ARCHITECTURE AND SCIENCE ASSOCIATED WITH THE DAIRY BARN AT THE UNIVERSITY OF WISCONSIN-MADISON

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Prof. Arnold R. Alanen of the Department of Landscape Architecture at the University of Wisconsin-Madison, supervised the UW-Dairy Barn study and served as overall editor for this report; Holly Smith wrote the section that features the architectural and structural features of the Dairy Barn; and Susan Haswell documented the scientific experiments that occurred within the building, and also traced the evolution of historic preservation efforts that relate to the Dairy Barn and College of Agricultural & Life Sciences campus environment. Christie O'Brien scanned the numerous images included in the report.

Special mention should be made of the contributions provided by Tom Zinnen, former Outreach Program Manager in the University's Biotechnology Center. It was Tom who spearheaded the ongoing activities that seek to document the Dairy Barn's importance as a Wisconsin and University landmark and icon.

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INTRODUCTION

This report features the history of the Dairy Barn at the University of Wisconsin-Madison (hereinafter referred to as the Dairy Barn). Specifically, the following objectives are addressed in the report:

1) to trace the architectural and physical evolution of the Dairy Barn;
2) to locate documentary evidence of scientific experiments that were conducted in the Dairy Barn; and
3) to consider the Dairy Barn within the context of historic preservation efforts that have occurred on the UW-Madison campus.

Before dealing with the specific features of the UW Dairy Barn, it is important to note briefly the influence that the facility had on barn design throughout the nation and even other areas of the world. In fact, Alan Noble, one of America's foremost barn scholars, has classified the "Wisconsin Dairy Barn" as a specific type that can be readily identified in the United States. Of special importance are two design features—the relatively narrow width of the barns, and the numerous windows employed throughout the structures—both of which allowed light to penetrate into the interiors of the buildings. Other distinguishable features included the two rows of cattle stanchions; the low ceilings, usually eight to nine feet high, which conserved the heat generated by cattle during the winter season; and the ventilation system, which cooled the barn during the summer.[1] All of these features will be discussed in greater detail in the subsequent section of the report.

THE PHYSICAL AND ARCHITECTURAL FEATURES OF THE UW DAIRY BARN

This section of the report traces the physical evolution of the UW Dairy Barn from 1898, the year it was constructed, up to 2000. The following objectives are addressed: 1) to document the physical characteristics of the building complex as it was constructed, including architectural features, materials, and technological innovations; and 2) to document the major changes made to the complex since its completion.

The primary sources used in this section of the report include records and publications of the UW Experimental Agriculture Station; manuscripts, photographs, plans, and maps held in the State of Wisconsin Building Archives; materials found in the Manuscript and Visual Materials Archives of the State Historical Society of Wisconsin; and documents in the University of Wisconsin Archives. Secondary sources included several texts about the history of the UW campus and the College of Agriculture; and a number of studies, most of a preliminary nature, that have featured the Dairy Barn.

Background

President Abraham Lincoln's signature on the Morrill Act, which established America's land grant universities, resulted in the reorganization of the University of Wisconsin. The first Professor of Agriculture was hired in 1866.[2] However, little activity occurred in Wisconsin's agricultural education program until William Arnon Henry was hired to assume the post of agricultural professor in 1880[3] (Figure 1). In that position, Henry was to teach botany, meet with Wisconsin farmers, and assume responsibility for the university farm. At the time of his hiring, no agriculture students were enrolled and facilities at the farm were sparse. He later recalled that "aside from the farm with a limited amount of stock and tools, and a couple of wheel-barrow loads of books in the library, any evidence of a department of facilities for instruction" was lacking.[4]

It was largely through Henry's efforts and considerable lobbying skills that the resources and the activities of the department grew.[5] The development of the short course, established in 1885-1886 to provide "brief, practical instruction in agriculture designed to meet the wants of young farmers who could be spared during the winter months," was successful in attracting students.[6] The concurrent development of the Farmers' Institutes brought agricultural education to farmers all over the state, while the establishment of the University Farm as an agricultural experimental station established its role as a center of research. Henry, who was named Dean of the College of Agriculture in 1891, summarized the three-part role of the college:

> In our triune system for the advancement of agriculture, we have the Farmers' Institutes instruction forming the base of the pyramid. Here all farmers and others studying agriculture who cannot attend the university find instruction and assistance. At the University, facilities are provided for those who are gathered there to learn of agriculture. Finally, at the apex of the pyramid, we have original investigation under the direction of the Experiment Station.[7]

Following the establishment of the short course, legislative appropriations made it possible to expand agricultural instruction, to hire more instructors, and to increase teaching facilities. In the 1895 Farmers' Institute Bulletin, Dean Henry wrote a chapter aimed at prospective students that described the programs and facilities of the Agricultural College. He listed the following courses of instruction: "a Graduate Course; a Long Course, requiring four years for its completion, and leading to the degree of Bachelor of Science in Agriculture; a Dairy Course, which fits young men for conducting a creamery or cheese factory, and, lastly, a Short Course in Agriculture."[8] The courses, taught by twenty-two instructors, covered subjects that included animal husbandry and breeding, feeds and feeding, veterinary science, farm dairying, agricultural chemistry, agricultural physics, horticulture, bacteriology, carpentry, and so forth.[9] Henry reported that in the 1897-98 season, 157 students had been enrolled in the short course and 115 in the dairy course.[10]

Reflecting the increasing demand for dairy instruction, as well as the importance of dairy research in the growing dairy industry of the state, a new, up-to-date dairy barn became necessary. In 1895, the Wisconsin Legislature appropriated $5,000 for the construction of such a barn for the college.[11] The following year Dean Henry traveled throughout the eastern United States, where he visited barns and gathered ideas for the proposed dairy facility. Other faculty members also toured barns in Canada and several Eastern states to collect ideas for the Wisconsin barn.[12] However, it was soon determined that the original appropriation was insufficient for the kind of research and teaching facility the college needed.

It was not until 1897 that a larger appropriation made it possible to build the facility deemed necessary by the college faculty. That year, Dean Henry hired Chicago architect J.T.W. Jennings, who had designed the UW's King Hall and the Agricultural Heating Station, to design the barn[13] (Figure 2). Jennings had been educated at Brooklyn Polytechnic Institute, New York University, where he received a degree in civil engineering in 1877. He first worked in the Midwest in 1883, when he became an assistant engineer and architect for the Chicago, Milwaukee and St. Paul Railway. In 1893 he established a general practice in Chicago that he maintained until 1899, when he came to the University of Wisconsin; he served as the University Architect and the Superintendent of Buildings and Grounds from 1899 to 1906. During that period he designed a number of campus buildings including, Agriculture Hall and the Horse Barn

(Figures 3 & 4). Jennings designed the Dairy Barn while still in private practice in Chicago.

Designed as a large and efficient, "state of the art" facility intended for agricultural research, experimentation with dairy cattle, and instruction, the Dairy Barn was completed in 1898.[14] Jennings modeled the barn's exterior after an architectural style used commonly for rural buildings in Normandy, France, while the interior layout was planned by faculty and staff in consultation with agricultural and construction specialists.[15] The original structure consisted of a group of three attached frame barns surrounding a classroom/stock judging arena. The structure had fieldstone foundations, clapboard siding covering the first floor, and shingles on the second and third stories (Figure 5).

The architectural style Jennings used for the barn had ancient precedents in the Normandy region of France. The use of half-timber construction was common for rural farmhouses and farms (Figure 6). These were also frequently augmented with elaborate details on the building gables, dormers, and porticos (Figure 7). In Normandy, many farmhouse and farm buildings also display facades and towers ornamented with decorative masonry, and the latter often are crowned with tent roofs (Figure 8). In views of the UW Dairy Barn, taken just after its completion, one can see the Norman influence in the structure's overall architectural style and in the dormer, portico, silo, and cupola roof details (Figure 9).

Building Massing and Exterior Facades

The original structure consisted of a three-story main barn that was 86 feet long and 50 feet wide. Two perpendicular two-story wings were attached to its southern facade—one, a barn used for housing the dairy cattle (70 feet long and 40 feet wide), and the other a barn for young stock stall (70 feet long but only 30 feet wide) that included a bull stall. Located between these two barns was a 70-foot-long by 40-foot-wide stock-judging arena. The large size of the main barn was designed to accommodate the feed processing and storage needs of the dairy herd, as well as the research facilities and milk processing activities that would be situated there. The livestock wings where the herd was housed were sized to accommodate cattle efficiently according to the university's recommendations for maintaining a healthy herd.

