; memorandum concerning federal appropriations supporting agricultural research at the University of Wisconsin, typescript dated 30 Oct. 1933, *ibid.;* "WARF Report," reprinted from *The Wisconsin Alumnus,* June 1948, *ibid.;* Russell to President E. A. Birge, 16 Apr. 1925, WARF files; Steenbock to Haight, 7 Dec. 1929, *ibid.;* Richardson, "Research" (cit. n. 22), pp. 15–18; and Beardsley, *Harry L. Russell* (cit. n. 10).

Russell, one of WARF's most ardent supporters, explained how he saw the duties of the foundation in managing patents for the public good: 1. protecting discoveries from crass commercialism; 2. using licensure to control the quality of the products and their advertising; 3. granting limited licensing to minimize the monopolistic character of patents; and 4. applying profits to further university research. "In a word," he wrote in 1931, "we are hoping to retain all of the social advantages that may come to the public and at the same time handle the business to be developed with something of the efficiency which at least theoretically obtains from private corporate control. We recognize the experimental nature of this effort to socialize these values. Russell, "WARF's Purpose" (cit. n. 13).

formative years in the 1920s and 1930s, so closely that it can be very difficult to separate his role from that of WARF trustees or the WARF laboratory. Moreover, WARF, and often Steenbock personally, oversaw the advertising campaigns of manufacturers licensed under the Steenbock patents to see that companies did not make unwarranted claims and promises (see Fig. 2). WARF even produced its own advertisements to educate the public about vitamin D and irradiated products (see Fig. 3).

IV. LICENSING

Steenbock had correctly foreseen the commercial potential of his vitamin-D research. One of the first manufacturers to approach him about his vitamin-D process was Quaker Oats. Studies had demonstrated that dental caries were common in countries and areas where oatmeal was widely consumed. Moreover, nutritional experiments had shown convincingly that test animals fed oatmeal exclusively were more likely to develop rickets. As early as June 1925 representatives of the company visited the university and "stated without qualification that it [ultraviolet irradiation] was the greatest discovery yet made in the field of nutrition and they were frank to state that they were desirous of taking over the rights to the process for cereal products, and stated their willingness to spend money freely for the investigation and to make suitable contracts covering the case."[26]

The contract drawn up between Quaker Oats and WARF in February 1927, even before Steenbock had been granted his first patent, represented a compromise between Steenbock's idealism and the realities of the marketplace. Despite his discomfort with granting any manufacturer an exclusive contract, Steenbock understood that the Quaker Oats Company needed a promise of exclusivity before embarking on the costly construction and testing of irradiation equipment. In fact, he used just such a situation to argue for patenting. Before investing heavily in product development, companies needed to know that other firms could not just copy their processes and undersell the developers. Therefore WARF granted Quaker Oats exclusive use of the process for their products until 1940. WARF also recognized the expense of designing, constructing, and testing new technology; consequently, the contract limited the initial royalties paid by Quaker Oats to $5,000 a year. However, once the company began marketing irradiated products the royalty schedule increased first to $25,000, then to $35,000, and afterward to $60,000 a year.[27]

Other manufacturers saw in irradiated products more palatable, more attractive forms of vitamin D than the usual cod-liver oil. Fish oils had long been used as a remedy for such conditions as rheumatism and gout and also as a general tonic. In the early years of the twentieth century researchers demonstrated that some fats, including cod-liver oil, contained vitamin A and that there was a connection between this vital food accessory and some eye conditions. A short while later, others proved that rickets was a dietary deficiency disease and that certain oils, especially cod-liver oil, exerted preventive and curative effects in rachitic cases. At first researchers thought that vitamin A was the antirachitic factor, but

[26] [Charles Slichter] to W. S. Kies, 6 Oct. 1925, Steenbock WARF, Box 2.

[27] For correspondence about the Quaker oats contract see Steenbock, WARF, Box 1; Fred, "Years of Decision" (cit. n. 24); and Taylor, "Birth of WARF" (cit. n. 1).

