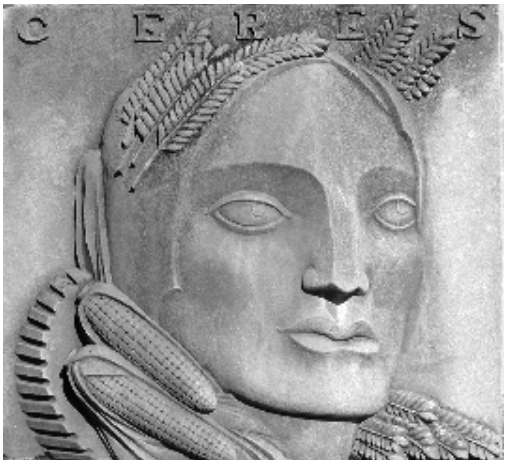
# A Pioneering Department

## *Evolution from Rural Engineering to Biological and Environmental Engineering at Cornell University, 1907-2007*

By Ronald B. Furry





Edited by John Marcham

The Internet-First University Press
Ithaca, NY

Liberty Hyde Bailey, director of the College of Agriculture, breaks ground in 1905 for new buildings for the college east of Cornell University's original quadrangle.

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**Cover:** Bas relief faces of Ceres and Pomona, the goddesses of grains and fruits, on the exterior of Riley-Robb Hall

The Internet-First University Press, Cornell University, Ithaca, New York 14853.

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Printed in the United States of America

# Contents

# *Acknowledgements*

Heartfelt thanks go to all those who provided data, information, illustrations and other assistance in the preparation of this document, including Louis Albright, Glenn Applebee, Eugenia Barnaba, Jim Bartsch, Calvin Beale, Myrah Bridwell, Doug Caveney, Lois Chaplin, Thomas Eddy, Nancy Fairchild, Susan Fredenburg, Byron and Faith French, Anne Furry, Lynne Irwin, William Jewell, Martin Jorgensen, Diane LaLonde, Gilbert Levine, Dave Ludington, Brenda Marchewka, David Orr, Allison Pelletier, Brian Richards, Norman Scott, James Spencer, William Splinter, Thomas Wakula, Michael Walter, Anitr Wilson, and Tori Wishart, with special appreciation to Professors Emeriti Everett Markwardt and Gerald Rehkugler who served as reviewers, J. Robert Cooke who diligently formatted the final manuscript for publication, and John Marcham who provided superb editorial assistance. And, lest we not forget, sincere commendations are in order for those who preceded us and left footprints in their time of their work and extraordinary accomplishments.

Sources of illustrations are listed on page 173, for which we thank the many providers.

An effort to locate, condense and relate information covering a century of activity is challenging. To do so accurately with fair and proportionate inclusiveness is demanding, and sincere apologies are made for inaccuracies, omissions, misstatements and other errors.

Please send errata to Department History, Office of the Chair, Department of Biological and Environmental Engineering, Riley-Robb Hall, Ithaca NY 14853.

*—R. B. Furry*

*The author is Ronald Bay Furry, Cornell University Class of 1953, professor emeritus of biological and environmental engineering at Cornell.*

# *Dedication*

To the faculty, staff, students, alumni, administrators, sponsors, donors, friends and cooperators who have faithfully supported the department's mission, thank you immensely.

The wave of the future starts with a little ripple.

Porter Morton of Groton, New York, sharpens a scythe on his farm in 1903.

# *Whence We Came*

Why does a Department of Biological and Environmental Engineering exist at Cornell University and what was the vision of those who saw the need?

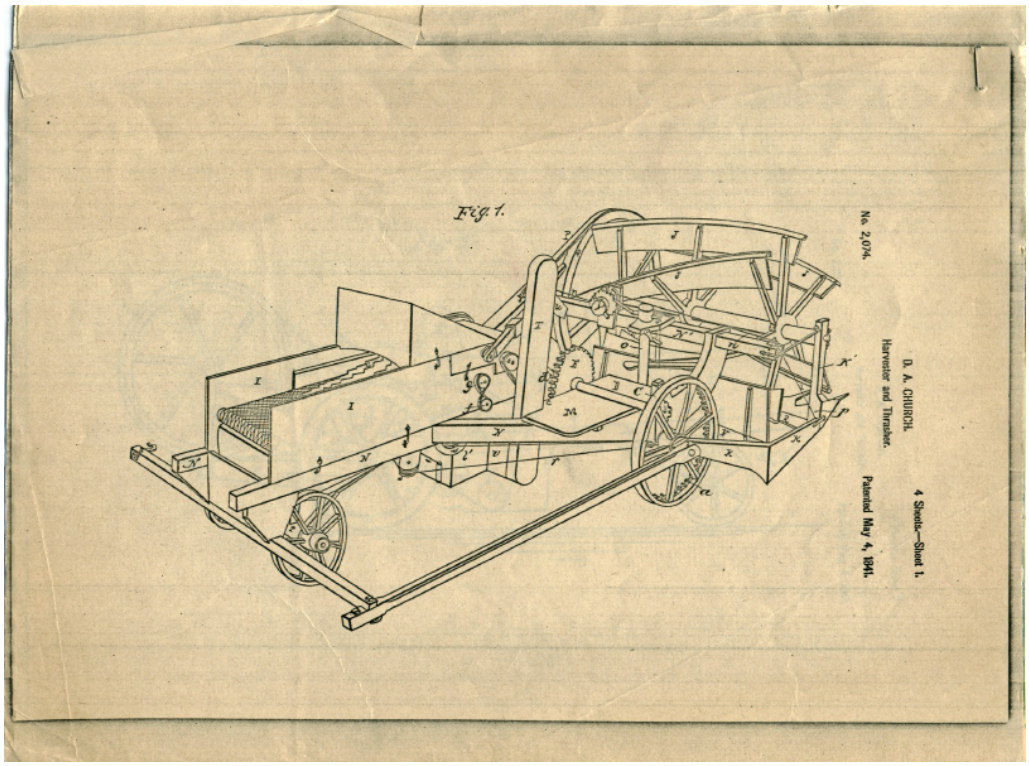
Early in their time on Earth, humans harnessed nature to collect water, grow crops, provide shelter, and domesticate animals for traction as well as for food. They learned how from one another, and in due course organized this engineering of their environment into informal programs of education.

In the United States in the nineteenth and early twentieth centuries, the process advanced quickly with the creation of what came to be known as land-grant colleges in each state, and of agricultural research stations and outreach or Extension programs associated with those colleges.

Cornell University in Ithaca, New York, became the Land-Grant institution in New York State.

Through its teaching, research, and outreach (Extension), Cornell's Department of Biological and Environmental Engineering has been a leader since its founding.

What began as a farm-oriented discipline, directed mainly by bright American men with rural backgrounds, has broadened into a theoretical and applied discipline made up of men and women from around the world who work to discover how best to make use of and preserve the resources of the Earth.




**Above,** application for a harvester-thresher patent, No. 2074 issued on May 4, 1841 to Damon A. Church of Friendship, Allegany County. Church went on to produce the machine in New York State and in Chicago, Illinois. The combine sold for $500, required 4 horses and 2 men to operate, and harvested 400 bushels of wheat a day. It was not the first combine invented, but became America's first practical combine. Cornell's Professor Howard W. Riley conducted early demonstrations of horse-drawn grain combine harvesters and also staged one of the first tractor demonstrations in New York State.

**At left**, a labor-intensive way of gathering: C. Beals cradles oats in Central New York in 1907.

# The Start of Agricultural Engineering

In the latter half of the nineteenth century and the early part of the twentieth century, three acts of the U.S. Congress provided the basis for state, federal and private funds to be employed in Land-Grant institutions to further the education and welfare of a then mostly agrarian population through on-site instruction and outreach by colleges and universities.

The Land Grant Act, signed by President Abraham Lincoln in 1862, and written by Senator Justin S. Morrill of Vermont, provided to each state public land that could be sold for "the endowment, support, and maintenance of at least one college where the leading object shall be, without excluding other scientific and classical studies and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes on the several pursuits and professions in life." Cornell University, founded in 1865, is the Land-Grant institution in New York State.

In 1887, Congress passed the Hatch Act, which funds the nation's agricultural experiment stations based at land-grant colleges and universities. New York State and Connecticut are the only states that have two agricultural experiment stations. The Cornell University Agricultural Experiment Station (CUAES) is the federally-designated state agricultural experiment station, and the New York State Agricultural Experiment Station (NYSAES) is located at Geneva, New York. Both experiment stations have been exceedingly important to the development and mission of this department.

## Cooperative Extension

In 1914, the Smith-Lever Act established Cooperative Extension "…[I]n order to aid in diffusing among the people of the United States useful and practical information on subjects relating to agriculture, home economics, and rural energy, and to encourage the application of the same, there may be continued or inaugurated in connection with the college or the colleges in each State, Territory, or possession, now receiving, or which may hereafter receive, the benefits of the Act of Congress approved July second, eighteen hundred and sixty-two, entitled "An Act donating public lands to several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," and "of the Act of Congress approved August thirtieth, eighteen hundred and ninety, agricultural extension work which shall be carried on in cooperation with the United States Department of Agriculture...," and, further,

"…[C]ooperative agricultural extension work shall consist of the development of practical applications of research knowledge and giving of instruction and practical demonstrations of existing or improved practices or technologies in agriculture, home economics, and rural energy, and subjects relating thereto to persons not attending or resident in said colleges in the several communities, and imparting information on said subjects through demonstrations, publications, and otherwise and for the necessary printing and distribution of information in connection with the foregoing; and this work shall be carried on in such manner as may be mutually agreed upon by the Secretary of Agriculture and the State agricultural college or colleges or Territory or possession receiving the benefits of this Act."

In A History of Cornell (Cornell University Press, 1962), Morris Bishop relates that "Dean I. P. Roberts had in 1886 summoned a Farmers' Institute to meet at Cornell; this was the first in the state, and the forerunner of the Farm and Home Weeks and of the great Extension Service." In 1894 a bill introduced in the New York State Assembly by Assemblyman S. F. Nixon of Chautauqua County appropriated "...$8,000 for experimental work in his district. This was the initiation of extension work in New York State. The subsidization settled the question whether Cornell professors might properly engage in it...

"Now [Liberty Hyde] Bailey and his aides set up a coherent program of extension work. In the winter of 1896-1897 fifteen hundred farmers were enrolled in a correspondence course, and the numbers grew rapidly....

"The character of agricultural extension work changed gradually. It moved out from the college to establish itself in the counties, to ally itself with a new system of farm and home bureaus, county agents, and home demonstrators, supported by the counties and the federal government as well as by the state. This localized work began in Broome County in 1911, with John H. Barron '06 as the first county agent. The College of Agriculture remained the executive center of the work. Its service was, and is, to provide technical information, to offer lectures and demonstrations, to publish a giant library of bulletins for farmers and homemakers, and to contribute toward the training and support of the county extension agents. Cornell is the state's agent in the supervision of the State Extension Service."

## *"Agricultural Engineering"*

The roots of today's Department of Biological and Environmental Engineering at Cornell University are planted firmly in the well mixed soils of agriculture and engineering. In a paper titled "Early History of Agricultural Engineering at the University of Nebraska" (2005), W. E. Splinter, director of the Lester F. Larsen Tractor Test and Power Museum in Lincoln, Nebraska, recounts the formal beginning of a new field of study by J. Brownlee Davidson, a 1904 Mechanical Engineering graduate of the Industrial College at the University of Nebraska:

"In 1905, after one year at Nebraska, Davidson moved to Iowa State College (now Iowa State University), as instructor in Farm Mechanics under the Agronomy

Department where he quickly moved up as associate professor-in-charge and where he set up the first academic degree program in Agricultural Engineering by 1910. At that time there was great discussion, nationwide, about naming this emerging engineering program directed toward agricultural production. Use of the term Agricultural Engineering goes back at least to 1859 when a program in Civil and Agricultural Engineering was established in the Michigan Agricultural College (now Michigan State University).

"Although an Agricultural Engineering course was offered, there is no record of degrees being awarded. The terms Farm Mechanics, Mechanical Arts, and Rural Engineering were also being used at other Land-Grant institutions. O. V. P. Stout had held the title of Agricultural Engineer as well as Irrigation Engineer since 1895. As we have seen, the program Davidson first headed at Nebraska started out as the Farm Mechanics program. Davidson's preference at Iowa State was Agricultural Engineering and that name was eventually accepted world wide."

## *Founding ASAE*

Another event of national significance that greatly influenced the direction of this and other similar departments in their formative years, and well beyond the middle of the twentieth century, was the founding of the American Society of Agricultural Engineers (ASAE) in Madison, Wisconsin at a conference held by 17 men during December 27 and 28, 1907. At this meeting, Jay Brownlee Davidson of Iowa State College was elected ASAE's first president, with C. A. Ocock first vice president, F. R. Crane second vice president, L. W. Chase secretary, and W. M. Nye treasurer.

ASAE held its first annual meeting in Champaign, Illinois in 1908. The first head of this department at Cornell, Howard W. Riley, who was a Cornell mechanical engineering graduate, not only led the development of the department but was also one of the charter members of the American Society of Agricultural Engineers in 1907, and served as its president in 1912. Today, the Society is comprised of some 9,000 members in more than 100 countries.

Riley's important contribution at the initial conference in 1907 was summed up in "Fifty Candles to Light the Future" by Roger M. Busfield of the Speech Department and H. F. McColly of the Agricultural Engineering Department at Michigan State University, in a presentation prepared for ASAE's 50th anniversary, as follows.

"The aims and purposes of the field of agricultural engineering were spelled out at that first meeting in 1907 by Howard W. Riley of Cornell University. Riley explored the chief areas of concern for the agricultural engineer. These broad aims have remained substantially unchanged in the past fifty years.

"There were five areas of activity designated by Riley. The first was in field engineering where the chief problem was in the laying out, mapping, draining, irrigating, and fencing of the farm. The eastern, southern, and midwestern States had too much water--swamps and bogs with immense swarms of mosquitoes and

flies. But the western states needed water for parched acres to grow crops. The first concern was **drainage and irrigation**.

"But a farm must be accessible to transportation and marketing centers. The people who live on a farm must be able to get to town...to school and to church... so a second major concern was set forth for the agricultural engineer--the field of **rural highway constructions**.

"Another major problem to be constantly attacked by the agricultural engineer is rural architecture...the **design and construction of farm buildings**. Davidson joined with Riley to urge a concern for the construction, ventilation and sanitation of farm buildings. The **farm homes** of today reflect the agricultural engineer's research and their regard for the way of life of the farmer and his family.

"But a farmer no longer works with his hands...thanks to the agricultural engineer...nor does he spend too much time on his feet. As a matter of fact much of his arduous labor has been reduced to pushing a button or throwing a switch or guiding an implement...for the agricultural engineers attacked in mass the problems of **improving farm implements and mechanizing the farm** from fence to silo, from the barn to the fields. Farm machinery has kept abreast and even ahead of the mechanization developments in many other industries...thanks largely to the agricultural engineer.

"The fifth and last major concern cited by Professor Riley was the **use of electrical power on the farm**. The men of vision in 1907 realized that the harnessing of electrical power could go a long way toward making the farmer's task easier and this concern was not to abate until electrical power was made available to every farm in the nation. But with electrical energy at hand the farmer has to be in a position to take advantage of it and the agricultural engineers also were to concern themselves with developing new uses for electrical power. Is there a farm today that could operate efficiently for twenty-four hours without using electricity?

"Yes, the founding fathers spelled it out when they said the agricultural engineer must be irrigation and drainage expert, an architect and a builder, a designer and a machinist!

"While the original thought of the founders of the society of agricultural engineers seems to have been an organization to serve primarily the interests of the college teachers of agricultural engineering, this idea soon gave way to that of encouraging closer contact, understanding and cooperation between agricultural engineers in college and those in industry, as the logical means of insuring well-rounded progress in developing the various phases of engineering as applied to agriculture.

"The constitution adopted in 1907 said the object of the American Society of Agricultural Engineers (ASAE) is "to promote the art and science of engineering as applied to agriculture." It also declared eligible for membership all persons engaged in some line of engineering closely identified with agriculture. From the beginning the scope of the ASAE was not to be limited to the classroom but was to reach beyond it to include the commercial and industrial engineers and, of course, the manufacturers of goods for the farm.

"At the second meeting of the society in 1908 at Champaign, Illinois--the first to be held under the name of American Society of Agricultural Engineers, a committee

was appointed to investigate the subject of a bureau of agricultural engineering in the U. S. Department of Agriculture. The Society began an active agitation that was to be renewed each year until the Bureau of Agricultural Engineering was a reality in 1931!

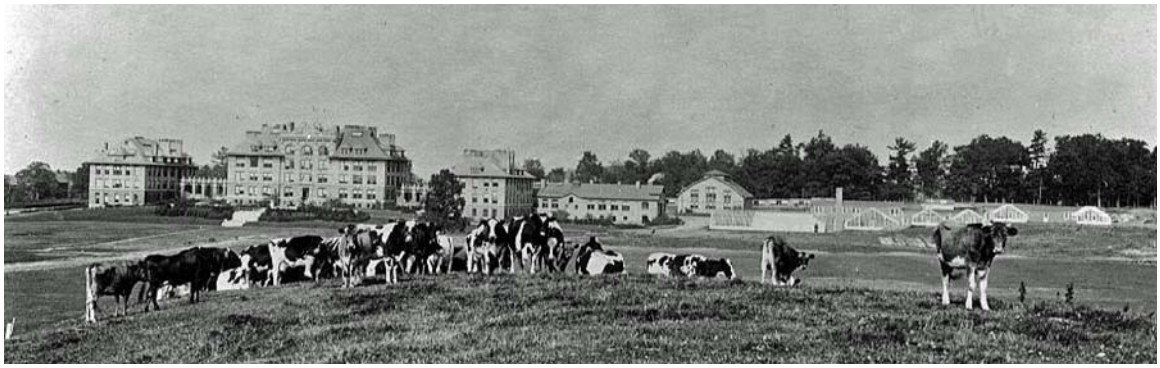
"As early as 1912, when the ASAE held its meeting at the Sherman Hotel in Chicago, the question of developing a rural electrification program in the United States was actively pursued. In later years it became obvious to the membership that first they had to educate the utility companies--show them how they could best serve the power needs of the farmer...at a profit...and, second, they were faced with the task of educating the farmer as to how he could most profitably utilize the electrical power. For the next ten years the agricultural engineers studied the subject and aroused sufficient interest to cause the creation in 1923 of the National Committee on the Relation of Electricity to Agriculture (CREA).

"The name most closely associated with the rural electrification movement has been Dr. E. A. White, a charter member of ASAE, who spearheaded the movement as the director of the national CREA. Under his leadership, the parent organization realized the establishment of state committees and research projects in 25 states.

"When Earl A. White helped found the ASAE he was a teacher of farm mechanics at the University of Illinois. He went on to the University of Wisconsin to earn his master's degree and thence to Cornell University where he distinguished himself by becoming the very first doctor of philosophy in Agricultural Engineering."

Riley was a highly energetic, determined, knowledgeable, and outgoing visionary. Needless to say, dramatic changes have taken place in the demographics of the United States since he formed the department. In 1907, the population of the United States was approximately 87 million, and in 1910 there were 32 million on the farm. In 1990, the farm population was about 3.8 million, representing only 1.6 percent of the total population. In the 2000 Census, less than 3 million lived on the farm. As of this writing, the population of the United States has reached 300 million, nearly three and one half times that of a century ago.

In New York State, the farm population in 1920 was 806,000. By the 2000 Census that number had decreased by more than a factor of 13 to 61,503. The current total population of New York State is about 19.3 million. The technology changed as well, and along with it the need for pertinent educational programs upon which society depends for advancement. The department was destined not to invest its effort in improving gadgets or duplicating the efforts of others, but rather strike out in a direction that would impart its own unique flavor to its programs using cutting edge technology. The challenge had been set. Time was on its side, but there was a long road and a lot of work ahead. Coincidentally, the year 1907 was also the 100th anniversary of the birth of Cornell University founder Ezra Cornell (January 11, 1807 in Westchester County, New York).



The original Agronomy Building (Stone Hall) that initially housed the Division of Rural Engineering and Architecture is at the far left, connected by a covered walkway to Roberts Hall with East Roberts on the right. The College of Agriculture's dairy herd grazes in the foreground on what would become Alumni Field. This view looks north from approximately where Lynah Rink now stands.

# A Department that Leads

Ezra Cornell, the founder of Cornell University, had a deep interest in farming, with special consideration given to purebred cattle, and farm machinery and implements, especially plows. In 1868 Cornell President Andrew D. White and founder Ezra Cornell agreed to purchase the Rau model plow collection from Germany. The 187 model plows, beginning with those used in ancient Egypt, were made at the Academy of Agriculture and Forestry of Hohenheim, Germany under the direction of Professor Ludwig Rau, and displayed at the Paris Exposition of 1867. It's been reported that White thought that physical things were better than text books as teaching tools. He wrote the following in a letter to Ezra Cornell on May 21, 1868 after a visit to Rau in Germany:

"I was intensely interested in their collection of models of all sorts relating to agriculture, among the others a complete collection of models of ploughs used in all nations & times, one hundred & eighty-seven in number. They were on a small scale, 1/8 natural size, I think, but so perfectly made that every bolt & screw & even every cord (as in the primitive ploughs) were exactly given. From the rudest plough used in Bible times & earlier to the English Howard plough & American improved ploughs, all important modifications are given.

"They are the result of the studies of Prof. Rau of Hohenheim and the mechanical skill of their master mechanic of the College.

"There was also the most complete collection of horseshoes in existence, of all times & countries & for all emergencies and conditions of the animal.

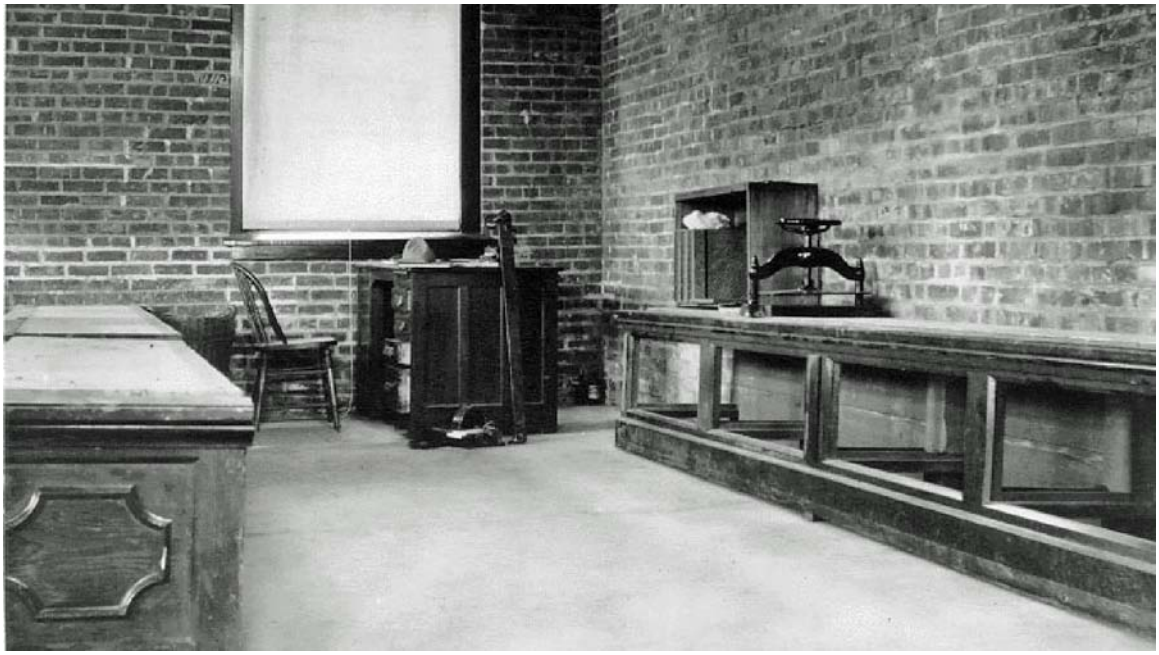
"If anyone had told me a year or two ago that I could ever be interested in a collection of ploughs & horseshoes, I should have laughed heartily of this idea, but I have rarely seen anything of late more interesting."

This exquisite collection of handmade models was exhibited by the Department of Agronomy faculty at county fairs all across New York State. In the 1970s, Professor Gerald E. Rehkugler classified and put on view an extensive set of the models to illustrate the historical development of this human and animal powered tool.

A small subset of the Rau model plows displayed in the lounge of Riley-Robb Hall is shown on the next page.

# Name and Other Changes

At Cornell, engineering in agriculture was first taught by the Department of Agronomy, which provided instruction in the elements of farm mechanics from



The department's beginning, a two-person desk in the basement of Stone Hall that would be shared by its first professors, Howard W. Riley and Byron B. Robb.

Display of Rau plow models in the first floor lounge of Riley-Robb Hall. The models were provided by the university's first president, Andrew D. White.

Professor F. L. Fairbanks.

1900 through 1907. The beginning of the present Department of Biological and Environmental Engineering at Cornell was as the **Division of Rural Engineering and Architecture**, formed when Liberty Hyde Bailey, dean of the College of Agriculture, invited Howard W. Riley (photo, next page), a Cornell mechanical engineering graduate, to head it in 1907.

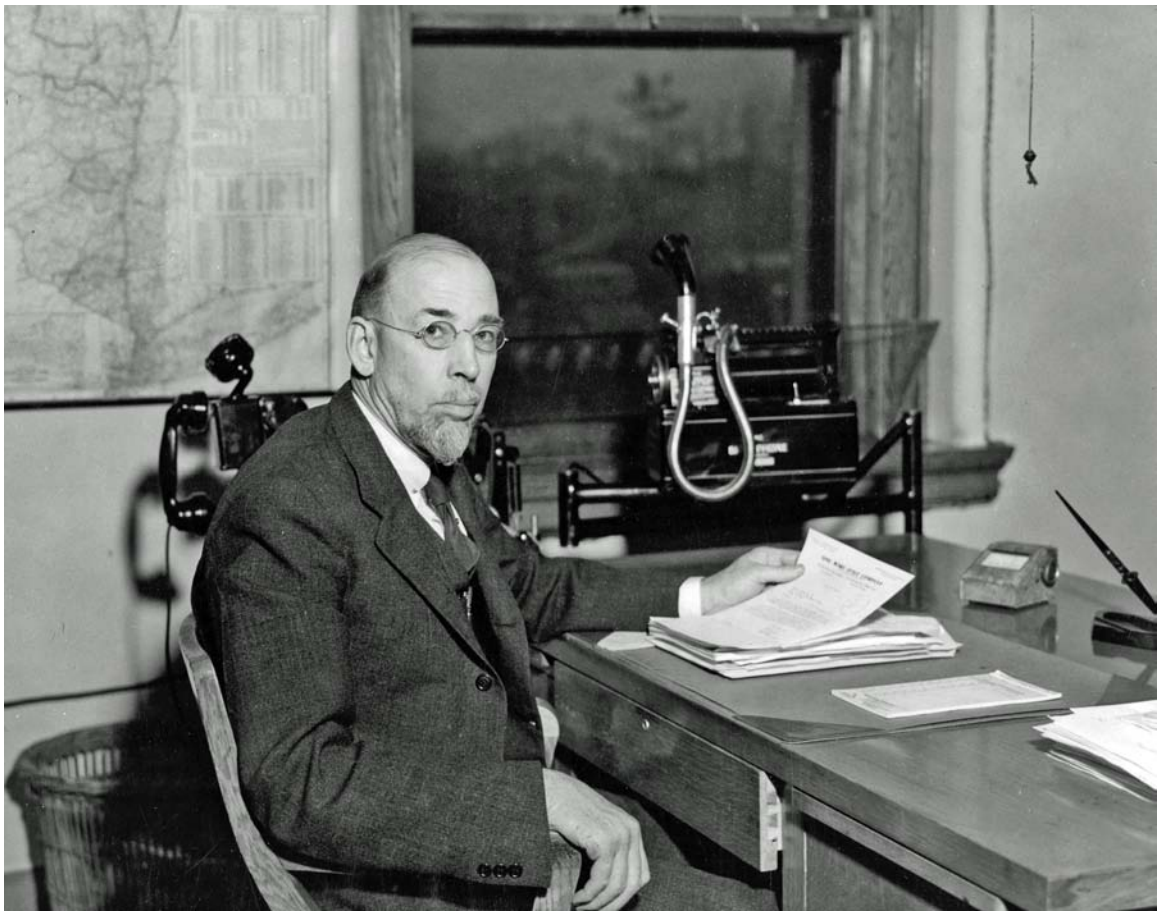
Department status came in 1909 with the name **Department of Farm Mechanics**. In 1913 it was renamed the **Department of Rural Engineering**. The name **Department of Agricultural Engineering** was adopted in 1930 and remained until July 1, 1988, when the name was changed to **Department of Agricultural and Biological Engineering**. The program subsequently evolved into two integrated focal areas, and in 2001 the name was changed to **Department of Biological and Environmental Engineering** to reflect that orientation.

# *The Early Years*

Byron Burnett Robb, Cornell Class of 1911, was the first faculty member hired (1911) by Howard W. Riley, Cornell Class of 1901, and was co-leader in molding the department; he was later responsible for the crucial War Emergency Farm Machinery Repair Program in New York State that was initiated in early 1942. Robb (next page) was the first student at Cornell to take his advanced degree study (MS, 1913) in the area of agricultural engineering. In 1923, he did graduate work at Harvard University while on sabbatic leave. Other faculty members hired in the first decade were J. E. Reyna (1912), J. C. McCurdy (1915), and F. L. Fairbanks (1917).

Fairbanks (opposite page) died on March 5, 1939 at the age of 54 from injuries received in an automobile accident in central New York State, where his car was struck at an intersection by another vehicle while on official work in the field for the University. Both McCurdy and Fairbanks were graduates of Cornell, McCurdy from the School of Civil Engineering, and Fairbanks from the Sibley College of Mechanical Engineering. As a point of interest, McCurdy was the engineer in charge of foundations for the Plant Science building on the campus during its construction. Reyna studied three years in the Sibley College of Electrical Engineering, and then transferred to Columbia University where he received his degree; he also had training in mining and civil engineering. Riley had also trained in electrical engineering at Cornell; however, electrical engineering was academically young without department status when he graduated so degrees were granted to those students under mechanical engineering. The battle concerning whether AC or DC generation of electricity would win the power struggle was still under way at that time, but Cornell University would be the first in the country to establish a Department of Electrical Engineering.

The north basement of the original Agronomy Building (pag10), known as Stone Hall and located on the north side of Tower Road, was used to house the college's new Division of Rural Engineering and Architecture upon Riley's appointment in 1907. The Stone, Roberts and East Roberts Hall complex was razed in 1990 to



The department's founders: **Above,** a later office of Professor Riley with modern equipment—phone, left center, and Dictaphone, right center. (His desktop computer obviously had not yet arrived, and his countenance appears to reflect that fact!)

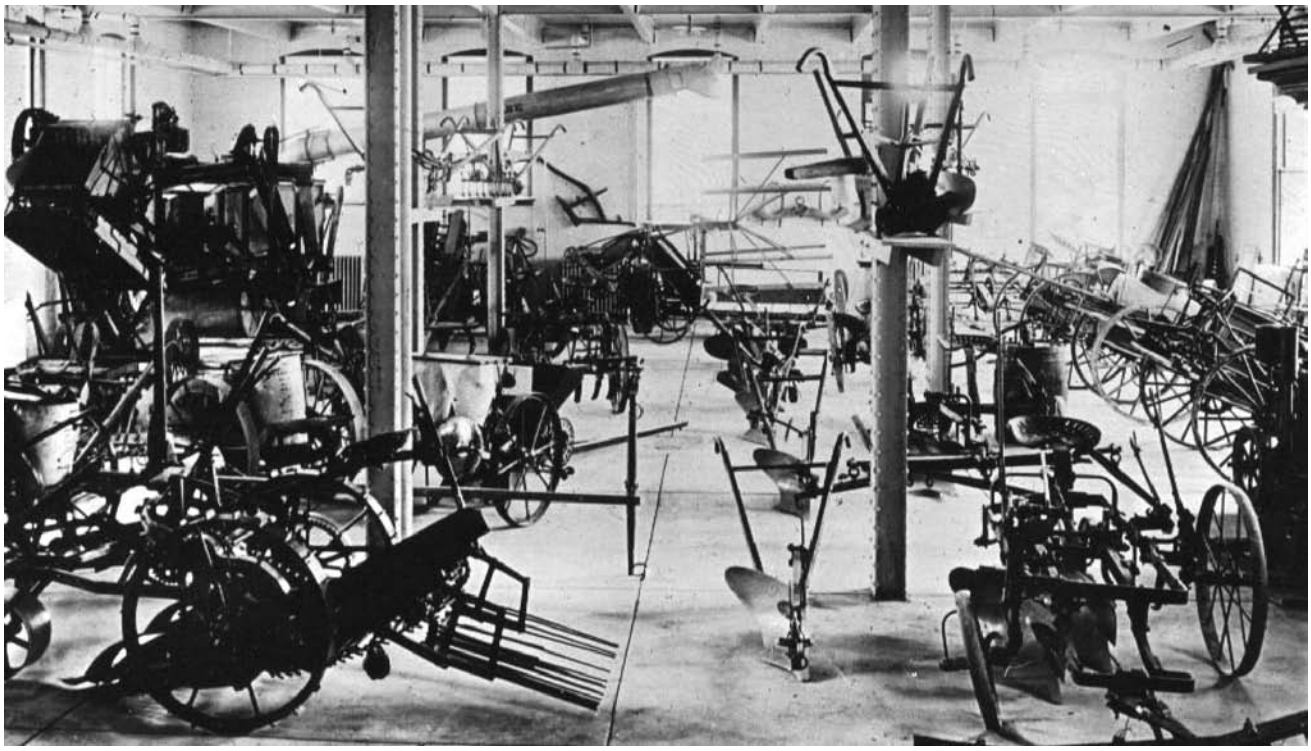
**Below**, Byron B. Robb, the first faculty member hired by Riley, in his original office in the Stone Hall basement.

make way for more modern administrative and classroom facilities for the College of Agriculture and Life Sciences. One of the first pieces of furniture acquired, the two-person desk shown standing in front of the window in the photo on page 10, would be initially shared by the department's founding fathers, Riley and Robb. The desk is shown there in the basement of Stone Hall where the department's fledgling program gained a foothold in the very early years of the 20th century. It must have been a spartan, lonely place! On page 24, Howard W. Riley and Byron B. Robb are shown seated across from each other at that same two-person desk much as they had been during their early active years in the department. The desk can currently be seen in the second floor library of Riley-Robb Hall.

On the May 17, 1946 radio broadcast of the Agricultural College Hour, Riley recounted to fellow faculty member Professor Forrest B. "Doc" Wright what it was like when he began work in 1907: "...the statute creating the State College of Agriculture specified that there was to be provided in the buildings space for an exhibit of farm machinery and that is what I found when I began work in the fall of 1907, an exhibit of farm machinery in the 2 basement rooms of Stone Hall where the Agricultural Library is now. There was no active teaching, no tools, no office, no desk, no chair, no typewriter, no stenographer. Director Bailey had a small office built. There appeared an old desk and a kitchen chair. I wrote letters long hand and copied them in a letter press, tools were bought, new equipment secured and there was started active teaching from the engineering point of view. Part of the work was on engines and the vibration from these seriously interfered with the use of microscopes in Botany on the top floor of the same building..."