All three barns forming the original structure had gambrel roofs, also recommended by the Experiment Station because of the optimal loft space they provided. On the main barn, the slate roof was supported by simple wooden brackets along the flared eaves, while decorative trusses and verge boards were situated on each gable end; the mid-point of the roof along the northern side was punctuated by a pair of attached gabled dormers, which themselves were flanked by two smaller hipped dormers (Figure 10). The southern side of the roof displayed three of the smaller hipped dormers. Each livestock wing also revealed three hipped dormers (Figure 11). The classroom flanked by the wings had a gable roof into which eight large multi-paned skylights were set.

The wagon entry into the main barn, located at the center of the northern facade was covered with a gabled portico with flared eaves. Displayed on the eastern end of the barn was a smaller, gable-roofed portico, ornamented with a scaled-down replica of the main gable decorative trusses and verge boards. This portico marked the pedestrian entry into the milk room, which was situated in the southeastern corner of the barn's first floor.[16] Pedestrian access was also provided directly into the barn through a door in the eastern facade between the portico and silo. Double wagon doors were also located on the western facade of the main barn where a trestle led to the third floor loft.

Both perpendicular wings and the arena had wagon and/or pedestrian entries along their southern facades. The eastern wing--the cattle barn--had both a pedestrian door and a central double door that provided a wagon entry for feeding the cattle, while the young stock barn was designed and built with a single large central door. Both wings had double loft doors as well. The arena displayed centrally located large double doors that allowed wagons, livestock, and pedestrians to enter from the barn yard.

The Norman architectural influence was especially evident in the tower silo that Jennings designed for the barn (Figure 12). Situated at the northeastern corner of the structure, it had a half-timber upper story on top of a brick tower, all of which were topped by a tent roof with flared eaves. The form was ornamented with individual multi-paned windows set just under the eaves in the half-timber upper story, and a series of very small windows that circled the top of the brick section of the structure, just above a band of diamond-pattern decorative brick work.

Providing adequate sunlight was an important consideration in the design of the barn. Light penetrated the third floor loft of the main barn through the dormers and two tiers of windows on both ends. The upper windows, located just beneath the gable, consisted of two small multi-paned adjacent windows. Below these, on the eastern end, were three larger multi-paned windows. In the western facade, two multi-paned windows flanked the third floor wagon doors. Centered below the trestle was a pair of small, adjacent, multi-paned windows. Below them, three multi-paned windows provided light to the first floor, and in the southwestern corner, a small multi-paned window was located adjacent to a pedestrian door. In the eastern gable end of the barn, the second floor was illuminated through three multi-paned windows, while the first floor was lighted through four windows that flanked the pedestrian doors. On the northern facade, the symmetrical fenestration pattern consisted of a pair of three adjacent multi-paned windows that flanked the portico on both the first and second stories.

The provision of adequate sunlight was considered especially important in the livestock barns. The barns demonstrated the placement of windows that the researchers advocated (Figure 13). Ten multi-paned windows were evenly arranged along both the eastern and western walls of both the dairy cow and the young stock barns. Multi-paned windows that flanked the first and second floor doors were also placed symmetrically on the southern barn facades. The southern facade of the arena/classroom contained sixteen large multi-paned windows that covered most of the facade, and brilliantly illuminated the room.

Floor Plans

The original plan of the main barn provided extensive work areas for efficient storage and feeding capabilities, as well as stable areas and educational facilities. The building accommodated most of the livestock feed. The third floor loft housed equipment for the processing, weighing, and distributing of grain, hay, and ensilage around its perimeter, while retaining a large enough open space for wagons to turn around (Figure 14). Inside the double doors at the top of the trestle was a wagon scale used for the weighing of loads. Very large two-story hay bays flanked the scales. Hay was passed to the livestock areas through chutes on either end of the loft. At the eastern end, a fodder cutter and feed grinder were powered by an electric motor that was mounted on a cart that could be shifted from one side of the barn to the other on a short iron track.[17] Ensilage was cut and dropped down into the silo, whereas grain passed through trap doors into grain bins on the second floor.

The second floor of the barn was designed for grain, hay, and fodder storage (Figure 15). Placed along the southeastern wall of the space were five grain bins with a capacity of twenty to thirty tons each; the bins stored the oats, bran, corn meal, shorts, and oil meal that were dropped in from the loft above.[18] The remainder of the floor was devoted to storage space for cut fodder and the two hay bays.

The first floor of the main barn was a center for feeding and milk processing activities (Figure 16). A feed storage area, situated below the second-story feed bins, was located along its southern wall near the livestock barns; opposite the central corridor through the building was a hay mow. The wagon passageway entered from the north up a stone ramp, passed in through the northern entry portico, and then went through the center of the building into a stock judging room. The first floor also housed critical facilities such as the milk room--which had a tile floor, a marble baseboard, and was lined with steel sheeting coated with white porcelain paint--as well as hospital stalls, an office, a bed, and a bathroom.[19]

The basement of the main barn was divided into two rooms: one held the workshop and heating plant, as well as an artesian well, where water was pumped by means of an electric motor into the water tank on the top of the silo; the other room was utilized for the storage of root crops and other items.[20]

Cow Barn

The cow barn, laid out for thirty-six cows in two rows of eighteen stalls, had the cows facing a 10-foot-wide central passage that accommodated a feed wagon. The barn was lined with corrugated galvanized iron sheeting that could be readily scrubbed and hosed down daily. The floor, made of Portland cement and crushed granite, was slightly sloped so that water would run into the sewer drains. The manure gutters and mangers were formed of the same material as the floor (Figure 17). The gutters were sixteen inches wide and sloped slightly to the inside edge where traps could be opened in order to flush out the gutters. The concrete mangers, 2'-6" wide and 8" high near the cow and 16" high near the central passageway, ran the length of the barn along each side of the central passage. Sloping towards a central drainage valve, they served as both feeding and watering troughs.[21]

The stalls were constructed of gas pipe posts anchored in the concrete floor, and panels of steel wire mesh (Figure 18). The front panels were designed to be adjustable so that the stall length could be fitted to an individual cow. The side panels were hinged to allow access for milking and to make it possible for the animals to exit their stalls without having to back out over the manure gutters[22] (Figure 19).

Young Stock Barn

Arranged in an overall fashion like the cow barn, including a central corridor and mangers running between the livestock areas, the young stock barn contained calf pens, young stock stalls, and bull stalls. Also like the cow barn, it was lined with galvanized iron and had a cement floor. All but the very young calves were fed in cement mangers. The stall partitions consisted of gas pipes embedded in the concrete floor (Figure 20). The calves and heifers were allowed to move freely in their stalls, except at feeding times, when they were restrained in stanchions. The two bull stalls at the southern end were built of heavier bars.[23]

Classroom

The bark-floored classroom/arena was a largely open space that included a section of wooden bench seats arranged along the western wall[24] (Figure 21). Intended for use as a classroom, and as a stock-judging arena where animals could be photographed, it was well lit by spacious skylights arranged on both sides of its gable roof and by sixteen large symmetrically placed multi-paned windows that filled its southern gable end[25] (Figures 22, 23, & 24).

Silo

The silo designed by agricultural physicist Franklin Hiram King (Figure 25) for the University's dairy barn was a circular tower structure, 33 feet deep with an inside diameter of 18 feet. A frame structure, lined on the outside with cream brick and inside with brick and a "heavy coating of Portland cement," the imposing structure sat on a stone foundation (Figure 26).[26] Filled from the third story of the main barn, the silage was retrieved from the silo through a chute to the first floor where an ensilage cart mounted on a track transported the feed to the cattle mangers.[27] Within the octagonal half-timber upper story, King installed a water tank that supplied water to all of the University farm buildings.

Wagon Trestle

Another remarkable feature of the dairy barn was the imposing wagon trestle that led into the third story loft (Figures 27 & 28). Passing over six light steel spans set on brick piers, the wooden runway led at a seven percent grade up to the double doors in the western gable end of the main barn.[28]

Ventilation

Many features of the University dairy barn were the result of research that the faculty and staff had conducted at the College of Agriculture. The overall proportion and layout of the livestock barns, the placement and number of windows that provided adequate light, the stall and manger design, the construction materials used inside the barns, the milk processing equipment, and the feed storage and processing facilities were considered state-of-the-art "scientific" features.