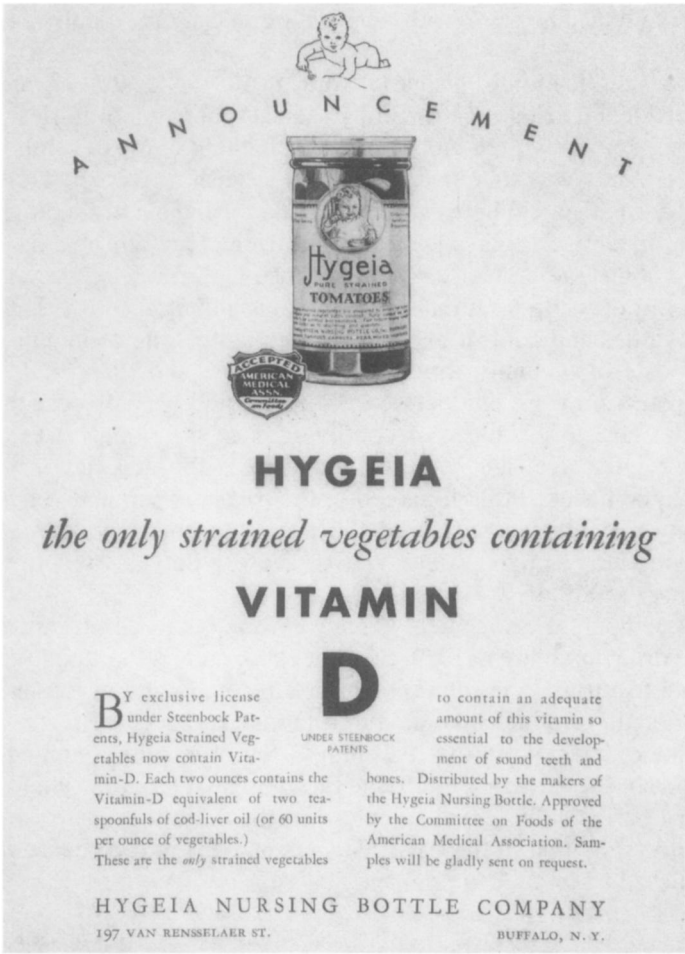

Figure 2. *Hygeia advertisement.* Hygeia, *1931,* 9:*1168.*

they soon discovered that the ingredient was another food accessory factor, vitamin D. During the same period, commentators observed an "epidemic" of rickets in Europe in the aftermath of World War I, and physicians discovered that rickets was widespread in this country also. Physicians, health officials, and other child-health workers recommended that vitamin-D-rich cod-liver oil be given not only to those suffering from obvious cases of rickets but also to all infants and children as a prophylaxis.[28] Despite its undoubted curative and preventive benefits, cod-liver oil had a major disadvantage: it was not very palatable. Not surprisingly, manufacturers quickly recognized the possibilities of

[28] Ruth A. Guy, "The History of Cod Liver Oil as a Remedy," *American Journal of Diseases of Children,* 1923, *26*:112–116; Elmer Verner McCollum, *A History of Nutrition: The Sequence of Ideas in Nutrition Investigations* (Boston: Houghton Mifflin, 1957), pp. 135–137, 217–234, 271–287; Alfred F. Hess, *Rickets Including Osteomalacia and Tetany* (Philadelphia: Lea & Febiger, 1929), pp. vii–viii, 17–19, 40–44; J. Lawson Dick, "Geographical Distribution of Rickets: Distribution in America," in Dick, *Rickets* (New York: E. B. Treat Co., 1922), pp. 56–70; Helen C. Goodspeed and Emma Johnson, *Care and Training of Children* (Philadelphia: J. B. Lippincott, 1929), p. 82; L. Emmett Holt and John Howland, *Holt's Diseases of Infancy and Childhood: A Textbook for the Use of Students and Practitioners,* rev. by L. Emmett Holt, Jr., and Rustin McIntosh, 10th ed. (New York: Appleton-Century, 1936); and John Lovett Morse, "Progress in Pediatrics: A Summary of the Literature of the Last Few Years on Rickets," *Boston Medical and Surgical Journal,* 1922, *186*:507–513.

advertising irradiated products that were both antirachitic and more appetizing than cod-liver oil.

Only a few months after publication of his early work, in 1924, Steenbock was approached by pharmaceutical houses such as Eli Lilly and Abbott Laboratories. Despite the companies' great interest, the biochemist felt that talk of the development of vitamin-D supplements was then premature. By 1928, however, he had concluded that several pharmaceutical houses were probably using his irradiation process without license or control. Subsequently WARF entered into negotiations with four firms (Abbott Laboratories, Mead Johnson, Parke Davis, and Winthrop Chemical Co.) to draw up a mutually advantageous contract, one that would ensure WARF royalties and control over the production of a new vitamin-D substance, named Viosterol (actually irradiated ergosterol), and that would afford the companies protection from competition. E. R. Squibb was also eager to gain a license. As the largest producer of cod-liver oil in the country, the company stood to lose a great deal if it were excluded from the negotiations. Squibb was so anxious to be licensed that it agreed to the royalties demanded by WARF, though company executives considered the price too high. By March 1929 differences between the companies and WARF were resolved, and the foundation granted licenses to all five.[29]

Other pharmaceutical companies also sought a license from WARF. In turning down the request of one drug company in 1929, Steenbock explained that the five licensees would "be able to furnish the requirements of the trade and made supervision of the quality of the product manufactured [Viosterol] relatively simple."[30] Moreover, Steenbock made sure that the item in the drugstore complied with the standards set out in the licensing contract. First his own laboratory and later a WARF laboratory periodically tested samples bought in local drugstores. Steenbock also took a direct interest in the advertising campaigns of the licensed pharmaceutical companies.[31]