This difficulty prompted the construction of a laboratory from materials salvaged from an old barn near where Bailey Hall now stands. Riley continued, "Professor Robb was with us then and he and our stenographer and I had offices in this laboratory building. Later we moved our offices first to Caldwell Hall and then to a wooden building vacated by Landscape Art at which time we built a second laboratory. These two laboratories, increased in size, are now located east of the Alumni Field and we have offices in them and the Dairy Industry Building." The Dairy Industry Building is now called Stocking Hall.

Riley went on to describe the initial staffing: "Professor Robb came in early to help in teaching mechanics and in giving a course in surveying and he early became, in the summer time, drainage engineer for the farms of the State Institutions, an activity that later developed into the first of our extension work, help to farmers in drainage problems. And then very soon the work developed to such an extent that other help was required. Prof. McCurdy came over from Civil Engineering to give our surveying work; tractor schools in the First World War brought in the late Prof. Fairbanks and Prof. Jennings; drainage work with State owned ditchers brought Prof. Norman Steve who later left to start farming; general extension work and 4-H Club work brought in Prof. Warren K. Blodgett, who later left to go to administer a school for orphans; shopwork for state teachers brought in Prof. Roehl; Prof. Goodman came up from Texas and Washington to do general extension work, and you yourself [F. B. Wright]took graduate work in education in Agricultural Engineering and later have taken over the course in Household Mechanics initiated by Prof. Robb for women students. The Second World War brought the staff of District Engineers most of



Farm machinery laboratory display in Stone Hall basement.

Power laboratory in the basement of Stone Hall. Vibration during operation caused serious interference with the use of microscopes in the Botany facilities on the top floor.

Tractor laboratory in the department's first "temporary" building ca. 1915. The machines look extremely elementary compared to today's designs. Note the contrasting types of dress on the women at right center.

Farm equipment laboratory ca. 1918. Students, including the women, appear overdressed for the class work that is underway. Space is at a premium and the building's volume is used as efficiently as possible.

Groundbreaking for Riley-Robb Hall on September 26, 1953. Byron B. Robb, left, and Howard W. Riley share a golden shovel.

Official dedication of Riley-Robb Hall, October 6, 1954, looking north, with Wing Drive yet to be extended at the left.

whom are still with us doing fine work in the counties." The fortieth anniversary of the department's founding was just one year away from this broadcast.

## *Sharing Quarters*

As Riley related, Stone Hall was woefully inadequate to fulfill the needs, and in 1912 members of the department built a 40' x 96' "temporary" farm mechanics building on the "plains of Abraham," land now covered partly by Mann Library and Plant Science, and "Case" Hall was literally built around a Case thresher north of this temporary building. In 1914, department offices and drafting and laboratory rooms were located in the original Caldwell Hall. Another 40' x 96' laboratory close to the temporary building, with Case Hall connecting them, was built by the staff in 1918 (page 110).

In 1924, these buildings were moved east of where Riley-Robb Hall now stands, and a new connecting head house and courtyard were added (more than 82 years later, these temporary buildings are still in use and currently named Surge 3!). Offices were provided in Stocking Hall (the former Dairy Building). In 1948 and 1949, the department added two Quonset huts on Judd Falls Road, one for classroom use and the other to store vehicles and laboratory equipment. In 1949, the U.S. Engineers Soils Building on the south side of Tower Road on the east end of the upper campus was acquired for teaching and a Rural Highways Project. In 1953 an adjacent building was obtained for use by the Rural Highways Project. It was a diffuse operation, to say the least.

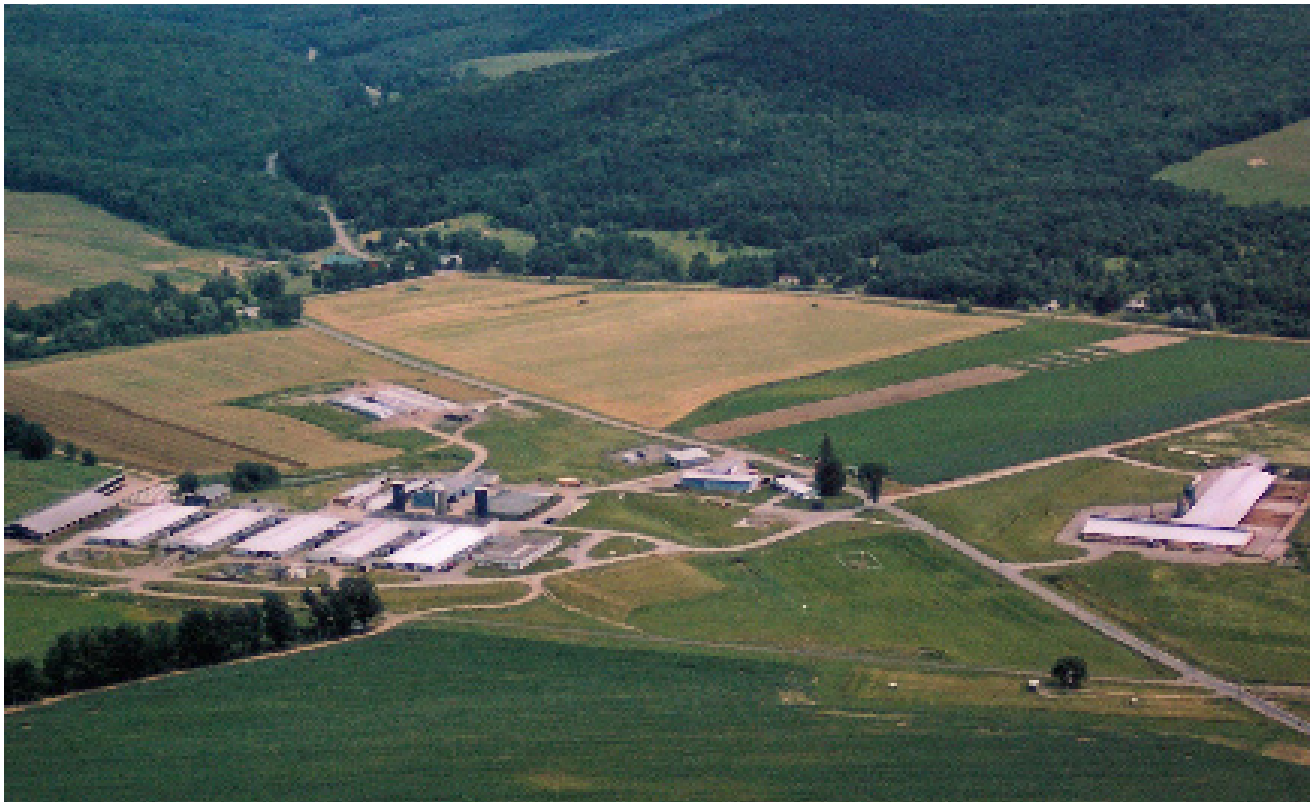
The department used a wide variety of other buildings across the campus through the years, with the main office and some faculty and teaching space being located in Stocking Hall immediately before moving into its present facilities in Riley-Robb Hall in February 1956.

At the new building's dedication ceremony (opposite and next pages) held October 6, 1954, Department Head Orval C French placed historical records sealed in a metal box into the cornerstone on the northwest corner of the building, and New York State Governor Thomas E. Dewey laid the cornerstone. Remarks were made by French, Governor Thomas E. Dewey, Cornell President Deane W. Mallott, President of the State University W. S. Carlson, College of Agriculture Dean W. I. Myers, Class of 1955 Agricultural Engineering undergraduate student Hugh Cotcamp, State University of New York Trustee Joseph Myler and Cornell Trustee George Pfann. The Cornell Band provided appropriate music, opening the ceremony with the Alma Mater. It was a grand and promising occasion and this writer remembers it well.

In later years, external facilities utilized by the department included an Agricultural Engineering Laboratory and other structures located at the Animal Science Teaching and Research Center (ASTARC) in Harford (next page), and the Agricultural Waste Management Pilot Plant, constructed in 1969, located on Game

Governor Thomas E. Dewey trowels mortar to install the cornerstone of Riley-Robb Hall at the building's dedication in 1954.

Agricultural Engineering undergraduate Hugh Cotcamp, Class of 1955, addresses the assembly.



The 2,600-acre Animal Science Teaching and Research Center (ASTARC) operated by the Department of Animal Science in the Town of Harford, 15 miles from the Ithaca campus, opened in the 1970s. This facility was used by the Agricultural Engineering department for a variety of research work, including studies on waste management systems, environmental control for calves and cows, milking systems, and production of fish in recirculating water systems.

Farm Road southeast of the campus. The department has also been involved in research and outreach in many facilities owned and operated by others around the State, such as the Miner Institute in Chazy, the Ronald Space Farm near Groton, and numerous demonstration sites throughout the state.

## A Program Develops

At startup, Riley took the entire burden of program development and teaching, but by 1912, five years after the department's inception, seven courses were being taught by a faculty of two, with five student assistants. Extension work was formalized in the department on July 1, 1920 as Project 18 under the Smith-Lever Act. Project 18 was titled Demonstrations in Rural Engineering, "To conduct demonstrations among farmers in farm machinery and power plants; farm sanitation and sewage disposal; farm buildings; farm and muck land drainage." The scope of the work specified was very, very broad, utilizing everything from lectures to field demonstrations followed by meetings, and a wide range of target audiences was delineated. Winter work included teaching in extension schools. By the fifteenth year, 1922, the faculty had grown to 12, with five assistants, and was also doing extension teaching.

Cornell's program was the third formed after Davidson adopted the name Agricultural Engineering for the new field at Iowa State College in 1905. As one might expect, communication among engineers in this new and developing field was very important, and regional similarities eventually brought about the organization of subgroups of the parent society, ASAE. The Department of Rural Engineering at Cornell was a founding member of the North Atlantic Section of ASAE, which was organized at Cornell on April 10-11, 1925. The photograph on page 154 shows faculty members F. L. Fairbanks and H. W. Riley at the first annual meeting of this section held in Schenectady, New York, December 10-12, 1925. Section 1 now includes Delaware, Labrador, Maine, New Brunswick, Newfoundland, New Jersey, New York (except eastern Lake Ontario), Nova Scotia, Ontario, Prince Edward Island, and Quebec.

## Ag Engineering Grows

On April 23, 1929, Riley received a large 28- by 35-inch hand lettered blueprint summary of agricultural engineering programs in the United States titled *Agricultural Engineering Data 1929 (Revised)*, compiled and distributed by the Committee on the Advancement of Agricultural Engineering Education, ASAE. In essence, this document was a "state of the profession" report. The tabular summary listed all 42 institutions that had agricultural engineering programs at that time. Included were

data on program names; dates established; student enrollment categories; courses being taught, including the content of professional, service and short courses; teaching, research and extension faculty salaries; funding; buildings; equipment; acres of land held, and miscellaneous remarks.

Three departments were administered solely under a College of Engineering, 26 under a College of Agriculture, and 13 jointly by Colleges of Agriculture and Engineering. Sixteen programs were professionally oriented. Total credit hours reported that were required for graduation amazingly ranged from 73-2/3 to 219. Twenty-five of the 42 were on an academic semester basis.

The total number of students registered in the programs, including those designated as (a) Professional, (b) Agriculture Majors in Agricultural Engineering, and (c) Service, ranged from 9 to 821, the latter number being at Iowa State College where Agricultural Engineering had begun 19 years before. Clearly, Davidson and Iowa State had an advantage! For Cornell, 4 students had graduated with an Agricultural Major in Agricultural Engineering, and 359 others were listed as Service students in the department. Courses in the departments were being taught for agriculture students, as well as department majors. Department head salaries ranged from $1,800 to $6,000 per year (Riley's salary was $5,000); and for faculty: professors $3,300 to $5,175, associate professors $2,400 to $4,300, assistant professors $1,100 to $3,800, and instructors $450 to $3,500. The Stock Market crashed just 6 months after Riley received this report, on Black Tuesday, October 29, 1929.

Would this event and its aftermath put a hard brake on the department's development? Apparently not. By 1932, its quarter century mark, the department still had 12 faculty members, now supported by 9 assistants, who were teaching 24 courses, carrying out a significant extension program, and were engaged in applied research. Research activity increased between World Wars I and II with early work on poultry and dairy building ventilation by Professors F. L. Fairbanks and Alpheus M. Goodman that led to the Fairbanks-Goodman system of dairy stable ventilation, along with studies on electric fence controllers and milk house design by Professor Burton A. Jennings, concrete use on the farm by Professor Joseph P. McCurdy, and spray nozzle and boom design for fruit and vegetable sprayers by Professor Clesson N. Turner. They were heavily involved in solving real-world rural and farming problems in the field throughout New York State in a hands-on fashion, applied engineering at its best. Dean Bailey had charged Riley with developing applied engineering educational programs to improve the life of rural people and he'd made a superlative choice.

At the 35-year mark, in 1942, early in World War II, a faculty of 15 and 16 support staff, many of whom were undergraduate students, was dramatically enlarged with the addition of 15 District Agricultural Engineers in a statewide War Emergency Farm Machinery Repair Program. As a member of the Farm Machinery Division of the Emergency Food Commission of the New York State War Council, B. B. Robb was responsible for organizing this corps of district agricultural engineers who were originally assigned 3 to 5 counties each and resided within their area of geographical activity. Later, some district engineers had responsibility for more than 5 counties. The district agricultural engineer program continued, along with a central core of extension faculty members located at Ithaca, until 1955 when the district approach was replaced in favor of 10 Extension Specialist positions centralized in

the department at Ithaca. A new format for outreach had begun, but direct service to the field was continued in cooperation with county Extension agents; the word "service" was then still in the name Cornell Cooperative Extension Service, and the department provided a great deal of engineering service directly to farmers.

## *Leadership Changes*

Howard W. Riley was head of the department for 38 years, until 1945, when Byron B. Robb assumed the position. Orval C French was appointed head in 1947 and held the position for 24 years, until 1971. Before coming to Cornell, French had been a faculty member of the Agricultural Engineering Department at the University of California at Davis, and was a research engineer on the World War II Manhattan Project at the University of California's Radiation Laboratory during 1942-45. He had begun his training in electrical engineering, but later became interested in agricultural engineering and changed majors.

Upon French's retirement in 1971, E. Stanley Shepardson became Head. Following Shepardson, administrative nomenclature changed, "heads" were out and "chairs" were in, and Norman R. Scott was chair from 1978 to 1984. Gerald E. Rehkugler became chair in 1984 when Norman R. Scott was appointed director of the Office for Research for the College of Agriculture and Life Sciences. In July 1990, Gerald E. Rehkugler assumed the responsibilities of associate dean for undergraduate programs in the College of Engineering, and Ronald B. Furry was appointed chair of the department from 1990 to 1994, before his retirement in 1995. Michael F. Walter, the current chair, was appointed in 1994.

A comment simply must be made at this point concerning Orval C French's name—just in case you've been noticing, or rather not seeing, the missing period. Orval was born on January 3, 1908 on the plains of Kansas where there was no access to a local government office to record his birth; consequently, he had no birth certificate bearing his name. His father, Oliver Collins French, had wanted to call him Orval Clyde; his mother wanted to call him Orval Claude, but they could not agree, so they settled on Orval C with no period following the C because it was not an abbreviation for a formal name. This example of his parents' approach to problem solving would serve Orval well in his later years as an administrator!

What annoyed him most, however, was the fact that when he had to make out forms that requested his name, they usually required that he supply his middle name, often insisting upon it, and whenever authentication of his birth was required he had to seek letters of attestation from people who knew him back home. It was not until July 12, 1940 when Orval was 32 years old that Orval's father signed an Affidavit of Birth "for use in cases where Certificates of Birth cannot be supplied" and the problem was resolved. The seminar room in Riley-Robb Hall is named in honor of Orval C French. After his full name was lettered on its entrance door in the "standard format," the period following the C was later removed!

French was proud of the people in his department of Agricultural Engineering and always kept an eye out for them and the facilities as well, never hesitating to pitch in at any need. One particular example comes to mind when Riley-Robb Hall was finally ready for imminent occupancy by the staff, with the cleaning and waxing of the floors in the 2 1⁄4 acre complex being the last item on the check list that had been accomplished – with one notable exception, a back-order for toilet seats for all of the rest rooms had left them unfinished. They finally appeared at the site on the weekend immediately prior to the move, and Orval personally installed every seat in the house. For this he was affectionately awarded the temporary title of "Head Mechanic".

Riley, too, had a real sense of perspective in problem solving. As a member of the Christian Science Church in Ithaca, he served as First Reader at Sunday services, reading from behind a lectern while standing on an elevated platform. However, the church service required two readers standing nearly side by side and the Second Reader was a very short lady, creating an especially pronounced comparison when placed next to Riley who was very tall. To mitigate this discrepancy in height, and probably keep the congregation's attention on the lesson rather than on the readers, Riley had a hole cut in the floor into which he would step at the appointed time, and the height incongruity between them literally disappeared into the woodwork.

## *Research and Teaching Gain*

Both research and instruction made significant advances starting in 1947 with French's appointment as department head. A sincere, capable, fair, warm and encouraging leader, he guided development of a research faculty to build a strong graduate program that would draw students from around the world and make it the leading program in the country. He also shepherded the institution of an accredited five-year BS Agricultural Engineering degree program with the College of Engineering that was inaugurated in 1954. A five-week summer practical exposing agricultural engineering students to the topical areas of soil and water engineering, farm structures, farm power and machinery, farm electrification, and rural roads in which Professors Gilbert Levine, Harold Gray, and Wesley Gunkel participated was then a requirement for agricultural engineering students. The five-year program evolved into a four-year joint College of Agriculture-College of Engineering BS program in 1965 with a fifth-year Master of Engineering degree; the Master of Engineering degree in this field was the first in the nation. The latter programs continue today.

When the five-year BS program was initiated, only department faculty members who had a direct connection to the professional degree teaching program were permitted to be members of the College of Engineering Faculty. Today, faculty in Biological and Environmental Engineering are members of the faculties of both the colleges of Engineering and Agriculture and of Life Sciences, and advise students in both colleges. In contrast to the undergraduate program, the graduate program is

administered through the Graduate School and is a separate entity to which faculty are admitted on a Field by Field basis, with some Fields having no corresponding undergraduate departments. Many of the department's graduate faculty are members of more than one Field. Administration of some graduate degree programs, such as the Master of Engineering and the Master of Professional Studies, are delegated to the respective colleges by the Graduate School with department faculty participating in their oversight.

The first PhD in Agricultural Engineering in the nation was awarded at Cornell to Earl Archibald White in 1917. White became an authority on power farming, holding academic, commercial and government positions. The second PhD in Agricultural Engineering in the country was awarded to Forrest B. Wright (Cornell BS 1922, MS 1924) in 1933, who served on the department's faculty until his retirement in 1958.

A Local Roads Program of research and Extension was formally initiated in 1951, although the department was active in road engineering as far back as the 1930s. It continues today as one of the largest outreach programs in the college and one of the largest research programs in the department. The department's Extension and teaching programs became increasingly popular across the years and were strongly supported. The very early teaching programs were primarily for student majors in the College of Agriculture, with Agricultural Engineering I reaching enrollments of 240 students per year; Farm Machinery 185, and Farm Power 140; Structures attracted 90; and Farm Shop over 150 students. Since 1954, courses have been taught both for engineering degree student majors and College of Agriculture and Life Science majors, and the topics and number of offerings have increased dramatically as well.

## *The Department at 50*

At its half century mark in 1957, the department family had grown to include 24 professorial line faculty, 14 faculty assistants, 12 professional support staff, and 6 graduate students for a total of 56 people; a critical mass was now on board to make propitious use of facilities available to the department for the first time in its history in its new home, Riley-Robb Hall.

For comparison, in its 100th year there are 22 professorial line faculty, 22 faculty assistants, 23 professional support staff, and 77 graduate students for a total of 144 people, slightly more than two and one-half times the number in its fiftieth year.

A list of the faculty and staff in 1942, 1957, and 2007 are on pages 112, 120, and 123, and a list of courses in 1942 and 2007 are on pages 32, 34 and 35.

At the dedication dinner for Riley-Robb Hall March 3, 1956, department heads Howard W. Riley, left, and Byron B. Robb sit at the double desk they first occupied in the early 1900s. Incumbent Head Orval C French sits in the background.

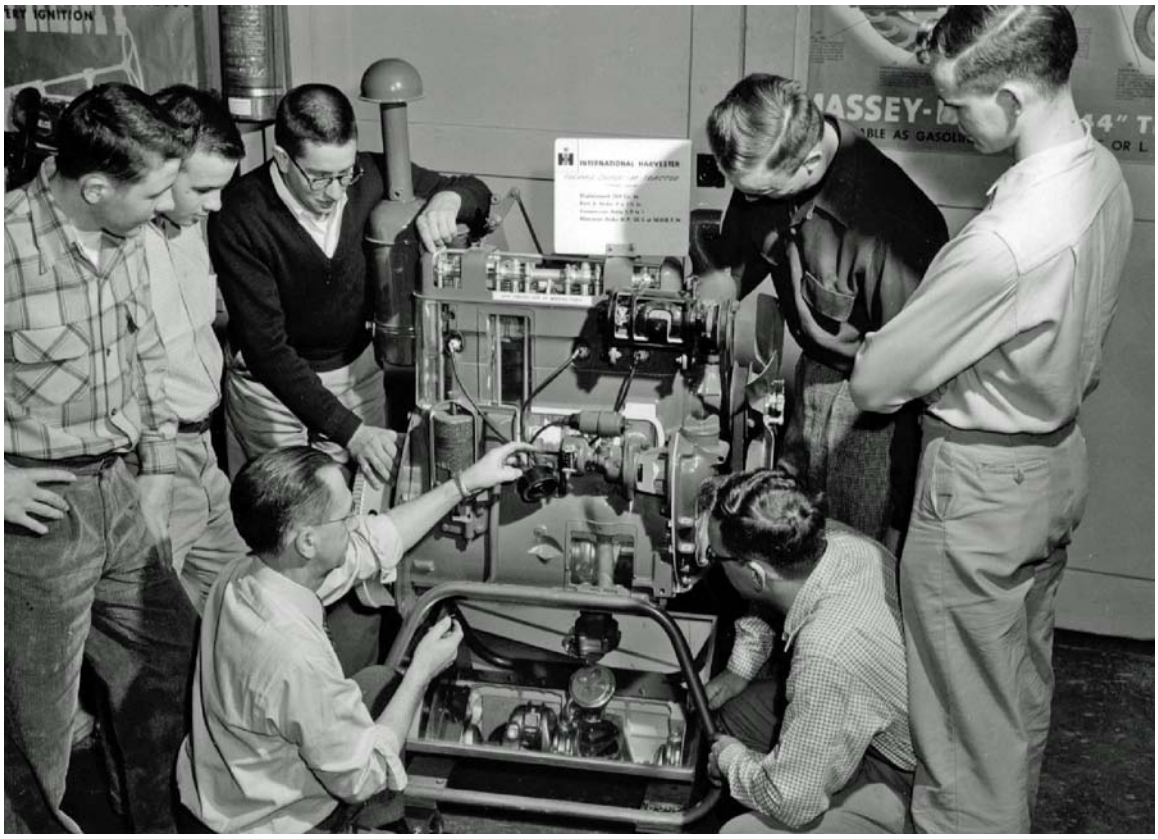

Professor J. Robert Cooke performs duties of the university marshal at the 2005 Commencement ceremonies in Schoelkopf Stadium, one of a number of department members to serve in college and university posts over the years.

# ...And Today

Over the years, the department's teaching, research, and Extension programs grew in both quality and variety of activities through the excellent cooperation and strong support of the Colleges of Agriculture and Life Sciences and Engineering. The future would show that distinguished program quality would be a hallmark of the department. A study in 1978 by an independent institution, as well as the Gourman Reports, gave the department a Number One ranking in the nation. A separate evaluation of U.S. graduate programs also gave the department a Number One national ranking. In 2006, Cornell University was ranked by *U.S. News and World Report* as having the fourth best program in agricultural engineering in the country and tenth for best undergraduate engineering programs at schools whose highest degree is a doctorate.

Recent years have brought a renewed vigor and resurgence of activity dealing with solutions to environmental concerns. Waste disposal and treatment, recycling and reuse of residuals, water quality maintenance and protection of the environment from chemicals have become major departmental thrusts. In addition, bioprocessing of materials for environmental enhancement and the production of food and fuels has become a major activity, along with applications of technology at the cellular level.

At the end of its first century, the department continues evolving to adjust to current and future needs for engineering in agricultural and biological systems and the environment, and has developed one of the major graduate programs in these areas in the United States. One recent benchmark in this evolution was the change of the department's name to Biological and Environmental Engineering in 2001. This name corroborates the trend in the engineering practice of the department toward a stronger integration of engineering with the biological sciences, and the teaching, research, and Extension programs manifest that movement.



Professor C. W. Terry instructs a class in the Power and Machinery Laboratory of Riley-Robb Hall in the late 1950s.

# Service through Teaching

That there was a growing need for information and instruction for things mechanical when the Division of Rural Engineering and Architecture was formed at Cornell in 1907 almost goes without saying. Historically, machines had been developed for a wide variety of uses, including warfare, but the industrial revolution that began in the eighteenth century provided special impetus that reached into farming as well. Removing drudgery along with increasing efficiency and production were certainly incentives of the first order: the broad substitution of new power sources for manual and animal means, as well as water, was just around the corner, and American inventors were about to have a field day.

The National Academy of Engineering web site <http://www.greatachievements.org/> lists electrification and agricultural mechanization as two of the Top 20 Greatest Engineering Achievements of the Twentieth Century, recounting that "in 1900 farmers represented 38 percent of the U.S. labor force. By the end of the century that number had plunged to 3 percent-dramatic evidence of the revolution in agriculture brought about by mechanization. Beginning with the internal combustion engine and moving on to rubber tires that kept machinery from sinking in muddy soil, mechanization also improved the farm implements designed for planting, harvesting, and reaping. The advent of the combine, for example, introduced an economically efficient way to harvest and separate grain. As the century closed, "precision agriculture" became the practice, combining the farmer's down-to-earth know-how with space-based technology." The Division of Rural Engineering and Architecture would begin its own contribution to developments in these areas first through its teaching and outreach efforts, and then later expand its role in an evolving and highly productive research program.

And just who had been providing this "engineering in agriculture" instruction at Cornell prior to the birth of the Division of Rural Engineering and Architecture? Not engineers. During 1900-07, Dean of the College of Agriculture Roberts, along with agronomists Lauman, Hunt, Frazier and Gilmore, and Ayres from the Dairy Department, taught 5 courses that dealt with (a) the inspection of roads, bridges and farm buildings, and comparison of farms; (b) the study and design of farm buildings; farm vehicles and machinery; power, water, drainage and irrigation; (c) dynamometers and other tests of wagons and farm implements; (d) farm motors; and (e) dairy mechanics. The course on the study and design of farm buildings was required for seniors in the College of Agriculture.

# Machines for Farms

At the start of his tenure as head of the Division of Rural Engineering and Architecture at Cornell, in 1907-08 Riley taught "Course Number 52: Farm Machinery, dealing with machine elements and design, with special study of motors, including steam boilers, gas and steam engines, windmills, hydraulic rams, water wheels, and the laws and application of electricity; as well as farm machinery for tillage, seeding, harvesting, threshing and cleaning; with discussion of the cost life, and special mechanical features of some of the machines then on the market." For a man who was born in East Orange, New Jersey, Riley must have spent some very long days and nights preparing course materials and securing equipment for such a broad spectrum of topics, especially those related to farm equipment.

In those days, courses were not listed under department names, hence the high number for the first course to be taught in his new Division of Rural Engineering and Architecture. In 1908-09, he added a course that included farm water supply, sewage disposal, surveying and mapping the farm; construction of foundations for buildings, and cement and concrete selection and use. In 1910, he developed a Special Work course, described as "...the study of problems in connection with any of the numerous branches of farm mechanics. May be undertaken by students of sufficient training or natural aptitude for the work." This appears to be the very early forerunner of the Special Topics courses later taught in the department. He was indeed a busy man. In spite of the broad subject matter of his courses, his very special interest in the internal combustion engine would earn him the nickname "Gas Engine" Riley, said to be reinforced by his daily appearance early on in the only automobile on the Agriculture Campus.

In 1910-11, Riley initiated a course on Research in Farm Mechanics, and B. B. Robb appeared on the scene. Riley, Instructor M. E. Evens, and 4 student assistants, R. D. Burdick, L. W. Kephart, B. B. Robb and A. M. Goodman, taught courses in Farm Mechanics, Dairy Mechanics, Research in Farm Mechanics, Farm Engineering, and Farm Engineering Advanced. Six other agricultural engineering courses were given, taught by members of the Farm Practice Department, Horticulture Department, and the Soil and Technology Department, and included a new course on greenhouse construction. The Poultry Department added a course on Poultry House Construction in 1912-13, and J. E. Reyna joined as an instructor in the Department of Drawing. Responsibility for instructional effort related to engineering subject matter was still very broad-based and the demand was increasing rapidly.

By 1913-14, now under the name Department of Rural Engineering, 10 courses were offered by a faculty of 2 (Riley and Robb), 4 instructors, and 5 assistants and the course offerings had more or less been regularized into well defined topical areas. They were solidly on their way!

A course in Steam Machinery was started in 1915-16 by Riley, and then taught by Professors L. E. Hazen and Fairbanks. (It's a small world! The son of L. E. Hazen, Professor Thamon E. Hazen, would become the author's PhD program chairman in agricultural engineering at Iowa State University in 1963.) Wood Shop was added in 1917-18, and Farm Shop was taught in 1918-19. Shop courses would be of real interest for decades to come because of the need of farmers to be self-reliant in farmstead

construction, field repairs, and maintenance on-site.

In 1919-20, Mechanical Drawing was listed as an engineering course for the first time and taught by Reyna; he would later add another course on perspective drawing, which was a special field of endeavor at that time. Course 10, Household Mechanics, was offered for the first time in 1921-22, taught by Robb and B. A. Jennings, later by F. B. Wright and finally by R. W. Guest. (photos, next page). This course over its lifetime would eventually enroll the highest total number of students in the department, approximately 10,000. Students in the College of Home Economics took this course to satisfy their graduation requirements in physics.

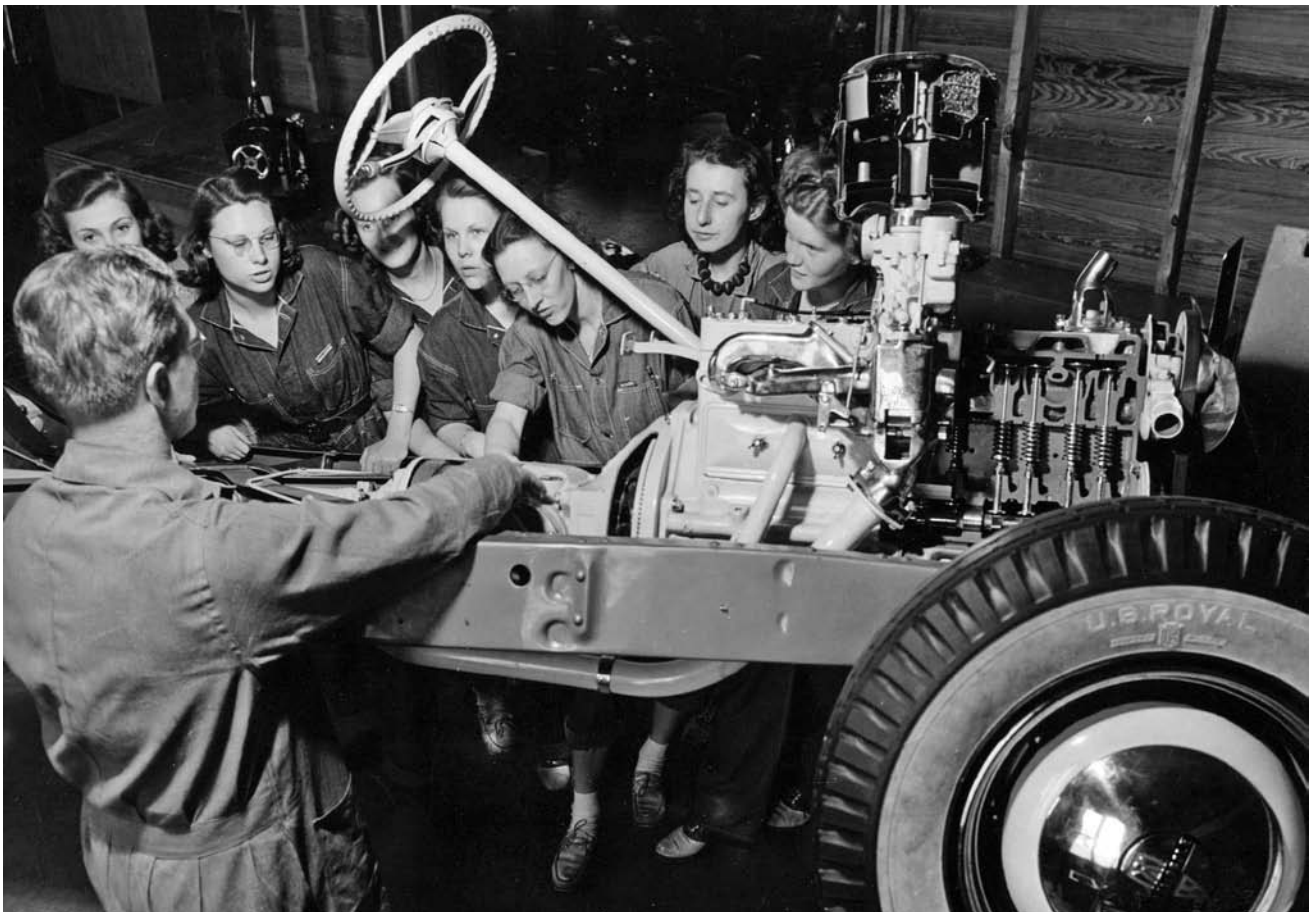
## *The Coming of Tractors*

In a 1918-19 administrative report, contained in the College of Agriculture's thirty-second Annual Report to the New York State Legislature, Riley states that "So keen is the interest in farm tractors at this time that the regular students in the College of Agriculture presented a petition asking this Department to offer a course in tractors during the spring term, and at the request of the Dean such a course was offered. The fact that laboratory apparatus was provided in five tractors donated to the College by the New York State Food Commission, and that laboratory space and necessary instructors were made available by the temporary discontinuance of the regular course in dairy mechanics, contributed to make this course possible." Tractors were high on the list of farmers' interests, and tractor schools of three weeks duration, not open to regular students registered in the University, were also offered on campus to provide instruction in their overhaul and repair. Applicants exceeded the space available.

Similar interest was exhibited in tractors in the Extension program, and faculty members were involved in tractor schools in the field, cooperating with the New York State Food Commission, farm bureaus, and tractor manufacturers. During the winter of 1918-19, the enrollment in 21 tractor schools was 1,131, with special evening sessions teaching rope splicing and belt lacing. The latter activities reflected the fact that farmers often made ropes by hand, and wide belts were extensively employed in power transmission to equipment. Incidentally, Riley wrote a popular bulletin on knots, splices and hitches that was used as the pattern for that same section of the *Boy Scout Handbook*. This period also marked the beginning of milking machine and farm-mechanics extension schools, dealing with gas engines for powering milking systems, water supply, sewage disposal systems and pipe fitting. Department members were also involved in designing drainage systems and demonstrating the use of power ditching machines provided by the New York State Food Commission.