One of the most important technological innovations provided for the barn was its ventilation system. Designed by F. H. King, the duct system provided air circulation for the livestock barns. With the construction of tighter livestock barns, King realized that proper ventilation was needed to ensure animal health. Therefore, he devised a duct system, which became known as the "King System," and demonstrated it in the dairy cow and young stock wings of the University's dairy barn.[29]

King's system consisted of two sets of flues, one for moving fresh air into the barn and the other for removing stale air. These are marked in the section and plan of the barn (Figure 29). The barn walls were hollow, with paper and siding on the outside and flooring and galvanized iron on the inside. Iron was also mounted on the ceiling, just below the loft floor. These spaces provided insulation from the heat and cold.[30]

Through these spaces, ducts were constructed to bring in fresh air. Intake flues, located along the exterior wall, were spaced approximately 10 feet apart on both sides of the barn. The exterior opening was located near the bottom of the wall (F in Figure 29); the air rose through the flue and entered the barn near the ceiling (G), where it would not blow directly on the cattle. Valves at F and G allowed precise control over the amount of exterior air entering the building.

The main flues for removing air were located in the center of each side wall and in the ceiling. The 18"x 24" side-wall ducts had openings near the floor of the barn (A) and near the ceiling (B), both of which could be adjusted individually. The ceiling duct (C), 12 inches in diameter, which led directly to the main flue, could also be opened or closed. These ducts joined the main iron flue (D), which was 36-40 inches in diameter and rose 50 feet above the barn floor inside the ornamental cupolas that crowned the barn's roof.[31]

This system was recommended for diary farmers throughout Wisconsin. C.A. Ocock, an agricultural engineer at the University Agricultural Experiment Station, wrote a bulletin on the King system in 1908, including plans and instructions for its installation (Figure 30). He noted that the station received many requests from farmers asking for help in providing proper ventilation for their livestock.[32] He remarked that the design, "as installed in the University diary barn has been used satisfactorily for eleven years, and has also proved successful when installed in other stables."[33]

The "Cow Palace"

The Dairy Barn was a showplace for the College of Agriculture. Heated with steam and illuminated with electricity, the barn provided the latest in research and educational facilities (Figure 31). And, it was simply a beautiful building. An author for *The Daily Cardinal*, the University of Wisconsin student newspaper, reflected the general sentiment about the barn:

> All who are in a position to appreciate its usefulness are very enthusiastic in their praises of the new barn. From without it is truly a beautiful building. The tower in the corner and the little cupolas--resembling minarets--give it an artistic appearance. But once within the building we are surprised and astonished at the many inventions that have been utilized in order to make the building as up-to-date and useful as possible.[34]

The many early photographs of the barn provide eloquent evidence of the public's appreciation of the striking building. Even postcards were produced featuring the structure (Figures 32, 33, 34, & 35). Known among some campus workers as the "cow palace," the University Dairy Barn was a remarkable testament to the important role the College of Agriculture played at the University of Wisconsin-Madison.

EVOLUTION OF THE UW DAIRY COMPLEX

As the role of the College of Agriculture grew and expanded, the need for larger facilities also increased. For several decades, the changes that took place in and around the Dairy Barn remained relatively small scale. Eventually, new buildings were constructed and attached to the original barn to create a larger dairy complex. Alterations were also made to the original structure over the decades, which resulted in the loss of many architectural details. The investigation concluded for this project have been successful in documenting most of the large scale additions to the original barn, but to date very little has been discovered to document when many of the internal changes occurred.

The need to provide better fodder for the dairy cattle during periods of summer drought led to the first documented change to the original structure when a new "80-ton stave" silo was constructed next to the barn in 1908. Intended to store silage for summer feeding, the silo was located on the western side of the main barn, just south of the wagon trestle.[35]

The first building added to the original structure was designed by University Architect Arthur Peabody, and constructed in 1909 for a cost of $1,426[36] (Figure 36).

Known as the litter shed, the gambrel-roofed structure was built just west of the original barn and south of the wagon trestle (Figure 37). Peabody sited the shed parallel to the original barn's wings, and aligned its southern edge with these wings. The eastern and southern ends of the building were open and supported on cedar posts, while the western and northern facades were covered with siding. The two-story, 40' x 60' structure was designed to hold 300 tons of manure on the ground level. The upper story was to be utilized for the storage of "coarse fodder."[37] At a later point, the shed was connected to the main barn by a narrow passageway that led from its northeastern corner into what had been the young stock barn.

Two major additions were made to the UW dairy complex in 1916-17. A new dairy cattle barn, called the Experimental Dairy Barn, and a new milk house, the Experimental Dairy, were constructed east of the original structure and connected to the main barn by an enclosed passageway (Figure 38). Like the litter shed on the opposite side of the original barn, the Experimental Dairy barn was sited parallel to and aligned with the existing livestock wings. Its exterior details were designed by the Office of the State Architect to match those of the original barns[38] (Figure 39).

The Experimental Dairy Barn was built according to the specifications advocated by the dairy faculty. It was 70 feet long and 36 feet wide, the standard width recommended by the Experiment Station to accommodate two rows of cattle. Furthermore, it was designed with two lines of seventeen stalls that faced the central feeding alley, where the concrete mangers could be filled easily from feed wagons (Figures 40 & 41). Individual water fixtures were to be situated at each stall; a track mounted on the concrete floor around the perimeter of the barn was to carry the litter carts and milk can carriers. However, many of these items were omitted in a 5 December 1916 addendum to the building specifications, which included the following statement:

> 4. Omit stable fixtures, cork brick floors of cow stalls. Omit cow stalls, litter carrier, milk can carrier, track, track hangers and switches, supports for carrier outside of barn, water buckets, regulating tanks, manger and gutter drains, window ventilators, heating, lighting and plumbing.[39]

Just when the stable fixtures were installed in the barn has yet to be documented, but it seems likely that the barn did not remain unused for a very long period of time.

Yet, other than these omissions and several minor other changes, the basic structure was constructed as planned. The building was constructed on a concrete foundation; its exterior walls were covered with wood siding up to a belt course, above which they were clad with cedar shingles. The roof, punctuated with two double multi-paned shed-roofed dormers on each side, was also covered with cedar shingles.[40] The second story of the barn functioned as a hay loft and had two hay chutes that were used for dropping feed to the livestock below. The King ventilation system was utilized in the barn, with parts and ventilators supplied by the James Manufacturing Company in Fort Atkinson, Wisconsin (see Figure 30 for location of intake and outtake flues).[41]

The milk house, sited between the two barns, was designed to function as both a dairy on the first floor and as a dormitory for students on the second. Its exterior siding and cornice details were also designed to match those of the original barn. The first floor of the new dairy, which contained rooms for weighing, separating, and dispensing the milk, opened on its southern side to the six-foot-wide enclosed corridor that connected the Experimental Barn to the original structure.

These structures, as a group, created a complex of barns that served as the University's dairy facility for years. They remain intact despite the fact that dairy activity

has, for the most part, moved into newer facilities. A review of plans for the grouping demonstrates, however, that the number of silos attached to the complex has changed as both the research needs and technology evolved. For example, a 1939 plat plan of the dairy barns reveals that after 1908 a wooden silo had been attached to the northern end of the Experimental Barn, a concrete one had been built on the western end of the main barn, and one large and two small concrete silos had been added to the eastern side of the diary cattle wing of the original structure. By the time the 1942 Sanborn Insurance Map of the complex was prepared, another concrete silo had been constructed south of the same wing. A detailed plan of the complex, drawn in 1955, reveals that the 80-ton stave silo built in 1908 had been removed, and that the three silos east of the dairy cattle wing were constructed of steel.

CHANGES TO THE ORIGINAL STRUCTURE

The remainder of this section reviews the interior and exterior changes that have occurred to the Dairy Barn since its construction. As is described, major changes were made to both the interior and exterior of the building

Interior Changes

While the basic structure of the original dairy barn designed by J.T.W. Jennings and College of Agriculture faculty has remained intact at the core of what became a larger dairy complex, a number of alterations were made to the interior of the building. The first documented alterations occurred in 1919 when additional grain bins and box stalls were constructed in the main barn. The two new stalls were constructed north of the hay mow on the first floor of the barn, while new grain bins were added on the first floor north of the original feed room. A set of bins was constructed on what was called the mezzanine, located between the first and second floors, as well as on the second floor. These storage areas were situated above the new stalls and new first floor bins, and were connected to them with chutes. Although no written explanation for the alterations has been located, the bins were built to store specific grain types as labeled on the plan, indicating that they were designed and constructed for the grain feeding experiments being conducted by College faculty.