[29] Steenbock to E. H. Volwiler, Abbott Laboratories, 6 Jan. 1925, University of Wisconsin Archives, Harry Steenbock General Correspondence Files, 9/11/13/2, Box 1-A; G. H. A. Clowes, Director of Research, Lilly Research Laboratories, to Steenbock, 29 Oct. 1924; and Clowes to Steenbock, 6 Mar. 1925; Haight to Steenbock, 27 Mar. 1928; Steenbock to W. S. Kies, 28 June 1928; Steenbock to Haight, 10 Oct. 1928; Steenbock to L. M. Hanks, 10 Oct. 1928; M. K. Hobbs to Steenbock, 22 Oct. 1928; Parke, Davis & Co. to Haight, 29 Dec. 1928; Steenbock to Hanks, 29 Jan. 1929; Steenbock to Carroll Dunham Smith Pharmaceutical Co., 25 Apr. 1929; Steenbock to H. E. Gunn, 27 Nov. 1929; and Gunn to Steenbock, 29 Nov. 1929; all in Steenbock WARF, Box 1.

Other pharmaceutical companies denied use of the Steenbock process looked for alternatives. Upjohn, e.g., attempted to irradiate by sunlight. The large trays of ergosterol that were set out in fields in the sunny Southwest did produce vitamin D, but high costs made this method commercially unfeasible. As manufacturers were aware, the vitamin-D potency of cod-liver and other fish oils varies tremendously. By 1936 Upjohn had discovered that the most potent oil came from Iceland. Six months of careful assaying proved that the best oil came from cod caught off the north coast of Iceland during the autumn. At about the same time, the International Vitamin Corporation of New York had found that ethylene dichloride dissolved vitamin D and could extract vitamin D from cod-liver oil. Upjohn obtained an exclusive U.S. license for the concentrating process and employed it to produce a concentrate from the extrapotent Icelandic cod-liver oil. Using this concentrate to manufacture capsules and commercial liquid concentrates, Upjohn successfully competed in the vitamin-D market, even without the Steenbock process. Leonard Engel, *Medicine Makers of Kalamazoo* (New York: McGraw Hill, 1961), pp. 70–74; Steenbock to Edward S. Rogers, 2 Jan. 1930, Steenbock WARF, Box 1; and Audrey Davis, "The Rise of the Vitamin-Medicinal as Illustrated by Vitamin D," *Pharmacy in History*, 1982, *24*:59–72.

[30] Steenbock to Carroll Dunham Smith Pharmaceutical Co., 25 Apr. 1929, Steenbock WARF, Box 1.

[31] See, e.g., Steenbock General Subject Files (cit. n. 3), Boxes 13 and 16; Steenbock to Gunn, 27 Nov. 1929, Steenbock WARF, Box 1; and Steenbock to L. M. Hanks, 17 Sept. 1930, *ibid.*, Box 3.

In addition, a multitude of food manufacturers were anxious to irradiate their products. Interested firms ranged from Anheuser Busch, the beer manufacturer, and Fleischmann's, producer of yeast, to C. E. Wheelock, manufacturer of jams and jellies, and Bottled Beverages, Inc., of Cleveland, Ohio, who in 1929 were "working on a chocolate drink with the idea of introducing Vitamine 'D' thru irradiated argosterol [*sic*]. This, of course, will make a chocolate drink worthwhile to sell to the public school children and other kiddies thruout the land."[32] Most of the many, many letters of inquiry met with rejection. Steenbock explained that WARF issued licenses only to "the most important food products such as milk, cereal, fats, and the like"; thus researchers could "ascertain the reaction of the public" and "have available exact data on the physiological effect of the product on human nutrition."[33] Nonetheless, several companies were able to work out satisfactory licensing contracts with WARF.

As their dealings with Quaker Oats and the pharmaceutical companies demonstrate, Steenbock and the foundation soon developed a keen appreciation of the realities of commerce. Another telling case is that of Wisconsin's dairy industry. On the question of oleomargarine versus butter, even faculty members usually reluctant to see university research patented agreed with Steenbock that patenting was necessary. Denying an irradiation license to oleomargarine, these professors believed, was, like the principle of protective tariffs, "simply . . . a protection of Wisconsin's main agricultural industry." As Morrison explained to Dean Russell as early as 1925, "If human suffering could be alleviated only by licensing the irradiation of oleo margarine, then I will agree that we would be remiss in our duty if we opposed it, even though it might be detrimental to the financial welfare of the College. However, it is not necessary for people to secure the anti-rachitic property of oleomargarine."[34] Steenbock and WARF agreed with this rationale and for years continued to refuse oleomargarine licensing. By 1942, though, the situation had altered significantly. When Steenbock first applied for his patent, in 1924, the only other form of vitamin D available had been fish oils, whose unpleasant taste provoked consumer resistance. Since then, various other processes had been developed that produced more palatable vitamin-D products, sometimes at less expense than direct irradiation. Therefore, Steenbock felt, his process no longer monopolized the synthetic vitamin-D field, and consequently WARF was no longer in any position to protect the butter industry.[35]