Professor Burton A. Jennings was one who demonstrated the use of these large ditching machines for tile drainage systems, and on one occasion while driving a ditcher back to Ithaca took an unfamiliar short cut that unknown to him had a covered bridge on the route. Unfortunately, only after entering the covered bridge

**A**n early Course 10 Household Mechanics laboratory class.

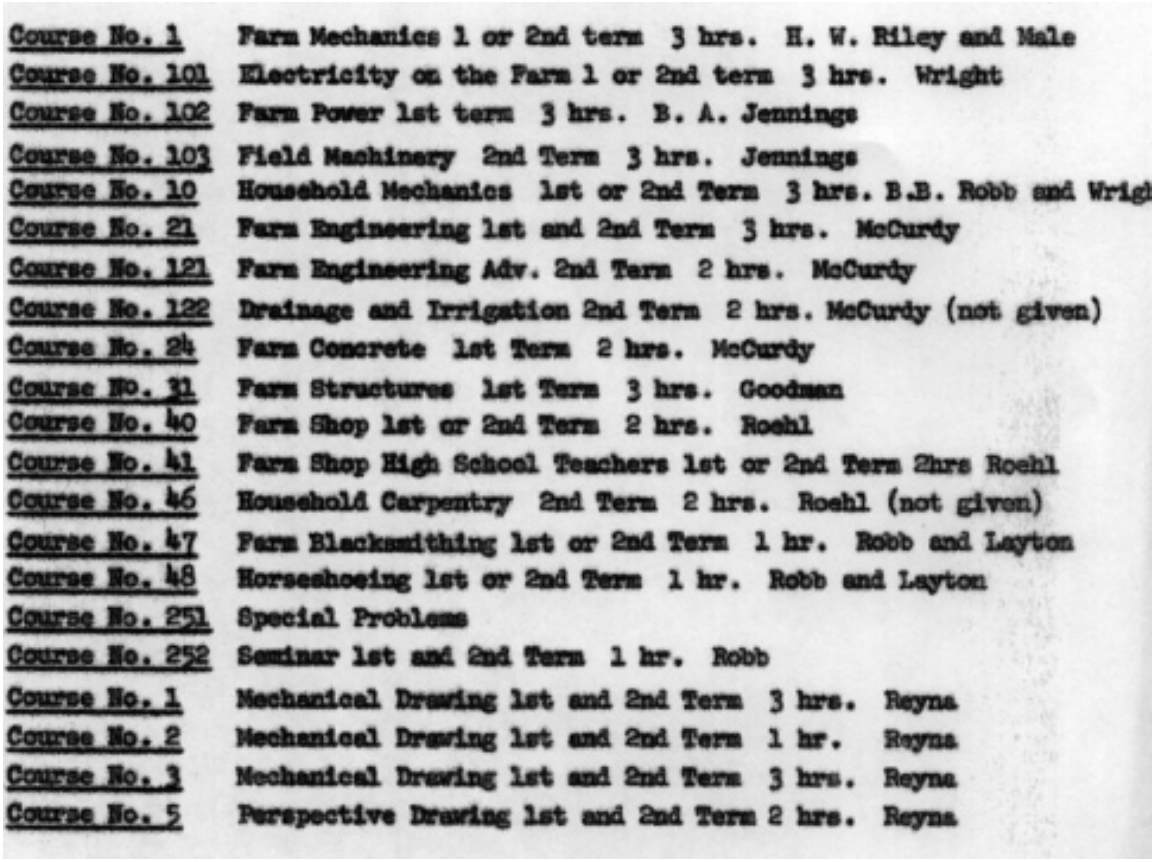



**L**earning about the automotive power train in the same course.

Professor Burton A. Jennings instructs a farm field machinery class on the requirements for balancing forces on a moldboard plow outside the relocated temporary laboratory buildings on Judd Falls Road.

The earlier way, eighteen teams plow and harrow at the Don Backus farm in Central New York in 1911.

**Course and instructor assignments for 1941-1942**



| | |
|---|---|
| Course No. 1 | Farm Mechanics 1 or 2nd term 3 hrs. H. W. Riley and Male |
| Course No. 101 | Electricity on the Farm 1 or 2nd term 3 hrs. Wright |
| Course No. 102 | Farm Power 1st term 3 hrs. B. A. Jennings |
| Course No. 103 | Field Machinery 2nd Term 3 hrs. Jennings |
| Course No. 10 | Household Mechanics 1st or 2nd Term 3 hrs. B.B. Robb and Wrigl |
| Course No. 21 | Farm Engineering 1st and 2nd Term 3 hrs. McCurdy |
| Course No. 121 | Farm Engineering Adv. 2nd Term 2 hrs. McCurdy |
| Course No. 122 | Drainage and Irrigation 2nd Term 2 hrs. McCurdy (not given) |
| Course No. 24 | Farm Concrete 1st Term 2 hrs. McCurdy |
| Course No. 31 | Farm Structures 1st Term 3 hrs. Goodman |
| Course No. 40 | Farm Shop 1st or 2nd Term 2 hrs. Roehl |
| Course No. 41 | Farm Shop High School Teachers 1st or 2nd Term 2hrs Roehl |
| Course No. 46 | Household Carpentry 2nd Term 2 hrs. Roehl (not given) |
| Course No. 47 | Farm Blacksmithing 1st or 2nd Term 1 hr. Robb and Layton |
| Course No. 48 | Horseshoeing 1st or 2nd Term 1 hr. Robb and Layton |
| Course No. 251 | Special Problems |
| Course No. 252 | Seminar 1st and 2nd Term 1 hr. Robb |
| Course No. 1 | Mechanical Drawing 1st and 2nd Term 3 hrs. Reyna |
| Course No. 2 | Mechanical Drawing 1st and 2nd Term 1 hr. Reyna |
| Course No. 3 | Mechanical Drawing 1st and 2nd Term 3 hrs. Reyna |
| Course No. 5 | Perspective Drawing 1st and 2nd Term 2 hrs. Reyna |

**Course and instructor assignments for 2006-2007**

*BEE 102(1102) Introduction to Microcomputer Applications, P.E. Hillman*

*BEE 110(1030) Introduction to Metal Fabrication Techniques, T.J. Cook*

*BEE 132(1040) Introduction to Wood Construction, T.J. Cook*

*BEE 151(1510) Introduction to Computer Programming, Staff*

*BEE 200(1200) The BEE Experience, J.A. Bartsch*

*BEE 222(2220) Bioengineering Thermodynamics and Kinetics, J.B. Hunter*

*BEE 251(2510) Engineering for a Sustainable Society, B.A. Ahner*

*BEE 260(2600) Principles of Biological Engineering, A.J. Baeumner*

*BEE 299(3299) Sustainable Development: A Web-Based Course, N.R. Scott*

*BEE 305(3050) Principles of Navigation, Lt. Gamicchia*

*BEE 310(1050) Advanced Metal Fabrication Techniques, T.J. Cook*

*BEE 325(3250) Environmental Management, W.J. Jewell*

*BEE 331(3310) Bio-Fluid Mechanics, K.G. Gebremedhin*

*BEE 350(3500) Biological and Environmental Transport Processes, A.K. Datta*

*BEE 360(3600) Molecular and Cellular Bioengineering, U. March*

*BEE 362(3620) Fundamentals of Tissue Engineering, R.C. Gorewit*

*BEE 365(3650) Properties of Biological Materials, J.A. Bartsch*

**(continued on page 34)**

did he discover that a roof tie blocked a portion of the superstructure of the ditching machine. He solved the problem by neatly sawing out the offending bridge section and continued on his way. After spending 36 years on the faculty, Professor Jennings was reminded of this intransigence at his retirement party in 1958!

At the end of his administrative report, Riley made a plea for appropriate facilities for the conduct of the department's programs: "The prospect of securing additional space for a tractor laboratory and a small wood shop and instructor's office in the new temporary building merely serves to emphasize the great need of the department for really adequate quarters. World War I has emphasized with renewed force the importance of engineering in present-day agriculture, and it is clearly the duty of the State to see to it that adequate quarters for the teaching of so important a division be provided in the very near future." As it turned out, "the very near future" was nearly a half-century away, but he was in there swinging at every opportunity. And there's that word "temporary" again!

About 1921, more topically specialized courses began to appear, such as Farm Field Machinery, Farm Power Machinery, Drainage, Farm Concrete, Hotel Engineering/ Power Plants/Auxiliary Equipment, and Farm Blacksmithing. Although most course offerings in the teaching program were oriented toward farm production, the needs of the household had not been neglected: recall the course in Household Mechanics mentioned previously, and the addition later of a new course in 1929 on Household Carpentry taught by Roehl. A course in Research in Agricultural Engineering was offered in 1933-34 along with a new course, Electricity on the Farm, taught by F. B. Wright. In 1934-35, Hotel Engineering was no longer listed under Agricultural Engineering.

In 1941-42, when World War II became the dominant national priority, the department constituents included District Engineers for the first time and permanent on-site engineering assistance to the farming community began in the field across the State. By that time, the roster had grown to 46 and the formal course offerings to 21 (opposite page), with personnel assignments as shown on page 112.

## *Our Scope Broadens*

It is interesting to compare the 21 courses listed at the thirty-fifth year of development of the department with the 73 courses currently offered at the 100-year mark shown on pages 32, 34 and 35. Topics dealing with soil, water, wood and metal use and fabrication remain, but are now taught at a decidedly different technical level. Upon Professor Roehl's retirement in 1948, Professor Edward W. Foss was hired to teach farm shop and woodworking courses, and later also had an assignment in rural housing. In 1957, after Riley-Robb Hall was occupied, Professor Fred G. Lechner was appointed to develop hands-on laboratories for the teaching of carpentry, plumbing, electricity, welding and lathe work. Later, Thomas Cook taught these courses which were very popular across the campus, attracting students from a wide range of undergraduate majors.

**Course and instructor assignments for 2006-2007 (cont'd)**

*BEE 368(3680) Biotechnology Applications: Animal Bioreactors, R.C. Gorewit*
*BEE 371(3710) Physical Hydrology for Ecosystems, T.S. Steenhuis and M.T. Walter*
*BEE 401(4010) Renewable Energy Systems, L.D. Albright*
*BEE 427(4270) Water Sampling and Measurement, L.D. Geohring and T.S. Steenhuis*
*BEE 435(4350) Principles of Aquaculture, M.B. Timmons*
*BEE 450(4500) Bioinstrumentation, D.J. Aneshansley*
*BEE 453(4530) Computer-Aided Engineering: Applications to Biomedical Processes, A.K. Datta*
*BEE 454(4540) Physiological Engineering, D.J. Aneshansley*
*BEE 459(4590) Biosensors and Bioanalytical Techniques, A.J. Baeumner*
*BEE 464(4640) Bioseparation Processes, J.B. Hunter*
*BEE 471(4710) Introduction to Groundwater, L.M. Cathles and T.S. Steenhuis*
*BEE 473(4730) Watershed Engineering, M.F. Walter and M.T. Walter*
*BEE 474(4740) Water and Landscape Engineering Applications, T.S. Steenhuis and L.D. Geohring*
*BEE 475(4750) Environmental Systems Analysis, D.A. Haith*
*BEE 476(4760) Solid Waste Engineering, D.A. Haith*
*BEE 478(4780) Ecological Engineering, W.J. Jewell*
*BEE 481(4791) LRFD–Based Engineering of Wood Structures , K.G. Gebremedhin*
*BEE 482(4820) Biothermal Engineering for Humans, P.E. Hillman*
*BEE 484(4840) Metabolic Engineering, R.M. Spanswick*
*BEE 487(4870) Sustainable Energy Systems, N.R. Scott and L.D. Albright*
*BEE 489(4890) Engineering Entrepreneurship, Management, and Ethics, M.B. Timmons*
*BEE 493(4930) Technical Writing for Engineers, Staff*
*BEE 494(4940) Special Topics in Biological and Environmental Engineering, Staff*
*BEE 495(4950) BEE Honors Research, Staff*
*BEE 496(4960) Capstone Design in Biological and Environmental Engineering, Staff*
*BEE 497(4970) Individual Study in Biological and Environmental Engineering, Staff*
*BEE 498(4980) Undergraduate Teaching, Staff*
*BEE 499(4990) Undergraduate Research, Staff*
*BEE 501(5010) Bioengineering Seminar, D. Lipson*
*BEE 520(5900) M.P.S. Project, BEE Graduate Faculty*
*BEE 533(5330) Engineering Professionalism, M.B. Timmons*
*BEE 551(5950) Master of Engineering Design Project, BEE Graduate Faculty*
*BEE 625(6250) Environmental Management, W.J. Jewell*
*BEE 647(6470) Water Transport in Plants, R.M. Spanswick*
*BEE 649(6490) Solute Transport in Plants, R.M. Spanswick*

*BEE 651(6510) Bioremediation: Engineering Organisms to Clean Up the Environment, B.A. Ahner*

*BEE 655(6550) Thermodynamics and Its Applications, J.-Y. Parlange*

*BEE 659(6590) Biosensors and Bioanalytical Techniques, A.J. Baeumner*

*BEE 671(6710) Analysis of the Flow of Water and Chemicals in Soils, J.-Y. Parlange*

*BEE 672(6720) Drainage, T.S. Steenhuis and L.D. Goehring*

*BEE 673(6730) Sustainable Development Seminar, N.R. Scott*

*BEE 687(6870) The Science and Engineering Challenges to the Development of Sustainable Bio-Based Industries, L.P. Walker*

*BEE 694(6940) Graduate Special Topics in Agricultural and Biological Engineering, BEE Graduate Faculty*

*BEE 697(6970) Graduate Individual Study in Agricultural and Biological Engineering, BEE Graduate Faculty*

*BEE 700(7010) BEE Seminar Series, Staff*

*BEE 740(6430) Veterinary Perspectives on Pathogen Control in Animal Manure, D.D. Bowman*

*BEE 750(7000) Orientation to Graduate Study, D.J. Aneshansley*

*BEE 754(7540) Watershed Management, T.S. Steenhuis*

*BEE 760(7600) Nucleic Acid Engineering, D. Luo*

*BEE 771(7710) Soil and Water Engineering Seminar, T.S. Steenhuis, J.-Y. Parlange, M.F. Walter, and M.T. Walter*

*BEE 781(7810) Structures and Related Topics Seminar, Staff*

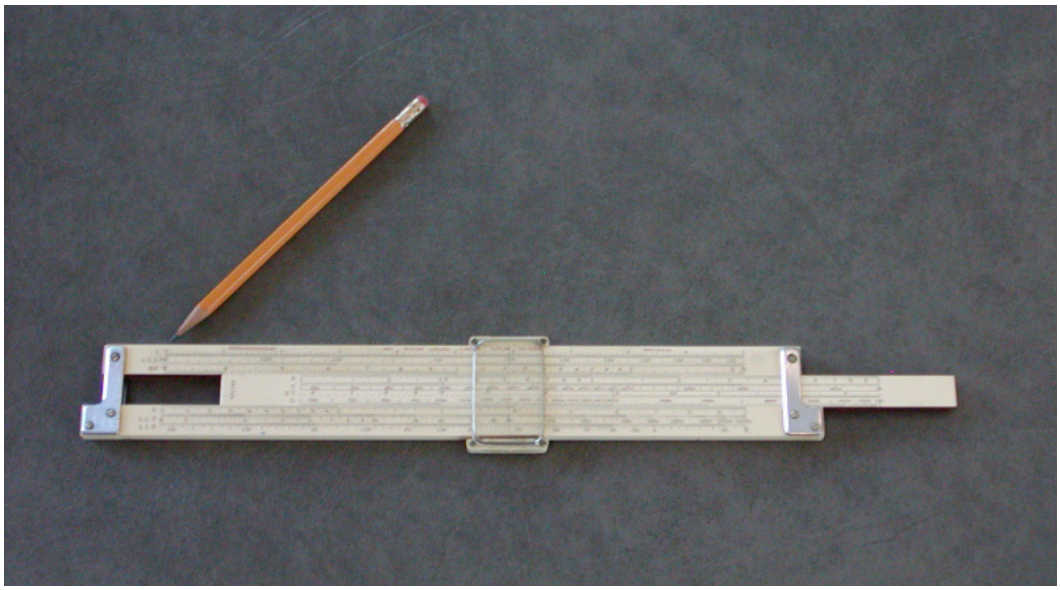
*BEE 785(7850) Biological Engineering Seminar, Staff*

*BEE 787(7870) Industrial Ecology of Agriculturally Based Bioindustries, L.P. Walker*

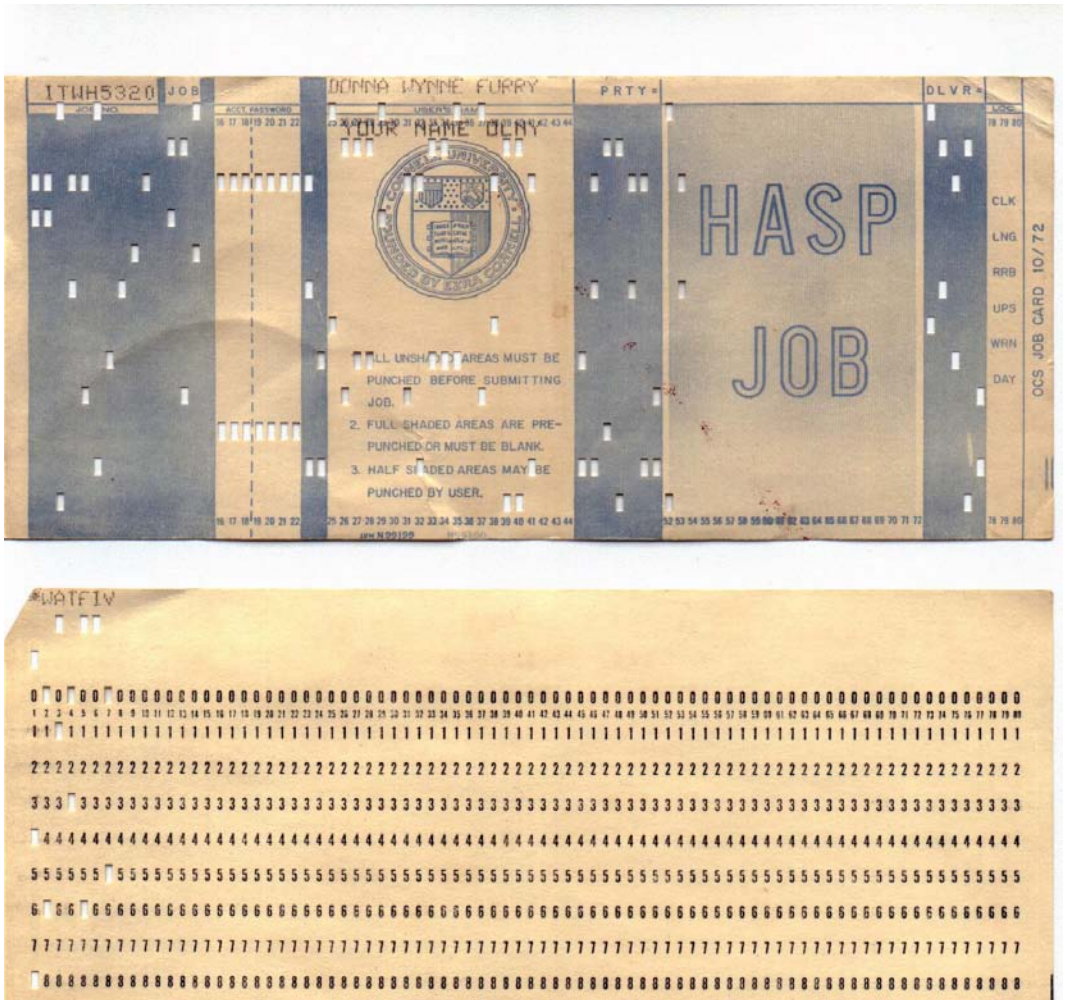
*BEE 788(7880) Biomass Conversion of Energy and Chemicals, L.P. Walker*

*BEE 800(8900) Master's-Level Thesis Research, BEE Graduate Faculty*

*BEE 900(9900) Doctoral-Level Thesis Research, BEE Graduate Faculty*



**Above,** The author's Keuffel and Esser slide rule from the early 1950s. No engineer could afford to be without one. Pi was conveniently placed at each end of two of the scales, with scales for different functions on both the front and the back of the slide rule. **Below,** relics of the past include a preprinted spelling error in the name area of a HASP Job card, and the first card of a WATFIV computer program deck that had been punched, verified, batch-processed, and then returned to the programmer along with the printed output.



Note especially that the great initial emphasis on farm power and machinery in the curriculum of the early years no longer remains. The objective of satisfying the needs of those early times had been met with great success both in the classroom and the field, and the department had begun to nudge in a new direction. Most notably, the move toward a biological orientation in the course offerings is readily apparent. Quality facilities for research, however, were not available until Riley-Robb Hall was constructed. But one great advantage of the department's applied research program in the field was that the new knowledge gained moved swiftly into the classroom, bypassing the glacially slow textbook production process of that time - a big advantage for the students; and that's still true for the research programs underway today, where undergraduate students participate with faculty in exciting investigations on a whole new scale of direct involvement.

Unlike the courses listed at the top of page 32, almost all courses now either depend heavily upon or utilize digital computers in some way. Even teaching the use of the slide rule (opposite page) had been supplanted by manual and electrically operated desktop calculators (e.g., Friden, Marchant, Monro) along the way, then came pocket calculators, and finally the ubiquitous multi-form digital computer. With the lack of a slide rule or a pocket calculator hanging from a student's belt, there is no longer an easy way to ascertain an engineering student on campus from a distance just by sight; now, multi-function cell phones have wormed their way into the dress code!

When main frame digital computers first appeared on the scene, the slide rule was still the engineer's preeminent computational tool and computer science had not yet been invented. Possessing an extra long slide rule with expanded functionality (e.g., Log-Log Duplex Trig) permitted both better accuracy in a calculation and convenience. They were important instruments in an engineering department in both teaching and research. Professor Millier owned a slide rule for use in his research work that was two feet long!

At first, learning how to write computer programs was optional in the curriculum and engineering students at Cornell were given a short, voluntary introduction to the programming language CORC (for CORnell Compiler) developed in the early 1960s. Its big advantage to the user was that the computer programs looked less cryptic compared with the ALGOL and FORTRAN computer programming languages and more like English statements; however, CORC was rather "wordy." Eventually, computer programming became a required course for engineering students, and Professor Gilbert Levine taught programming to department majors flavored astutely with agricultural engineering applications. Those were the days when computer programs were laboriously lettered on special 80 column wide Coding Forms which were then sent to trained machine operators who punched and verified the related code into Hollerith cards. The punch cards (opposite page) were then fed into card readers in batch format, the program translated into machine code, and the card deck and printed output from the program were returned to the user to hunt for inevitable errors! Hopefully, the cards in the job deck were in the correct order. Turnaround time from submission of the coding forms to receiving the output from a computer run was on the order of 24 hours.

The computer world is quite different today; even "instantly" is now seemingly too slow! It is to be noted, however, that the department still teaches Introduction to Computer Programming to its majors, using modern equipment and facilities that would be the absolute envy of the early founders. In 1979, the first interactive instructional computer facility in the department was established by R. B. Furry who developed a computer laboratory in basement Room 15 of Riley-Robb Hall, teaching FORTRAN and engineering graphics to departmental majors using TERAKs and flatbed plotters; an adjacent space provided public access to Apple II computers. In 1984, after microcomputers had become prevalent, a 4,800-square-foot computer facility costing a half-million dollars was established in the southwest first-floor wing of Riley-Robb Hall. The Riley-Robb Hall Computing Center included laboratories for PCs and Macintosh computers, a computer graphics laboratory, Manager's office and attendant service and storage areas. Professors Cooke, Scott, Rehkugler and Furry were instrumental in establishing this Center. Over the years, computer programming and the use of application packages have been taught to department majors by L. D. Albright, Furry, J. R. Cooke, P. E. Hillman, Levine, H. A. Longhouse and G. E. Rehkugler. Furry and Hillman also taught other computer courses to large numbers of non-majors. Currently, the numerical computing environment and programming language MATLAB (for MATrix LABoratory) is being used in the engineering curriculum. Doing engineering class assignments is getting easier, but requires a much higher level of sophistication!

## *More Women, Research, and Disciplines*

Student interest in the department's undergraduate and graduate programs developed at a moderate pace after World War II, when many veterans attended college under the GI Bill to obtain their first degrees, and some returned again several years later to obtain graduate degrees. The most significant development was the availability of research laboratories in Riley-Robb Hall beginning in 1957 that assisted in giving the graduate program, as well as faculty research, a decided impetus. Then, in the 1970s Furry developed an annual nationwide undergraduate recruitment program directed at high school guidance counselors and students that more than doubled enrollment in the department's freshman class in its first year of operation.

Undergraduate student demographics and interest began to shift, too. For the ten-year period from 1985 through 1994, the number of women undergraduates nearly doubled, increasing from 22 to 41 percent of the total undergraduate students advised by the faculty, with most (249, or 80 percent) of the men and women being enrolled in the professional engineering degree program. The largest increase in total combined enrollment in undergraduate and graduate programs began in 1990, and by Fall Semester 2006 the undergraduate program had 352 students enrolled, with the graduate program enrolling 76, distributed as shown next.

**Fall 2006 Enrollment**

| | | | |
|---|---|---|---|
| BS Engineering | 335 | MS | 10 |
| BS Technology | 17 | MS/PhD | 6 |
| MEng | 10 | PhD | 47 |
| MPS | 3 | Total All Programs | 428 |

A comparison of undergraduate degrees granted at the end of the academic year for 1996 and 2006 illustrates the continuing trend of undergraduate student interest in the biological and environmental engineering curriculum. The total number of graduates increased by 30 percent during this period.

| | BS in Engineering | BS in Technology | Total Graduates |
|---|---|---|---|
| May 1996 | 42 | 14 | 56 |
| May 2006 | 71 | 2 | 73 |

The Office of the University Registrar declined to provide historical data on department graduates, citing privacy concerns, therefore long term trends in graduation rates and demographics could not be included.

A computer-searchable compilation of graduate degrees, listed both by year received and alphabetically by name of the recipient, compiled by Professor J. R. Cooke, Mrs. Ruth Stanton, and Mrs. Sandra Bates, recorded 566 graduate degrees that had been awarded by the department for the period 1913-1995.

Like many other engineering programs in the U.S., the number of women undergraduate majors in the department increased dramatically near the end of the twentieth century, and for the Class of 2007, 57 percent of all undergraduate students advised by the department are women. For men and women advisees, the biological engineering aspect of the program currently attracts the vast majority of both the professional engineering and technology majors.

# *Up to Date*

The department is right in tune with the times: engineering and engineering technologies are currently among the most chosen baccalaureate fields at Cornell, and women now make up 28 percent of undergraduates in the College of Engineering, 53 percent in the College of Agriculture and Life Sciences, and 49 percent of the total undergraduate enrollment at Cornell. Based on Fall Semester 2006 data, the university currently exceeds its operational maximum total on-campus undergraduate enrollment target of 13,000 by 562 students.


Students used multiple-unit bench type work stations in drafting class on the 4th floor of Stocking Hall prior to the move to Riley-Robb Hall in 1956. Along with an appropriate text, standard equipment owned by each student consisted of a drawing board (actually a bread board!), T-square, triangles, French curves, drafting pencils of different hardness, an eraser and eraser shield, a set of precision drawing instruments, a bottle of India ink, along with opaque paper, tracing paper for ink drawings to be reproduced, and, of course, a roll of drafting tape. The curriculum required majors to take two laboratory sessions a week for two semesters. As it is today, communicating design information through graphical means was an important aspect of engineering training.

Riley had envisioned a profession where "...the ideal professional agricultural engineer is a farm raised boy with natural ability in engineering who has completed in agriculture and in engineering training so complete in both these branches of knowledge that he is thoroughly competent in each one. A man so trained will be able to make decisions that are wise from the agricultural point of view and he will also be fully able to solve the engineering problems that the needs of agriculture present." At Cornell, all of that has come to pass, and much, much more.

A half century after J. C. McCurdy taught in the summer surveying camp of the School of Civil Engineering, Professor Gilbert Levine, who held a joint appointment with the College of Engineering, repeated the practice. Levine is in the second row, ninth from the left behind the man holding a hat in the front row. The Agricultural Engineering Department also taught surveying for students in its curriculum for decades.

Reminiscing on this six-week Civil Engineering summer camp experience in late August to September 1955 at a camp at Cayuta Lake, Levine described it as one "that provided field experience in route surveying, hydrographic surveying, base line establishment and basic astronomy. Accompanying the technical material was exposure to tent living, outhouses, a hand crank phone to an operator's bedroom, starvation rations (to hear it from the students), and days that went from 7 a.m. to 11 p.m. All in all, an experience that resulted in a strong bonding among the urban clientele."

# Students, a Key Element

Students in the department have traditionally taken part in a very wide variety of organizations on and off the Cornell campus. With the formation of the American Society of Agricultural Engineers in 1907, however, it was inevitable that related student organizations for those who had both professional and technical interests in the field would follow, and a Student Branch of ASAE was subsequently formed at Cornell.

Student Branch membership at Cornell reached its peak after World War II (next page). It was active both socially and professionally, and had superb interaction with department faculty and graduate students. Students greatly enjoyed trouncing the faculty in an annual spring softball game (page 46). This was during the era when the department was still organized primarily along the original lines of specialization in ASAE, which related back to Riley's five areas of professional activity promulgated in 1907: soil and water engineering, rural roads, farm power and mechanization, farm structures, and farm electrification. Students tended to associate themselves with one of these areas. Later, ASAE would establish a Technical Council with six major Divisions: Electrical and Electronic Systems, Emerging Technologies, Food and Process Engineering Institute, Power and Machinery, Soil and Water, and Structures and Environment, and student associations again generally followed suit.

They were good financial managers, too, and earned their own way, so to speak. In the late 1940s and early 1950s, the Student Branch derived its income from the sale of well crafted metal models of farm machinery as well as dues from its members to obtain funds for its activities. Professor E. S. Shepardson had a very respectable collection of these models. Later on, the students identified an opportunity to supply the users of Riley-Robb Hall with coffee, donuts, and lunch milk. For the latter activity they purchased a vending machine and stocked it themselves with cartons of milk processed by the Dairy Department in Stocking Hall. There were no vending machines of any type prior to this in Riley-Robb Hall and their activity clearly filled a need.

The Student Branch's 1961-62 Farm Equipment Institute (FEI) Report submitted to ASAE showed receipts of $1,235.21 and a balance of $630.24, a respectable bank account in those days, much of which was derived from proceeds from the sale of milk from the vending machine. The Student Branch was later deprived of this income source when the university decided that such sales could only be made from university owned and serviced machines.

In 1975, the John W. Layer Memorial Fund was established specifically to encourage participation of department undergraduates in professional activities. By 2007 a total of 70 undergraduate majors had received partial or total support from the endowment's earnings for professionally related activities and conferences, with Professor R. B. Furry serving as the faculty administrator for the awards from

Some 29 of the 47 members of the Cornell Student Branch of American Society of Agricultural Engineers in 1950-51 and Professor Harold E. Gray, first row, fifth from the left, branch advisor. John W. Layer, first row, third from left; Ronald B. Furry, first row, second from right; and Lafayette "Pete" Knapp, first row, center, would go on to become members of the department faculty. From left, top row, Edward Polansky, Richard Sickmon, Francis Gross, Albert Rivoir, Walter Dragon, Kenneth Van Liew, Charles Stratton, Dexter Benner, William Loper, and David Dirksen; second row, Daniel Saracino, John Price, Howard Brandstein, William Plevich, Donald Youmans, Guy DeChadenedes, Wesley Payne, Antonio de Lozada, and Douglas Church; bottom row, Ronald Space, Peter Monkmeyer, John Layer, Robert Andrews, Dr. Harold Gray, Lafaytte Knapp, John Pedersen, Douglas Day, Loyal Towers, Ronald Furry, and Raymond Wilkes. Absent, Robert Angus, Edward Bailey, Reginald Barker, Garth Brink, Charles Bush, John Chadwick, David Cook, Paul Corwith, Howard McDonald, Donald McFarland, Leonard McNight, John Paget, Everett Pendleton, Samuel Schenck, Matthew Smith, Harry Theocharedos, and Zane Unterzuber.

Department Head Orval C French welcomes national ASAE Student Branch members to Cornell at the June 21-24, 1959 ASAE 52nd Annual Meeting, for which the department was the host.

Professor John W. Layer, in whose memory the Student Branch gives awards to department undergraduate majors to support their professional activities.

its inception. Professor Layer succumbed to amyotrophic lateral sclerosis in 1975 at age 47.

In recent years, as national concerns and professional directions changed to meet new challenges, students also migrated to new organizations that served these new interests, and Student Branch activity subsequently declined. Peter Hillman and Larry Goehring are the current ASABE Student Engineering Branch Advisors.

When women enrolled in the department's undergraduate programs in increasing numbers in the latter quarter of the twentieth century, they formed WinABEN (Women in Agricultural and Biological Engineering), an organization designed to meet their own social and professional pursuits, with Professor Susan Capps as their advisor. Eventually, their interest moved to the Cornell Student Section of the Society of Women Engineers (SWE) that provided a broader variety of social, outreach, and professional development services for its members and WinABEN disbanded.

The Cornell University Student Chapter of the Institute of Biological Engineering (IBE) was established to encourage inquiry and interest in the field of biological engineering in the broadest and most liberal manner possible, as well as promote the educational and professional development of its members. The IBE strives to enhance the opportunities, experiences and futures of its members through several ambitious initiatives. Professors Norman Scott and Dan Luo are the student chapter's current advisors.

Alpha Epsilon is an honor society for outstanding biological and agricultural engineers. The objectives of the honor society are to promote the high ideals of the engineering profession, give recognition to those biological and agricultural engineers who manifest worthy qualities of character, scholarship and professional attainment, and encourage and support improvements in the biological and agricultural engineering profession that make it an instrument of greater service to mankind. Professor James Bartsch is the society's current advisor.

The Biological and Environmental Engineering Graduate Students Association (GSA) provides social interaction among graduate students outside of an academic setting and fosters a sense of camaraderie among the students within the department. Additionally, the GSA provides a forum in which issues effecting students within the department can be discussed and addressed. Professor Daniel Aneshansley is the association's current advisor.