By 1955, when detailed plans of the dairy complex were prepared, the University had constructed a new dairy center that assumed some of the original functions of the old barn. Space began to be utilized for other purposes and by other departments. A comparison of the original 1898 barn plans with those in 1955 reveals that a number of alterations had occurred in the interim.

By 1955, the basement had been divided into a rabbit room, which occupied its eastern end, while the remaining space contained livestock stalls. On the first floor, the northern end of the young stock barn had been partitioned off and was utilized as a genetics laboratory. What had been the original milk room and bathroom near the eastern entrance to the main barn had been closed off from the outside and converted, by 1955, into an operating room. An elevator running from the basement to the third floor had also been installed in the main barn between the brick silo and operating room.

Since that time, remodeling has continued to occur in several sections of the barn. In 1961, a partition was built in the genetics laboratory that created a rabbit room out of the eastern half and a new manure chute that emptied into the basement. Both the partition and chute were removed in 1978, however, when the genetics lab was remodeled again. Also, at that time, the original windows in the space were covered with plywood and an enclosed wooden ramp was constructed leading from the lab to the basement.

Exterior Changes

A number of alterations have been made to the original Dairy Barn exterior. Most obvious, perhaps, is the absence of the wagon trestle leading to the third floor loft of the main barn. The ramp had been substantially re-built in 1922. The original steel towers were braced, and some of the brick piers on which they rested were replaced with concrete supports. Two new steel braces were also added to support the ramp. The wooden runway was replaced with a reinforced concrete surface supported by the steel towers[42] (Figure 42). Sometime between the time these improvements were made and before 1942, the remarkable structure was entirely dismantled.

The most notable losses to the Jennings' design have occurred in the exterior facade of the main barn and in the roof. A number of windows have been removed or covered up in the main barn and in the original silo (Figure 43). All of the dormers have been removed from the main barns and original wings, and the striking ventilation cupolas have also been dismantled. The skylights were removed from the stock judging arena and the roof of the entire original structure is now covered with asphalt shingles. Finally, the distinctive decorative barge boards have been removed from both the main barn and Experimental Barn (Figure 44). While the removal of these features most likely stems from changes in technology and the use of the structure, they have resulted in a significant loss of architectural detail that was central to the overall remarkable design.

THE DAIRY BARN AND HISTORIC PRESERVATION ACTIVITIES ON THE UW CAMPUS

The Dairy Barn's *local* significance as an enduring campus landmark is indisputable. By virtue of its role in the early development of the University of Wisconsin's College of Agriculture, the Dairy Barn's significance to *state* history also is readily apparent. Demonstrating *national* significance, however, requires placing the events that took place in the Dairy Barn within a much broader historical context. To aid in such analyses, the National Historic Landmarks program (NHL) is producing a series of "theme studies," which will provide a national context for specific topics in American history or prehistory. Unfortunately, no theme study is available yet for biochemistry or life sciences research.[43] In the absence of a NHL theme study, establishing a site's national significance would present formidable challenges.[44] At the very least, such an undertaking would require: 1) identifying all the research centers in the United States where highly significant biochemical discoveries have taken place; and 2) contacting state historic preservation officials and university administrators to determine the current status of buildings where those events occurred.

Such measures are beyond the scope of this phase of the project, which has the less ambitious goal of establishing a chronology of events that took place in the Dairy Barn. These preliminary findings will prove helpful if subsequent researchers choose to make a case for the building's national significance.

Considering the maelstrom of development that swept the UW campus after World War II, the Dairy Barn's survival is remarkable and, indeed, somewhat puzzling. In the 1940s, university officials struggled to accommodate a host of war-related programs and attempted to plan for the huge influx of veterans expected to enroll after the war (Figure 45). A. F. Gallistel, then superintendent of the UW Department of Buildings and Grounds, chaired a committee that inventoried campus buildings and made recommendations about their maintenance and retention. By 1946, Gallistel's committee

had passed judgment on campus buildings that were at least 35 years old. The Dairy Barn, 49 years old at the time, was deemed "obsolete" and an "extreme fire hazard," with the committee recommending that the barn be razed "when replacement is available." For reasons unknown, the Dairy Barn survived, along with several other campus landmarks deemed obsolete by Gallistel's committee. Among the College of Agriculture buildings considered ripe for razing at the time were Hiram Smith Hall (1892); King Hall (1894; originally known as Horticulture and Agricultural Physics); the "Old Horse Barn" (1900); and the Agricultural Bulletin Building (1900; formerly known as the Agricultural Heating Station).[45]

A bulletin produced in the late 1940s to publicize the University's construction "wish list," *Building Wisconsin*, recommended that the Dairy Barn be replaced by "a safe, economical building, equipped with classroom and laboratory space, [which] would make the University's dairy facilities satisfactory for teaching and suitable as a 'show window' for Wisconsin's dairying." The bulletin maintained that the Dairy Barn "contradicts almost everything recommended in dairy housing," that the building was "out of step with modern dairying," "highly inflammable," and "not planned for the saving of time and money in herd care."[46]

In light of post-war attitudes about the utility of older buildings, how did the Dairy Barn survive? One possible explanation is that its demolition became unnecessary after the University obtained funds in the early 1950s to build the Dairy Cattle Instruction and Research Center. The site chosen for the new facility was immediately east of the Dairy Barn, where Kleinheinz Hall then stood.[47] Originally a sheep barn, Kleinheinz Hall had been converted into a dormitory for College of Agriculture short course students. A fire that occurred in 1950 when the students were in residence heightened awareness of the building's inadequacies.[48] The following year, a site was being selected for a new dairy cattle facility; a report on the selection process noted that "the only buildings that would have to be torn down are some which now constitute a serious fire hazard."[49] Ultimately, Kleinheinz Hall was razed to make way for the new dairy research center. Possibly, the Dairy Barn survived because the construction project did not require the space it occupied. An alternative explanation is that funds for razing the barn simply were not included in the project's appropriation. Further research would be required to confirm these hypotheses.

By the 1970s, celebration of the U. S. Bicentennial had strengthened public support for historic preservation. One local manifestation of this trend was a book published in 1977, *Barns of Wisconsin*, written by College of Agricultural & Life Sciences Professor Jerry Apps and illustrated by Allen Strang. Not surprisingly, *Barns of Wisconsin* contained a description of the Dairy Barn. Apps noted that the building had been altered somewhat over the years, but that it continued to be a "reminder of the college's role in providing leadership to the emerging dairy industry in Wisconsin."[50]

Around the same time, the UW-Madison Department of Planning and Construction was compiling an inventory of cultural resources on campus--historic architecture, archaeological sites, and memorials. The resulting report, *Perspectives of a University*, recommended that an agricultural campus historic district be nominated to the National Register of Historic Places. The study identified several Agricultural campus buildings as "first priority," a rating defined as "possessing a high degree of architectural or historical integrity and whose retention is essential." Included on the "first priority" list was the Dairy Barn.[51]

By the 1980s, many of the Agricultural campus buildings that the Gallistel committee had recommended for demolition were listed on the National Register of

Historic Places (see Table 1). The most recent National Register nomination involving Ag campus buildings is the Henry Mall Historic District, which was listed on January 22, 1992.[52]

Clearly, campus planners' attitudes about historic preservation changed profoundly from the 1940s to the 1970s, and the Dairy Barn probably owes its existence to that trend. Condemned in the post-war period as an obsolete fire hazard, the Dairy Barn emerged during the Bicentennial era as a cherished campus landmark whose retention had become "first priority." Nevertheless, a National Register nomination drafted for the Dairy Barn in 1985 never has been submitted.[53]

Table 1
College of Agricultural and Life Sciences Properties
Listed on the National Register of Historic Places
as of March 1997

Historical name	Address	Date of historical significance*	Date listed on NRHP
Agricultural Chemistry Building	420 Henry Mall	1912	6-19-85
Agricultural Dean's Residence	10 Babcock Drive	1896	9-20-84
Agricultural Engineering Building	460 Henry Mall	1907	6-27-85
Agricultural Heating Station	1535 Observatory Drive	1901	3-14-85
Agriculture Hall	1450 Linden Drive	1903	3-14-85
Henry Mall Historic District	map available	1903-1913	1-22-92
Hiram Smith Hall and Annex	1545 Observatory Drive	1891 & 1909	3-14-85
Horticulture and Agricultural Physics, and Soil Science Bldg.	1525 Observatory Drive	1896 & 1915	3-14-85
Stock Pavilion	1675 Linden Drive	1908	7-11-85

*This source provides the "date of historical significance" for each listed property. Some dates shown above vary slightly from those provided by other sources.