Steenbock and WARF were very aware of the development of alternative sources of vitamin D. During the 1930s the problem of producing fluid milk rich in vitamin D presented a significant commercial challenge. Several milk companies and creameries inquired about the possibility of vitamin-D milk shortly after Steenbock's initial announcement, but he did not turn his attention to the problem until sometime after 1930. There were several different methods that could be used to produce milk rich in vitamin D. The most likely process for Steenbock was to irradiate the milk directly. Under WARF's direction a few manufacturers of dairy equipment developed machinery that produced irradiated vitamin-D milk with no off taste. By 1934 WARF was licensing large dairies to produce this milk,

[32] H. W. Hibbard to Steenbock, 14 Aug. 1929, Steenbock WARF, Box 1.

[33] Steenbock to C. E. Wheelock Co., Peoria, Ill., 28 Feb. 1929, *ibid.*

[34] F. B. Morrison to Russell, 28 Oct. 1925 and 14 Dec. 1925, WARF files; Steenbock, "Relations to WARF" (cit. n. 6).

[35] Steenbock to C. A. Dykstra, 1 Dec. 1942, and Steenbock to Chris L. Christensen, 30 Nov. 1942, Steenbock WARF, Box 2.

which soon confronted stiff competition from another form of vitamin-D milk fortified with a concentrate called Vitex, produced by the National Oil Products Company. Over the next several years it became clear that Vitex milk, which was less expensive for small milk companies to produce, was preferred by many dairies. Aware of the importance of vitamin-D milk both for the health of the public and for its own economic health, WARF financed the development of their own vitamin-D concentrate for milk, UVO, which was introduced in New York in 1937 "as a defensive measure in competition with Vitex."[36]

The decision to develop UVO should not suggest that Steenbock or even WARF cared only for monetary gain. The motivations of researchers and the foundation were much too complex to warrant such a simplistic conclusion. The expense of the irradiation process raised the price of milk, whereas concentrates were so cheap that there was no difference in price between vitamin-D milk and unfortified milk. "Our original goal in the fluid milk field," the trustees reminded themselves in 1936, "was to secure the treatment of the milk of the masses. We will never realize this on the basis of a premium milk." While concerned for its financial health, the WARF board of trustees was also acutely aware of its social responsibilities.[37]

V. RESEARCH AND THE PROBLEM OF COMMERCIALIZATION

By the 1940s WARF was firmly established and financially secure. Steenbock's dream had become reality. The biochemist had wanted to protect the public from fraud and quackery; therefore, he insisted on patenting his discovery. He had wanted to acquire and disburse funds for further research without the taint of commercialism; thus he designed and established the Wisconsin Alumni Research Foundation to manage the patents. The dream had become reality, but a reality shaped also by the pressures of the marketplace.

To avoid any hint of profiteering from his discovery, Steenbock refused to accept a share of the royalties paid to WARF. He worried that payments would compromise his position as a scientist and that other researchers might bargain with the foundation over royalties, thus commercializing the procedure. However, the WARF trustees insisted that he receive some remuneration. They argued that if Steenbock received nothing from the foundation for his patents, other faculty might be unwilling to turn their patents over to WARF. Finally the board of trustees forced Steenbock to accept 15 percent of the net income generated from his patents; WARF invested the remaining 85 percent.[38]

Though at first unwilling to accept any royalties, over the years Steenbock came to appreciate the money, which he used to fund additional research. In other ways, too, his views changed under the press of commercial considerations. Before the founding of WARF, the professor clearly sought to establish himself as a researcher and to eschew the role of applied scientist. In the early

[36] Milk Report Nos. 25 (31 Mar. 1941), 8 (20 Apr. 1935), 9 (27 July 1935), 10 (22 Oct. 1935), 13 (26 June 1936), 14 (15 Aug. 1936), 16 (20 Jan. 1937); 18 (23 Aug. 1937), 22 (21 Oct. 1938), 20 (21 Jan. 1938), 23 (25 Mar. 1939), all in Steenbock WARF, Box 2; 3rd annual report of the Director of WARF, 1932, *ibid;* and Evan A. Evans to Trustees, 26 Mar. 1934, *ibid.*, Box 3.

[37] Milk Report No. 13 (26 June 1936), Steenbock WARF, Box 2.