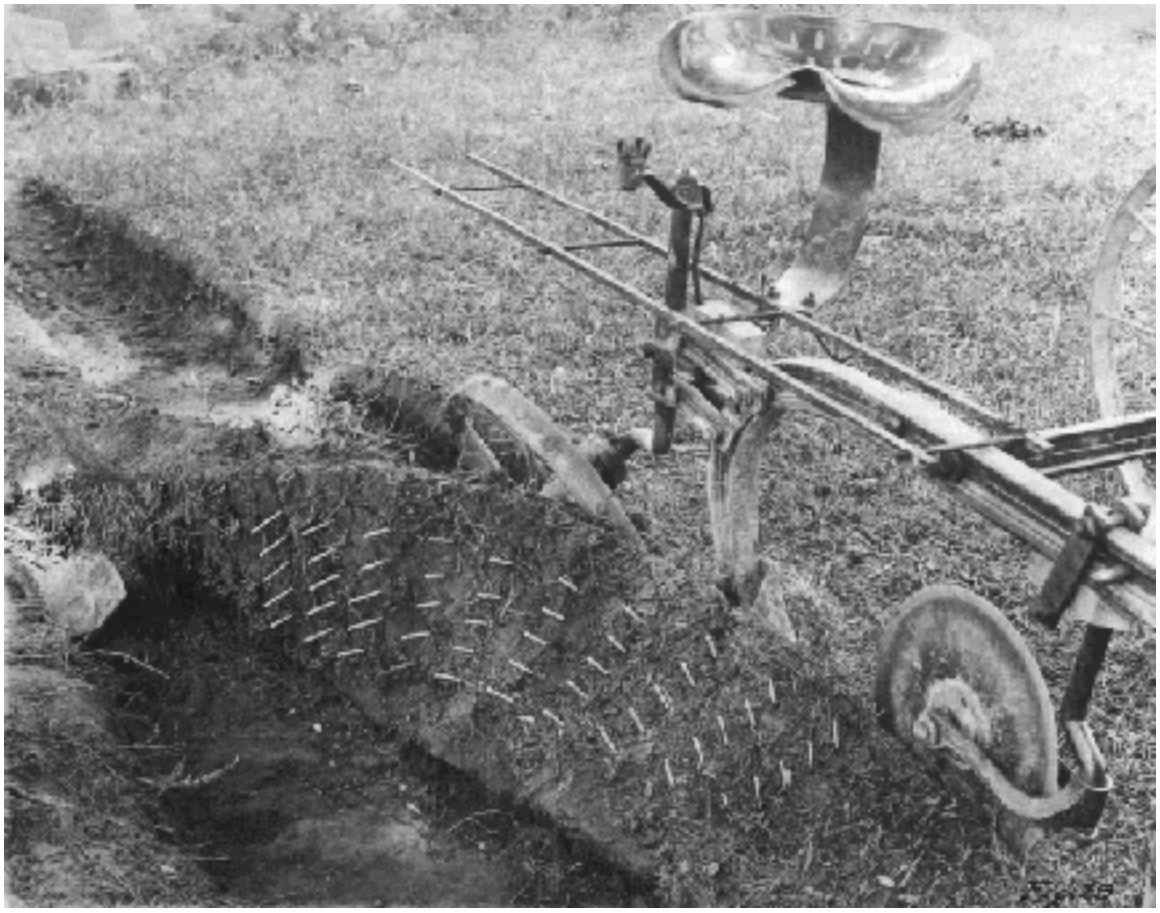
Social and professional interaction in formal and informal settings continues to be an important aspect of life within the department family.

**A**n early ASAE Student Branch-faculty picnic; food, fun and frolic, and more food. Above, Department Head Orval C French umpires a softball game from a position of relative safety behind the pitcher.

The faculty occasionally win. French presents Professor Lannie Boyd with the Riley-Robb Softball Trophy.

Professor J. W. Spencer is in the center, along with Professor E. D. Markwardt at the extreme right. Taughannock Falls State Park on the west shore of Cayuga Lake was the favorite location for these events.


On May 12, 1904, students organized a parade to celebrate the May 9, 1904 founding of the College of Agriculture by the New York State Legislature. For the May 12, 2004 re-enactment of this parade by the College of Agriculture and Life Sciences, BEE graduate and undergraduate students and staff constructed an entry that won the Dean's Award for the Best Overall Parade Float, an animated bee hovering over Riley-Robb Hall.



Field verification of Earl Archibald White's mathematical analysis of plow action uses pins imbedded in the soil to permit measurement of the coordinates of points in the furrow-slice that were on the moldboard. White's was the first Ph. D. awarded in the field of agricultural engineering.

# *Service through Research*

In the publication *One Hundred Years of Agricultural Research at Cornell University* (1987), prepared when N. R. Scott was director of the Cornell University Agricultural Experiment Station to commemorate the passage of the Hatch Act on March 2, 1887 and incorporating work accomplished by the College of Agriculture and Life Sciences, the Divisions of Biological Sciences and Nutritional Sciences, the College of Human Ecology, the New York State Agricultural Experiment Station at Geneva, Special Programs, and the College of Veterinary Medicine, Professors Rehkugler and Gunkel summarized the research activities of the department over its 80 year history to that date. Their excellent summary description is incorporated below, augmented as needed and updated to reflect developments to the present.

Although the department faculty had always maintained an interest in applied research, the major focus was on instruction and Extension until the late 1940s when research was initiated on pesticide application equipment. Then, in the 1950s a vigorous research program began to emerge directed toward both spraying equipment and mechanization. This research thrust was supported by a superbly equipped machine shop and fabrication laboratory managed and staffed by experienced personnel, including Clarence Mulligan, Samuel Baughman, and lastly by Douglas Caveny.

Waste handling and treatment became the major research emphasis of the 1960s, followed by the concern for energy use in agriculture in the 1970s. The 1980s were characterized by continuing research on groundwater quality, soil conservation, waste treatment, biotechnology, and energy efficiency. The age of biotechnology stimulated new research in bioprocess engineering, food engineering, livestock engineering, plant and cell mechanics, and the preservation and handling of agricultural products. Now, at the end of the department's first century, biological engineering, environmental engineering, and food and fiber engineering constitute overlapping areas of research endeavor conducted from the macro- to the nano-scale level.

Each era in the evolution of the department brought new technology to the solution of engineering problems in agriculture. Professor Riley, in 1908, studied spray nozzles; Professor Wesley W. Gunkel, in the late 1940s and early 1950s developed concentrate sprayers; and later integrated pest management (IPM) brought the study of spray application procedures to reduce the amount of material applied to crops. In 1910, Professor Byron B. Robb initiated research in land drainage (now called soil and water engineering), which was followed by drainage work by Professor A. M. ("Goodie") Goodman in the 1920s through the 1940s.

Drainage research subsequently continued in a statewide water management program. Environmental control for animals interested Professors Fairbanks and Goodman in the 1920s and 1930s and was followed with fundamental ventilation studies by Professor Turner and graduate student (later, faculty member and

Professor) William F. Millier in the late 1940s. Among his many other engineering interests, Professor F. B. Wright invented an automatic egg handling, washing and drying machine that was marketed by the GLF Cooperative (later known as Agway). The machine washed and dried 5 cases of eggs per hour using hot water and rotating cloth disks. Their work was accomplished in spite of the lack of research facilities.

The longest running, single purpose research project in the department was instituted in November 1936, when Professor B. A. Jennings installed a fence wire corrosion test site on Snyder Hill southeast of the campus in cooperation with the American Society for Testing Materials (ASTM) to establish coating standards for wire and metal roof product manufacturers. More than 900 specimens of lengths of wire and wire strands, farm field fence, barbed wire and chain link fence with various base materials and coatings were exposed to the weather, with annual evaluations and samples periodically returned to ASTM for more detailed physical and chemical analysis. Eleven such installations were originally sited across the United States to study corrosion effects due to rural, industrial and seacoast environments.

Upon Jennings retirement, the project was continued by Furry, and later by Professor Robert T. Lorenzen. In 1986, exactly 50 years after its inception, the project at Cornell was terminated by ASTM with only the original rural sites at Ithaca and Ames, Iowa having samples remaining that seemingly refused to deteriorate completely in their relatively benign environments. At the time of termination, a large sample stainless steel chain link fence section at the Ithaca site looked as good as the day it was installed in 1936. It actually seemed to sparkle in the sunlight. Ah, if we could only afford stainless steel fencing, or, as highway engineer Professor J. W. Spencer once mused, roads!

## *Early Studies*

Domestic sewage disposal studies were begun by Professor F. G. Behrends in the 1920s and continued by Professor Burton A. Jennings. In addition, Riley had developed a new and original design of a concrete septic tank that was readily adopted and used in several states. Riley was eager to educate people to improve their lot and put all of his energy into a project once he saw a need and devised a plan of attack. One monumental effort occurred during the summer of 1920, when, with a truck and trailer full of demonstration equipment, he made a 3,500 mile tour throughout the State presenting demonstrations on how to install water and sewage disposal systems in farm homes. In the 1960s, the management and disposal of animal wastes became a major research activity when urban pressures and environmental impacts forced careful evaluations of animal waste disposal practices.

Work in that era began with Professor David C. Ludington's study of poultry waste disposal. The arrival of Professor Raymond C. Loehr in the late 1960s, and later Professor William J. Jewell, gave the program in waste management a worldwide reputation for the development of effective and innovative means to apply animal and other waste to the land. Fundamental studies of the physiological response of

animals to their environments were also initiated by Professor Norman R. Scott in the 1960s, and continued with work by Professors Louis D. Albright, Kifle G. Gebremedhin and Daniel J. Aneshansley. Dr. Peter E. Hillman's interest in the thermal physiology of livestock also supported this effort, and his current interest deals with cooling dairy cattle in hot environments to avoid reduced milk production and breeding inefficiencies.

Professor Goodman, in the 1920s, studied apple storage structures, which are the forerunners of controlled atmosphere and temperature (CA) storages of today. Professors Ronald B. Furry, John W. Layer and James A. Bartsch in cooperation with fruit and vegetable scientists, and plant physiologists and pathologists, continued the development of storages for agricultural products, applying modern control systems and technology. Research studies by Professor L. L. Boyd on potato storages and Professor W. W. Gunkel on onion storages developed recommendations for ventilation, environmental control, and product handling and treatment that decreased spoilage and brought a better product to market out of storage to benefit the consumer.

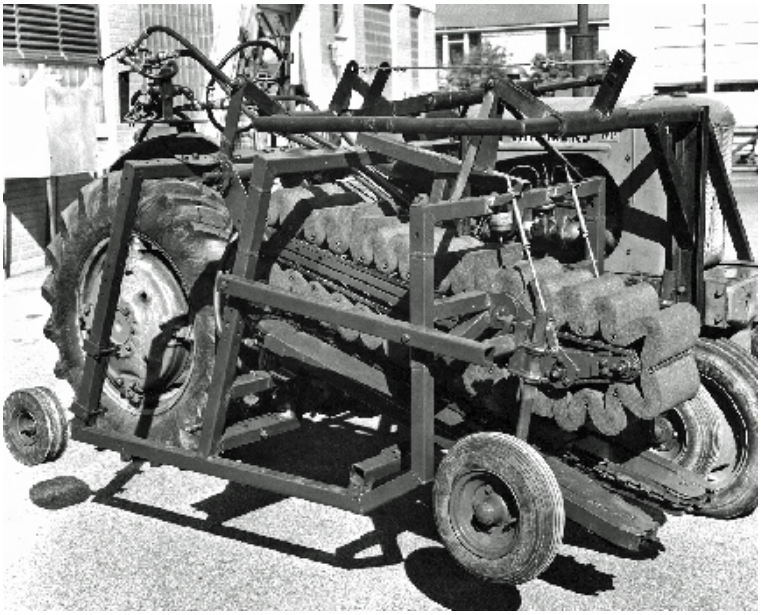
## *Changes in Emphasis*

In addition to the research related above that initiated a thread connecting the entire history of research in the department, each era was characterized by special problems and distinctive research endeavors. The late 1940s brought the development of a unique high-concentrate sprayer by Professor Wesley W. Gunkel and the revolutionary slot intake ventilation system for agricultural buildings by Professors Turner and Millier. In the early 1950s, materials handling studies dominated the research of many faculty members. Professors William F. Millier, William Larson, David C. Ludington, Gerald E. Rehkugler, and Wesley W. Gunkel contributed research that resulted in improved forage handling, reduced labor for dairy chores, improved silage conveying, and fundamental data on auger conveyor performance. In the late 1950s the research emphasis changed to the harvest mechanization of many different crops. Professor E. Stanley Shepardson, as Coordinator of Research for the department, helped to organize the total department research effort.

Harvest mechanization work began in earnest with the development of shake-catch harvesting of cherries by Professor Everett D. Markwardt and colleagues in 1959. Today essentially all cherries are harvested by this method. Professor Shepardson and colleagues at the New York State Experiment Station at Geneva, New York began the development of a mechanical grape harvester in 1957 that ultimately resulted in the total mechanization of the grape harvest in the State. The mechanical grape harvester accomplished the work of 40 people.

The Shepardson design spurred interest by other researchers and was a leading force in the complete mechanization of the grape harvest in the United States. Development of a cabbage harvester (next page) began in 1963, initially by Professor Rehkugler, and was completed with Professor Shepardson and John G. Pollock.


Final research version of the mechanical grape harvester in 1961.



An early proof-of-concept prototype cabbage harvester.

This machine did the work of a dozen people. The current commercial harvester for cabbage for processing is based on their design. Additional harvest mechanization work during the 1960s included the development of a lettuce harvester (page 58) and the beginning of a fresh market apple harvester by Professor Millier in 1966.

## *Yet More Complex Studies*

The decade of the 1960s was especially fertile for research development across a broad front. Professors Scott and Landis L. Boyd began studies of the relationship between environment and physiological response of poultry leading to an understanding of the basic response of the bird to environmental conditions. Controlled atmosphere and temperature studies of cabbage storage started by Professor Furry resulted in the commercialization of that practice. Professor Millier initiated studies to determine the effect of seed pellet coatings on seed germination and seedling emergence. A basic mathematical study of vibratory removal of fruit by Professor J. Robert Cooke resulted in understanding the fruit detachment process.

Professor Gilbert Levine began irrigation system design studies as well as soil and water conservation design procedures that are forerunners of procedures used today. Professor Richard Black conducted drainage research in field settings and was an advocate for the formation of the New York State Land Improvement Contractor's Association. Animal waste management was approached from an analytical perspective as well as by innovative management and treatment techniques developed by Professor Loehr and colleagues. An Agricultural Waste Pilot Plant, constructed southeast of the campus on Game Farm Road, was placed in operation in 1969 and utilized extensively by Professor William J. Jewell.

Planning for the Animal Science Teaching and Research Center (ASTARC) located on a 2,600-acre farm at Harford, and livestock engineering research in this new facility engaged the efforts of several members of the department faculty in the late 1960s and the 1970s. Professors Furry, Richard W. Guest, David C. Ludington, Wilmot W. Irish, Shepardson, and others assisted with the design and plans for the dairy, beef and sheep units. Professor Furry served on the Operating Committee and led the development of a Livestock Engineering Program with Professor Albright joining the program in the 1970s to provide leadership in studies of ventilation and thermal environment for dairy animals. Professor Scott and his associates carried out bioengineering studies of estrus detection and the mechanics of the milking process.

During the 1970s the major focus of department research involved energy and the environment. Waste management, treatment and disposal research resulted in new techniques for nitrogen management by Professor Raymond C. Loehr, bioconversion of wastes into useful byproducts and energy by Professor William J. Jewell (next page), and the land application of sludge. Professor Douglas A. Haith completed research on systems models for nutrient and waste movement in the environment along with studies of water and nutrient management in crop production systems.

Lettuce growing in the Controlled Environment Agriculture (CEA) hydroponic greenhouse.

Sewage being converted to drinking water quality in Professor William Jewell's hydroponic treatment unit; as waste flows from left to right the plants become nutrient limited and smaller.

Nitrogen movement and water management in the area of soil and water conservation were examined under the direction of Professor Michael F. Walter. The worldwide economic energy crisis in the 1970s stimulated evaluation of energy use by Professors Donald R. Price, Gunkel, and colleagues, followed by alcohol and ethanol studies by Professors Larry P. Walker and Jewell in the early 1980s.

In the 1980s many of the research trends that had developed previously continued with renewed vigor. Milking mechanics research and development initiated in the late 1950s by Professor R. W. Guest continued for three decades and included basic studies of the mechanics of milk movement in the teat. These studies were conducted by Professors Shepardson and Scott and their graduate students. Professor Scott and his students developed numerous devices and approaches for acquiring data on dairy cattle for estrus detection, milk flow, calving detection, and animal health. In 1998, Scott redirected his work toward sustainable development, focusing on converting dairy manure-derived biogas from anaerobic digestion to electricity and heat on the dairy farm, with the objective of assessing the feasibility of using fuel cell technology for energy conversion of biogas.

Other studies made fundamental contributions in many different areas of agricultural engineering research. Mechanical damage to agricultural products was studied in numerous ways. Professor Ronald E. Pitt developed both an experimental and theoretical understanding of the failure mechanics of plant cells. Professor James A. Bartsch established an understanding of impact damage to cabbage during handling, and Professor Rehkugler along with James A. Throop established a means for detecting bruises in apples by digital imaging. Greenhouse environmental control models were developed by Professor Albright enabling a specialized hydroponic greenhouse (opposite page) to be built in 1998 to implement Controlled Environment Agriculture (CEA) technology, developed jointly by Albright and Professor Robert Langhans of the Department of Horticulture, to optimize light, temperature and plant growing conditions. In 2005, this facility was licensed to Challenge Industries in Ithaca for the commercial production and distribution of lettuce and other suitable plants.

The movement of pesticides and nutrients in the environment and groundwater has been extensively studied by Professors Haith, Tammo S. Steenhuis, and Jean-Yves Parlange, resulting in both analytical and systems models for prediction of the environmental impact of these materials (page 60). Groundwater research continues to be a major research focus in the department. The early studies of Professor Gilbert Levine on tropical irrigation resulted in an international cadre of professionals trained at Cornell who led tropical irrigation works throughout the world. Levine became an International Development Consultant on water resources and among his many other activities directed work of Cornell's Center for International Studies, the Water Resources and Marine Science Center, the Center for Environmental Research and the Center for the Environment. As a professor emeritus, he is still active as a Fulbright advisor in Cornell's Center for the Environment.

Research technicians Clayton Van Hout and Clarence Mulligan measure air flow from an experimental row-crop mist-concentrate sprayer designed by Professor W. W. Gunkel.

A 1965 mechanical harvester for apples to be processed. Fruit detached by the mechanical shaker on the right falls onto decelerating strips, then are moved on padded conveyors to a tiltable bulk box filler located behind the elevating conveyor at the left center. The bulk box is inclined to reduce bruising of the fruit by decreasing the distance the fruit drops into the container.

# Some Big Results

The department has a proud history of research accomplishments, many of which have had profound and far-reaching impacts on both the national and international scene. In 1917, Cornell University awarded Earl A. White the first PhD in agricultural engineering in the United States. White's thesis, "A Study of the Plow Bottom and Its Action on the Furrow Slice," provided a mathematical basis for describing both the shape of the moldboard plow and the trajectory of the soil particle passing over the plow bottom surface. White tested his results using both laboratory and field studies (page 48), and showed that plow geometry had dramatic effects on power requirements and movement of the furrow slice. Many of White's techniques and mathematical equations are still used in designing and analyzing moldboard plows.

University founder Ezra Cornell would have felt right at home with Earl A. White, and a bit proud, too, of his definitive research on the plow bottom because in his early, decidedly lean years Cornell traveled from the South to Maine selling plows, and probably often wondered about the most effective design. Little did he know that the answer would come from an institution bearing his own name.

Research conducted intermittently on agricultural pesticide application equipment played a major role in improving both application methods and equipment. Early work by Professor H. W. Riley led to the development of the Cornell sprayograph for evaluating the distribution and character of spray from any nozzle at any pressure or range, which, in turn, resulted in vastly improved spray nozzles. In early 1950 a cooperative project among the departments of Agricultural Engineering, Agricultural Economics, Entomology and Limnology, Pomology, and Plant Pathology was initiated to study the cost and effectiveness of different insect and disease control practices in New York apple orchards.

Partial results, showing that more than 60 percent of the average cost of spraying per acre went for spray materials, spurred research to develop improved application methods and equipment. At the same time, research by Professor W. W. Gunkel and Professor J. L. Brann of Entomology and Limnology resulted in the development of experimental mist-concentrate sprayers for both orchard and row crop application. Spray concentrations as high as 10 times normal with corresponding savings of 90 percent of transported water resulted in improved insect and disease control. This spray application method is still recognized as an appropriate technique (opposite page).

# Machine Harvesting

Department researchers became recognized leaders in the area of mechanical harvesting and handling of fruits and vegetables and their work had an important impact on the development and widespread adoption of equipment and techniques. Research on mechanical harvesting of tart cherries started in 1960 by Professor Everett D. Markwardt and colleagues when a suitable design for a fruit catching

Cherry harvester: Tractor-mounted boom shaker and fruit-catching frame, with conveyor loader to the right. Harvesting time takes about 4 seconds.

Field testing a prototype lettuce harvester. Professor E. Stanley Shepardson inspects the cutter head. A superbly equipped machine shop in Riley-Robb Hall makes new machine development like this possible, but places high demands on the personnel that resulted from a surge in faculty research activity.

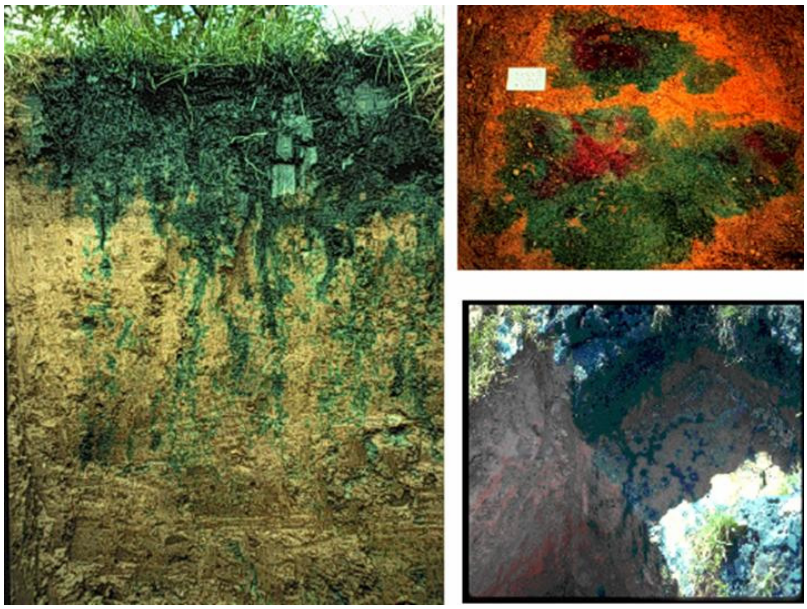
frame was developed. Growers quickly adopted this method of harvest as commercial equipment became available. One machine could replace 90 hand pickers (opposite page). Now, nearly all tart cherries are harvested by machine. In 1961, the researchers utilized the cherry harvesting equipment to harvest processing apples; however, unacceptable bruising of the fruit was caused by fruit rolling down the sloping wings of the catching frame and falling on other apples, leading to a new design by Markwardt and colleagues in 1964. The new harvester was highly maneuverable, had a low profile, and featured level conveyors to move fruit to a loading conveyor, with padded cleats and decelerator strips over the entire catching frame to slow the fall of the fruit to reduce bruising.

Working with researchers from the Food Science and Pomology departments at the Geneva Agricultural Experiment Station, they demonstrated the feasibility of mechanical harvesting processing apples without causing excessive damage to the fruit. The engineering design and principles developed by Markwardt and colleagues were quickly accepted by commercial equipment builders, and by the late 1960s 25 percent of the western New York State processing apples were being harvested by machine. Harvest rates of 40 to 50 trees per hour were typical on semi-dwarfed trees. The apple harvester accomplished the work of 30 hand pickers. The Cornell experimental and commercial machines were used to harvest cling peaches, prunes, pears, and tart cherries.

However, apple harvesters using the shake-catch method (page 56) were not satisfactory for harvesting the tender, fresh market varieties such as McIntosh and Golden Delicious and Professor W. F. Millier led in developing new methods and machines for removing and catching these tender apples. His work incorporated the use of a tree trunk impact shaker that significantly reduced bruising during fruit removal. It also included the study of the energy needed to remove fruit and not cause excessive damage to the bark of the tree, as well as devise ways of reducing the energy of apples falling through the trees. In related work, Professor Rehkugler and James A. Throop, conducting research on automatic bruise detection, developed the first digital image processing system for automated detection of surface defects on apples.

Development of a mechanical harvester for grapes (page 52) from Professor E. S. Shepardson's research with colleagues at the Geneva Agricultural Experiment Station led to the first successful commercially available grape harvester. This machine was designed for harvesting grapes grown with the Geneva Double Curtain (GDC) vine-training system developed by Nelson J. Shaulis. This work not only contributed original solutions to the grape harvesting problems but also spurred other researchers to develop harvesting machines. Almost all of the grapes grown for processing are now mechanically harvested.

Mechanical cabbage harvesting research conducted by Professors G. E. Rehkugler and E. S. Shepardson led to a successful cabbage harvester design that for the most part characterizes today's commercial cabbage harvester (page 52). Today, cabbage for processing is almost all harvested by machine.



Fluorescent and nonfluorescent dyes applied by Professor Tammo Steenhuis and colleagues at the soil surface are used to reveal finger-like structures that are indicative of preferential flow paths beneath the plow layer.

Research Support Specialist Martin C. Jorgensen leaves a farm storage room that holds several hundred tons of cabbage after removing product samples for quality assessment. An air pack is required because of the very low oxygen, high carbon dioxide gas concentrations in a controlled atmosphere storage environment.

Studying thermophysiological relationships in poultry.

Measuring pressures during the milking cycle.

# Environmental and Biological Applications

The effects of compaction on the seed bed were studied by Professor C. S. Winkelblech, who developed equipment and techniques for minimum tillage, and built one of the first plow-plant machines. He also developed equipment for ridge planting on muck soils that was immediately accepted by growers, and designed a strawberry plant runner cutter that was used to implement a new technique in strawberry culture where manual labor to remove runners was excessive.

Professor H. W. Riley's early research on ventilation of farm structures followed by work by Professors C. N. Turner and W. F. Millier led to the widespread adoption of the slot-type ventilation system used in animal housing structures, solving the critical problem of removing moisture to maintain animal health as well as maintain the structural integrity of the building.

After nearly two decades of study in cooperation with the departments of Vegetable Crops, Plant Pathology, and Pomology, prototype controlled atmosphere (CA) cabbage storage research conducted by Professor Ronald B. Furry resulted in the immediate adoption of the technique manifested by the construction of several large controlled atmosphere cabbage storage rooms by producers (opposite page). Cabbage became the only vegetable being stored commercially in a very low oxygen, high carbon dioxide environment, allowing producers to remain active in the market every month of the year and provide a consistent supply of a quality product to the consumer.

Professor W. F. Millier's seed pelleting research led to improved seed pellet materials for the vegetable and flower industries. His laboratory pelleting machine and techniques have been used in agricultural and forestry research facilities throughout the world.

Department members took the lead in bioengineering research in areas including biophysical factors affecting energy requirements for poultry production, biomechanics of machine milking (opposite page), estrus and calving detection, and automatic cow identification. Professor N. R. Scott developed an electronic instrument for detecting estrus in cattle which was made commercially available. His research on automatic data acquisition for dairy herd management also led to the development of a passive electronic transponder system for animal identification. Professor Daniel J. Aneshansley studied biological systems to understand their function, with special interest in bioinstrumentation and applications to bioinspection, biomimetics, cellular transport, electrophysiology, and energy.

Water and waste management have been special areas of interest since the department began, and have included significant international aspects in the second half of the twentieth century. Working cooperatively with economists and sociologists, Cornell agricultural engineers developed strategies for improved water management in the Third World countries of the humid tropics. Professors Levine and M. F. Walter are recognized leaders in the area of tropical water management, including irrigation systems. Professors R. C. Loehr and W. J. Jewell are recognized national and international leaders in the area of waste management and biogas. Their research results have had a profound impact on the methods used for treating, handling, utilizing, and disposing of agricultural waste products.

Research and education in safe use of agricultural machinery was also an important departmental concern. In addition to his research interest in pesticide application equipment, Professor C. W. Terry studied tractor stability and braking systems and provided valuable consulting to faculty and staff because of his broad experience in engineering theory and application of the physical sciences. In the mid-1950s, Professor L. W. ("Pete") Knapp, who had responsibility for the development of the Farm Safety Program, was active in extension demonstrating the dangers of tractor overturns to farmers. Using a full-size farm tractor suitably equipped with overturn protective devices, he was one of the first to demonstrate the unstable characteristics of farm tractors, particularly on sharp, high-speed turns, and downhill travel. Professor G. E. Rehkugler and graduate students later developed a tractor motion simulation program, SIMTRPLC, which provided an accurate prediction of measured tractor motion.

Wood had long been the preferred material for the construction of farm buildings and homes as well as crop structures in the State because of its abundance and the close proximity of many local sawmills. In 1956, with a testing laboratory in the new Riley-Robb Hall now at hand, Professor Landis L. Boyd and David P. Dirksen initiated a study of the bending strength of log-run lumber as it comes from the saw to determine the effect of defects, such as knots, grain slope, shake, checks, splits and wane, to determine realistic working stresses that could be used in structural design. These studies were aided by use of the first mainframe digital computers on campus. Decades later, Professor Kifle G. Gebremedhin would make extensive use of digital computers to extend understanding the effects of forces on wood framed structures. His work included testing a full-sized building and scaled-down structural systems, and the development of engineering software for the analysis and design of two- and three-dimensional structures, including diaphragm action.

Research in food engineering would also come into focus in the department through the study of microwave processing, drying and freezing using a combination of empirical methods and mathematical modeling conducted by Professor Ashim K. Datta, and the study of the engineering aspects of microbial and enzymatic processes and the separation of biological materials by Professor Jean B. Hunter. Concomitantly, Professor James A. Bartsch's research interest lay in the mechanical properties of biological materials.

Professor J. Robert Cooke studied water utilization by plants, including stress analysis of guard cells, stomatal diffusion and oscillations, and the role of carbon dioxide in regulating water usage. Cooke's work was mathematically based, with his more recent effort focused on the structural mechanics of plants utilizing the finite element analysis technique. Professor Roger M. Spanswick studies transport and metabolism in crop plants to determine the relationship to economic yield and their capacity for bioremediation, while Professor Beth A. Ahner's research deals with the interaction of pollutants in an ecosystem and the effects on the organisms living in the ecosystem. On a broader scale, Professor M. Todd Walter studies water and what it transports (e.g., nutrients, organisms and sediments), with special interest in the linkages between hydrology and ecosystems.

# *Studies Large and Small*

At the nanoscale level, in the late 1990s Professor Carlo Montemagno's interest centered on nanomachines, powering inorganic nanodevices with biomolecular motors, micro robotics and tissue engineering. Professor Dan Luo's research group developed a nanobarcode detection system for living cells that can be used in genomic research, clinical diagnosis, drug testing, environmental monitoring and monitoring for biological terrorism. It can detect E. coli, anthrax and tularemia bacteria, and Ebola and SARS viruses, and has the ability to distinguish several different pathogens simultaneously.

Professor Antje J. Baeumner's research is centered on analytical biotechnology, with special interest in the development of electrochemical and optical sensors to detect harmful microorganisms and compounds and the development of easy-to-use sensing devices that can also be incorporated into complex automated systems. In 2007, Baeumner was awarded a renewable grant by the CD4 Initiative managed by Imperial College at London, England to develop a quick, easy and inexpensive test for HIV/AIDS, similar in design and function to a standard pregnancy test, thus permitting testing in areas of the world that do not have access to detection technology, such as Third World countries. Professor John C. March's effort focuses on reconfiguring biological systems to improve performance in the areas of biomedicine and sustainability, with work concentrating on signal transduction, metabolism and eukaryotic-prokaryotic interactions.

In 2004, one of the Federal Government's five Sun Grant Centers of Excellence was established at Cornell, with the university as the lead institution in the Northeast Sun Grant Institute of Excellence and Professor Larry P. Walker as director. The objective of this program is to promote the development of bio-based energy technologies along with environmental sustainability with a focus on biopower, biofuels and bioproducts.

Professor Tammo Steenhuis and Professor Christine Shoemaker of Civil and Environmental Engineering began a study in 2005 to identify the best ways to reduce the polluting impact of phosphorus from urban and rural areas in the Cannonsville watershed, one of the nine reservoirs that provide drinking water to millions of people in and around New York City. Their objective is to develop Best Management Practices (BMP) applicable to conditions in New York State and the Northeast. Soil and water engineering continues to be an important aspect of the department's long history of involvement in environmental concerns

In 2007, Professor Beth Ahner received one of the first Research Iniative Awards for women faculty from the Cornell ADVANCE Center. Funded by the National Science Foundation, Ahner's work entails transforming plants by bringing plant molecular biology tools to engineering applications. Her interest lies in how organisms adapt to trace metals, with a current specific application in phytoremediation of contaminated soils by facilitating lead uptake into plant root tissues.


A four-panel display in Thurston Hall in May 1954 depicts progress in farm mechanization from the early 1800s to the 1950s, with two Rau plow models evident on the second shelf of the panel at top right. The other handmade and manufactured models in the display panels are still on exhibit in Riley-Robb Hall.

# *$10 Million for Biofuel Study*

In December 2006, Governor George Pataki approved the funding of a $10 million grant from the Empire State Development Corporation for the New York State Biofuels/Industrial Biotechnology Sector Development and Life Sciences Research Investment to enable research directed at the development of economically viable methods for producing biofuels through industrial biotechnology. This research program will utilize enzymes, microorganisms and plants to produce energy, industrial chemicals and consumer goods. Development of a pilot-scale facility to produce ethanol from lignocellulosic biomass feedstocks, such as perennial grasses and willow, will result in the renovation of the former Power and Machinery Laboratory in Riley-Robb Hall to accommodate the department's involvement in this effort under the direction of Professor Larry P. Walker. Cornell is an academic partner with the Syracuse Center of Excellence in Environmental and Energy Systems in this endeavor.

The department's research program has grown markedly over the years, and currently expends $4.2 million annually, with 68 projects, engaging 39 faculty and research support personnel. Seventy-seven students currently participate in the graduate program, many as research assistants. Many undergraduate students are also active in selected aspects of faculty research.

A Farmers Week crowd in the early years watches a bull judging in front of Roberts Hall. Note early automobiles in the background. Years later, Farmers Week gave way to Farm and Home Week and finally to Ag Progress Days as means of showing farmers and homemakers the fruits of College of Agriculture teaching, research, and Extension work.

# Service through Outreach

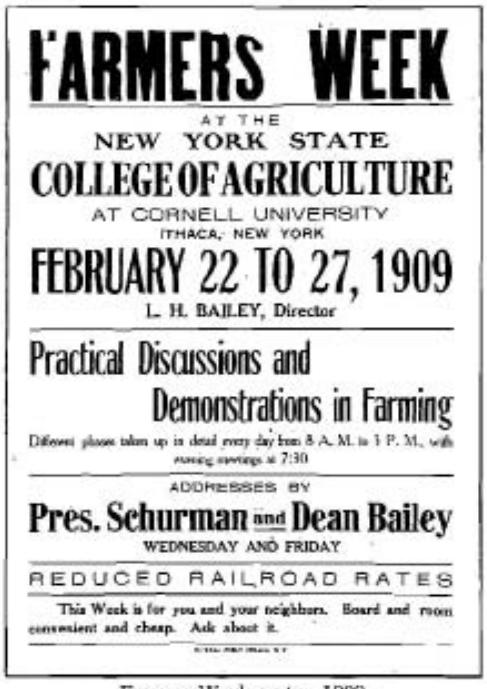
The development of a highly organized outreach program in the department was most likely not a high priority in the very early years--the problems of getting a staff up and running and developing and teaching courses for which there was high demand came first on the list. B. B. Robb is the individual responsible for the development of extension work in the department, and the program that eventually emerged was led sequentially by Robb, A. M. Goodman, C. N. Turner, Robb (for a second time), P. R. Hoff, E. D. Markwardt, R. W. Guest, J. C. Campbell, D. C. Ludington, M. B. Timmons and M. F. Walter.

In 1913-1914, C. M. Warren and F. G. Behrends were the first individuals hired specifically for Extension work in the department, albeit part time. In 1918, Assistant Professor W.K. Blodgett was the first person hired for full-time Extension work. In 1919, Goodman joined the department with full responsibility in Extension work, along with N. D. Steve and R. E. Britt. Goodman's initial work addressed land drainage, water supply, sewage disposal, gasoline engines, and ventilation of farm structures. One had to be a "Jack of all trades" to meet the needs of the rural audience. Britt was hired specifically for work with a "water supply demonstration truck," illustrating the importance of bringing information about developing reliable water supplies to rural areas.

In 1921, J. M. Maloney, H. D. Brokaw and M. H. Phillips were hired for Extension work during the winter months, and in 1922 F. J. Newcomb was similarly employed. In 1923, Professor Robb taught an Extension Leader course, and C. Bullard joined to work during the winter months. Reaching out to farm families during the winter season was an obvious concession to the very busy life they experienced during the growing season.