Source: *The National Register of Historic Places and the State Register of Historic Places in Wisconsin* (Madison: Division of Historic Preservation, State Historical Society of Wisconsin, March 1997), 10-12.

LIFE SCIENCE RESEARCH CONDUCTED WITHIN THE UW DAIRY BARN

Oral tradition at the UW-Madison has identified the Dairy Barn as the site of groundbreaking research in the life sciences, including the animal nutrition experiments that led to the isolation of Vitamin A. Recently published descriptions of the Dairy Barn have reinforced these oral traditions.[54] The primary objective of this section of the report is to find documentary evidence of experiments that took place in the building, and thereby provide a foundation for demonstrating the significance of the Dairy Barn in the history of life sciences research in the United States.

Findings

In its one century of history, the Dairy Barn has sheltered thousands of livestock demonstrations, judging events, and experiments. The initial focus of this project, however, has been to determine what role the building played in a specific line of research: the animal nutrition experiments that led to the discovery of Vitamin A.

Animal nutrition research at the UW dates back to the earliest years of the University of Wisconsin Agricultural Experiment Station, which was established in 1883.[55] Henry Prentiss Armsby, author of a manual on cattle feeding, arrived in Madison that year to establish the department of agricultural chemistry. From 1883 until his departure in 1887, Armsby conducted a series of controlled feeding experiments in which he attempted to determine the relative value of foods.[56] Many of Armsby's experiments were housed in the basement level of the building now known as the Horse Barn. It was one of three buildings that housed the university's agricultural program in the early 1880s. The remainder of the agricultural program's "physical plant" consisted of a stock barn and a two-story farmhouse.[57]

While Armsby was conducting research at Wisconsin's experiment station, Stephen M. Babcock (Figure 46) and his assistant, E. B. Hart (Figure 47), were analyzing animal feeds at the New York state experiment station in Geneva. As Hart recalled many years later, the results of these experiments "shook Dr. Babcock's confidence in the evaluation of feed materials by chemical analysis." Chemical analysis was the only known method of determining food values at the time.[58]

Babcock joined the UW College of Agriculture faculty in 1887. Within three years, he had developed a revolutionary new method for determining the butterfat content of milk. Meanwhile, W. A. Henry continued to pursue feed analysis research. Henry's classic animal nutrition text, *Feeds and Feeding*, was published in 1898.[59]

During these years, the College of Agriculture began to outgrow its administrative headquarters in South Hall.[60] In 1901, the state legislature appropriated $150,000 for "the construction of a central building for the College of Agriculture," and the building was completed in 1903.[61]

Agriculture Hall, as the building is known today, represented the culmination of a ten-year construction boom on the College of Agriculture campus. A cluster of four new buildings had arisen on the western end of Observatory Hill: the Dairy Building (1892, now called Hiram Smith Hall); the Horticulture-Agricultural Physics Building (1893-98, now called King Hall); the central heating plant (ca. 1899-1901, now called the Agricultural Bulletin Building); and Agriculture Hall (1902-3).[62] Between the Dairy Building and Lake Mendota stood the Dean's new residence (1897), which commanded a view of the farm grounds and the new Dairy Barn, completed during the winter of 1897-98.[63] Several other structures on the College of Agriculture campus had undergone renovation or relocation during this period, as well.[64]

By the turn of the century, several barns were providing shelter for experimental animals.[65] In addition, contemporary plans for Agriculture Hall show rooms earmarked for animal research. An "animal room" and animal crematory were located in northwestern corner of the basement level. Chemical research laboratories, both for students and for higher-level researchers, were located throughout the building.[66]

Thus, when E. B. Hart arrived in Madison in 1906 to succeed Babcock as professor of agricultural chemistry, he found a modern (if soon to be outgrown) research facility. Hart intended to continue Babcock's animal nutrition experiments, which involved feeding heifer calves on rations balanced from restricted sources.[67] He began immediately to search for a qualified assistant, and early in 1907 hired Elmer V. McCollum (Figure 48).

McCollum arrived in Madison that summer, quickly striking up a friendship with the semi-retired Babcock. The elder man visited the young researcher's lab in Agriculture Hall on a daily basis, holding forth on the history of nutritional investigations and the inadequacies of methods then used for food analysis.[68]

As Hart's assistant, one of McCollum's responsibilities was to monitor the ongoing heifer feeding research. Years later, he recalled his first encounter with the experimental animals:

> They presented amazing contrasts. The wheat-fed cows were small of girth and rough-coated. They were all blind, as shown by the lead color of the eyes and by their inability to find their way about. Each had recently given birth to a greatly undersized premature calf and all calves were dead when born. The oat-fed cows carried their young to full term. Though the calves were of normal weight at birth, all but one were dead then. . . . The corn-fed cows were, by standards of animal husbandry, in excellent condition. . . . Though all the cows had had feed of the same chemical composition, they differed enormously in physiological status. I was employed to discover why this was so. It was a man-sized job for a beginner.[69]

In the four months following his arrival in Wisconsin, McCollum developed profound misgivings about the feeding experiment's methodology. Looking for alternative approaches, he reviewed European nutrition research, some of which had used small animals. Ultimately, McCollum concluded, "the only promising course lay in the use of the simplest possible diets in the chemical sense, and of employing small animals."[70] When he suggested to Hart that rats might be fruitfully employed in nutrition research, however, "It was clear that he disapproved of my plan."[71] The heifer experiment had attracted a good deal of favorable publicity, and Hart believed that it held great promise. Frustrated, McCollum confided in Babcock, who "was highly enthusiastic" and encouraged McCollum to present his ideas to Harry Russell, dean of the College. Russell, too, was unreceptive: "If it ever got noised about that we were using federal and state funds to feed rats we should be in disgrace and could never live it down."[72]

Nevertheless, Babcock encouraged McCollum to proceed, and accompanied him to Hart's office to re-argue his case. In deference to Babcock, Hart grudgingly gave McCollum permission to start a rat colony. He refused to sign McCollum's requisition for two dollars' worth of supplies to build cages for the animals, however. At first, McCollum attempted to start a colony with wild rats trapped at the University horse barn, but quickly discovered them "too savage. . . for breeding and experimental work." Instead, he bought a dozen albino rats from a Chicago pet dealer, and began his first experiment in January 1908. "As far as I can recall," McCollum wrote many years later, "my rat colony was never made a project with funds allocated for its support. No publicity was given to it. It was tolerated rather than approved except by Dr. Babcock."[73] According to McCollum, his was the first rat colony in America maintained for nutrition studies.[74] Although McCollu's memoirs fail to mention where he kept the animals, it seems likely that the colony was housed initially at Agriculture Hall, the site of McCollum's lab.[75]

Meanwhile, McCollum continued to conduct chemical analyses for Hart's cow feeding experiment. Results of that research were published in June 1911 as Research Bulletin 17 of the University of Wisconsin Agricultural Experiment Station (Figure 47). The report was co-authored by Hart, McCollum, Harry Steenbock, and G. C. Humphrey.[76] Steenbock had been one of two students enrolled in McCollum's first lecture course on the biochemical aspects of nutrition.[77] As chair of the department of animal

husbandry, George C. Humphrey had been responsible for the care and feeding of the experimental animals.[78] The cows "were kept in the fairly well lighted basement of the University dairy barn and allowed outdoor exercise in a vegetation-free paddock during all days that the weather would allow."[79]

Unfortunately, the bulletin provides no information about how their rations were processed or stored. A description of the Dairy Barn written in 1898 tells of its facilities for grain handling:

> The grain required for feeding the stock is . . . taken into the building on this [top] floor and emptied through trap doors in the floor into the feed bins on the second floor and from thence is drawn through spouts to the feed room on the main floor. . . . A feed grinder is placed on this [top] floor so that feed may be ground for the stock before passing into the bins below.[80]

Accompanying floor plans show five trap doors on the top floor of the barn. Just below on the second floor are five small rooms (the feed bins), labeled on the plan as "oats, oil meal, bran, shorts, and corn meal."[81] On the main floor underneath is the feed room, along the inside wall of which five small squares are shown (representing the end points of the grain dispensing apparatus). It was in the feed room, presumably, that these components were mixed according to the formulae required by the barn's various inhabitants.