[38] E. B. Fred, "Years of Decision" (cit. n. 24), pp. 23–24, quoting the Minutes of the Board of Trustees, 18 Feb. 1927 and 22 June 1929; and Steenbock to Slichter, 24 Mar. 1928, Steenbock WARF, Box 2. Even afterward, in many years Steenbock refused the money or put his share in a fund specially earmarked for his department.

1920s, when food manufacturers approached Steenbock for help with their production problems, he disassociated himself from such questions. For example, when A. V. H. Mory, director of the Technical Bureau of the Biscuit & Cracker Manufacturers' Association, inquired in 1922 about the possibility of manufacturing a "vitamine" cracker (this before Steenbock's vitamin-D work), Steenbock responded,

> I know nothing of the manufacture of crackers and assure you that from my knowledge of the properties of the different vitamines, I do not want to say off-hand what processes could be used to advantage. To outline experiments in this field is quite another matter, but that, I think, is a problem of your consulting chemist and technologists rather than that of one who is interested in the problems related to vitamines from the scientific standpoint.[39]

Nonetheless, he soon recognized how difficult it would be to separate basic and applied research. "Obviously before commercial use can be made of the findings to date," he wrote an executive of the Postum Cereal Company in 1924, "extensive experiments will have to be carried out to make its commercial use economically practical. We are prosecuting such experiments as rapidly as possible."[40] In the case of vitamin-D milk and in many other instances, Steenbock found himself drawn more and more into the production end of ultraviolet irradiation.

Helping manufacturers develop effective irradiation processes, particularly in the 1920s and 1930s, was one way Steenbock carried forth his, and WARF's, mission to protect the consumer. In addition he and WARF bought and tested licensed irradiated products in their own laboratory to ensure their uniformity and reliability. As more and more manufacturers enriched their products with vitamin D, whether using the Steenbock process or another form of supplement, Steenbock became less committed to protecting the public from such fortified foods. The April 1936 issue of *Modern Brewer* contained an article extolling the virtues of vitamin-D beer, just the sort of "frivolous" product that Steenbock had ridiculed earlier. WARF's board considered demanding a retraction from the magazine, including statements that "will point out the fallacy of incorporating Vitamin D in beer." Steenbock, however, doubted "very much if it would be wise for . . . the Foundation to send a letter of protest." He believed that WARF could no longer attempt to function as the public's shield against the folly of indiscriminate vitamin-D enrichment. As he viewed the case of vitamin-D beer,

> In the past in the absence of competition from other sources of vitamin D and in the absence of the slightest attempts on the part of governmental control, it was perfectly proper for the Foundation to state succinctly what responsibilities it was assuming and to what extent it was actively protecting the public. But at the present time there is no question but that the policy of functioning as a protecting agent is rapidly being undermined. . . . It no longer is advisable for the Foundation to assume an ultra-idealistic attitude. In other words, if the public should demand vitamin D in its beer, there is no reason why the Foundation should not provide it—because it may do some good and it most certainly will not do any harm.[41]

[39] Steenbock to A. V. H. Mory, 6 Jan. 1923, and Mory to Steenbock, 20 Dec. 1922, Steenbock General Correspondence Files (cit. n. 29), Box 1.

[40] Steenbock to M. S. Fine, 22 Sept. 1924, Steenbock WARF, Box 1.

[41] Steenbock to Hobart Kletzien, 6 May 1936; memo from Kletzien to Steenbock, undated; Alfred E. Bott, "Brewers Are Turning to Vitamins," *Modern Brewer,* Apr. 1936, pp. 44–46, clipping in Steenbock WARF, Box 2.

By 1942, as we have seen, a disillusioned Steenbock had even accepted the irradiation of oleomargarine, the one product he had always insisted must not be licensed.

VI. WARF'S DEVELOPMENT

Since its establishment in 1925 the foundation had changed also. A pioneer among nonprofit, university-affiliated patent-management agencies, WARF had become a model, emulated throughout the United States. By 1956 there were more than fifty similar, separately incorporated organizations.[42] At the beginning WARF's trustees, primarily business people and lawyers working on a volunteer basis, conducted nearly all the business of the foundation. But soon the phenomenal success of the Steenbock patents demanded more professional administration. The problem of patent litigation plagued the foundation. As patents were granted, the task of reviewing license applications grew; so did the job of negotiating royalties and monitoring payments. The WARF laboratory kept busy testing licensed products to make sure they met foundation standards. Similarly, WARF personnel, and often Steenbock, reviewed and rewrote advertisements for products licensed by WARF. These tasks constitute one side of patent management. WARF also handled the investment and disbursement of royalties.[43] With interest in the Steenbock patents high in the 1930s, the royalty fund increased dramatically.