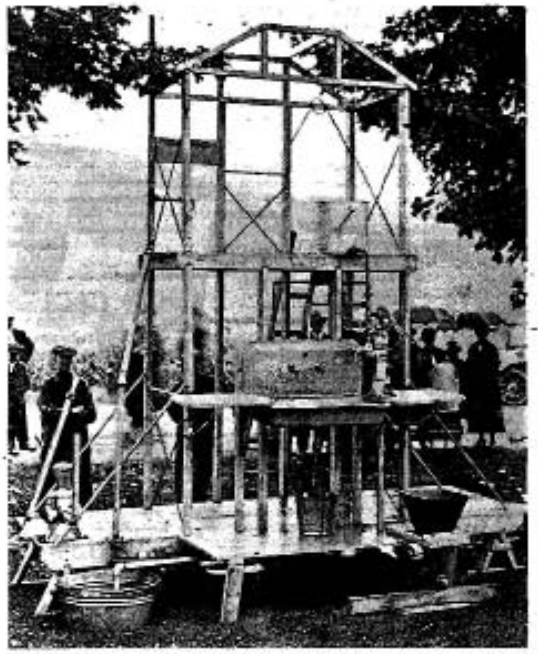
## Growth of Field Specialists

The title Extension Leader first appears on the staff roster in 1924, when Robb took on the responsibilities of the growing outreach program, and H. T. Blewer was hired for winter Extension work. B. A. Jennings joined the Extension staff in 1925 with primary responsibility in drainage and farm machinery; he would later also teach courses in farm power, machinery, and mechanics. H. S. "Si" Pringle was hired in 1925 as an assistant instructor. The pattern of hiring staff to work in Extension during the winter months was common and continued until 1933, with R. C. Burnette, W. T. Middaugh, P. Newton, R. A. Steadman, and R. E. Butt also working in that capacity. Some temporary winter season appointees went on to become permanent staff


FARMERS WEEK
AT THE
NEW YORK STATE
COLLEGE OF AGRICULTURE
AT CORNELL UNIVERSITY
ITHACA, NEW YORK
FEBRUARY 22 TO 27, 1909
L. H. BAILEY, Director
Practical Discussions and Demonstrations in Farming
Different phases taken up in detail every day from 8 A. M. to 5 P. M., with evening meetings at 7:30
ADDRESSES BY
Pres. Schurman and Dean Bailey
WEDNESDAY AND FRIDAY
REDUCED RAILROAD RATES
This Week is for you and your neighbors. Board and room convenient and cheap. Ask about it.

Farmers Week poster, 1909.

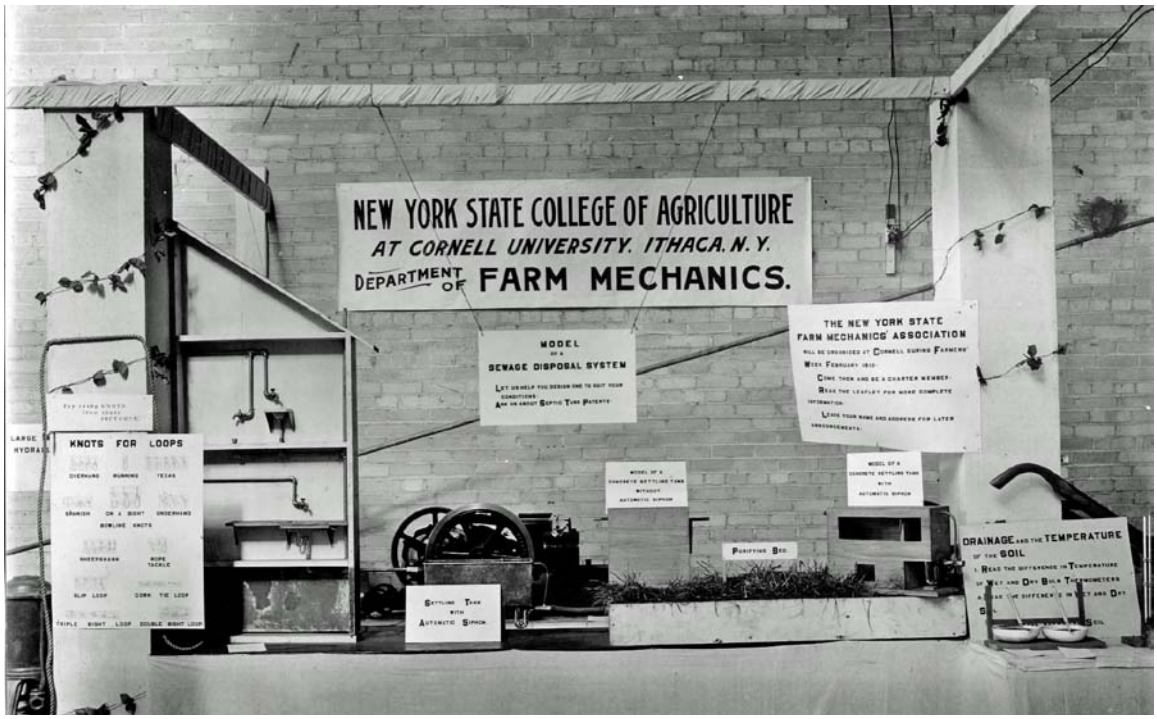
Poster for a 1909 Farmers Week at Cornell.



Demonstration of a home water-supply system arranged by H. W. Riley

Professor H. W. Riley's portable home water system shows farmers how to install indoor plumbing to replace carried water and outhouses

American Indian farmers at the 1921 Farmers Week at Cornell.




Riley's interest in promoting water distribution and sewage disposal systems for the farm home, knot tying, and the benefits of soil drainage is evident in this 1911 display at the State Fair in Syracuse. The display also announces the organization of a New York State Farm Mechanics' Association at Cornell during the February 1912 Farmers' Week.

An early belt-powered grain thresher.


**Above,** an early New York State Fair Rural Electrification exhibit designed to emphasize the use of electricity on the farm for more than just lighting.

**Below,** even though cluttered, a lighted shop is a real advancement when rural electrification begins in the 1920s. The benefits of electrification to be gained across the farmstead as a whole would take decades to realize.

members. W. H. Ashton, department draftsman, was another individual initially hired on the winter season employment basis who would later be temporarily pressed into teaching to help accommodate high course demands.

In 1933, E. L. Arnold joined the Extension staff along with E. S. Shepardson. In 1935, A. M. Goodman became Extension Project Leader, and C. N. Turner and E. E. Murphy joined the program. In 1936, Goodman added teaching to his duties, having developed a course in farm structures in 1935 because of his interest in farm building ventilation, and Shepardson took on responsibility for 4-H programs in farm electrification as an Extension instructor. In 1938, C. N. Turner became Extension leader, and the department now had five full-time Extension faculty, with both Pringle and Shepardson then taking on responsibilities for 4-H work. Later, Shepardson worked with adult audiences in farm electrification, farm machinery, farm power, and related home applications. In 1939, G. W. Crowther, P. R. Hoff and A. H. DeGolyer joined, and the Extension staff then totaled seven.

## *The Huge Impact of World War II*

So, this was the state of affairs until the United States entered World War II in December 1941, following which District Engineers were hired to assist in the war effort. Dean of the College of Agriculture C. E. Ladd had foreseen the potential need for a farm machinery repair program in the event of the U.S. entering the war and advised the New York State Agricultural Defense Committee of which he was a member in May 1941 that such a program should be organized. His proposal was approved and the department responded to the need without hesitation, inaugurating the Emergency Farm Machinery Repair Program and the hiring of district agricultural engineers (next page). Funds were made available from the New York State War Council on January 5, 1942 and 15 district engineers received simultaneous appointments in the department on that same date, with the program in operation in the counties within two weeks from their hiring.

At that time Turner was Extension project leader and the Extension faculty included Hoff, Pringle, Shepardson, and DeGolyer. The initial district engineers were G. E. Allen, R. E. Bowman, J. M. Carney, Jr., N. H. Chadwick, H. R. Davis, R. F. Elliott, C. P. Loomis, P. T. Luce, L. H. Mehlenbacher, W. F. Millier, R. E. Morse, R. N. Overton, R. N. Spickerman, P. E Turner and D. L. Walseman. Later, R. O. Erickson and L. F. Walker were Extension appointees for a few months. Pringle then went on leave through 1945 to assume the duties as chief of the Farm Machinery Section, Office of Civilian Requirements of the War Production Board, in Washington, D.C. Robb was responsible for organizing the war emergency program effort and training the district engineer staff, each of whom was supplied with a fully equipped mobile farm equipment repair shop. New vehicles were impossible to obtain at that point in the war, so used pickups and light panel trucks were acquired.

It was soon discovered that electrical equipment on the farms needed as much attention as the farm machinery, so a 2-ton truck that was originally used to carry

The original Extension District Engineers in January 1942. From left: first row, Ronald Bowman, Ralph Morse, Hollis Davis, College of Agriculture Dean C. E. Ladd, Donald Walsemann, and Robert Spickerman; second row, Cameron P. Loomis, Jr., Roswell Elliott, P. J. Luce, George Allen, N. H. Chadwick, William F. Millier; third row, S. R. Shapley, College of Agriculture Farm Practice; Professor C. N. Turner, Extension Project leader; John M. Carney, Jr., Richard Overton, Leon H. Mehlenbacher, Paul Turner, and Professor Robb, program director.

supplies to the district engineers in the field was also instrumented and outfitted as a fully equipped electric motor repair shop to travel the state. The district engineers' work in the field would directly impact the state's contribution to the war effort by repairing, reconditioning, adjusting and demonstrating the proper use of farm machinery and equipment, including tractors, electric motors, pumps and virtually anything else utilized on a farm, through meetings, lengthy repair workshops and direct emergency service calls to individual farms.

Machinery was important because it replaced a scarce farm resource during the war, human labor, so keeping every farm machine and electric motor as possible in proper operation translated into crops saved, people fed, and steel, copper and fuel conserved for the war effort (page 78). Even junked equipment and machinery was salvaged, repaired and returned to service; new electric motors were patently unavailable. On top of this the District Engineer cadre itself kept changing, partly because some of the men entered military service, and training new personnel was a continuing job of the faculty in Ithaca.

The size of the field effort was staggering. As an example, between November 15, 1943 and November 1, 1944—two weeks shy of a year—1,128 repair meetings, field demonstrations, lectures, and exhibits were held, producing 35,769 contacts and repairing 6,745 machines. Emergency service calls to farms alone totaled 4,102. Teaching farmers the engineering principles upon which the machines operated was extremely important so that they could later repair, maintain and adjust equipment themselves. A simple illustration of the need for this and the extent to which the engineers willingly involved themselves is characterized by the following anecdotes from the department's December 1, 1943 *Extension Report* to the New York State Food Commission:

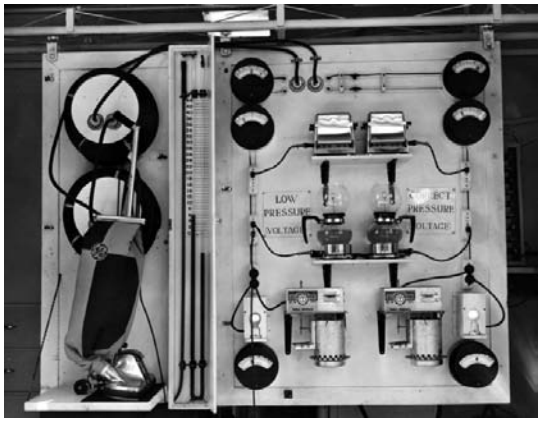
"In Cayuga County the District Engineer was passing a partly cut field of wheat about noon and noticed many untied bundles. The farmer was apparently at dinner so the District Engineer stopped and adjusted the knotter to correct the trouble without the farmer's knowing about it. That night when the engineer passed the field again he observed that it was all cut and that there were no more untied bundles. It is doubtful that the farmer knows as yet why the binder worked well after dinner when it hadn't before.

"Another incident happened in Greene County. A farmer was trying to cut corn with his 2-year-old corn binder that no one had ever been able to make work right. With the tall corn, the bundles that stayed tied weighed 75 to 100 lbs. The District Engineer was called and by making a simple adjustment, which he carefully explained to the group of farmers present, had the binder working perfectly in 15 minutes to the amazement of all those standing about waiting for corn to fill the silo.

"A pick-up hay baler in Cortland County could not be made to work by any available help that had worked on it. The farmers in the valley all knew that it wouldn't work, but wanted to get their hay baled, so the District Engineer was called. When he arrived several farmers were on hand to see if the baler could be made to work properly; in approximately half an hour it was working. The actual work done was small in amount but the time, and labor conserved and the hay saved do have a high value."

Extension's Wattmobile Electrical Demonstration unit receives power from any convenient power pole tap, upper right. People are eager to see the demonstrations without regard to the venue or weather.

**Below,** some of the Wattmobile's demonstration panels and equipment. Note the vacuum cleaner in the left photograph, along with toasters and coffee makers arranged to show the effects of low and correct voltages simultaneously, and manometers used to measure pressure drops in analogous water systems. In the right photograph are wiring devices for farm homes and buildings, and the use of electricity for chicken and pig brooders, grinding, drilling, electrical fence controllers, electromechanical actuators, and other farm applications.




The exceptionally successful implementation and execution of the district engineer program also had favorable fallout in Washington, D.C., as indicated in this excerpt from the same report:

"At the close of the 1941 crop season just prior to Pearl Harbor, the U.S.D.A. through the extension facilities foreseeing that we would be drawn into the war, launched a nationwide program to induce farmers to ascertain their machinery repair needs and order needed repair parts at the earliest possible moment. Federal workers have acclaimed New York State's Emergency Farm Machinery Repair Program as an especially commendable effort on the State's part to join in the efforts of the nation. This standing of the State was especially useful when it was desired to secure equipment to permit the material increase in the state's potato acreage last spring. To do this meant that we had to have 18 new tractor mounted power potato sprayers and 18 auto truck mounted supply tanks to equip 18 new 'spray rings.' When the situation was presented to the Washington authorities little difficulty was experienced in obtaining the necessary priorities to get the equipment. This was because those in authority at Washington felt that New York State had made every effort to contribute its full share to the nation's needs in time of war. For next year approval has been secured for the equipment for 35 new potato spray rings."

When the farm machinery repair emergency crisis had been somewhat mitigated, permission was received from the New York State Food Commission to permit district engineers to provide assistance for additional farmer requests, including land drainage, building remodeling and construction, ventilation of animal structures and development of water systems, as well as provide sewing machine repair, adjustment and cleaning instruction for hundreds of homemakers who needed to make clothes for their families because of the scarcity of commercially made garments due to the war. In all cases, for all applications that the district engineers met in the field, they were afforded training and direction from the department faculty in Ithaca.

The Ithaca faculty also produced written materials, radio briefs and talks, and other publicity to blanket the State to assure that the target audiences were reached and assistance rendered. County agents also cooperated closely in the venture, and commercial farm equipment dealers were encouraged to accommodate farmers by acquiring and stocking repair parts in a timely manner, i.e., well before the growing and harvesting seasons had started. The program effort was a resounding and demonstrable success. The department could be deservedly proud of its achievements.

In another wartime educational effort instituted by Shepardson and Pringle that used the slogan "Victory with Arms needs Machines and Farms," the Cornell University Wattmobile (opposite page) traveled the state explaining the principles and proper application of electricity to a wide range of rural audiences using live demonstrations that incorporated audience participation where appropriate. The analogy of the flow of electricity to the flow of water was used to take some of the mystery out of electrical systems. Loans of electrical equipment and household appliances installed in the demonstration unit were made by their manufacturers.


Visitors crowd into the Farm and Home Special in 1946, arranged by the New York Central Railroad and Cornell's statutory colleges to carry the Extension Service message across New York State. Because of gasoline rationing, farmers and others had been unable to travel to Ithaca for Farm and Home Week during the war years.


Women look over Extension displays in a car of the Farm and Home Special.

# Postwar Changes

When Riley retired as department head on June 30, 1944, Robb was appointed to that position. In 1945, Turner became Farm Electrification Project leader and Robb again temporarily took the role of Extension Project leader along with teaching, with Paul R. Hoff as acting project leader. Several district engineers left the program in 1943-1945, but others replaced them, and a few who left joined the teaching program.

In 1946, Hoff was in charge of the Farm and Home Special, an agriculture demonstration train sponsored by the College of Agriculture that traveled throughout New York State for three weeks on the New York Central rail system to show the farming community what was new in agriculture (opposite page).Hoff received outstanding commendations for his leadership and management of this significant college-wide effort. The Extension Service was using all means possible to reach its clientele and the information was being delivered as quickly as possible, but radical advances in mass media communication still lay decades ahead.

B. B. Robb retired as department head on August 31, 1947 and Orval C French replaced him on September 1, 1947. At that time, the Extension personnel consisted of 12 district engineers, now including D. W. Bates, I. W. Bigalow, N. H. Chadwick, H. R. Davis, A. R. Grout, G. R. Henderson, C. P. Loomis, Jr., E. D. Markwardt, F. J. Newcomb, R. P. Rooney, G. T. Sullivan, and T. H. Wilson, along with 6 Extension faculty members based in Ithaca, Goodman, Hoff, Turner, DeGolyer, C. M. Edwards, Miss Ruby M. Loper (Rural Housing) (page 78), and Shepardson. In 1949, Hoff was appointed Extension Project Leader, and later Professor Edward W. Foss was assigned responsibilities in the rural housing program because of his extensive experience in the use of wood and home construction.

And by July 1, 1949, the ongoing problem of maintaining a complete staff of 12 district engineers had finally resolved itself, making it possible to serve 12 districts continually, covering all of the agricultural counties in the state. District engineer staff turnover had been caused by a demand for qualified agricultural engineers by educational institutions and industrial organizations that exceeded the supply. The department's approach to Extension programming was also changing: whereas the district engineer program began during World War II with the main emphasis on direct service through farm visits, it was now moving to a program with educational emphasis, including integrating the engineering into commodity-based programs of the counties.

Participation in Farm and Home Week held annually on the Cornell campus, and the construction of a fully operational modern dairy system, including a farm home, shop and machinery storage at the State Fair grounds in Syracuse in the 1950s also provided special opportunities for delivering engineering-related subject matter to large audiences. At this juncture, department headquarters was "distributed" around Stocking Hall, the home of the Dairy Department, with no room to spare, and new facilities for the department were yet nearly a decade away.

In 1954, just before the close of the district engineer program and the subsequent change to Extension Specialists located only in Ithaca, the cadre of 12 district engineers included I. W. Bigalow, H. R. Davis, G. R. Henderson, L. W. Knapp, Jr., J.


E. Stanley Shepardson, Extension instructor, left, with district agricultural engineers Hollis R. Davis, center, and William F. Millier, repair electric motors in the Chemung County Highway Garage in Big Flats after a flood on May 28, 1946.

Ruby M. Loper, in the white hat, attends a Rural Housing Training Conference for county Extension workers in the Rochester city demonstration agent's office in 1949. She graduated from the College of Engineering and Architecture at the University of Nebraska in 1934 and was appointed an assistant agricultural engineer before joining the Cornell faculty in 1946, where she held a dual appointment in the Home Economic's Department of Housing and Design and the Department of Agricultural Engineering. She was the first woman to hold this position in New York State.

W. Layer, R. A. Miller, F. J. Newcomb, A. W. Reynolds, R. P. Rooney, F. C. Smith, P. R. Wilson, and C. F. Wolf. Seven faculty members based in Ithaca having primary Extension or dual responsibilities now included L. L. Boyd, farm buildings; C. M. Edwards, 4-H; P. R. Hoff, Extension project leader; Miss Ruby M. Loper, rural housing; E. D. Markwardt, farm machinery; C. N. Turner, farm electrification; and J. W. Spencer; rural roads.

The contributions of the district engineer program to the rural communities and the war effort were immense, and a great reservoir of engineering knowledge had been translated and converted to field practice. By 1956 it became evident that a staff of college-based specialists in specific discipline areas would better serve the Engineering Extension program and the county agent staff. Department Head Orval C French and Professor Everett D. Markwardt reorganized the department Extension staff into specialized program areas and reassigned some of the district engineers to specialist positions.

Markwardt was named project leader, a position he held for 27 years until his retirement in 1982, making him the longest serving project leader in the history of Cornell Cooperative Extension. His responsibility also included specialized crop machinery and irrigation. Other program assignments were: Paul R. Hoff, general field machinery; Landis L. Boyd, farm structures Plan Service; Hollis R. Davis, poultry structures; John W. Layer, storage structures; Roger A. Miller, dairy structures; Carl S. Winkelblech, soil and water engineering and tillage machinery; Carl M. Edwards, 4-H Club work; L.W. "Pete" Knapp, farm safety and 4-H Club work; Gordon C. Perry, farm electrification; James W. Spencer, rural roads; and Harold E. Gray, structures for growing crops. Photographs of the Extension engineering faculty in 1956 appear on page 117.

At this juncture, the department Extension program had evolved into a highly specialized and focused operation that responded to the engineering related needs of county agents and the rural and farming communities throughout New York State and was still service oriented. Later Extension specialists who succeeded some of these individuals included J. K. Campbell, tillage and implements; R. B. Furry, dairy structures, and later the Plan Service; R. W. Guest, materials handling; and W. W. Irish, dairy structures and the Plan Service.

Guest, in cooperation with colleagues from the departments of Animal Husbandry, Dairy, and Food Science, and the College of Veterinary Medicine, developed and led a highly successful program named Project M (for Milking Machine Management) that used a mobile demonstration laboratory that traveled throughout the state to show thousands of dairy farmers and milking equipment suppliers how to adjust and operate milking systems to prevent mastitis in cows and more efficiently produce high quality milk, benefiting both animal health and the economics of the dairy farm operation. This effort led to significant advances in milking system operation and design, and spawned a highly productive department research program on the mechanics and biological aspects of milking.

The early days: A horse-drawn road scraper in Central New York in 1904.

Technician Charles D. Ditmars and Professor James W. Spencer discuss hand-feel testing of gravel mixtures in 1956.


Dr. David Orr and Professor Lynne Irwin prepare for a falling- weight deflectometer roadbed test 50 years later in 2006.

# Help with Rural Roads

The Cornell Local Roads Program (CLRP) is the fulfillment of one of the five principal areas of concern that Howard Riley enumerated for the American Society of Agricultural Engineers at its founding in 1907 (page 5). Its roots go back to 1923 when the Civil Engineering Department at Cornell University held a conference on highway engineering. The first School for Highway Superintendents was held in 1938, the second in 1940. A few years were skipped during World War II, and then the school began annual meetings in 1947. The 62nd Annual School was held in June 2007, with an attendance of 725.

Currently, CLRP is one of 58 Local Technical Assistance Program (LTAP) Centers established by the Federal Highway Administration. Sponsoring agencies are the Federal Highway Administration and the New York State Department of Transportation, with additional funding provided by Cornell University and participants' training fees. Training and technical assistance is provided to local highway and public works officials in New York State through a series of 60 workshops per year, attended by 1,200 officials. The first director of the program was Professor James W. Spencer, who in reviewing the program's exceptional progress at its 30th anniversary in 1968 quipped that he couldn't make the first school in 1938 because he "...had a prior commitment in the 6th grade!"

Professor Lynne Irwin succeeded Spencer as the second director of the program in 1970, and is the current director. Spencer introduced a research component to the program, which Irwin has expanded greatly in recent years. A PhD project, modeling seasonal changes in pavement layer strength, was recently completed for the New York State Department of Transportation, and a new method for calibrating falling weight deflectometers is currently in progress, sponsored by the Federal Highway Administration. CLRP imported the first falling weight deflectometer into the United States from Denmark in 1982. There are now nearly 250 machines in use in the U.S., mainly by state highway departments and consultants, for testing pavement strength.

# Buildings for Farm and Home

Another of the objectives that Howard Riley had enumerated in 1907 was the improvement of farm buildings and the farm home. To assist farmers and farm families in accomplishing this, the USDA instituted a program to design farm buildings and equipment and distribute related plans throughout the United States. Plans were also developed at the state college level, and along with those from some commercial sources, such as the Portland Cement Association, a wide variety of designs and information ultimately became available to the agricultural community at large. The college level designs usually reflected the farming specialties of the state and were specific to the needs of the time; dairy farms were predominant

in New York State, and later a large poultry industry developed. The department faculty developed a multitude of designs, and distributed thousands of plans for an astounding variety of applications, from dairy barns, poultry houses, storage and feeding systems, to labor saving equipment and farm homes. The primary sources of plans were the USDA, the Cornell Extension Plan Service, and the Midwest Plan Service which was headquartered in the Agricultural Engineering Department in Ames, Iowa.

In 1956, Professor L. L. Boyd developed and distributed topical catalogues of plans (e.g., dairy facilities, poultry facilities, crop storages, feeding equipment, farm homes, etc.), listing the specific application, plan number, a brief description of the design and usually a three dimensional image. This not only helped the end user to select appropriate designs to order, but also essentially gave the county agents throughout New York State a ready library of ideas that could be used in their work with farmers, builders and lenders. The plans were reproduced in the department using the Ozalid process (producing blue lines on a white background that is easy to read, cf. a blueprint that has white lines on a blue background), with a nominal per sheet charge to the user.

Architect Ruby Loper (page 78)was responsible for the farm home area of the department's Plan Service. R. B. Furry contributed to the development and expansion of the Plan Service using a large cadre of department graduate and undergraduate students to perform the drafting and inking of original designs, which was the standard preparation procedure in the days before the advent of automated computer technology. He also developed a *Dairy Structures Guide for County Agricultural Agents* to provide them with a reference manual presenting engineering applications, design procedures and construction methods for dairy systems that was updated regularly to maintain currency, and produced and distributed a monthly newsletter directed specifically to builders of farm structures in the State. Later, W. W. Irish headed the Plan Service, followed by Professor Michael Timmons.

Eventually, the need for a Plan Service waned for a number of reasons, including the huge decrease in farm numbers, increasing size of farms, greater specialization and vertical integration in some areas of the farming industry, an increase in commercial sources of information along with the advent of prefabricated structures and equipment, and the increasing economic ability of farm owners to hire design work that addressed their specific needs. The Plan Service was phased out after an extremely successful history of service to the agricultural community.

# *Electrification*

In 1901, Guy Roosevelt Beardslie, a graduate of West Point, created the very first rural electrification installation in New York State. Beardslie had built a 180 KW hydro plant on a creek for his own use in threshing, cutting ensilage and other farmstead needs. Charles Cook of St. Johnsville in the Mohawk Valley was the first New York farmer to use Beardsley's electricity. People stated with utmost certainty

that Beardslie could not deliver electricity uphill from the creek and over the hills to get power to his customers! In spite of this opinion, he would go on to develop his distribution system and sell electric power to his neighbors and others, including commercial users. Doubters, beware! By 1950, there were 52,000 miles of rural electric lines in New York State.

B. B. Robb is the one who pioneered the department's rural electrification program, which started at an organization meeting at Cornell in 1926—another of Riley's "big five" objectives for ASAE was underway in New York State in a resolute way (pages 69, 70, 76, 78, and the next page). Later, Professor C. N. Turner would be instrumental in organizing the New York State Farm Electrification Council (FEC) on May 11, 1943, and would be appointed its project leader on April 1, 1944. The FEC consisted of seven electric power company representatives, along with College of Agriculture Dean W.I. Myers, Dean of the College of Home Economics Sarah Blanding, Director of Research C. E. F. Gateman, Director of Extension L. R. Simons, Head of Agricultural Engineering B. B. Robb, Professor C. N. Turner, General Secretary of the State Farm Bureau Federation G. S. Foster, and State Public Service Commissioner R. F. Bachman. It enjoyed enthusiastic support, with funding coming mostly from the investor-owned electric companies in the State.

The council's objective was to direct a research and educational program that would make available information on the uses of electricity in New York State agriculture. Power to the farmers! Hay drying and preservation was a principal concern, and a study of 15 hay drying installations was reported at that first meeting, along with work on baled hay conveyor elevators, electric fan ventilation of dairy and poultry buildings, and various other farm issues related to potential use of electricity. Dairy stable ventilation using electric fans, grain drying and electric powered labor saving devices would become special topics of interest for quite some time, along with developing potable water supplies for farmstead use, including milk cooling.

The first meeting of the Operating Committee of the FEC was held at the Hotel Belmont Plaza in New York City on September 29, 1943. The general aims and purposes of the council were "to conduct a cooperative Research and Educational Program to make available information concerning the uses of electricity in New York State Agriculture." Both Riley and Robb were directly involved in the activities of the FEC until French took over as department head in 1947.

French warned that the FEC's research objective could not be met because there was no laboratory space on campus in which to perform such work. When Riley-Robb Hall was planned, laboratory space for FEC-related research was a primary installation concern to be sure! During its existence, the FEC developed numerous publications to disseminate the knowledge gained from both field and laboratory research to benefit the farming community.

Turner directed the FEC as project leader for 20 years, until 1963, with Professor Donald R. Price succeeding him. Price was a good fit for the FEC because his interests lay in systems engineering, farmstead mechanization, electric power and processing, and energy utilization, and in 1977 was appointed director of the Office of Energy Programs. The Energy Program was an inter-college effort between the College of Agriculture and Life Sciences and the College of Human Ecology that coordinated all research and Cooperative Extension programs related to energy

**Above**, washing clothes is a real chore on the Nelson R. Peet farm, located near Webster, New York, before rural electrification became widespread. Note the hand cistern pump on the right side of the kitchen sink. The Peet farm was later used as an electrification proving farm by the department.

**At right,** an early electrified farm kitchen. Even today some senior citizens call a refrigerator an "ice box," reflecting a time when mechanical refrigeration had not yet reached the consumer public and ice was used as the cooling medium.

**Below,** the tool storage area of an early appropriately lighted and organized farm shop. Professor Edward W. Foss would later lead the way in providing functional designs for the layout and equipping of farm shops for the maintenance and repair of farm equipment and machinery.

conservation and alternative sources, economics and policy, and energy use patterns and projections.

Without a doubt, Robb and the originators of the FEC would be both delighted and awed to see what had transpired since the humble beginning of rural electrification at the turn of the 20th Century.

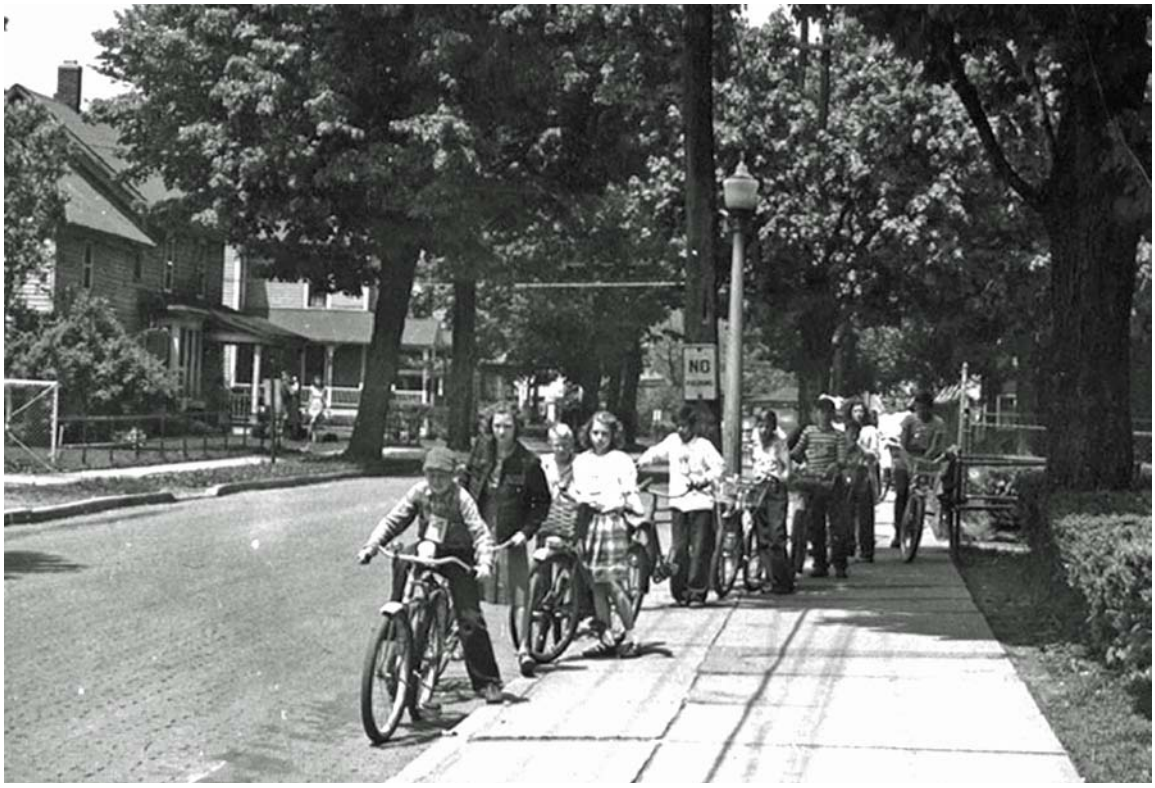
In 1989, Professor David C. Ludington formed the Cornell Agricultural Energy Program (CAEP) to encourage the efficient use of electrical energy through conservation and load management. As with the FEC, CAEP was sponsored by several electric power companies, with project support also coming from other agencies. A variety of means were used to demonstrate effective energy use and concomitant savings for milk harvesting and cooling, farm production facility ventilation system selection and operation, stray voltage elimination, proper lighting, water heating, and similar on-farm applications. A representative set of operating dairy farms were closely monitored and utilized for demonstration purposes. In addition, Ludington developed and patented a two-level vacuum system controller with an adjustable speed drive that substantially reduced power use in the milking process and is in use on commercial dairy installations today.

## *A Program for Young People*

On the youth program side, Professor Carlton M. Edwards, 4-H Agricultural Engineering Specialist, supervised the department's 4-H Tractor Maintenance Program in New York State beginning in 1945. The objective of this endeavor was to teach farm youth who were using tractors to follow good practices in safe operation, as well as to know the best practices for maintenance. He led the effort to develop a Tractor Operators Contest (next page) for 4-H members who enrolled in the Tractor Maintenance Program, and many faculty members judged the contest annually at the State Fair in Syracuse. Maryland had developed a similar contest, and, after first joining in a two-state contest, it was expanded to 17 eastern states through the sponsorship of AMOCO (American Oil Company). AMOCO, farm equipment dealers and their mechanics, County 4-H agents, department faculty and others were all essential elements in providing this program that enrolled thousands of 4-H members in New York State.

Later, Professor E. W. Foss was instrumental in the establishment of the farm tractor certification program for youth, as well as the farm safety program with the State Rural Safety Council. Edwards also initiated the 4-H Bicycle Safety and Care Program that taught safety related subject matter over a three year period, involving county 4-H agents and countywide committees consisting of representatives from the sheriff's office, police departments, the Red Cross, local schools, and service organizations, to reduce accidents between bicyclists and motor vehicles (next page). At that time, there was one bicycle for every 13 persons in the United States, most of them used by children, and deaths and injuries to bicyclists were found to be greatest for youths aged 5 to 14.

An Eastern Regional 4-H Tractor Operator's Contest in Richmond, Virginia in the mid-1950s. C. M. Edwards, the New York State coach, attended with his team.



Sixth grade boys and girls line up to take a safety performance test in the 4-H Bicycle Safety and Care Program in 1948.