The single-grain experiment animals received only one of the five types of rations shown on the 1898 floor plan, however: corn meal.[82] Other ingredients that were used in the experiment (corn gluten, wheat gluten, and wheat meal) presumably would not have been dispensed through the gravity-fed apparatus. In addition, the single-grain experiment animals received corn stover (dried stalks and leaves), wheat straw, and oat straw.[83]

Across the hall from the feed room, adjacent to the Dairy Barn's office, was a stairway. Rations for the single-grain experiment cows probably would have been carried down these steps. The 1898 description of the Dairy Barn indicates that the basement originally was intended for use as a root cellar and workshop. In other words, the space had not been planned to accommodate animals. Why the cows were housed in the basement remains unknown; perhaps the stalls and pens on the main floor were fully occupied at the time the experiment began in 1907. It's also possible that the researchers were anxious to conceal the deteriorating condition of some animals.

Decades later, Hart reflected on the significance of the single-grain feeding experiment, maintaining that the study had

> . . . disclosed the complete inadequacy of the theory of balanced rations as it prevailed at the beginning of this century. Protein and energy were the total concepts of nutrition needs at that time. This work disclosed that there were other nutritional factors needed and was of immense stimulation for further research, not only here but throughout the country. Modern textbooks on nutrition refer to these early experiments as initiating a new era so far as America was concerned in reference to the field of nutrition.[84]

McCollum's assessment was more modest: "All we were able to do was to describe the experiment and the effects on the cows of feeding single-plant rations. We were unable to explain why the animals on the different rations contrasted so strongly in physical development and physiological well-being."[85]

Attempting to identify those "other nutritional factors needed," McCollum ran scores of experiments with his rat colony. His collaborator was Marguerite Davis, a meticulous and dedicated researcher who came to McCollum's lab in 1909 to learn

biochemistry and subsequently took over responsibility for the rat colony.[86] Their first breakthrough occurred in 1912, when they demonstrated that "contrary to the prevailing belief[,] fats differed in nutritive values."[87] Up to that time, fats had been regarded as concentrated energy sources, all with equal nutritional value. The paper reporting this initial discovery appeared in the *Journal of Biological Chemistry* in 1913.[88] A second paper, published in 1914, described how McCollum and Davis had isolated a growth-promoting substance from butterfat. That growth-promoting substance turned out to be Vitamin A.[89]

Davis continued to work with McCollum until 1916, when she resigned. Their collaboration produced ten research papers, nine of which appeared in the *Journal of Biological Chemistry*.[90] In addition to Davis, McCollum's collaborators at Wisconsin included Nina Simmonds and William Pitz.[91] Their research also was published in the *Journal of Biological Chemistry*.[92] Nutrition breakthroughs at Wisconsin gained wide notoriety when *Hoard's Dairyman*, the national farming weekly based in Fort Atkinson, published a series of articles by McCollum in the summer of 1916.[93]

McCollum's work had caught the eye of the national scientific community. In January 1917, he accepted an invitation to present a lecture to the prestigious Harvey Society in New York City. His trip to the East included a stop in Baltimore, where he was offered chairmanship of the department of chemistry at Johns Hopkins University's new School of Hygiene and Public Health. It was a once-in-a-lifetime invitation that McCollum eagerly accepted. Years later, he recalled his excitement:

> I could scarcely realize that I, a worker in an agricultural experiment station, with no medical training and no contacts with public health, was the first professor selected to take charge of a department in the new and exciting adventure of training medical and nonmedical students to reduce or control, and perhaps to eradicate, the great scourges in the form of diseases which afflicted mankind.[94]

Not surprisingly, McCollum's colleagues at Wisconsin responded to the news of his impending departure with less enthusiasm. Sworn to secrecy by the Johns Hopkins administrators, he waited until April 1917 to announce his intentions.[95] Later that summer, Harry Steenbock complained to College of Agriculture Dean Harry L. Russell that McCollum had refused to turn over his nutrition notes and experimental rats. According to Steenbock, McCollum had told him that ‘from now on they were scientific rivals’ and that he had no intention of sharing his findings. McCollum denied Steenbock’s charge and told Russell that he had already promised to leave behind both notes and rats. He claimed that Steenbock ‘was trying to take over the work’ before he had any right to do so. A good deal of resentment resulted.[96]

Oral tradition suggests that McCollum may have sought retribution by setting free the Wisconsin rat colony shortly before his departure for Baltimore. Certainly, McCollum regretted the fact that his rat colony had received little support or recognition from his superiors. However, it seems highly unlikely that he would sabotage lines of research in which he had played such a prominent role for so many years. Such an act also would incur the wrath of one of the nation's most respected biochemical research teams, colleagues whose good opinion he could not afford to lose, regardless of his exalted achievements.

According to his autobiography, McCollum made arrangements for the accommodation of a rat colony at Johns Hopkins during his January 1917 visit to Baltimore. It remains unclear, however, whether he established a new colony or transported the Wisconsin rats to Baltimore.

Ongoing Research

The fate of McCollum's rats is one of many intriguing questions that remain unanswered at this stage of the Dairy Barn research project.[97] Oral tradition suggests that experimental rats and/or mice were housed at the Dairy Barn at various times over the years. In light of the negative opinions held by Harry Russell and E. B. Hart about supporting barnyard pests with public funds, however, it seems likely that the rat colony maintained by McCollum and Davis would have been kept near their lab in Agriculture Hall. At that time, the Dairy Barn was a College of Agriculture showcase, a must-see destination for visiting dignitaries from throughout the state. By keeping his rats at the Dairy Barn, McCollum would have exposed his colony to the public eye, thus risking additional opprobrium.

After completion of the Agricultural Chemistry (now Biochemistry) building in December 1913, McCollum probably moved along with his colleagues to the new facility at 420 Henry Mall.[98] It seems reasonable to assume that his rat colony moved along with him. A 1978 survey of cultural resources on campus identifies the Biochemistry Building as the site of McCollum's discovery of Vitamins A and B.[99] The building was listed on the National Register of Historic Places in 1985.[100] Another building associated with McCollum, his Baltimore home, was listed on the National Register in 1976.[101]

The fate of McCollum's papers—his research notebooks, correspondence, manuscripts, etc.—remains unknown. They are not among the collections of personal papers at Johns Hopkins University's Alan Mason Chesney Medical Archives. According to a reference staff member at the Chesney Medical Archives, portions of McCollum's papers are held by the University of Kansas and Indiana University.[102] University of Kansas archivist Ned Kehde reports that the McCollum collection at KU is "pretty insubstantial," however, consisting mainly of memorabilia from his undergraduate days.[103] An on-line search of the manuscript collections at Indiana University's Lilly Library failed to turn up any references to either McCollum's or Harry Day's papers.[104]

While the whereabouts of McCollum's papers remain unknown, the papers of other contemporary biochemical researchers and the departments with which they were affiliated are available at the University of Wisconsin Archives. These collections are likely to contain valuable information about the work of McCollum and other researchers connected with the Dairy Barn. After 1917, other Wisconsin investigators--including McCollum's superior, E. B. Hart--continued similar lines of research.[105] The UW Archives hold Hart's papers. The collection includes notebooks and photographs documenting research projects conducted by Hart and his students.[106] The Hart papers should be searched for references to the single-grain feeding experiment and any previous or subsequent research involving the Dairy Barn.

In addition to Hart, several prominent biochemists are represented in the UW Archives' collections, as well as many other College of Agriculture faculty members who have used the Dairy Barn for their teaching, research, or extension activities. These collections should be reviewed, with the objective of compiling a more complete chronology of the building's long and distinguished career.