As early as the late 1920s the administration of the many components of WARF clearly required the involvement of a full-time director and professional staff. The trustees selected Dean Harry Russell to head WARF. In 1925 the dean had supported Steenbock's proposal to patent the irradiation process, and he had urged the university to accept and administer the patents. Though recognizing problems with this arrangement, he was nevertheless strongly convinced that the benefits outweighed any difficulties. "This discovery is fraught with so much significance," he wrote the university's president, Edward A. Birge, "that the University cannot afford to make the mistake of neglecting the opportunity of perhaps controlling this patent in such a way as will probably redound materially to the benefit of further scientific research."[44] When the university rejected Steenbock's offer, Russell threw his energies into the establishment of WARF. In 1930 he resigned his deanship to become WARF's first full-time director. Concerned with all the many foundation activities, Russell was a powerful voice in the organization, and consequently Steenbock's involvement became less visible. Moreover, since Steenbock apparently preferred to work behind the scenes, and since he agreed in general with Russell's approach to patenting and research support, the biochemist allowed the former dean center stage in the development of WARF.[45]

WARF attracted other researchers at the university with patentable discover-

[42] Archie M. Palmer, *Nonprofit Research and Patent Management in the United States* (Pub. 371) (Washington, D.C.: National Research Council, National Academy of Sciences, 1956).

[43] Initially an inventor would receive 15% of the royalties and WARF the remainder. These proportions have changed over the years. Today inventors receive 20% and the inventor's department 15%; the remainder becomes part of WARF's pool of resources.

[44] Russell to Birge, 16 Apr. 1925, WARF files.

[45] Interview with Ihde (cit. n. 4).

ies. By 1985, the latest year for which statistics are available, WARF had seen the granting of 448 patents, of which 203 had been licensed. These have not all been financially successful: only 100 have produced income greater than expenses, and 10 alone have generated 90 percent of WARF's royalty earnings.[46] Yet patents, which by 1986 had brought WARF more than $30 million, account for only 20 percent of the foundation's income. Of even more significance in the development of WARF's substantial endowment was the skill of its trustees in investment. Under an early policy decision, WARF did not use the royalties themselves to fund research; instead, monies paid WARF were invested, and research was funded from the interest.

WARF's success was particularly timely for the University of Wisconsin research community. In the first two decades of the twentieth century, the university numbered among the country's leading state universities. It fell from prominence in the interwar years, owing partly to a critical lack of funding for research. University trustees did not give research high priority and funded few projects directly. Moreover, other research universities were much more successful in fund-raising at this time. (Wisconsin was unusual in not using a professional fund-raiser.) One major source for research money was, of course, foundations. Unfortunately in 1925, in the tradition of Wisconsin Progressives, the trustees prohibited the university from accepting any foundation funds.[47] By the time this ban was rescinded in 1930, Depression conditions made fund-raising even more difficult. Therefore, university researchers were highly appreciative of the funds flowing from WARF, and the continued success of WARF is an important element in the university's current status as a major research institution. As the historian Roger L. Geiger concluded recently, "The vitality of research at Wisconsin owes much to the existence of the Wisconsin Alumni Research Foundation."[48]

WARF disbursed its first research funds to the university in 1928/29, $1,200 to support one project. By 1933/34, the foundation grant for the university for the year was $147,663. In the following year the university faced a severe financial crisis and contemplated laying off faculty. Steenbock, Russell, and Slichter urged the WARF trustees to help. They agreed, and for the first and only time the endowment capital was used to support twenty-nine "leave of absence" professors, that is, to support research appointments for scientists. Figures for WARF's income are sketchy,[49] but one board member claimed in 1935 that the foundation had accumulated $1,600,000. Another trustee estimated in 1961 that WARF's total net income was more than $13 million and that the foundation held a stock portfolio with a market value of $60 million. The Steenbock patents alone brought $20 million to WARF and earned the biochemist himself $990,000. In the sixty years since its founding, WARF has donated more than $150 million to the University of Wisconsin.[50]

[46] [Clarence A. Schoenfeld], *WARF Summary Report* (Madison, Wis.: WARF, 1 Jan. 1986).

[47] Merle Curti and Vernon Carstensen, *The University of Wisconsin: A History*, 2 vols. (Madison: Univ. Wisconsin Press, 1949), vol. II, pp. 223–232. The immediate cause for this prohibition was a grant from the General Education Board, with "tainted" Rockefeller money.

[48] Roger L. Geiger, *To Advance Knowledge: The Growth of American Research Universities, 1900–1940* (New York: Oxford Univ. Press, 1986), p. 316.

[49] Since the foundation is legally completely separate and distinct from the university, its records are not available for public scrutiny.