In 1958, Professor Edward O. Eaton joined the department with responsibility for the 4-H engineering program, now encompassing a wide variety of activities including bicycle safety, fire prevention and safety, woodworking, electricity, small engines, tractors, and energy. In 1958, youth enrollment in agricultural engineering 4-H projects was 25,000, increasing to 220,000 annually by Eaton's retirement in 1979. Approximately 2 1/2 million boys and girls were enrolled in various agricultural engineering projects during his tenure. His Tractor Operator's Contest entrants always placed near the top and won four times at the Eastern Regional competition. Later, Howard A. Longhouse would assume responsibility for the 4-H program.

## *Information, and Northeast Cooperation*

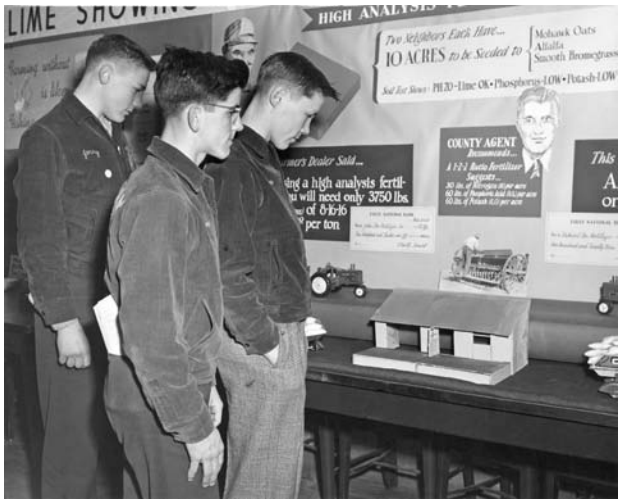
The department faculty had been exceedingly productive in providing timely written material in the form of information sheets, leaflets, pamphlets and Extension bulletins across the years of its outreach efforts. After moving into Riley-Robb Hall and acquiring Multilith offset printing equipment, production and distribution of in-house Extension publications exceeded 100,000 per year.

Eventually, Extension engineers in the Northeast realized that many states had need for, or were producing publications to address the same or similar topics, and a proposal for a Northeast regional facility was prepared by Cornell Extension engineers. The proposal was submitted to Director of Extension David L. Call, who, because he was not familiar with the details of the plan, asked Professor Everett D. Markwardt to accompany him to the Northeast Extension Directors meeting in New York City in 1974 to explain it to the assembly. Markwardt presented a detailed outline of the proposed organization and a method for funding by the states that employed the Smith-Lever proportioning of funds assigned to each state. He listed the dollar amount each State would commit and showed how it would eventually be reduced by the sale of plans, publications and conference fees.

The directors agreed with the proposal and moved to set up a Northeast Regional Agricultural Engineering Service (NRAES). This avoided duplication of effort, reduced costs, centralized the publication and distribution process, and provided a vehicle for increased regional program cooperation. The NRAES headquarters was designated to be at Cornell University. Professor Markwardt served as the first chairman of the Executive and Operating committees, and leadership was rotated among the states. Robert Parsons and Professor Wilmot W. Irish were the early managers. NRAES became a major source of engineering educational materials for the member states, while requiring minimal staff and facilities to produce them. In 1998, the name was changed to the Natural Resource, Agriculture, and Engineering Service, and the acronym NRAES remained.

Reflecting changes over the original operation, the scope had broadened to include the areas of horticultural production; dairy, livestock, and poultry production systems; agricultural waste management; consumer education; natural resources management; farm safety; biological engineering; and environmental engineering.

Crowd at an early Farmers Week pours out of Bailey Hall, which had been built in 1913.




**Above**, high school students check out an exhibit at Cornell in the 1950s during Farm and Home Week. The exhibit tests visitors' judgment of the best way to raise a crop on a particular field.

**At right,** visitors look at the insides of a model of a cow.

The service gained nationwide recognition for the quality and appropriateness of its publications. NRAES is now housed in the Department of Animal Science in Morrison Hall. Senior Extension Associate Martin Sailus is the current NRAES director.

## *Changes in Organization*

Organization of the department's Extension program changed substantially in the 1990s. Tenured faculty retirements prompted shifts from the Extension Specialist-centered approach to program-centered outreach, and also led to broader cooperative relationships both within and outside of the College of Agriculture and Life Sciences. Eight programs were primarily department centered: (a) the Aquaculture Program, led by Timmons; (b) the Bicycle Safety Education Program, led by Extension Associate Lois Chaplin; (c) the Composting Program led by Extension Associate Brian Richards; (d) the Cornell Agricultural Energy Program (CAEP) led by Ludington and Aneshansley; (e) the Cornell Local Roads Program (CLRP), led by Irwin and Senior Extension Associate Antonia Rosenbaum; (f) the Health and Safety Program led by Senior Extension Associate D. Greenstein; (g) the Natural Resource, Agriculture, and Engineering Service (NRAES), led by Senior Extension Associate Martin Sailus; and (h) the Rural Health and Safety Program, led by Extension Associate John G. Pollock and Senior Extension Associate Eric Hallman. These programs enjoyed popular support, satisfying timely needs in an evolving rural/suburban/urban society where lines of demarcation were increasingly fuzzy, if not sometimes altogether erased.

In addition, the department participated with major input in a number of College of Agriculture and Life Sciences Extension programs: (a) Agriculture and the Environment: Water Quality, by Senior Extension Associate Larry Goehring, Walter, Extension Associate J. Boll and Senior Extension Associate Peter Wright; (b) Animal Nutrition: Preservation of Silage and Hay, by Ronald Pitt; (c) Dairy Systems: Livestock Waste, by Montemagno and Wright; (d) Food and Fiber Production: Water Management, by Senior Extension Associate Larry Goehring; (e) Pest Management: Machine Systems and Spray Technologies, by Derksen; (f) Post Harvest: Engineering, by Bartsch; and (g) Youth: Tractor Certification by Longhouse, and Science and Technology by Senior Extension Associate D. Greenstein. Additional program support staff included J. Boll, D. Chamberlain, D. Deming, G. Farmer, D. Hill, D. Orr, J. Potter, T. Richard, and T. Szebenyi. Each program exhibited unique characteristics with outstanding productivity and success; some had local, state, national and international reach. The new outreach model also blended teaching and research into the mix, and one might speculate that in effect this was more or less somewhat of a return to the way the department operated in its first half-century, but now with a directed topical management structure.

The dairy industry has been and continues to be a very large and important component of New York State agriculture, with the state ranking third after California and Wisconsin in number of cows and milk production. Currently, Senior Extension

An early way: Men and horses stack hay in Central New York about 1922.

Associate Curt A. Gooch is responsible for dairy facilities and waste management engineering in the College of Agriculture and Life Sciences Pro-Dairy program. The goal is to further understanding of dairy housing and waste management systems and develop recommendations that result in profitable dairy housing and appropriate on-farm waste management. Consistent with the department's century-long support of dairy farming, the program includes conducting applied research and developing and delivering educational materials in the areas of dairy facilities and dairy waste management. Gooch succeeds a long line of department faculty who had responsibility for the dairy engineering program in New York State, including in the department's last half century Extension Specialists Roger Miller, Ronald Furry, and Wilmot Irish.

## *Shifts of Emphasis*

Outreach continues to be an important aspect of the department's overall program but with a decidedly different structure as it enters its second century. The clientele is larger in some application areas and greatly diminished in others, and there are connections to new public and private groups that affect the farming community, reflecting the changing times. The highly successful service-oriented Extension program reached its zenith in the middle of the twentieth century, and then evolved into an educational program that now utilizes fewer professionals participating in broadly integrated cooperative efforts. The need for technology transfer remains and the department continues to respond to the challenges.

President Andrew D. White prepares to turn a ceremonial shovelful of earth at the cornerstone laying in 1905 for the first College of Agriculture buildings on Tower Road. Liberty Hyde Bailey is at right. Also, see the illustration on the inside front cover of this book.

The Agriculture college's original buildings: Stone Hall, center, with Roberts Hall and East Roberts to the right, looking northeast from the corner of Tower Road and Garden Avenue Extension. Kennedy Hall and the new Roberts Hall now stand on this site. Temporary walkways over the roads help keep pedestrians out of the mud. Caldwell Hall, at left, had been built several years after the original three.

# Facilities

## Begged, Borrowed, and Built

For almost 50 years from its inception, the department was a facility nomad, wandering from place to place on campus borrowing, as it were, space from others, often in basements. A few of these early locations are shown here. Among these were Stone Hall (the original Agronomy building), the original Roberts Hall, the Dairy Building (the original East Roberts) (page 92), the Drill Hall, i.e., Barton Hall both inside and its parking lot!, the original Caldwell Hall (next page), the Landscape Art building, and the Dairy Industry building (Stocking Hall, next page). Lectures and laboratories were held in a wide variety of places on campus. Finally, in 1956 the department moved into its own crown jewel, Riley-Robb Hall, the design for which had begun in the 1920s when Professor Burton A. Jennings took the lead in planning the department's new facility. Along the way, World War II and the need for a new agricultural library also intervened, postponing construction.

## How Riley-Robb Hall Came to Be

The earliest plan indicating the eventual rise of a new home for the department bears the date 6-27-'24. Blueprint Drawing No. B-403 for the "Dept. of Rural Eng'g, N.Y. State Coll. of Agr." is titled "Grades for New Bldgs." This plot plan shows a proposed facility in the location now occupied by Riley-Robb Hall, immediately to the south of the former Animal Husbandry Building (Wing Hall) and the Judging Pavilion (page 95). The only resemblance to what was eventually designed and built is the general shape of the head building to be used for offices and classrooms.

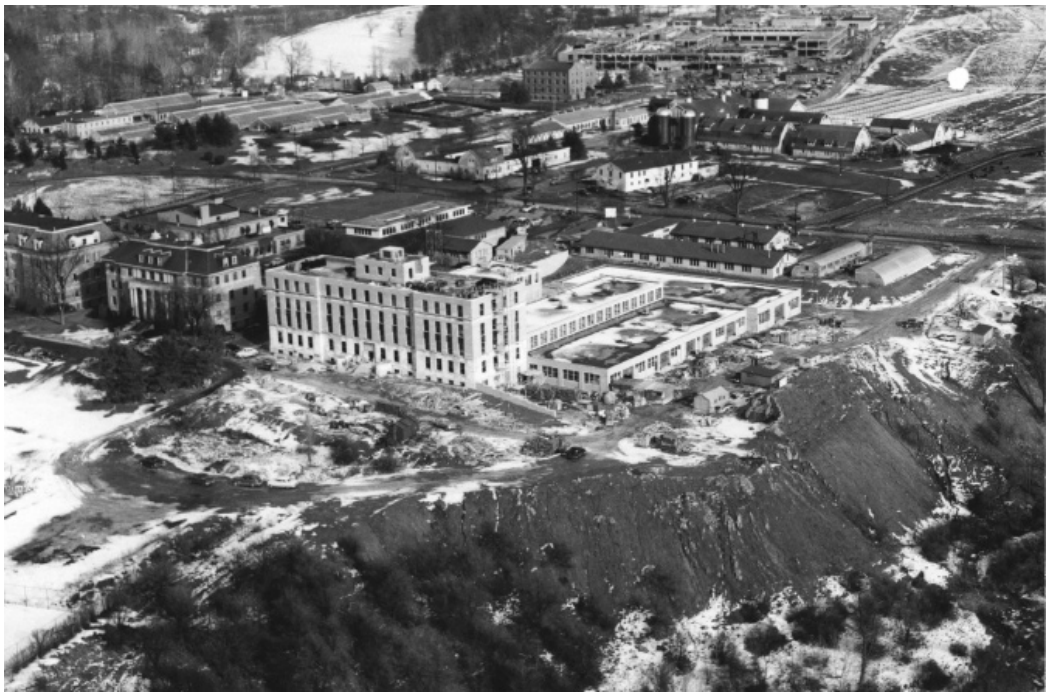
Located to the east of the head building was a series of five parallel laboratories on an east-west axis, occupying more than six times the footprint of the head building, with a large connecting structure between the head building and the laboratories that included a large main lecture room. And, of course, the "temporary" buildings moved from the area now known as the Agriculture Quadrangle are planted firmly in their place immediately east of the "proposed site" for the "proposed facility" (page 95). It would be just over 32 years before the Department of Agricultural Engineering would actually move into Riley-Robb Hall on that very site (pages 95-98).

Riley-Robb Hall, designed by Coffin and Coffin of New York City, provided 2¼ acres of office and laboratory space to house the department's teaching, research

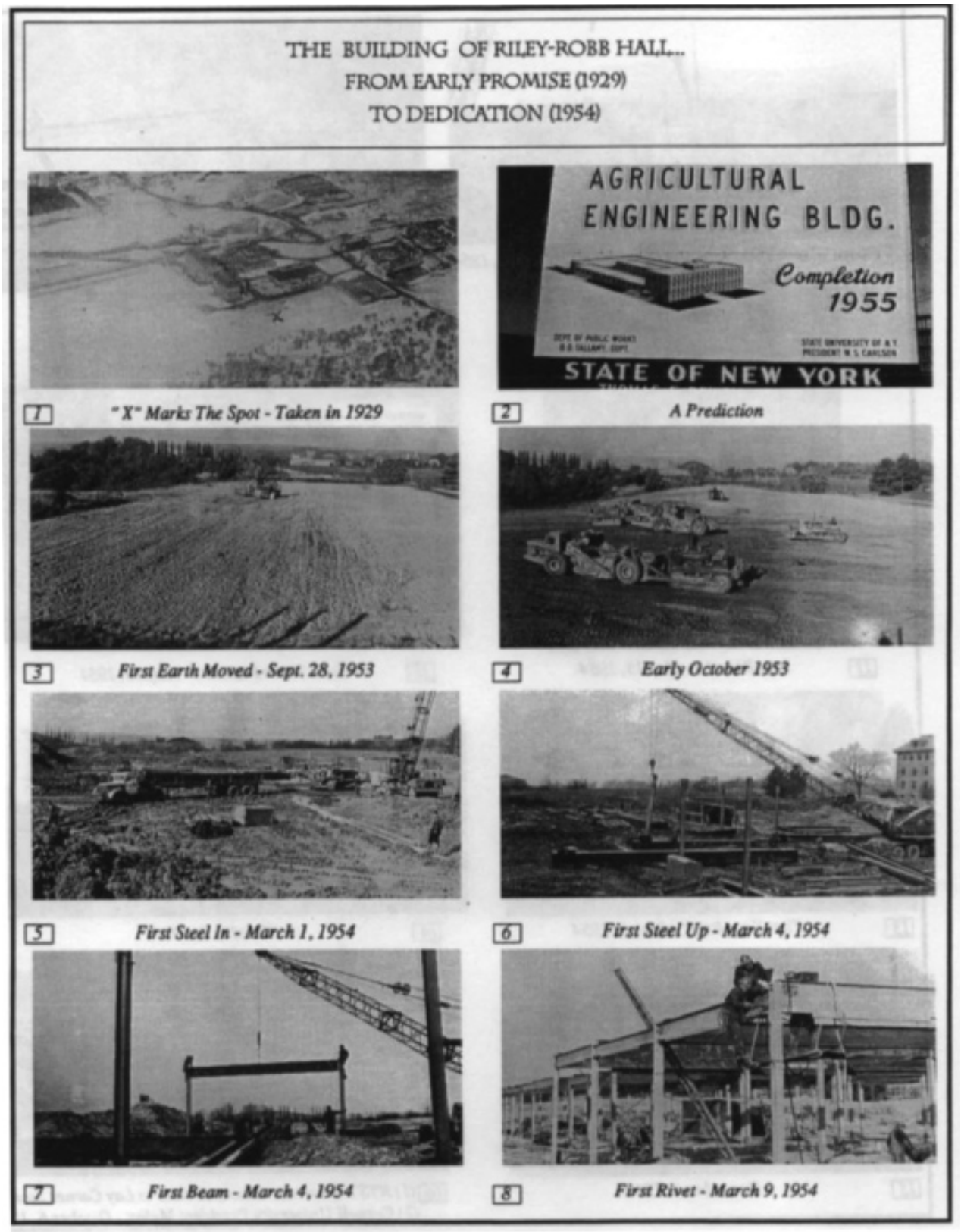
The original Caldwell Hall on the Agriculture Quadrangle, also seen on page 92.

An early view of the Dairy Industry Building, now called Stocking Hall. The department used a portion of the first and fourth floors for offices and instruction, and remained there until Riley-Robb Hall was constructed. A portion of the Animal Husbandry department's dairy barns can also be seen at the extreme left.


"X" marks the spot on this snow covered field where Riley-Robb hall would be built. Immediately to the left center are the Animal Husbandry Building (now Wing Hall) and the Judging Pavilion, with the department's temporary buildings at the right end of the field. This field was used to teach students about the use and operation of farm implements and tractors, as well as grow crops. The Animal Husbandry department's original dairy barns, destroyed in a fire in 1968, are shown immediately across the road from the temporary buildings in the top right of the photograph. It was a long, cold walk for students to make it to class to this location from the lower campus with only 10 minutes between classes. This photograph was most likely taken by Professor Forrest B. Wright, who was a pilot, and had organized and operated an aviation ground school in Elmira and Ithaca in the 1920s.



Riley-Robb Hall being built in 1955. Construction progress is shown on the next two pages.




Early stages in the construction of Riley-Robb Hall.


Later stages in the construction of Riley-Robb Hall.

Aerial view of the Riley-Robb Hall neighborhood at the intersection of Wing Drive, left, and Campus Road, bottom, April 14, 2001. North is at the top, with the head building at lower left, and attached laboratories. The temporary buildings, now Surge 3, and two Quonset huts (bright objects) are immediately to the east, at lower center-right.

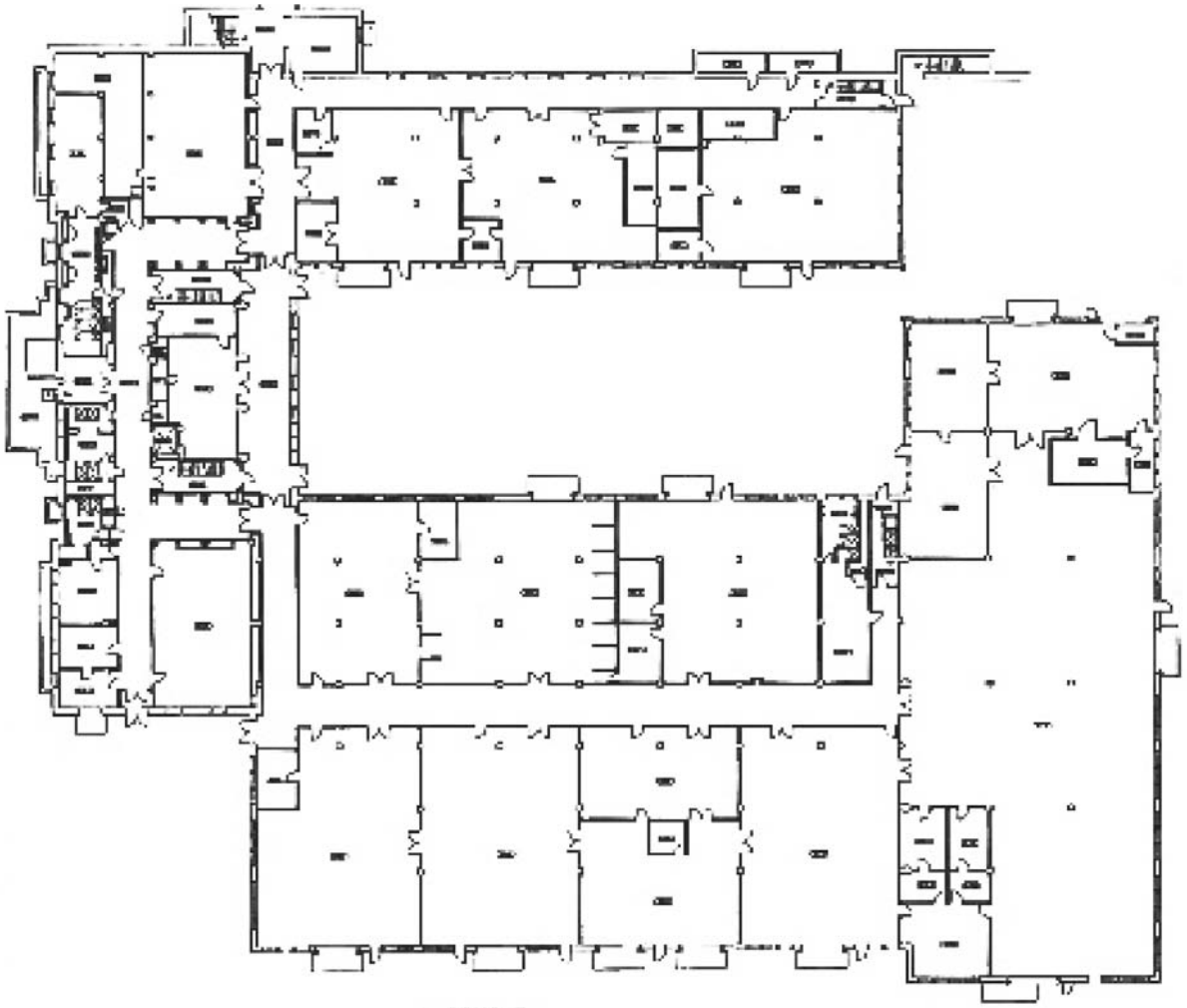
A mid-century farm machinery class in one of the temporary buildings.

and extension programs at a cost of $2.5 million in the 1950s. The most recent space renovation within Riley-Robb Hall, completed in 2004, just shy of the department's century mark, involved gutting the entire two floors of the north wing and installing environmentally controlled biological engineering laboratories. This project cost more than $6 million and provided 14,000 square feet of wet laboratory space for faculty and graduate student use. The next facility transformation will see the former Power and Machinery Laboratory renovated to accommodate research in industrial biotechnology from a $10 million grant from the Empire State Development Corporation.

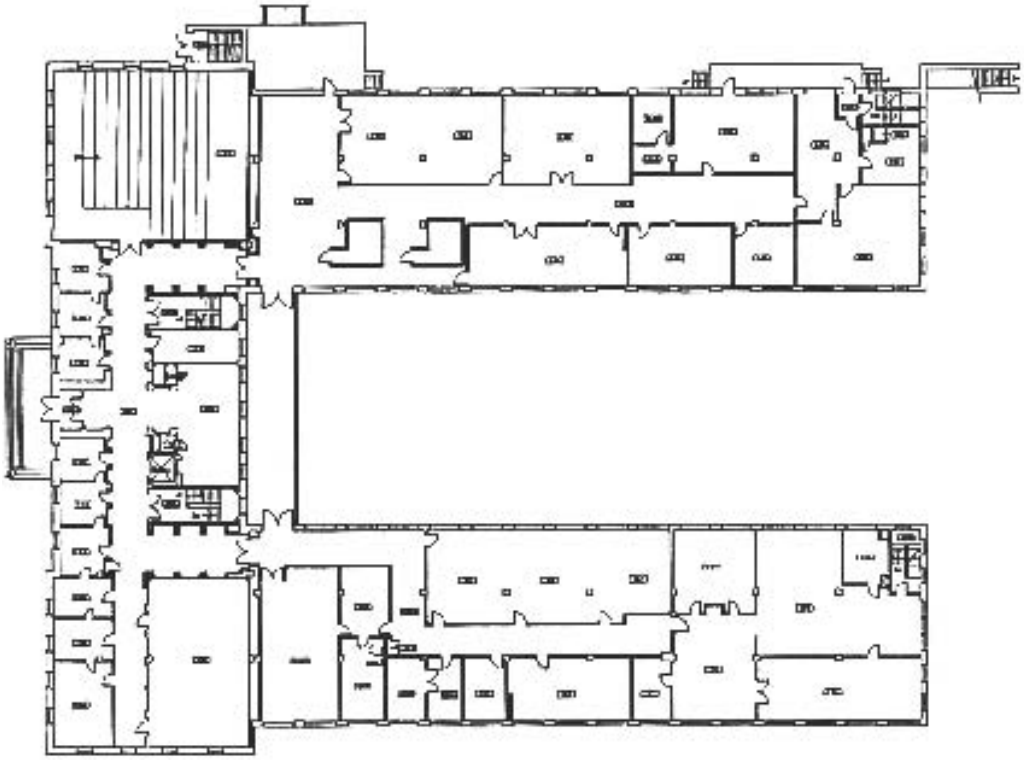
The floor plans on the next three pages show the space layout for Riley-Robb Hall in the early 1990s. Continual developments in the teaching, research, and Extension programs resulted in dramatic changes in use of floor space in both the head building and the three laboratory wings, almost from the day the building was first occupied in 1956. Originally, the principal problem was insufficient office space for an expanded faculty, staff, and graduate student population that was relocated from several places to one central facility. Additionally, both the basement and first floors of the east end of the north laboratory wing had been constructed as a Food Engineering Laboratory that also included office space along with large walk-in cold storage and freezer rooms.

Because there was no full-time food engineer on the faculty, this space was utilized by Professor Paul Buck, and later Professor Robert Zall, of the Food Science Department and renamed the Food Science Annex. When Zall retired, the space reverted to the Department of Agricultural Engineering and had mixed use, including some food related work by Professors Jean B. Hunter and Ashim K. Datta. As of this writing, 88 percent of the department's total laboratory wing space, including the north and south wings and the high ceiling clearance farm machinery laboratory wing on the southeast corner, is no longer used for the original intent and bears no resemblance to the first use.

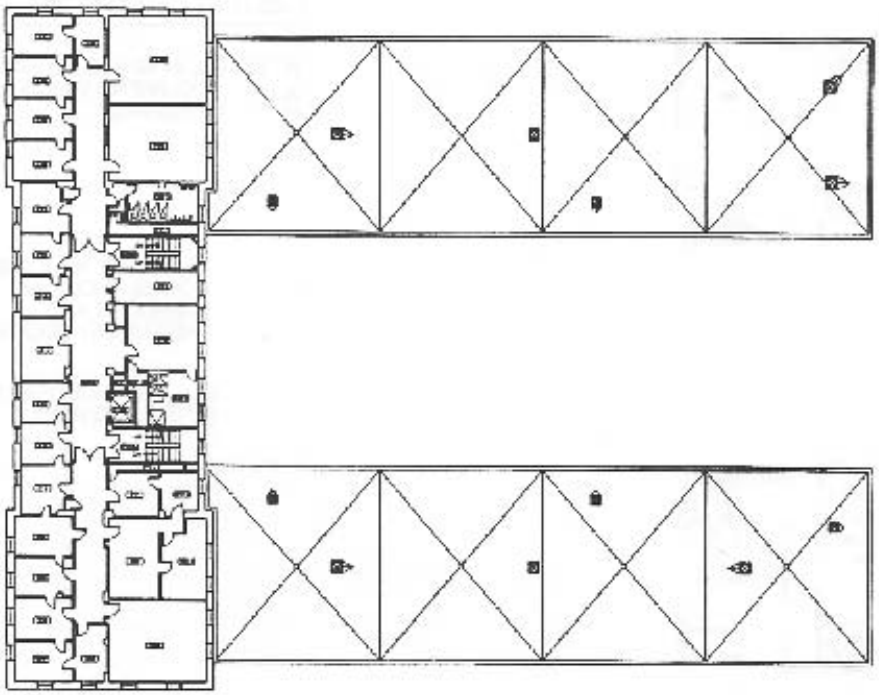
The head building (pages 101 and 102), mainly housing offices, lecture rooms, both large and small teaching laboratories, as well as service and storage areas, has undergone similar changes. Only the original offices, a large and small lecture room, the seminar room, a first and second floor lounge, and service and storage areas remain the same. All of the large teaching laboratories in the head building were converted to office space; even the ends of the halls on the second floor and a portion of the library were partitioned for offices. Planning for the complete renovation of Riley-Robb Hall was initiated in the early 1990s to accommodate projected program changes into the twenty-first century, as well as bring the building up to current code requirements; however, as of this writing, no comprehensive specifications or construction plans have been produced. The wait is on again!



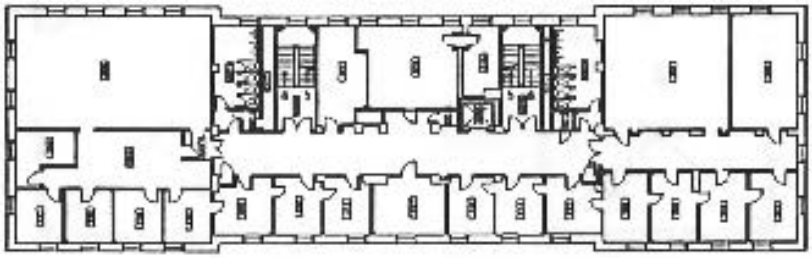
The basement level of Riley Robb Hall, with north at the top: the head building is at left and the laboratory wings at top and bottom. A high-ceiling-clearance machinery laboratory, on the east or far right, and a large service courtyard give vehicles access to five interior basement laboratories. The original Food Engineering Laboratory, later renamed the Food Science Annex, occupied the basement and first floor levels of the east end of the north laboratory wing.



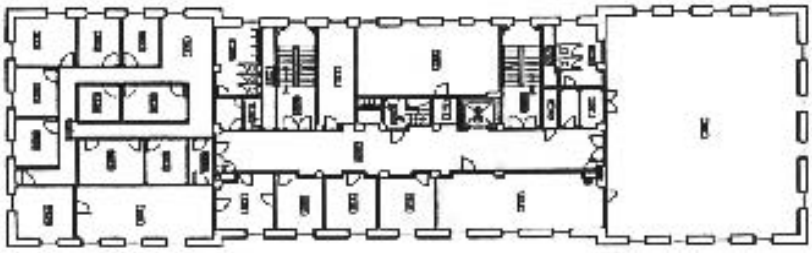
First floor level of Riley-Robb with the head building, left, and laboratory wings at top and bottom. An outside overpass at the left end of the central courtyard was originally used to permit tractors, implements, and other large pieces of apparatus to be moved from the north loading dock and vehicle ramp located near the top right of the head building to the large, formerly unpartitioned teaching laboratory in the south wing. The first floor of the north teaching wing was originally also largely unpartitioned.



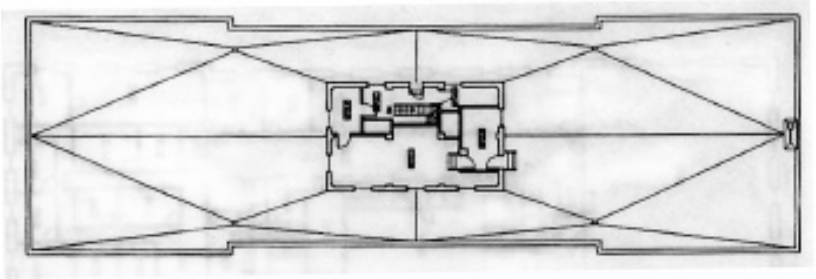
Second floor level: The central north-south hallway of the head building was partitioned at each end to provide additional office space. Later, the library at the north end was partitioned to make two additional offices to accommodate expanding program needs.



Third floor level of the head building: Large open classroom space on the north end, at the left, had given way in the late 1950s to the need for additional office space for new Extension faculty and a publication reproduction center.



Fourth floor level of the head building: The large open area at the right is the Orval C French Seminar Room which still exists, unchanged. At the opposite end of the building, a large drafting teaching laboratory was converted to multiple offices, and then modified again to make way for a Copy Center by removing the four offices shown here in the center core.



Roof level of the head building with elevator penthouse: The small rectangle at the extreme right end is the chimney for the working fireplace in the Orval C French seminar room located directly below on the fourth floor, which received a respectable amount of use for the many department social events for about a quarter of a century after Riley-Robb Hall was occupied.

The main entrance to Riley-Robb Hall as it enters the twenty-first century.

Aerial view of the Cornell University campus in 2006, looking west from above the 'B' Parking Lot, with College of Veterinary Medicine buildings at center right. Bartels and Barton halls are at left and the Library Tower rises against Ithaca's West Hill. Cayuga Lake is at the right. Bradfield Hall on the Agriculture and Life Sciences campus and the Herbert H. Johnson Museum of Art rise to its left. Alumni Field is in the left center of the photo, with Riley-Robb Hall the long flat building with a small fifth story, silhouetted against the field.

# The Second Century Beckons

The department's 2006 mission statement and program description provide a snapshot of the vastly changed size and scope of the renamed Department of Biological and Environmental Engineering as it enters its second 100 years.

A look at the currently active faculty and fields of specialization in 2007 is found on pages 123 to 144.

The mission statement:

"Educate the next generation of professionals and discover new knowledge in Biological and Environmental Engineering;

"Disseminate cutting edge research-based engineering information through the scientific media and outreach programs; and

"Conduct all programs in the context of a world-class university and deliver the highest value knowledge to our students, citizens and global society."

The program description:

"The Department of Biological and Environmental Engineering (BEE) is diverse with two distinct and highly integrated program areas: Biological Engineering and Environmental Engineering. Although these two program areas share significant commonality in teaching, especially with regard to the core curriculum, there are significant differences in emphasis and course options. These differences result in a flexible program that satisfies the diverse interests of our students. Accordingly, the intellectual breadth of the BEE department is even more strongly reflected by the diversity of the department's research and outreach activities.

"Biological Engineering integrates engineering practice and quantitative biology, with a focus on food systems, life sciences, human health, and the environment. Environmental Engineering is aimed at combining engineering and environmental sciences in a coordinated manner so as to include a balance of basic, developmental, and applied investigative efforts. Once concerned primarily with the rural environment, the program now addresses a wide range of environmental issues in both the private and public sectors.

"Much of the approximately $6 million annual department expenditures are directed at sponsored research. This research includes the development of nanobiomechanical devices, biosensors, a bio-based industry center, food processing, controlled- environment agriculture, preferential flow, sustainable watersheds, as well as many other projects and programs. Most BEE-led research is interdisciplinary and includes links to teaching and outreach.

"The approach to Extension and outreach used in BEE has changed considerably over the past ten years. A program that was coordinated primarily by full time professional faculty funded almost totally through core college funds is now conducted largely by faculty working with full-time senior Extension associates in programs

that are largely externally funded. The department has major Extension/outreach programs such as local roads, dairy systems, water and watershed management, and controlled environment agriculture.

"BEE is composed of an extraordinarily diverse professorial faculty of twenty-two. Faculty members have PhDs in agricultural engineering, biological engineering, chemical engineering, civil engineering, environmental engineering, electrical engineering, biotechnology, and applied math. While the faculty brings diverse backgrounds and expertise, they work in the two interrelated areas of biological and environmental engineering.

"BEE offers an undergraduate engineering major that is accredited by the Accreditation Board for Engineering and Technology and is unique at Cornell in that it is administered jointly by the College of Engineering and College of Agriculture and Life Sciences (CALS). Students matriculate into the program through either the College of Engineering or CALS but must spend their senior year registered in the College of Engineering. Students follow one of two curricula: environmental engineering or biological engineering. Environmental engineering students follow a joint curriculum offered between the Civil and Environmental Engineering (CEE) and BEE departments. The intention is to move this joint curriculum to an accredited major in environmental engineering offered by faculty from the two departments.

"Students who are following the biological engineering curriculum can concentrate in either biomedical engineering or a more broad-based animal or plant bioengineering curriculum. BEE offers the only undergraduate concentration in biomedical engineering at Cornell. In addition to the BEE major, the department offers a minor in Biological Engineering and, jointly with CEE, a minor in Environmental Engineering. Students in the Technology Program graduate from the College of Agriculture and Life Sciences.

"The BEE graduate field offers MS, PhD, and MPS (Master of Professional Studies) degrees through the Graduate School. The department offers a Master of Engineering (MEng) degree through the College of Engineering. Graduate student enrollment has been steady at about 70. BEE faculty also serve in other graduate fields such as Microbiology, Sustainable Development, Water Resources, International Agriculture, Geology, Food Science, Civil Engineering and Biomedical Engineering. BEE faculty members currently serve as the director of Graduate Studies for the Graduate Field of Biomedical Engineering and the Field of Water Resources Engineering.