Endnotes

[1] See Allen G. Noble, *The North American Settlement Landscape, Volume 2: Barns and Farm Structures*. Amherst: University of Massachusetts Press, 1984; Allen G. Noble and Hubert G.H. Wilhelm, eds. *Barns of the Midwest*. Athens: Ohio University Press, 1995; Allen G. Noble and Richard K. Cleek, *The Old Barn*

Book: A Field Guide to North American Barns and Other Farm Structures. (New Brunswick, NJ: Rutgers University Press, 1997).
[2]William Arnon Henry, "The Agricultural Department of the University of Wisconsin," *Wisconsin Farmers Institutes: A Handbook of Agriculture. Bulletin No. 12* (Madison: Democrat Printing Company, 1898), 138-39.
[3]W.H. Glover, *Farm and College: The College of Agriculture of the University of Wisconsin, A History.* (Madison: University of Wisconsin Press, 1952), 90.
[4]*Ibid*., 90; Henry, "The Agricultural Department," 140.
[5]Glover, *Farm and College*, 137.
[6]Henry, "The Agricultural Department," 140.
[7]*Ibid.*, 141.
[8]W.A. Henry, "Agricultural Instruction at the University of Wisconsin," *Wisconsin Farmers' Institutes: A Handbook of Agriculture*, Bulletin No. 9, (Milwaukee: Press of the Evening Wisconsin Company, 1895), 231.
[9]*Ibid*., 234-39.
[10]Henry, "The Agricultural Department," 141.
[11]William Arnon Henry, "A Brief History of the Agricultural College and Agricultural Experiment Station," in *Twentieth Annual Report of the Agricultural Experiment Station* (Madison: Wisconsin Agricultural Experiment Station, 1904), 33.
[12]W. L. Carlyle, "Description of the New Dairy Barn and Stock-Judging Building," in *Fifteenth Annual Report of the Agricultural Experiment Station* (Madison: Wisconsin Agricultural Experiment Station, 1898), 269.
[13]Jim Feldman, *The Buildings of the University of Wisconsin* (Madison: University of Wisconsin Archives, 1997, 85; Carlyle, "Description," 269.
[14]Henry, "A Brief History," 33.
[15]Carlyle, "Description," 269.
[16]*Ibid*., 270-72.
[17]*Ibid*., 270.
[18]*Daily Cardinal* (University of Wisconsin, Madison),December 15, 1897, 1.
[19]Carlyle, "Description," 273.
[20]*Ibid*., 281.
[21]*Ibid*., 273, 276-77.
[22]*Ibid*., 277-79.
[23]*Ibid*., 279-80.
[24]*Ibid*., 270-73.
[25]*Ibid.*, 270-72; *Daily Cardinal*, December 15, 1897, 1.
[26]Carlyle, “Description,” 281.
[27]*Ibid*.; *Daily Cardinal*, December 15, 1897, 1.
[28]Carlyle, “Description,” 270; Arthur Peabody, "Specifications for the Revision of the Runway to the Dairy Barn at the University of Wisconsin," September 22, 1922, Building File 0105, Planning and Construction Office, University of Wisconsin, Madison, Wisconsin.
[29]Carlyle, “Description,” 281-82; C.A. Ocock, "The King System of Ventilation," *University of Wisconsin Agricultural Experiment Station Bulletin No. 164*, December 1908, p. 3.
[30]Ocock, "The King System," 3-4.
[31]Carlyle, "Description," 282; Ocock, "The King System," 4-7.
[32]Ocock, "The King System," 3.
[33]*Ibid*., 9.
[34]*Daily Cardinal*, December 15, 1897, p.1.
[35]H.L. Russell, "Report of the Director," *University of Wisconsin Agricultural Experiment Station, Bulletin No. 171*, February 1909, p. 5
[36]Arthur Peabody Papers, State Historical Society of Wisconsin (microfilm).
[37]H.L. Russell, "Report of the Director," *University of Wisconsin Agricultural Experiment Station, Bulletin No. 203*, February 1911, p. 53.
[38]Specifications attached to “State of Wisconsin Standard Form of Agreement Between Contractor and Owner, Issued by the State Chief Engineer, Capitol Building, Madison,” in which contractor, Oscar Clow, agreed to build the Experimental Dairy Barn and Experimental Dairy according to specifications, January 11, 1917, p. 30. Dairy Barn Building File, University of Wisconsin Archives, Madison, Wisconsin.

[39]Addendum to the Specifications for Dairy Barn Extension for the University of Wisconsin, December 5, 1916. Dairy Barn Building File, University of Wisconsin Archives-Madison.
[40]"Specifications for the Experimental Dairy Barn," p.30.
[41]*Ibid.*, 39.
[42]Arthur Peabody, "Specifications for the Revision of the Runway to the Dairy Barn at the University of Wisconsin," p.1, Building File No. 0105, Planning and Construction Office, University of Wisconsin-Madison.
[43]A list of theme studies currently available is posted on the National Historic Landmarks Web site: www.cr.nps.gov/nhl/nhl-themes.htm
[44]Personal communication, Jim Draeger, Architectural Historian, Division of Historic Preservation, State Historical Society of Wisconsin, Madison, 15 July 1999.
[45]"Recommendations for Disposition of Buildings 35 or More Years Old," undated chart, ca. 1946. UW Archives, Series 4/0/3, Box 180, in folder labeled "Buildings, 35 or More Years Old." Serving on the committee with Gallistel were C. A. Halbert, R. C. Kirchhoff, and A. W. Peterson. Kirchhoff was state architect at the time.
[46]"Building Wisconsin: Their Future Rests in Our Hands," p. 14. Undated brochure, ca. 1947. UW Archives, Series 4/0/3, Box 180, in folder labeled "Building Bulletin."
[47]"Location of the University of Wisconsin Dairy Cattle Research and Instruction Center," a report to the State Budget Committee of the Legislative Council, 27 November 1951. UW Archives, Series 4/0/3, Box 177.
[48]"Kleinheinz Fire 'No Surprise'; Probe Lists Dorm as 'Hazard,'" *The Daily Cardinal*, 11 March 1950, front page.
[49]"Location of the University of Wisconsin Dairy Cattle Research and Instruction Center," 27 November 1951. The report makes no recommendations about the disposition of the Dairy Barn or Kleinheinz Hall, *per se*, but states that "the only buildings that would have to be torn down are some which now constitute a serious fire hazard."
[50]Jerry Apps and Allen Strang, *Barns of Wisconsin* (Madison: Tamarack Press, 1977), 101.
[51]*Perspectives of a University: A Survey of the Campus Architectural, Historical, Archaeological and Memorial Resources, and Recommendations for Preservation* (Madison: University of Wisconsin, 1978).
[52]*The National Register of Historic Places and the State Register of Historic Places in Wisconsin* (Madison: State Historical Society of Wisconsin, 1997), 11.
[53]Elizabeth L. Miller, National Register of Historic Places nomination for UW Dairy Barn, January 1985. Photocopy on file, office of Thomas M. Zinnen, UW Biotechnology Outreach Program, UW-Madison. Ms. Miller was employed as a Research Technician with the State Historical Society of Wisconsin at the time. Her draft nomination includes handwritten notes, sketches of Dairy Barn floor plans, and source citations.
[54]See Jim Feldman, *The Buildings of the University of Wisconsin* (Madison: University of Wisconsin Archives, 1997), 86: "In 1907 a series of single plant feeding experiments on cattle by Elmer McCollum which led to the discovery of vitamin A in 1913, and revolutionized agricultural nutrition [verb missing]. Testing of early models of milking machines were [*sic*] carried out here on a special herd." Feldman does not indicate where he obtained the "data" contained in these statements. A subsequent UW-Madison Office of News and Public Affairs release stated: "In the early 1900s, a series of cattle feeding experiments led by biochemistry professor Elmer McCollum led [to?] the discovery of the first vitamin--vitamin A--a finding that revolutionized animal and human nutrition." ("From cows to wows: Dairy Barn envisioned as life sciences museum," 16 October 1998).
[55]John W. Jenkins, *A Centennial History: A History of the College of Agricultural and Life Sciences at the University of Wisconsin-Madison* (Madison: College of Agricultural and Life Sciences, 1991), 11.
[56]Merle Curti and Vernon Carstensen, *The University of Wisconsin: A History, 1848-1925* (Madison: University of Wisconsin Press, 1949), vol. I, 354.
[57]William Arnon Henry, "A Brief History of the Agricultural College and Agricultural Experiment Station," in *Twentieth Annual Report of the Agricultural Experiment Station* (Madison: Wisconsin Agricultural Experiment Station, 1904), 27.
[58]E. B. Hart, "Major accomplishments in chemistry in the College of Agriculture during the past 40 years," undated typed manuscript, University of Wisconsin Archives, Biochemistry department file (Series 9/11).
[59]Curti and Carstensen, *The University of Wisconsin*, vol. II, 386, 394.
[60]Henry, "Brief History of the Agricultural College and Agricultural Experiment Station ," 35.