[50] Kies to Steenbock, 4 Feb. 1935, Steenbock WARF, Box 3; E. B. Fred, "The Role of the Wiscon-

Following Wisconsin's example, other universities established patent-management agencies. None, however, has been as financially successful as WARF.[51] The foundation's accomplishment resulted from a combination of fortuitous circumstances. The first was the Steenbock patents themselves. Vitamin D was in great demand, and the irradiation process made it relatively easy to market. Licensees were eager to pay royalties for the use of the patents. Then there was the time, energy, and skill donated by dedicated alumni and the efforts of Russell, the first director. Together the patents and the people established a strong basis for WARF's endowment fund. Journalism professor Clarence Schoenfeld, writing in a pamphlet he compiled for WARF, identifies four other important factors: "the exquisite timing that allowed WARF initially to escape, on the one hand, the stockmarket crash of 1929 and on the other, for a time, the arrival of onerous anti-trust and income-tax interpretations"; "imaginative marketing, legal defense, and money-management strategies"; "the good luck or grace that has produced, one after another, a series of lucrative patents"; and "the happy circumstance that each of those processes or products in turn has made such a profound contribution to the human condition."[52]

WARF is, in a word, unique.

VII. AFTERMATH OF THE STEENBOCK PATENTS: THE CONTINUING CONTROVERSY

Yet despite WARF's success, the rationale underlying its development remained in dispute: Should university researchers patent their discoveries? Over the years there were those who still maintained that discoveries and inventions emerging from university research should be given freely to the public, to benefit all without pecuniary profit for some. Consequently, WARF continued to face charges of unfair licensing practices. One 1947 article criticized the foundation for withholding vitamin-D licenses from products outside the dairy industry, explaining, "The University of Wisconsin is supported by the taxpaying dairy industry. Poor people, who are in the greatest need of Vitamin D, could not have vitamin D put into oleomargarine, a spread that they could afford. This would have been contrary to the interests of the dairymen."[53] Others who felt it wrong that Steenbock patented his ultraviolet process took more direct action; they challenged the patents in court.

In the summer of 1943 the Federal Court of Appeals in San Francisco held Steenbock's patents invalid. But, it is important to note, the court did not rule on whether a university or researcher could patent a discovery. The court decided on much narrower grounds instead: the irradiation of foods with ultraviolet rays was a natural process; Steenbock had discovered it but not invented it; and, most significantly, as a natural process it could not be patented. WARF continued the

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sin Alumni Research Foundation in the University of Wisconsin Today," typescript dated June 1961, archive copy in University of Wisconsin Archives; Tom Mahoney, *The Merchants of Life: An Account of the American Pharmaceutical Industry* (New York: Harper Bros., 1959), p. 224; and Schoenfeld, *WARF Summary Report* (cit. n. 46).

[51] Palmer, *Nonprofit Research and Patent Management* (cit. n. 42).

[52] Schoenfeld, *WARF Summary Report*.

[53] H. A. Toulmin, Jr., "Commercial Research by Universities Threatens Science and Education," *Product Engineering*, June 1947, reprint in Steenbock General Subject Files (cit. n. 3), Box 16. See also "Report of the Committee on Clinical Investigations and Scientific Research," *Journal of Pediatrics*, 1936, *8*:124–130.

court fight for several more years, but all litigation ceased in October 1945 when the Supreme Court refused to review the lower court's ruling; the Steenbock patents were invalidated. Interestingly, the main Steenbock patent, received in 1928, had expired on 13 August 1945. On 11 January 1946 WARF "dedicated to the public" the remaining three U.S. patents.[54]

Was Steenbock wise to patent his process? Were his critics vindicated? Had WARF managed to balance successfully the demands of research funding, the public welfare, and commercial growth? Clearly there is no simple answer. True, the patents, while they lasted, gave Steenbock and WARF some control over the commercial use of irradiation, enabling them to insist on standards of production and truth in advertising. Also, the royalties generated an enviable endowment fund for research at the University of Wisconsin. Still, WARF and Steenbock were, as they had to be, influenced by market considerations. As Steenbock rationalized: "While, of course, there are many questions of scientific interest which could be investigated . . . , there are some which under the circumstances assume more importance than others. Although, of course, it is not our desire to emphasize the practical unduly, yet it appears that there is no reason why certain phases distinctly scientific should not be given preference because of their utilitarian aspect."[55] The development of UVO, the denial of a license to the oleomargarine industry, the licensing of only five pharmaceutical houses, the granting of patents to Quaker Oats—all were decisions informed by commercial factors.

This chronicle of WARF and the Steenbock patents clearly demonstrates the problems and possibilities of patenting the results of university research. Advocates emphasize the importance of control, as Steenbock did.[56] A consistent theme running through his work and writing is his conscious commitment to the public good; he genuinely feared the effects of the uncontrolled application of irradiation. He devoted much of his research to devising more effective irradiation processes. Additionally, he felt responsible for the implementation of irradiation and thus impelled to monitor the products produced with his patents. Clearly, patenting shaped his laboratory work. That he spent time on application development and product testing could be interpreted as a "commercialization" of his research. It is clear, however, that he would have characterized it as "humanitarian," as protecting the public.