"BEE has demonstrated the ability and courage to make the changes necessary to effectively address the challenges of the twenty-first century. We will continue to meet the ever-increasing student demand for technologically advanced and relevant programs. We will improve on our broad-based biological engineering program by placing special emphasis on applications to molecular and cellular biology. Advancements are being made in the biological engineering curriculum, especially in the courses appropriate for biomedical engineering.

"Biological and Environmental Engineering is at the focus of three great challenges facing humanity in the twenty-first century:

- Protecting or remediating the world's natural resources, including water, soil, air, energy, and biodiversity.

- Developing engineering systems that monitor, replace, or intervene in the function and operation of living organisms.
- Ensuring an adequate and safe food supply in an era of expanding world population.

"Biological and environmental engineers solve problems related to non-point source pollution, such as movement of pathogens and chemicals through watersheds, soil, and underground aquifers. They design processes and equipment for the production, storage, and processing of food and fiber; for the assessment of food quality and safety; and for the expanding use of biological products. And they are involved in the development and application of technologies to diagnose diseases, protect living organisms from hazardous conditions, and improve human and animal health.

"As a field, biological and environmental engineering is rapidly evolving with advancements in biological sensors, nanotechnology, biotechnology, and molecular biology. New methods of computation are being used to simulate the dynamics of systems as small as the membrane of a cell, as large as an entire ecosystem, and as complex as the human genome.

"Cornell's Department of Biological and Environmental Engineering is a leader in providing innovative educational programs to meet the challenges of the 21st century. The ABET-accredited undergraduate program has a unique focus on biological systems, including the environment, that is realized through a combination of fundamental engineering sciences, biology, engineering analysis and design, and liberal studies. The research program is interdisciplinary and deals with a range of topics at the intersection of engineering and biology, including microbial and enzymatic processing, water quality, gene transfer, food production, and animal health. Technology transfer programs interface with private industry, government agencies, and the public.

"Career opportunities cover a broad spectrum of private industry, public agencies, educational institutions, and graduate programs in engineering, science, medicine, law, and other fields. In recent years, graduates have developed careers in environmental consulting, biotechnology, the pharmaceutical industry, biomedical engineering, management consulting, and international development. Two career development seminars are offered to educate students on the wide range of opportunities and how to prepare for them.

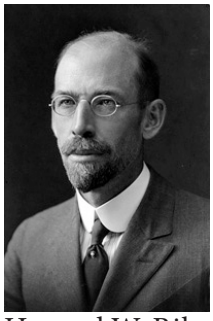
"The living world is all around us, and within us. The biological revolution of this century has given rise to a growing demand for engineers who have studied biology and the environment, who have strong math and science skills, who can communicate effectively, and who appreciate the challenges facing society. Biological and Environmental Engineering is educating the next generation of engineers to meet these challenges."

BEE Department founders Howard W. Riley, right, and Byron B. Robb in 1959.

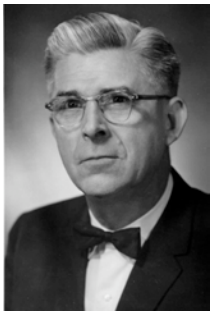
# The People of BEE

## Department Administrators in the First 100 Years

During its first century, the department has been led by a mechanical engineer with electrical engineering training (Riley), an agricultural engineer with electrical engineering training (French), and six agricultural engineers (Robb, Shepardson, Scott, Rehkugler, Furry, and Walter).


Howard W. Riley
1907-1945


Byron B. Robb
1945-1947

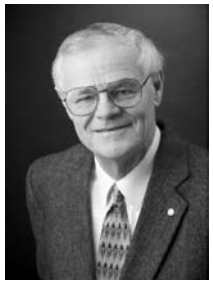

Orval C French
1947-1971


E. Stanley Shepardson
1971-1978


Norman R. Scott
1978-1984


Gerald E. Rehkugler
1984-1990

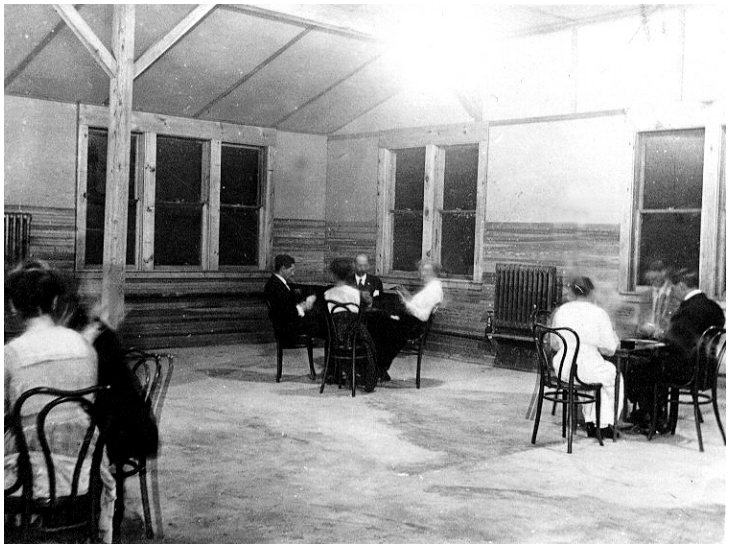

Ronald B. Furry
1990-1994


Michael F. Walter
1994-

**Above,** Professor Byron Robb at left toasts a gathering in "Jennings Hall," a temporary building the Ag Engineering department built between two other temporary lab buildings.

**At right**, a barbecue in the same room using a giant gear to hold the fire, with a coffee pot in the left foreground heated by a gas ring. Professor Juan Reyna is second from right in the front, and Professor J. C. McCurdy is at left in the back.

**Below,** playing cards in the building. Professor Howard Riley faces the camera at rear.



# The Social Side

The social life of the department in the early years was rather formal compared to today. The faculty and staff were relatively few but they did their best to develop camaraderie, using whatever venue was appropriate to their jurisdiction. The "temporary" buildings offered one such setting and they could be rightly proud because they had built the laboratories with their own hands. The link between the two north-south labs was nicknamed "Jennings Hall" after Professor Burton A. Jennings who planned and oversaw their construction.

Cleared of equipment, Jennings Hall was used for social gatherings, displays for Farm and Home Week, and other events. The author remembers when the ASAE Student Branch held some of its social events there, too.

When Riley-Robb Hall was built, faculty, staff, and student interaction increased dramatically because of the availability of a home for social activities, and for several decades a Social Committee planned and conducted all sorts of events on a monthly basis, including formal and informal dinners, traveling progressive dinners, and picnics at locations such as Arnot Forest, Taughannock Park, and Lansing Park.

The O. C French Seminar Room was the favorite location for the gatherings in Riley-Robb Hall. On one occasion, Casino Night, faux money was printed and distributed to the players for use at the various gaming tables, with one bill being different from all the rest. There was a special prize for the holder of this particular bill, which had to be won from the house at one of the gaming tables. The bill that was unique contained a photo of department head Orval C French and, wouldn't you know it, ended up in his wife Helen's winnings.

Informal mid-morning gatherings for coffee were held in the second floor lounge, and since 1991 a Friday morning Chit-Chat initiated by Furry has been held in the seminar room. This weekly event often includes special foods prepared by volunteer chefs. Currently, the longest running annual gathering is the December Chili Party, originated by Douglas Caveney, Carl Czarnieki, C. J. Solat, and Randy Lacey in 1979. Preparation takes two days, with the cooking of the chili accomplished in the kitchen for the seminar room, involving a variety of Riley-Robb volunteers. Held at noon, the twenty-seventh event in December 2006 attracted 200 people and featured seven different chili formulations, including two different chicken, plus sausage, beanless, vegetarian, traditional, and extra spicy offerings. Friends of the department are welcome, and for a $2.50 donation there are refills and all the trimmings!

In 2002, the spouses of BEE emeritus faculty formed the "Queen BEE's", an informal luncheon group that meets monthly during the academic year at a variety of venues located both within Ithaca and at reasonable driving distances to interesting sites.

1941 to 1942

Department of Agricultural Engineering

| Name | Degree | Rank | Work and Notes |
|---|---|---|---|
| H. W. Riley | M. E. | Professor | Head - Teaching Course 1 |
| A. M. Goodman | B.S.A. | Professor | Teaching Course 31 - On Leave |
| B. A. Jennings | B. S. | Professor | Teaching Courses 102-103 |
| J. C. McCurdy | B.S.C.E. | Professor | Teaching Courses 21-24-122 |
| B. B. Robb | M. S. | Professor | Teaching Course 10 |
| L. N. Roehl | B. S. | Professor | Teaching Courses 40-41 - On Le |
| P. R. Hoff | M.S.A. | Asst. Prof. | Extension |
| H. S. Pringle | B. S. | Asst. Prof. | Extension Machinery |
| J. E. Rayna | E.E.M.A. | Asst. Prof. | Teaching Drawing 1-2-3-5 |
| C. E. Turner | M. S. | Asst. Prof. | Extension Project Leader |
| F. B. Wright | PhD | Asst. Prof. | Teaching Courses 1-10-101 |
| G. W. Crowther | M.S.A. | Instructor | Teaching Course 1 |
| C. T. Male, Jr. | M. S. | Instructor | Teaching Courses 1-10 |
| W. F. Millier | B. S. | Instructor | Extension |
| C. W. Milligan | M. S. | Instructor | Teaching Courses 40-41 |
| E. S. Shepardson | B. S. | Instructor | Extension 4H |
| W. H. Ashton | - | Asst. Inst. | Draftsman Course 10 |
| J. W. Caddick | B. S. | Asst. Inst. | Teaching Course 40 |
| A. H. DeGoyler | B. S. | Asst. Inst. | Extension - Structures |
| N. W. Allen | - | Assistant | Teaching Courses 102-103 |
| R. E. Bowman | - | Assistant | Teaching Courses 1-103 |
| C. E. Brower | - | Assistant | Teaching Course 103 |
| D. B. Davidson | - | Assistant | Teaching Course 1 |
| R. Dudley | - | Assistant | Teaching Course 40 |
| T. P. Gaffney | - | Assistant | Teaching Course 101 |
| L. Mehlenbacher | - | Assistant | Teaching Course 103 |
| W. F. Millier | - | Assistant | Teaching Course 103 |
| L. A. Preston | - | Assistant | Teaching Course 101 |
| R. N. Spicherman | - | Assistant | Teaching Courses 102-103 |
| J. W. Sumner | - | Assistant | Teaching Course 103 |
| J. H. Whitaker | - | Assistant | Teaching Course 1 |
| G. E. Allen | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| R. E. Bowman | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| J. M. Carney, Jr. | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| N. H. Chadwick | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| H. R. Davis | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| R. F. Elliott | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| C. P. Loomis | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| P. T. Luce | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| L. H. Mehlenbacher | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| W. F. Millier | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| R. E. Morse | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| R. H. Overton | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| R. N. Spicheman | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| P. E. Turner | - | Dist. Eng. | Extension Appt. January 5, 1942 |
| D. L. Waleeman | - | Dist. Eng. | Extension Appt. January 5, 1942 |

In its 35th year, the department has few with advanced degrees.

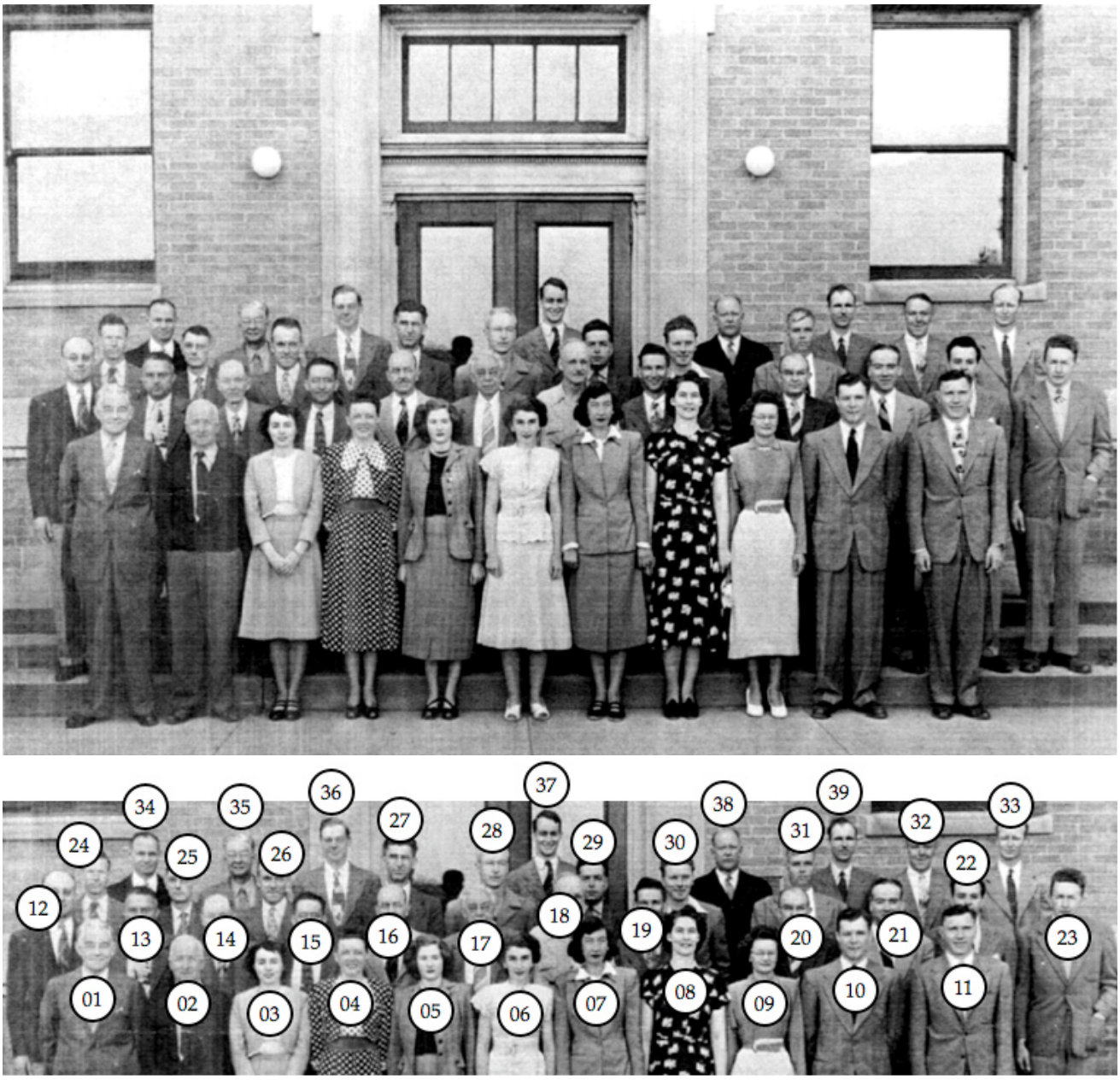
# *Professorial Faculty in the First 100 Years*

Members of the professorial faculty of the department have come from a variety of fields, including agricultural engineering, applied mathematics, architecture, biological engineering, biological science, biophysics, biotechnology, chemical engineering, civil engineering, electrical engineering, engineering science, environmental engineering, mechanical engineering and physics.

Members of the professorial faculty in the department's first century, giving their year of appointment, are shown below. For approximately the first half century it was very common for faculty to begin with an appointment as instructor. Cornell emeritus faculty are designated by an asterisk.

Beth Allyson Ahner, 1996
Louis Demont Albright, 1973
Daniel Joseph Aneshansley, 1985
Antje J. Baeumner, 1999
James Allen Bartsch, 1979
Donald Wesley Bates, 1946
F.G. Behrends, 1919
Richard D. Black*, 1959
W.K. Blodgett, 1918
Landis Lee Boyd, 1948
Joseph Kearns Campbell*, 1967
Susan G. Capps, 1992
James Robert Cooke*, 1966
Ashim K. Datta, 1987
Hollis Rexford Davis*, 1942
A.H. Degolyer, 1947
Richard C. Derksen, 1989
Deana Durnford, 1983
Edward Oscar Eaton*, 1958
Carl M. Edwards, 1945
Frank Latta Fairbanks, 1918
Edward Wilbur Foss*, 1948
Orval C French*, 1947
Ronald Bay Furry*, 1953
Kifle G. Gebremenhin, 1982
Alpheus Mansfield Goodman*, 1919
Ronald C. Gorewit, 2003
Harold E. Gray, 1948
Richard William Guest*, 1958
Wesley Winfred Gunkel*, 1948
Douglas A. Haith, 1971
Leslie Eugene Hazen, 1913
William L. Hewitt, 1970
Paul Raymond Hoff*, 1939
Elgin B. Hundtoft, 1962
Jean B. Hunter, 1985
Wilmot Wheeler Irish*, 1960
Lynne Howard Irwin, 1973
Lynn Jelinski, 1996
Burton Aaron Jennings*, 1920
William James Jewell, 1973
Lafayette W. Knapp, Jr., 1954
L. William Larson, 1953
John William Layer*, 1956
Fred G. Lechner*, 1957
Gilbert Levine*, 1952
Raymond C. Loehr, 1968
Ruby M. Loper*, 1946
Robert T. Lorenzen*, 1959
David C. Ludington*, 1959

**(continued on page 115)**

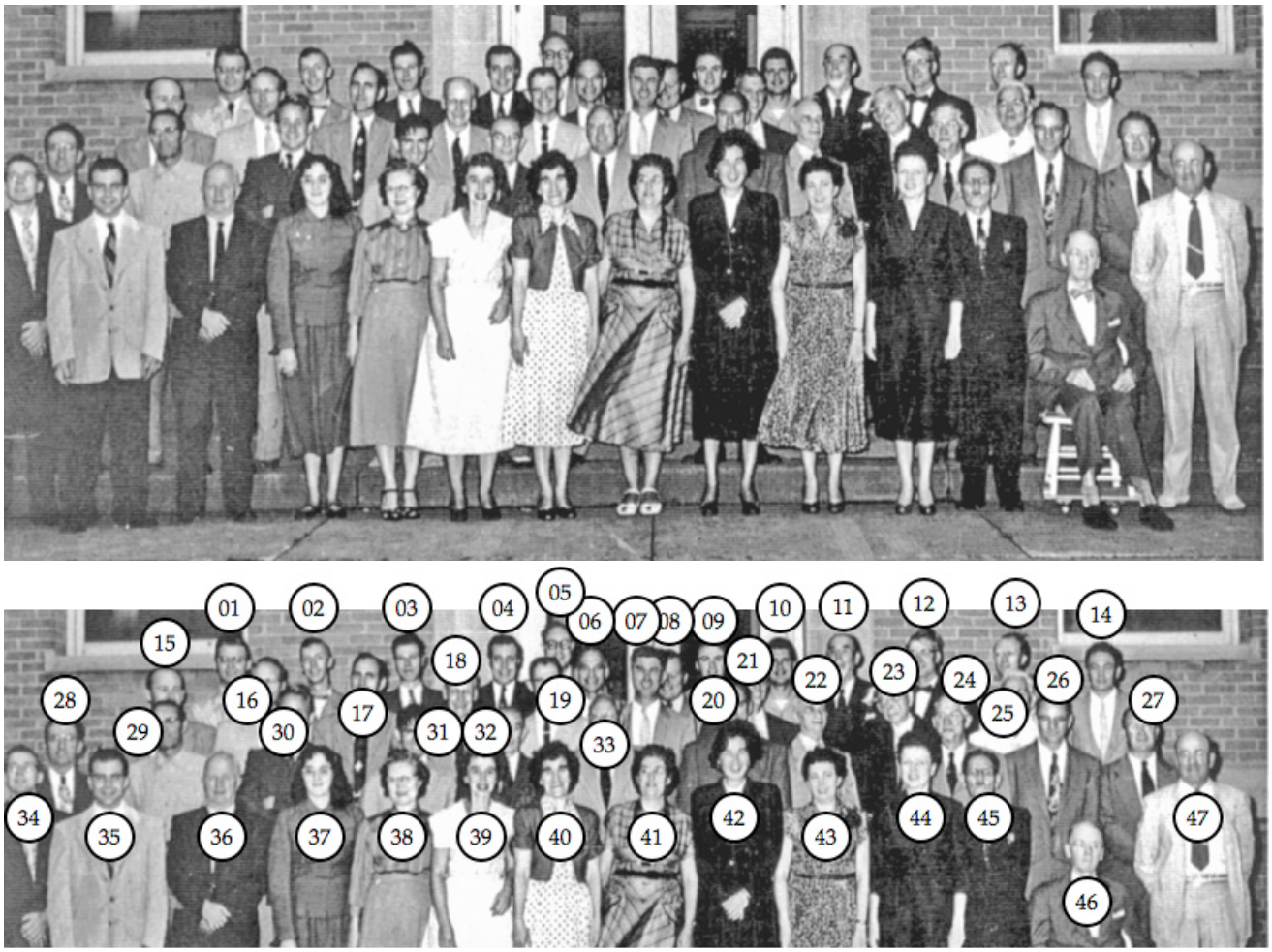



The faculty and staff of the Department of Agricultural Engineering stand on the front steps of Stocking Hall on June 14, 1949. From left: First row, 01 A. M. Goodman, 02 Harold Clough, 03 Jane Wilson, 04 Kate Hurlbutt, 05 Jo Erickson, 06 Ruth Beach, 07 Jane Martin, 08 Merle Johns, 09 Florence Ziolkowska, 10 L. L. Boyd, 11 W. W. Gunkel. Second row: 12 G. R. Henderson, 13 P. R. Hoff, 14 L. M. Roehl, 15 C. W. Terry, 16 F. B. Wright, 17 B. B. Robb, 18 B. A. Jennings, 19 W. N. Weston, 20 C. N. Turner, 21 E. S. Shepardson, 22 A. D. Pistilli, 23 R. P. Rooney. Third row: 24 E. B. Wahlgren, 25 W. H. Ashton, 26 C. P. Loomis, 27 O. C French, 28 D. W. Bates, 29 H. R. Davis, 30 I. W. Bigalow, 31 P. H. Wilson, 32 J. E. Scofield, 33 H. E. Gray. Fourth row: 34 C. W. Mulligan, 35 F. J. Newcomb, 36 C. M. Edwards, 37 J. W. Turner, 38 N. H. Chadwick, and 39 E. D. Markwardt.

Dan Luo, 2001
Everett D. Markwardt*, 1946
John C. March, 2005
John Clarence McCurdy*, 1915
Roger A. Miller, 1953
William Frederick Millier II*, 1948
Carlo D. Montemagno, 1995
Jean-Yves Parlange, 1985
Gordon Clark Perry, 1954
H.S. Pringle, 1926
Ronald Evan Pitt, 1979
Donald R. Price, 1963
F. H. Randolph, 1923
Gerald Edwin Rehkugler*, 1958
Juan Estevan Reyna*, 1912
Howard Wait Riley*, 1907
Byron Burnett Robb*, 1911
Louis Michael Roehl*, 1918
Norman Roy Scott, 1962
John Cornelius Siemens, 1963
Edwin Stanley Shepardson*, 1936
Roger Morgan Spanswick, 2001
James Wendell Spencer*, 1949
Tammo S. Steenhuis, 1978
N. D. Steve, 1920
J. L Strahn, 1913
Cyrl Waldi Terry*, 1948
Michael Ben Timmons, 1983
Clesson Nathan Turner*, 1935
E. B. Wahlgren, 1948
Larry P. Walker, 1979
Michael Faivre Walter, 1974
Michael Todd Walter, 2001
Carl Seymore Winkelblech*, 1954
Forest B. Wright*, 1920

# *Department Portraits*

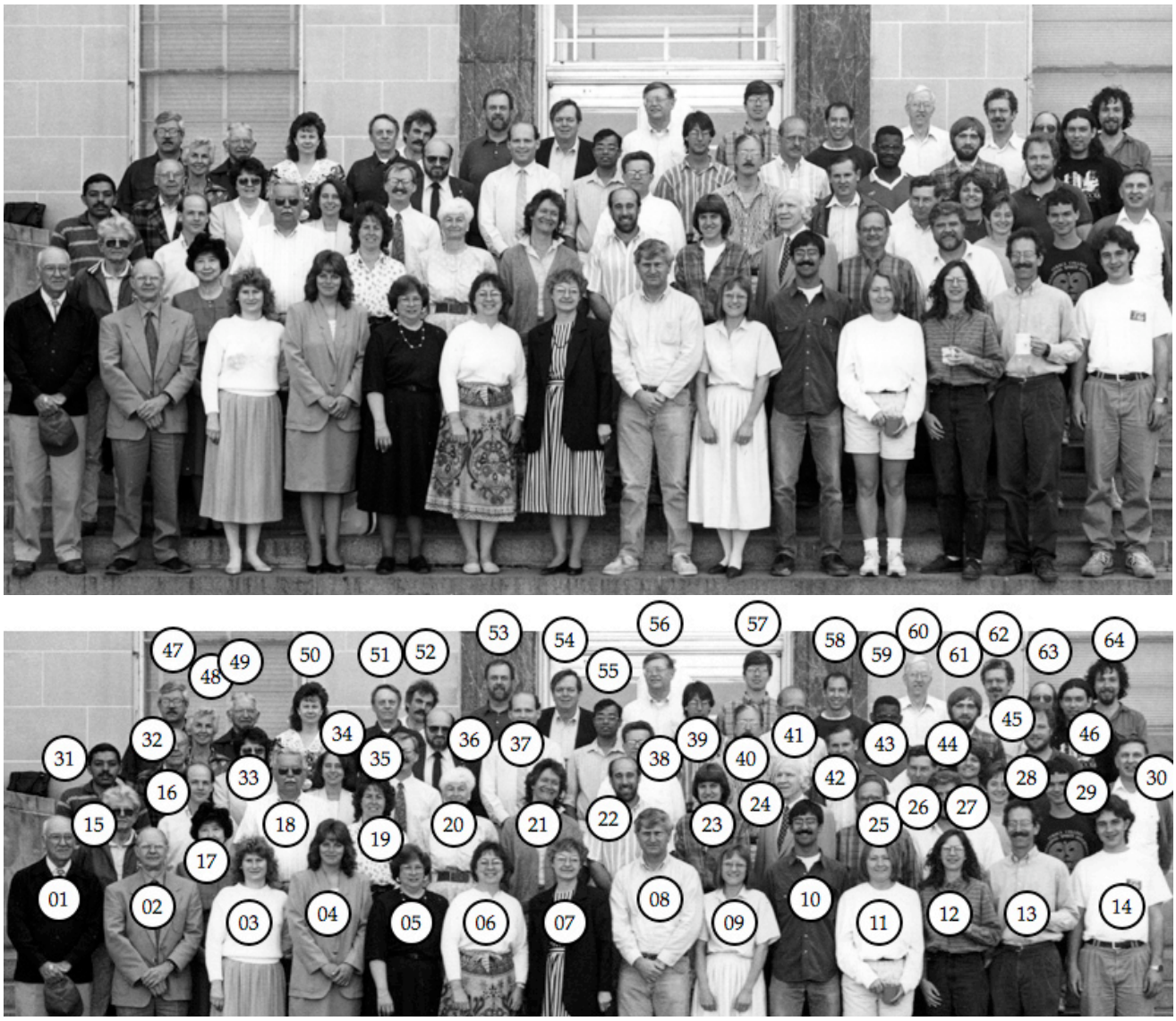
Few group pictures of the department faculty and staff are available, but one event that did merit a very special assembly was the preparation of documents to be placed in the cornerstone in 1954 of what would become Riley-Robb Hall. Although shirts, ties, jackets and dresses were the normal workday attire, everyone dressed just a bit beyond the usual call of duty for that occasion, shown on the next page. An earlier gathering in 1949 is shown on opposite page.



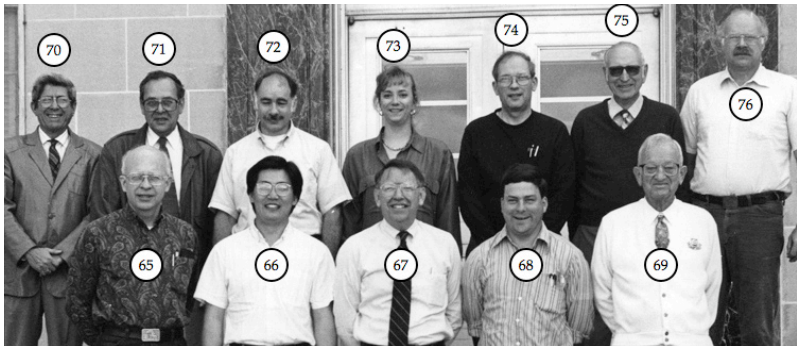

The Agricultural Engineering faculty and staff assemble on the front steps of Stocking Hall on October 2, 1954 to produce a photographic record for the Riley-Robb Hall cornerstone time capsule: 1 Jim Spencer, 2 Bill Burnett, 3 Gordon Perry, 4 ?, 5 Roger Miller, 6 Leon Charity, 7 Department Head Orval French, 8 John Layer, 9 Art Leach, 10 Gil Levine, 11 Howard Riley, 12 Carl Edwards, 13 Harold Gray, 14 Johnny Ordovesa, 15 Avery DeGolyer, 16 Bill Larson, 17 Ev Markwardt, 18, Burt Jennings, 19 Pete Knapp, 20 Carl Winkelblech, 21 Phil Wilson, 22 Joe McCurdy, 23 Byron Robb, 24 Frank Newcomb, 25 A. M. Goodman, 26 Clarence Mulligan, 27 Ed Foss, 28 Cy Terry, 29 Clayt Van Hout, 30 Herman Bouwer, 31 Frank Dean, 32 Clesson Turner, 33 Bill Millier, 34 Ron Furry, 35 Bill Chamberlain, 36 Harold Clough, 37 Joan Shelton, 38 Gladys Loomis, 39 Ruth Beach, 40 Jo Wilson, 41 Lois deChellis, 42 Jane Martin, 43 ?, 44 Kate Hurlbutt, 45 Juan Reyna, 46 Louis Roehl, 47 Forest B. "Doc" Wright, and absent, Stan Shepardson, Paul Hoff, Lannie Boyd, and Wes Gunkel.

In 1954, retired faculty are, from left: front row, Riley, Robb, Roehl, Goodman, Wright; and back row, Clough, Reyna, McCurdy, and Newcomb. Readers with really sharp eyes will find the retirees appear in both photographs.


The Extension engineering faculty at the beginning of 1956. Professor E. D. Markwardt originated *Agricultural Engineering* in 1956 to bring a variety of engineering-related information to as broad an audience as possible on a regular and timely basis.




The Agricultural and Biological Engineering family on the front steps of Riley-Robb Hall in May 1993. 01 Stan Shepardson, 02 Ron Furry (Department Chair), 03 Roberta Reniff, 04 Lori Budd, 05 Carolyn Vanderweide, 06 Toni Rosenbaum, 07 Ruth Stanton, 08 Franklin Griffin, III, 09 unidentified, 10 Raj Ramin, 11 Jean VanderGheynst, 12 Michelle Bothwell, 13 Tom Richards, 14 unidentified, 15 Dick Guest, 16 Steve Hall, 17 Cindy Wang, 18 Howard Longhouse, 19 Sue Roedel, 20 Jane Salino, 21 Lois Chaplin, 22 Rick Koelsch, 23 unidentified, 24 Wes Gunkel, 25 Roger Pellerin, 26 George Hoffman, 27 Larry Geohring, 28 unidentified, 29 unidentified, 30 Dick Krizek, 31 unidentified, 32 Bill Millier, 33 Sandy Bates, 34 Sue Fredenburg, 35 Eric Hallman, 36 Tom Szebenyi, 37 Rich Derksen, 38 John Potter, 39 David Chandler, 40 Jim Houser, 41 Doug Haith, 42 John Pollock, 43 George Hoffman, 44 Ginny Farmer, 45 unidentified, 46 unidentified, 47 Marty Jorgenson, 48 Mary Jane Baker, 49 Bob Lorenzen, 50 Debbie Lewis, 51 Bill Irish, 52 Tammo Steenhuis, 53 Doug Caveney, 54 Dan Aneshansley, 55 Ashim Datta, 56 Bob Cooke, 57 Paul Speicher, 58 unidentified, 59 unidentified, 60 Mike Timmons, 61 Brian Richards, 62 Doug Ley, 63 unidentified, 64 unidentified **(continued on next page.)**




*65 Lou Albright, 66 Andrew Hashimoto, 67 Dave Ludington, 68 unidentified, 69 Ed Eaton, 70 Bob Zall, 71 Joe Campbell, 72 Peter Hillman, 73 Susan Capps, 74 Jim Throop, 75 Ev Markwardt, 76 Tom Cook*

# Department Staff in 1957, the Half-Century Mark

**Faculty**

Boyd, Landis. L
Davis, Hollis R
Edwards, Carl H.
Foss, Edwin W.
French, Orval C (head)
Furry, Ronald B.
Gray, Harold E.
Gunkel, Wesley W.
Hoff, Paul R.
Jennings, Burton A.
Knapp, Lafayette W.
Larson, L. William
Layer, John W.
Lechner, Fred G.
Levine, Gilbert
Markwardt, Everett D.
Millier, William F.
Perry, Gordon C.
Shepardson, E. Stanley
Spencer, James W.
Terry, Cyril W.
Turner, Clesson N.
Winkelblech, Carl W.
Wright, Forrest B.

**Assistants**

Baughman, Samuel
Bennett, A. Herbert
Busch, Charles
Clough, Harold
Dart, Olin K.
Deane, Frank P.
Ditmars, Charles D.
Leach, Arthur
Ludington, David C.
Manley, Philip L.
Nebesky, Edward A.
Rochat Jr., Charles
Swart, Harold
Van Hout, Clayton C.

**Graduate Students**

Bennett, G. Keith
Dirksen, David P.
Fenzl, Richard N.
Just, Jerome O.
Merrell, Harold H.
Rehkugler, Gerald E.

**Office Professionals**

Alling, Mrs. Kris
DeChellis, Mrs. Lois
Diaz, Mrs. Virginia
Hurlbutt, Mrs. Catherine
Kellogg, Mrs. Catherine
Loomis, Mrs. Gladys
Martin, Miss Jane
Mitchell, Mrs. Mary Ann
Salino, Mrs. Jane
Shelton, Mrs. Joan
West, Miss Nancy
Wilson, Mrs. Josephine

# And Today

Over the years, the department's teaching, research, and extension programs grew in both quality and variety of activities through the excellent cooperation and strong support of the Colleges of Agriculture and Life Sciences and Engineering. . The future would show that distinguished program quality would be a hallmark of the department. A study in 1978 by an independent institution, as well as the Gourman reports, gave the department a number one ranking in the nation. A separate evaluation of U.S. graduate programs also gave the department a number one national ranking. In 2006, Cornell University was ranked by U.S. News and World Report as having the 4th best program in agricultural engineering in the country and 10th for best undergraduate engineering programs at schools whose highest degree is a doctorate.

Recent years have brought a renewed vigor and resurgence of activity dealing with solutions to environmental concerns. Waste disposal and treatment, recycling and reuse of residuals, water quality maintenance and protection of the environment from chemicals have become major departmental thrusts. In addition, bioprocessing of materials for environmental enhancement and the production of food and fuels has become a major activity, along with applications of technology at the cellular level.

At the end of its first century, the department continues evolving to adjust to current and future needs for engineering in agricultural and biological systems and the environment, and has developed one of the major graduate programs in these areas in the United States. One recent benchmark in this evolution was the change of the department's name to Biological and Environmental Engineering in 2001. This name corroborates the trend in the engineering practice of the department toward a stronger integration of engineering with the biological sciences, and the teaching, research and extension programs manifest that movement.