[61]W. A. Henry, "Report of the Director," in *Nineteenth Annual Report of the Agricultural Experiment Station of the University of Wisconsin* (Madison: Agricultural Experiment Station, 1903), 1; Henry, "Report of the Director," in *Twentieth Annual Report of the Agricultural Experiment Station of the University of Wisconsin* (Madison: Agricultural Experiment Station, 1904), 1.
[62]Henry, "A Brief History of the Agricultural College and Agricultural Experiment Station," 29-35.
[63]*Daily Cardinal*, 30 November 1897 and 15 December 1897; C. M. Hilliard, Report of Sub-Committee on Agricultural College, in "Report of the Board of Visitors, 1897-98," *Biennial Report of the Board of Regents of the University of Wisconsin for 1896-97 and 1897-98* (Madison: University of Wisconsin, 1898), 58-60.
[64]Henry, "A Brief History of the Agricultural College and Agricultural Experiment Station," 35.
[65]*Daily Cardinal*, 15 December 1897; 27 January 1898.
[66]W. A. Henry, "The New Agricultural Building," in *Twentieth Annual Report of the Agricultural Experiment Station of the University of Wisconsin* (Madison: UW Agricultural Experiment Station, 1904), 6.
[67]Hart, "Major accomplishments," 1.
[68]E. V. McCollum, *From Kansas Farm Boy to Scientist: The Autobiography of Elmer Verner McCollum* (Lawrence: University of Kansas Press, 1964), 102; E. V. McCollum, "My Early Experiences in the Study of Foods and Nutrition," *Annual Review of Biochemistry* 22 (1953): 5.
[69]McCollum, *From Kansas Farm Boy to Scientist*, 114.
[70]McCollum, "My Early Experiences," 6-7.
[71]McCollum, *From Kansas Farm Boy to Scientist*, 118.
[72]*Ibid*., 119.
[73]*Ibid*., 121.
[74]McCollum, "My Early Experiences," 7.
[75]Recounting his November 1907 interview with Harry Russell, McCollum wrote that he "went downstairs" from his lab to the dean's office, which was located on the main floor of Ag Hall. Thus, McCollum's lab would have been on the second or third floor. McCollum, *From Kansas Farm Boy to Scientist*, 118.
[76]E. B. Hart, E. V. McCollum, H. Steenbock, and G. C. Humphrey, *Physiological Effect on Growth and Reproduction of Rations Balanced from Restricted Sources* (Madison: University of Wisconsin Agricultural Experiment Station, 1911).
[77]McCollum, *From Kansas Farm Boy to Scientist*, 126. The course began in September 1907.
[78]Hart et al., *Physiological Effect on Growth and Reproduction*, 131. Humphrey had replaced W. L. Carlyle as chair of animal husbandry in September 1903. See W. A. Henry, "Report of the Director," in *Twentieth Annual Report of the Agricultural Experiment Station*, 2.
[79]Hart et al., *Physiological Effect on Growth and Reproduction*, 139.
[80]W. L. Carlyle, "Description of the New Dairy Barn and Stock-Judging Building," in *Fifteenth Annual Report of the Agricultural Experiment Station of the University of Wisconsin* (Madison: Agricultural Experiment Station, 1898), 270.
[81]Shorts are a by-product of wheat processing, consisting of bran mixed with coarse meal or flour.
[82]They also received rolled oats. Although one of the five grains shown on the 1898 floor plan is "oats," it's unclear what form of oats was being dispensed through the Dairy Barn apparatus.
[83]Hart et al., *Physiological Effect on Growth and Reproduction*, 135-39.
[84]Hart, "Major accomplishments," 1-2.
[85]McCollum, *From Kansas Farm Boy to Scientist*, 127.
[86]*Ibid*., 123-4.
[87]*Ibid*., 133.
[88]E. V. McCollum and Marguerite Davis, "The Necessity of Certain Lipins in the Diet during Growth," *Journal of Biological Chemistry* 15 (1913): 167-75.
[89]E. V. McCollum and Marguerite Davis, "Observations on the Isolation of the Substance in Butter Fat which Exerts a Stimulating Influence on Growth," *Journal of Biological Chemistry* 19 (1914): 245-50. At the time of publication, the substance was not yet known as "Vitamin A." In a paper co-authored with Cornelia Kennedy in 1916, McCollum proposed called the essential dietary factors discovered up to that time "fat-soluble A" and "water-soluble B," and proposed that the term "vitamine" be discontinued. See E. V. McCollum and Cornelia Kennedy, "The Dietary Factors Operating in the Production of Polyneuritis," *Journal of Biological Chemistry* 24 (1916): 492-93.

[90]Howard A. Schneider, "Rats, Fats, and History," *Perspectives in Biology and Medicine* 29 (Spring 1986): 402-403.
[91]McCollum, *From Kansas Farm Boy to Scientist*, 127.
[92]E. V. McCollum, N. Simmonds, and W. Pitz, "The Nature of the Dietary Deficiencies of the Oat Kernel," *Journal of Biological Chemistry*.29 (1917): 341-54; E. V. McCollum, N. Simmonds, and W. Pitz, "The Supplementary Dietary Relationship between Leaf and Seed as Contrasted with Combinations of Seed with Seed," *Journal of Biological Chemistry* 30 (1917): 13-32. For a complete bibliography of published work by or about McCollum, see Harry G. Day, "Elmer Verner McCollum, March 3, 1879-November 15, 1967," *Biographical Memoirs of the National Academy of Sciences of the United States of America* 45 (1974): 309-35.
[93]E. V. McCollum, "The Present Situation in Nutrition," *Hoard's Dairyman* 51 (21 July 1916): 989, 993; 52 (28 July 1916): 3, 7, 22; 52 (4 August 1916): 32-33; 52 (11 August 1916): 63, 74-75. *Hoard's Dairyman* republished the series in November-December 1917, after McCollum had left Wisconsin for his new post at Johns Hopkins University.
[94]McCollum, *From Kansas Farm Boy to Scientist*, 140.
[95]Ibid., 141.
[96] Edward H. Beardsley, *Harry L. Russell and Agricultural Science in Wisconsin* (Madison: University of Wisconsin Press, 1969), 80-81. Beardsley's source was Russell's Diary Notes, also known as his "Black Books," June 11 and August 17, 1917, in Harry L. Russell Papers, UW Archives/Steenbock. For McCollum's version, see *From Kansas Farm Boy to Scientist*, 141-51.
[97] Quoting from McCollum's autobiography, Harry G. Day maintains that "breeding stock" from the rat colony remained in Madison. Some of the rats apparently went to Baltimore with McCollum, however; Day states that after McCollum arrived at Johns Hopkins, he "quickly resumed nutritional investigations based largely on use of his transplanted rat colony." See Day, "Elmer Verner McCollum," 282-83.
[98]Arthur Peabody, "Report of the Architect," in *Biennial Report of the Board of Regents of the University for the Years 1912-13 and 1913-14* (Madison: University of Wisconsin, 1914), 341.
[99]*Perspectives of a University*, 83.
[100]*The National Register of Historic Places and the State Register of Historic Places in Wisconsin* (Madison: Division of Historic Preservation, State Historical Society of Wisconsin, 1997), 10.
[101]National Register Information System (NRIS) database (www.nr.nps.gov/nrishome.htm). McCollum's house is located at 2301 Monticello Road, Baltimore. It was listed 7 January 1976.
[102] Telephone conversation between Susan Haswell and Andrew Harrison, Alan Mason Chesney Medical Archives, JHU, Baltimore, 4 October 1999. The Chesney Medical Archives holds 221 collections of personal papers of individuals who have been associated with the Johns Hopkins Health System, the Johns Hopkins Hospital, and the health divisions of JHU (School of Health Services, School of Medicine, School of Nursing, and the School of Hygiene and Public Health, with which McCollum was affiliated).
[103] Telephone conversation between Susan Haswell and Ned Kehde, Kenneth Spencer Research Library, University of Kansas, Lawrence, 6 October 1999.
[104] Search of Lilly Library manuscript collections database, 12 Oct. 1999; accessed via the "Libraries" link on the Indiana University Web site (www.indiana.edu).
[105]*Perspectives of a University*, 83. See this source for a list of notable scientific research that took place in the Biochemistry Building.
[106]According to a UW Archives folder list for the Hart papers, notebooks from the "Single Grain Ration Experiment, 1914-16," are filed under Series 9/11/4/3-4, Box 1. A set of "experimental photographs" is filed with the Archives' iconography collection under Series 13/8.