Those opposed to patenting focus on the "money-making" aspects of the procedure and equate patenting with excessive royalties. In the 1920s and 1930s, for example, there were those who insisted that irradiated products would be much less expensive if manufacturers had no royalties to pay. They pointed to WARF's undeniably large endowment fund as proof of profiteering. Therefore, opponents find that patenting is detrimental to the public good.

Today the debate over patenting university research is somewhat muted, and

[54] "Proposed Statement by Mr. Haight," typescript, ca. 1946, Steenbock WARF, Box 2; "The Steenbock Patents," *Drug Trade News,* 19 July 1943, clipping, *ibid.;* and "Court Withdraws Ruling against Steenbock Patents," *N.Y. Herald Tribune,* 23 Aug. 1943, clipping in the E. B. Fred Files (cit. n. 23), 4/16/4.

[55] Steenbock to H. C. Jackson, 20 July 1939, Steenbock WARF, Box 1.

[56] In a contemporary recasting of this issue of control to protect the public, Patrick Kelly, a St. Louis attorney, engineer, and writer, has obtained a patent for a life-support machine to support bodyless heads. He does not intend to build the machine but patented the plans "in order to prevent anyone from building and using such equipment without a full public debate." Carolyn Levi, "Patent Probes: Ethics of Keeping Severed Head Alive," *Capital Times* (Madison, Wis.), 24 Feb. 1988.

patenting has become the norm on campuses all across the country.[57] With reductions in federal support and other funding sources, increasing numbers of universities have been considering the potential of patenting. Administration and faculty also recognize the commercial possibilities opening in new areas of research such as biotechnology and recombinant DNA.[58] For supporters, patenting represents a promising source of income, an incentive to faculty, and a means of expediting the transfer of knowledge from academe to the public arena. And the success of the Wisconsin Alumni Research Foundation has helped to stimulate interest in this source of revenue. In addition, patenting is encouraged by federal regulations that mandate patenting, or at least require that universities investigate the possibility of patenting. For example, since 1968 any discoveries developed through research funded in whole or in part by the Department of Health and Human Services must be reported to the patent-management agency of the university or to the federal government. To mollify critics who bemoan the encroachment of industry on the campus, universities look favorably on the idea of an independent agency such as WARF to buffer the academic from the commercial. To some extent the foundation has shielded the University of Wisconsin, since opponents more frequently charge WARF with profiteering than they do the university.

While WARF serves as a model of successful university-associated patent management, it is not obvious that WARF's prosperity can be duplicated today. Other university researchers have patented their discoveries, but none has achieved as much as the Steenbock patent.[59] WARF was also deeply involved in the production and marketing of vitamin-D products; such activities are now less attractive, particularly in light of today's liability litigation. For this reason, WARF no longer allows its seal or name to appear on its licensees' products.[60] Furthermore, patent infringement litigation, a continual possibility, is frequently very costly and can tarnish the university's image as an institution for disinterested basic research. In addition, changing federal regulations and tax legislation present today's patent-management agency with a very different financial situation than that which stimulated the development of WARF's endowment fund in the 1920s and 1930s. Nevertheless, universities contemplating the problems and possibilities of patenting share many of the hopes and dreams that motivated Steenbock. As he confided in 1929 to George Haight, a long-time trustee of WARF, "It was partly my pride in originating this scheme that led me to assign my invention to it unconditionally because I wanted it to be a success."[61] Even under the specter of commercialization, WARF developed as Steenbock and his supporters had envisioned—with costs and gains we live with today.

[57] Though muted, the controversy continues among some researchers and scholars. For more on this question see Dorothy Nelkin, *Science as Intellectual Property: Who Controls Research?* (AAAS Series on Issues in Science and Technology) (New York: Macmillan, 1984); also Martin Kenney, *Biotechnology: The University-Industrial Complex* (New Haven, Conn.: Yale Univ. Press, 1986); and Weiner, "Universities, Professors, and Patents" (cit. n. 12).

[58] David Blumenthal, et al., "Commercializing University Research: Lessons from the Experience of the Wisconsin Alumni Research Foundation," *New England Journal of Medicine,* 19 June 1986, *314*:1621–1626; and Weiner, "Universities, Professors and Patents."

[59] An exception may be the Stanley Cohen and Herbert Boyer patent on the basic recombinant DNA process at Stanford. See Weiner, "Universities, Professors and Patents."

[60] John Pike, Managing Director, WARF, interview 11 Feb. 1988.

[61] Steenbock to George Haight, 7 Dec. 1929, WARF files.