Emeritus faculty living at the time of this writing with their periods of service, functional responsibilities, and principal application areas of endeavor are listed below. Their combined active tenure on the department faculty totals 329 years.

# *Emeritus Faculty*

**J. Robert Cooke, 1966-2004**

BS North Carolina State College

MS University of North Carolina at Raleigh

PhD North Carolina State University

Teaching and Research: Biomechanics of Plants; Biological and Agricultural Engineering Analysis; Educational Software; Scholarly Publishing Strategies

**Edward O. Eaton, 1958-1979**

BS University of Vermont

MS Cornell University

PhD Cornell University

Extension: 4-H Engineering Programs

**Ronald B. Furry, 1953-1995**

BS Cornell University

MS Cornell University

PhD Iowa State University

Teaching, Research and Extension: Structures and Environments, Computer Education, Similitude Methodology, and Student Recruitment

**Wilmot W. Irish, 1960-1993**

BS University of Vermont

MS University of Illinois

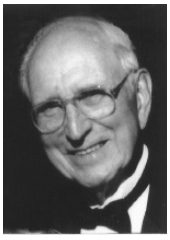
Extension and Research; Structures and Environments

**Gilbert Levine, 1952-1983**

BS Cornell University

PhD Cornell University

Teaching and Research: Soil and Water Engineering, Tropical Water Management, and International Consultant



**Everett D. Markwardt, 1946-1981**

BS North Dakota Agricultural College

MS Cornell University

Extension and Research: Power and Machinery and Irrigation Systems

**Robert T. Lorenzen, 1959-1982**

BSAE North Dakota State University

BSCE University of Wisconsin at Madison

MS University of California at Davis

Teaching, Research and Extension, Structures and Environments

**Gerald E. Rehkugler, 1958-1995**

BS Cornell University

MS Cornell University

PhD Iowa State University

Teaching and Research: Power and Machinery and Food Process Engineering

**David C. Ludington, 1959-1995**

BS Cornell University

MS Cornell University

PhD Purdue University

Teaching, Research and Extension, Electrification and Waste Management

**James W. Spencer, 1951-1987**

BCE Cornell University

MCE Cornell University

PhD Stanford University

Extension, Research and Teaching: Highway Engineering

# *The Faculty and Staff at 100*

## Current Professorial Faculty Interests

Summary descriptions of the interests of current professorial faculty in the programs of the Department of Biological and Environmental Engineering.

### Beth Allyson Ahner

BS, Civil and Environmental Engineering, MIT, 1989

PhD, Civil and Environmental Engineering, MIT, 1994

Associate Professor of Biological and Environmental Engineering

Specialization: Biochemical responses to trace metal stress in the environment and the effect that these responses may have on metal speciation in soil and aquatic ecosystems

Dr. Ahner's research group is working to determine whether specific ligands produced by marine phytoplankton influence the bioavailability of Cu in surface seawater. In a different project they are investigating whether specific uptake mechanisms in plants can be harnessed for phytoremediation of metal-contaminated soils. They also have been examining the bioavailability of trace metals in recirculating hydroponic plant growth media and are evaluating the effect of nutrient availability on transgenic protein production in hydroponically grown plants.

Ahner taught the interdisciplinary course for sophomores, BEE 250 - Engineering Applications in Biological Systems, for six years before the course was split into two courses: one more purely biological and the other more environmental. She developed the new environmental version of the course, BEE 251 - Engineering for a Sustainable Environment, and has now taught it three times. She also teaches a graduate level course, BEE 651 - Bioremediation, and helps to coordinate BEE 687, a seminar series entitled "The Science and Engineering Challenges to the Development of Sustainable Bio-Based Industries". She has been recognized for Excellence in Teaching by the College of Engineering twice.

Selected publications:

Dupont, C. L., R. K. Nelson, S. Bashir, J. W. Moffett, and B. A. Ahner. Novel copper-binding and nitrogen-rich thiols produced and exuded by Emiliania huxleyi. Limnology and Oceanography 49:1754-1762 (2004).

Wei, L., J. R. Donat, G. Fones and B. A. Ahner. Interactions between Cd, Cu, and Zn influence particulate phytochelatin concentrations in marine phytoplankton: Laboratory results and preliminary field data. Environmental Science and Technology 37:3609-3618 (2003).

Hill, K. A., L. W. Lion, and B. A. Ahner. Reduced Cd accumulation in Zea mays: A protective role for phytosiderophores? Environmental Science and Technology 36:5363-5368 (2002).

Ebbs, S., I. Lau, B. A. Ahner, and L. Kochian. Phytochelatin synthesis is not responsible for Cd tolerance in the Zn/Cd Hyperaccumulator Thlaspi caerulescens (J&C Presl). Planta 214:635-640 (2002).

## Louis D. Albright

BSAE, Agricultural Engineering, Cornell University, 1963

MS, Agricultural Engineering, Cornell University, 1965

PhD, Agricultural Engineering, Cornell University, 1972

Professor of Biological and Environmental Engineering

Specialization: Environment control and energy management of plant and animal confinement buildings

After receiving his PhD, Dr. Albright was an assistant professor of agricultural engineering at the University of California at Davis before returning to Cornell in 1974. In 1979 he received the Young Researcher of the Year Award, and in 1994 the Henry Giese Structures and Environment Award, as well as being named a Fellow by ASAE. He is a Weiss Presidential Fellow at Cornell and has won several teaching awards from the Colleges of Engineering, and Agriculture and Life Sciences, as well as a Northeast region teaching award from the National Association of State Universities and Land Grant Colleges in 2005.

Principal courses taught have included Introduction to Computer Programming, Undergraduate Seminar, Environment Control for Plants and Animals, Renewable Energy Systems Design, Introduction to House Design, and Sustainable Energy Systems. One textbook was written, based on the Environment Control for Plants and Animals course, published through ASAE.

Current research is concerned with Controlled Environment Agriculture. The scope of the current research program ranges from controlled systems for future NASA colonies in space, to plant growth rooms and chambers, to commercial greenhouses. Central features of the research are energy management, microclimate control, and interactions of enclosed biological systems with their enclosing physical system. Energy use and plant growth optimization are the typical motivations for the research. Several patents for environmental control and optimization algorithms have been awarded based on the research.

A primary application, in close collaboration with a faculty member in horticulture, has been development of hydroponics technologies suitable for local, year-round, commercial production of fresh vegetables. A demonstration greenhouse was completed in June, 1999, to integrate the many technologies for floating hydroponic lettuce production that have been developed through the research. The demonstration greenhouse produces 1,245 heads of butterhead lettuce every day of the year. Production technologies and environmental control are such that lettuce is harvested 35 days after seeding in a continuous growing mode, and production intensity is 70 heads per square foot, per year (approximately 400 tons per acre per year). The facility was recently (2005) licensed for operation by Challenge Industries, a local sheltered workshop, as a technology transfer effort. Future work will expand crops to other fresh vegetables and products of higher value, such as pharmaceuticals from plants, industrial enzymes and other chemicals of high value.

## Daniel J. Aneshansley

BSEE, Electrical Engineering, University of Cincinnati, 1965
MS, Electrical Engineering, Cornell University, 1968
PhD, Electrical Engineering, Cornell University, 1974
Professor of Biological and Environmental Engineering,
and Director of Graduate Studies

Specialization: Biological engineering and instrumentation

Dr. Aneshansley joined the Department of Biological and Environmental Engineering in 1984 after holding joint appointments in the School of Electrical Engineering and the Section of Neurobiology and Behavior at Cornell. As an undergraduate coop he developed his interest in electronic instrumentation and biology at Technology Inc. and refined them at the National Cash Register Company, working on speech recognition, and at Borg Warner working on control systems. He has been a national consultant on the effects of electric power distribution on livestock and provided testimony to the Wisconsin and Michigan Public Service Commissions. He is the joint holder of five patents.

His teaching experience began as a science and mathematics education consultant where he developed "hands-on" experiences for elementary and middle school students. Two of the courses he currently teaches are upper level "hands-on" laboratory courses, Bioinstrumentation and Physiological Engineering, that use engineering models to study animal physiology. He developed an introduction to microprocessors for AT&T Bell Laboratories for use in seven minority colleges and collaborated with Professor Thomas Eisner on research that has been the subject of television programs on "Discover", PBS, the BBC, and Canadian television, and a National Geographic special.

His research focuses on the development of sensors and techniques to measure biological phenomena and the development of engineering models to study animal physiology. Applications have included sensing the production variables (reproductive state and other physiological parameters related to animal health) in dairy cows, studying the effects of contact voltages on livestock, and development of non-destructive testing techniques to monitor the quality in fruit.

Current research projects include the evaluation and modification of planting and harvesting equipment and techniques used to produce willow as a biomass crop, and the development of machine vision techniques to evaluate color patterns of Y formed DNA to which a detector (antibody) and color markers are attached. Biomimetic applications found by studying how insects and plants solve engineering problems continues, as does the development and analysis of electrical models of mosquito kidney cells.

Dr. Aneshansley is the BEE Director of Graduate Studies and currently teaches courses on Bioinstrumentation, Physiological Engineering, Technical Writing, and Orientation to Graduate Study and co-teaches a course on Engineering Professionalism.

## Antje J. Baeumner

BS Technische Universität Braunschweig, 1990

MS Technische Universität Braunschweig, 1994

Ph.D. Universität Stuttgart, 1997

Associate Professor of Biological and Environmental Engineering

Specialization: Bioengineering, bioanalytical sciences and microsystems, nanobiotechnology

Dr. Baeumner joined the Cornell faculty in 1999 as an Assistant Professor in the Department of Biological and Environmental Engineering and was promoted to Associate Professor in 2004. She previously carried out two years of postdoctoral research in the Department of Food Science and Technology at Cornell University in Geneva. She received her MS in Biotechnology at the Technische Universität Braunschweig, Germany and her PhD in Technical Biochemistry from the Universität Stuttgart, Germany.

Dr. Baeumner's research focuses on the development of biosensors and bioanalytical microsystems μTAS for the detection of viable pathogenic organisms in food, the environment and in clinical diagnostic. Pathogens of interest range from Cryptosporidium parvum to Dengue virus to B. anthracis. Molecular biological recognition of the pathogenic organisms is integrated with micro- and nanofabricated devices in order to develop portable analytical systems for field use. In the research group, postdocs, graduate students and undergraduate students are working on projects investigating highly specific mRNA sequences of pathogens and how to amplify their presence using molecular biological techniques, modeling and designing of micromixers, miniaturization of RNA purification and amplification, developing micropotentiostats, novel cell lysis systems based on lasers, and combining all of this for the development of a μTAS. A novel software program for the identification of appropriate nucleic acid sequences has also been developed. Testing the biosensors in a variety of matrices such as apple cider, environmental water samples, blood, etc. is in progress for a couple of pathogen analytes.

More than 45 undergraduate students and more than 30 graduate students (MEng, MS and PhD) have carried out research with Dr. Baeumner. She teaches BEE 260 - Principles of Biological Engineering, BEE 459/659 - Biosensors and Bioanalytical Techniques and a unit in BME 712 - Fundamentals of Biomedical Engineering Research. She received awards for teaching from the College of Engineering, and for mentoring undergraduate students in research from the College of Agriculture and Life Sciences. Dr. Baeumner has given 30 (mainly invited) talks at national and international conferences and over 60 presentations as guest lecturer, has organized and co-chaired the 5th Conference on Biosensors and Bioanalytical Techniques in 2002, and was elected vice co-chair of the Gordon Conference on Bioanalytical Sensors in 2006. She has 35 refereed journal articles, 1 book chapter, 3 patents and 4 patent applications. Dr. Baeumner is member of three editorial boards and was recently elected to the Extended Executive Committee of the International Association of Environmental Analytical Chemistry (IAEAC).

## James A. Bartsch

BS, Agricultural Engineering, University of Wisconsin-Madison, 1970

MS, Agricultural Engineering, University of Wisconsin-Madison, 1973

PhD, Agricultural Engineering, Purdue University, 1979

Associate Professor of Biological and Environmental Engineering, and Director of Undergraduate Programs

Specialization: Postharvest systems for fruits and vegetables

Dr. Bartsch joined the Department of Biological and Environmental Engineering in 1979. Prior to coming to Cornell he worked with Sperry-New Holland as a research engineer, Stokely-Van Camp, and Ames Laboratory. He served with the U.S. Army Signal Corps in the U.S. and Vietnam.

When he first came to Cornell his work centered on engineering outreach for the postharvest industry in New York State and the northeast. This work involved research and outreach on postharvest systems that focused on safe, energy-efficient technology for refrigerated and controlled-atmosphere storage of fruits and vegetables. Later on, projects related to this work were conducted in developing countries with a goal of appropriate technology transfer and adult education for food loss prevention

As director of undergraduate programs in the Department of Biological and Environmental Engineering, he currently works with all faculty involved in the undergraduate programs in the department, chairing the department curriculum committee, and working with numerous academic offices and faculty in both the College of Agriculture and Life Sciences and the College of Engineering.

Bartsch teaches BEE 365 - Properties of Biological Materials, BEE 200 - The BEE Experience, and a section of Engrg 150 - Engineering Seminar in the College of Engineering. With the assistance of the undergraduate coordinator and the teaching and advising faculty, the department's undergraduate program presently serves over 320 students in the BEE majors.

In the past 10 years he has enjoyed working as a faculty advisor and BEE contact for many of the successful undergraduates in the BEE program. He was honored to receive the McCormick Advising Award in the College of Engineering, the Burgett Distinguished Advisor Award from College of Agriculture and Life Sciences, and the Carpenter Advising award.

Dr. Bartsch is a Registered Professional Engineer (PE).

## Ashim K. Datta

BTech, Agricultural Engineering, Indian Institute of Technology, 1979

MS, Agricultural Engineering, University of Illinois, 1982

PhD, Agricultural Engineering, University of Florida, 1985

Professor of Biological and Environmental Engineering

Specialization: Applications of transport phenomena to food and biomedical processes

Dr. Datta's research and teaching programs are built around the applications of transport phenomena (e.g., energy and water transport, fluid flow) in biological processes in an effort to better understand their complexities with the intent of improving them through optimization. He has been active in two broad application areas--industrial food processing and medicine. From a fundamental engineering standpoint, these two areas have much in common that become particularly evident when approached from the viewpoint of transport phenomena. In food process engineering, quantitative models are developed for complex processes such as frying and meat cooking under various heating modes (such as microwave and infrared) and their combinations, with a goal to improve safety and quality.

There are two ongoing biomedical projects, both joint activities, one involving modeling of airflow in the upper airway of an exercising horse (with Professor Normand Ducharme of the College of Veterinary Medicine at Cornell) and the other involving modeling of transport in radio-labeled antibody in radioimmunotherapy (RIT) to treat metastatic melanoma (with Professor Ekaterina Dadachova of the Albert Einstein College of Medicine). His teaching program provides the knowledge base in transport processes through two well-coordinated courses, BEE 350 and BEE 453. The first course deals with the basics of energy and mass transport and the second one builds on the first one through class projects involving real-life biomedical processes.

Selected publications:

Biological and Bioenvironmental Heat and Mass Transfer, Datta, A. K. 2002. CRC Press, Taylor & Francis Group, Boca Raton, Florida, ISBN 0-8247-0775-3, 383 pages;

Datta, A. K. 2006. Physics-based models in food processing: Heat transfer in Handbook of Food and Bioprocess Modeling Techniques, edited by S. S. Sablani, A. K. Datta, M. S. Rahman and A. S. Mujumdar, Taylor & Francis, Boca Raton, Florida;

Zhang, J., A. K. Datta and S. Mukherjee, 2005, Transport processes and large deformation during baking of bread, American Institute of Chemical Engineers Journal, 51(9):2569-2580;

Zhang, H., A. K. Datta, I. A. Taub and C. Doona, 2001, Electromagnetics, heat transfer, and thermokinetics in microwave sterilization, American Institute of Chemical Engineers Journal. 47(9):1957-1968.

## Kifle G. Gebremedhin

Dipl Engineer, Building Engr., Building College, Addis-Ababa, Ethiopia, 1970

BS, Civil Engineering, University of Wisconsin-Platteville, 1973

MS, Agricultural Engineering, University of Wisconsin-Madison, 1975

PhD, Agricultural Engineering, University of Wisconsin-Madison, 1978

Professor of Biological and Environmental Engineering

Professor of Civil and Environmental Engineering

Specialization: Structural engineering, heat and mass transfer, and computational fluid dynamics.

Dr. Gebremedhin's research interest in structural engineering has been in testing and modeling metal-plate-connected wood truss joints, testing and modeling system behavior of post-frame buildings including diaphragm action, and developing novel software for analysis and design of two- and three-dimensional structures including diaphragm action.

A second research interest has been the modeling of heat and mass transfer through porous media in biological systems as a means of characterizing stress factors of livestock and determining their energy budget for virtually any environmental conditions, and characterizing and modeling the flow field and environmental control in single or multiple-occupant ventilated spaces. He has published over 150-refereed journal articles and research technical publications, and has received several awards in research, teaching, mentoring and leadership excellence. His awards include: SUNY Chancellor's Excellence in Teaching Award, College of Engineering Excellence in Teaching Award (three times), Outstanding Educator Award for having influenced Merrill Presidential Scholar (three times); Research Paper Awards (five times); Bernon G. Perkins Award from the National Frame Builders Association; Henry Giese Structures and Environment Award for outstanding contributions in teaching, research and public service associated with structures and their environments from ASABE; and induction into the Rural Builder Hall of Fame in recognition of his leadership, foresight and outstanding contributions to the rural construction industry.

Gebremedhin teaches BEE 331 - Bio-Fluid Mechanics; BEE 481 - LRFD-Based Engineering of Wood Structures; and BEE 350 - Biological and Environmental Transport Processes.

He spent a sabbatical leave as a Visiting Professor at the Department of Structures, Polytechnic University of Madrid, Spain, and as a Visiting Engineer at TRADA, High Wycombe, U.K.

Dr. Gebremedhin is a member of the American Society of Civil Engineers, the Institute of Biological Engineering, the National Frame Builders Association, the American Society of Agricultural and Biological Engineers and several honor societies.

## Ronald C. Gorewit

BS, Biological Sciences, University of California at Irvine, 1969

MS, Microbiology, Michigan State University, 1971

PhD, Physiology, Michigan State University, 1975

Professor of Biological and Environmental Engineering

Specialization: Lactation biology, physiological and production effects of voltages (stray voltages) on dairy cattle, tissue engineering, breast cancer.

Dr. Gorewit came to Cornell in 1975 to work in the Department of Animal Science, and later joined the Department of Biological and Environmental Engineering in 2003 with research interests in the area of environmental and biological factors affecting mammary gland function and diseases such as cancer and mastitis. He also explores the use of mammary gland tissues, cells and milk components as models for tissue engineering, gene expression and the production of bioactive-medicinal components for humans and animals.

He has been associated with The Northeast Dairy Foods Research Center (NEDFRC), a cooperative research and extension effort between Cornell University and the University of Vermont that began operating in 1988. The NEDFRC is one of six dairy product research centers across the country established by the National Dairy Promotion and Research Board, now known as Dairy Management, Inc. (DMI) in cooperation with universities and dairy food manufacturers. DMI and all its activities are supported by funds from the dairy farmers of America. The mission of the NEDFRC is to conduct research and work with the dairy industry to implement results of research to maintain and increase utilization of milk produced on dairy farms in the United States, particularly the Northeast.

Gorewit teaches BEE 362 - Fundamentals of Tissue Engineering, including cell technology, cell function in constructs, and sources of cells for tissue engineering, biomaterials, diffusion and transport processes in engineered tissue, production processes, regulation and FDA approval of engineered products, and BEE 368 - Biotechnology Applications: Animal Bioreactors, that introduces students to the biotechnological applications of animals; their organs, tissues, and cells as bioreactors for the production of substances such as pharmaceuticals; growth factors, anti-tumor proteins, antibodies, and vaccines, including various design issues, technical constraints, societal concerns, and ethical considerations of this biotechnology.

Dr. Gorewit is also a member of the graduate field of Molecular and Integrative Physiology, with interests in lactation physiology and biochemistry; and reproductive physiology, breast cancer and tissue engineering.

## Douglas A. Haith

BS, Civil Engineering, Massachusetts Institute of Technology, 1964

MS, Civil Engineering, Massachusetts Institute of Technology, 1966

PhD, Civil Engineering, Cornell University, 1971

Professor of Biological and Environmental Engineering

Professor of Civil and Environmental Engineering

Specialization: Environmental engineering anad water resources

Dr. Haith has more than 30 years experience in water resources and environmental engineering. He has been a faculty member at Cornell since 1971 and has also held positions as hydraulic engineer, project manager and senior engineer in several consulting firms.

Haith has authored and co-authored 4 books, including textbooks on environmental and water resource systems analysis published by John Wiley & Sons and Prentice Hall.

He has served as a consultant for public and private organizations in the United States and Canada on numerous projects related to non-point source pollution.

His research is the development and application of mathematical models to aid in the management of environmental pollution. The models are tested with field data and implemented in software packages which are made available to practicing engineers and other environmental professionals. Examples include the GWLF watershed model, the MSWFLOW materials balance for municipal solid wastes, the Co-Composter model for evaluating mixed agricultural-municipal composting and TurfPQ, a model of pesticide runoff from turf systems, including home lawns and golf courses.

Dr. Haith's current research includes the development of a comprehensive model for turf pesticides, including runoff, volatilization and leaching, and use of the model for human health and ecological risk assessment.

Dr. Haith teaches BEE 475 - Environmental Systems Analysis, and BEE 476 - Solid Waste Engineering.

## Jean B. Hunter

BS, Chemical Engineering, Massachusetts Institute of Technology, 1976

MS, Chemical Engineering, Columbia University, 1982

PhD, Engineering Science. Columbia University, 1987

Associate Professor of Biological and Environmental Engineering

Specialization: Food and bioprocess engineering, and advanced life support technologies

After receiving her bachelor's degree, Dr. Hunter worked for Procter and Gamble and General Foods, where she developed manufacturing processes for new food products. She returned to school in 1980 on a graduate fellowship from the National Science Foundation, obtained her master's and doctoral degrees in chemical engineering, and joined the Cornell faculty in 1985. She is a member of the American Institute of Chemical Engineers, the American Chemical Society, the American Society of Agricultural and Biological Engineers, and the Society of Women Engineers.

Among the courses she has developed are ABEN 467 - Bioprocess Engineering; ABEN 367 - Introduction to Biological Engineering, one of the department's first biological engineering labs; BEE 222 - Bioengineering Thermodynamics and Kinetics; and BEE 464 - Bioseparation Processes. She has also taught ABEN 250 and BEE 350.

Dr. Hunter's early research at Cornell focused on food and bioprocess engineering, and included projects on bioconversion of whey to fuels and chemicals, enzymatic approaches to improving sauerkraut quality, silage stability, and modeling of solid-state fermentations. Since the mid-1990s her focus has shifted to the design of sustainable living systems, in particular life support systems for long term space missions, and has included work on crew diet and menu optimization and food processing approaches for space colonies, conversion of lignocellulosics to food ingredients such as sweeteners, acidulants and microbial oils, and techniques for recovery of water and other resources from solid wastes generated in astronaut habitats.

She enjoys outreach work and regularly gives presentations on foods for space flight, space suits, and various chemistry and engineering topics to elementary and middle school audiences.

## Lynne H. Irwin

BS, Civil Engineering, Texas A & M University, 1965

MS, Civil Engineering, University of California, Berkeley, 1966

PhD, Civil Engineering, University of California, Berkeley, 1973

Associate Professor of Biological and Environmental Engineering

Specialization: Highway engineering

Dr. Irwin's interest in the area of highway engineering places particular emphasis on highway materials and design, and structural evaluation of pavements. He is the Director of the Cornell Local Roads Program (CLRP), which provides local highway agencies throughout New York State with technical assistance and training through Cooperative Extension.

Irwin served for three and one-half years on the research staff of the Texas Transportation Institute at Texas A & M University prior to coming to Cornell in 1973. Before that, he taught civil engineering at California State University at Chico for three years.

A registered professional engineer, he has also worked for a building contractor, and a consulting engineering firm. He has been a consultant to industrial firms and government agencies, including the U.S. Army Corps of Engineers, the U.S. Forest Service, and the Federal Highway Administration. He also worked with the Strategic Highway Research Program at the National Research Council in Washington, D.C. He is a member of the American Society of Civil Engineers, the Transportation Research Board of the National Academy of Sciences, and the American Public Works Association.

His research deals primarily with the development of methods for nondestructive evaluation of existing pavements and with development of durable materials and methods for economical rehabilitation of pavements. The objective of non-destructive testing (NDT) is to identify roads that are near the end of their life, before they become broken and deteriorated. If scheduled for rehabilitation at the optimum time, the repair cost is minimized and the excessive road-user costs are eliminated.

Irwin's research work on stabilized materials seeks to identify ways of recycling existing road materials and, in the process, to improve their strength and durability significantly. Results with some full-scale field test sections have shown that the stabilized materials have much less tendency to become weak during spring thaw.

His recent research has dealt with understanding the laboratory test properties of stabilized materials, with the objective of developing a rapid procedure for the proportioning of stabilized mixtures.

## William J. Jewell

BS, Civil Engineering, University of Maine, 1963

MEng, Sanitary Engineering, Manhattan College, 1964

PhD, Environmental Engineering, Stanford University, 1968

Postdoctoral Fellow, University of London, Westfield College 1969

Professor of Biological and Environmental Engineering

Specialization: Environmental Engineering/Ecological Engineering

Dr. Jewell practices environmental engineering with a focus on micro- and macro-biological processes. Much of his teaching and research are in the areas of ecological engineering, natural system treatment and management of wastes, resource-recovery agricultural waste management, biotreatment of toxics, biological and chemical mechanisms involved in pollution control, energy conservation in waste treatment and renewable energy generation via anaerobic methane fermentation. These topics are incorporated in three courses that he teaches: ecological engineering, environmental management, and pathogen management in animal wastes (in the College of Veterinary Medicine).

His research program included a large R&D effort to develop small scale anaerobic digesters that could be cost-effective on small farms. This led to construction of the largest biomass digester in the world in 1982 in Arizona via his private company, Microgen Corporation. Today many of the several hundred farm-scale operating systems in the U.S. use the design developed in this extensive R&D program.

The development of natural processes for pollution control led to wastewater treatment systems referred to as "Resource-Recovery Waste Management" that have the potential to recover energy and other valuable products. This work was recognized by the USDOE for a national award for "Energy Innovation-Contribution to the Nation's Energy Efficiency" in 1988.

Recently, the Resource-Recovery approach has been applied to dairy waste management. A system that completely converts 100% of dairy waste into useful products (energy, purified humus, and high protein feeds) has been piloted and is awaiting full-scale demonstration.

Jewell's research program has been characterized by innovations in areas such as microbial biofilm-applications, invention of the anaerobic composting process, and hydroponic plant applications. Biofilm treatment of chlorinated ethanes led to the first biological process capable of completely removing the most common groundwater contaminate and this work was recognized as one of the most important studies in chemistry in 1993.

Jewell also served on the founding Board of Directors of the China-US Center for Sustainable Development based in Portland, Oregon.

## Dan Luo

BS, University of Science and Technology of China

PhD, The Ohio State University, 1997

Assistant Professor of Biological and Environmental Engineering

Specialization: Molecular engineering; nucleic acid engineering; nanobiotechnology; drug delivery including gene therapy and DNA vaccination

Dr. Luo is an assistant professor of Biological Engineering in the Department of Biological and Environmental Engineering at Cornell University. He is also a faculty member in the Nanobiotechnology Center, Cornell Center for Materials Research, Kavli Institute for Nanoscale Science, Biomedical Engineering Program and New Life Science Initiatives at Cornell. Dr. Luo obtained his BS degree from the University of Science and Technology of China (USTC) with an undergraduate thesis on molecular dynamics computer simulation. He received his PhD in 1997 from The Ohio State University in the Molecular, Cellular, and Developmental Biology program, working on topoisomerases and DNA networking. After postdoctoral training in the School of Chemical Engineering at Cornell focusing on polymers and synthetic DNA delivery systems, he joined the Cornell faculty in 2001.

The overall goal of Luo's research is the development of Biological Engineering at the molecular level by integrating molecular biology with engineering. More specifically, his research group is currently concentrating on engineering biomacromolecules, DNA for example, into useful, novel materials for both bio- (including medical) and non-bio applications (including nanoscale devices). Dr. Luo's research group is also pursuing molecular engineered materials for drug delivery, tissue engineering and repair, cell therapy, gene therapy and DNA vaccination.

Dr. Luo is an editorial board member for ***Nanomedicine*** and also for ***Nano Today***. In 2004 and also in 2006, Dr. Luo was selected by the National Academies as 1 of 100 scientists and engineers nationwide to attend the 2nd and also the 3rd Annual National Academies Keck Futures Initiative conferences. In 2006, Dr. Luo was awarded National Science Foundation's Early Career Development Award (CAREER Award). More information can be found on his website <http://LuoLabs.bee.cornell.edu>.

The following references encapsulate some of Dr. Luo's work so far:

Nature Materials 3, 38-42, (2004);

Nature Biotechnology 23, 885-889, (2005);

Nature Protocols 1, 995-1000 (2006);

Nature Materials in press, (2006).

## John C. March

BA, English, University of Georgia, 1991

BS, Biological Engineering, University of Georgia, 1996

MS, Biological Engineering, University of Georgia, 2000

PhD, Chemical Engineering, University of Maryland, College Park, 2005

Assistant Professor of Biological and Environmental Engineering

Specialization: Metabolic Engineering

Dr. March joined the Cornell faculty in 2005 after completing his PhD in Chemical Engineering at the University of Maryland. He worked for several years as a research engineer developing environmental biotechnologies with the Savannah River Site prior to completing his MS degree.

His current research is focused on metabolic signal transduction. Cellular populations respond to their environments through almost instantaneous signaling cascades, which can completely change cellular metabolism and physiology. His metabolic and signal engineering laboratory is working to understand cellular metabolism and signaling and to use these systems to develop novel technologies. In particular, the March research group is studying and manipulating bacterial and human signaling pathways important to medicine and environmental studies. Their work combines systems from several organisms in a synthetic biology approach.

Dr. March teaches BEE 360 - Molecular and Cellular Bioengineering.

He is the joint holder of 2 patents.

## Jean-Yves Parlange

Ingenieur Civil de l'Aeronautique, Ecole Nationale Superieure de l'Aeronautique (Paris), 1958

PhD, Brown University, 1962

Professor of Biological and Environmental Engineering

Specialization: Environmental engineering, applications of nonlinear mathematics

After earning his doctorate, Parlange stayed on at Brown University for a year as a research associate. He then served two years in the French Air Force before becoming a member of the Yale University faculty in 1964.

In 1968 he became interested in agricultural problems while working at a Connecticut experiment station as a research scientist. In 1977 he joined the faculty of the University of Washington as a professor in the College of Forest Resources, and in 1978 was appointed as a professor of applied mathematics at Griffith University, in Brisbane, Australia. He came to Cornell in 1985.

His research and teaching centers on the application of mathematics to agricultural and environmental problems. The aim is to provide analytical descriptions of complex problems that are reasonably accurate and can be used for practical management purposes. The models are validated by comparison with numerical simulations as well as laboratory and field experiments. Most of the work is carried out in close collaboration with other scientists in many disciplines. These researchers are at Cornell, other universities around the world, and at Agricultural Research Service laboratories of the United States Department of Agriculture. A list of his 518 publications to date can be found at the ISI website: <http://isihighlycited.com/>.

Recent interest centers on the areas of groundwater pollution, transport phenomena, water and solute movement in porous media, denitrification, surface and subsurface hydrology, watershed modeling, sediment transport and erosion.

Current Research Projects:

Water Movement in Porous Media

Solute Transport in Soils

Surface and Subsurface Hydrology

Erosion and Sediment Transport

Similarity Solutions of the Nonlinear Diffusion Equation

## Norman R. Scott

BS, Agricultural Engineering, Washington State University (with honors), 1958

PhD, Agricultural Engineering, Cornell University, 1962

Professor of Biological and Environmental Engineering

Specialization: Electronic applications in agriculture, renewable energy, bioenergy, sustainable development

Dr. Scott was involved in bioengineering research and teaching for over 20 years prior to spending 14 years as a Cornell administrator (1984-1998). His early research was focused on thermoregulation in poultry, biomechanics of machine milking of dairy cows and electronic applications in agriculture, with particular attention to automatic identification and estrus detection of livestock, as well as the effects of transient current on dairy cows. Since returning to the faculty in 1998, he has focused on research in sustainable development. This research is directed to development of sustainable communities with emphasis on biologically derived fuels, renewable energy, recycling, managed ecosystems and industrial ecology. Specific effort has been directed to anaerobic co-digestion of animal and food waste and biofuels. He has also been engaged in leading a consortium of thirteen land-grant universities to address sustainable agriculture and development in China.

Upon returning to the faculty in 1998, Scott developed three new courses, each of which is taught annually. These courses address issues of sustainability broadly: BEE 299 - Sustainable Development: A Web-based Course (totally web based), BEE 673 - Sustainable Development Seminar (joint with the Johnson Graduate School of Management), and BEE 487 - Sustainable Energy Systems.

His honors and awards include:

Elected to National Academy of Engineering, 1990;

President, Institute of Biological Engineering (IBE), 2001;

President, American Society of Agricultural Engineers (ASABE), 1993-1994;

Member, Board on Agriculture of the National Research Council (1993-1996);

Fellow of ASABE, 1986;

McCormick-Case Gold Medal (ASABE), 2002;

Henry Giese Award (ASABE), 1989;

Alumni Achievement Award, Washington State Alumni Association, 1991;

Founding fellow of American Institute for Medical and Biological Engineering (AIMBE), 1992;

Fellow, American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), 1996;

J. P. and Mary Barger Excellence in Teaching Award, Cornell College of Engineering, 2003.

He has more than 90 refereed publications and three patents.

## Roger M. Spanswick

BSc, Physics, University of Birmingham, U.K., 1960

Diploma, Biophysics, University of Edinburgh, 1961

PhD, (Biophysics), University of Edinburgh, 1964

Professor of Biological and Environmental Engineering

Specialization: Plant metabolic engineering; membrane transport

Following postdoctoral work at the University of Cambridge, Dr. Spanswick was appointed as an assistant professor of plant physiology in the Division of Biological Sciences at Cornell in 1967. In 2001 he transferred to the Department of Biological and Environmental Engineering.

His research program has emphasized quantitative approaches to the investigation of ion and organic molecule transport in plants. This has included: identification of the sites of active ion transport in plant cells; the proof of the presence of an electrogenic ion pump at the plasma membrane; the demonstration of proton pumping ATPases, as electrogenic pumps, at the plasma membrane and tonoplast; and the use of electrophysiological methods to show that plasmodesmata permit ion flow between plant cells. The investigation of sucrose and amino acid transport in developing seeds, including the demonstration of proton cotransport systems, provided the basis for his current emphasis on the role of transport systems in controlling the influx of sucrose in the cotyledons of developing canola seeds in relation to oil synthesis, in the context of oil utilization as a feedstock for fuel (biodiesel) and chemicals.

Dr. Spanswick's teaching includes courses:

BEE 487 - Metabolic Engineering,

BEE 647 - Transport of water in plants, and

BEE 649 - Transport of solutes in plants.

His honors and awards include:

Science Research Council (U.K.) Senior Visiting Fellowship (Botany School, University of Cambridge, 1973-74);

John Simon Guggenheim Memorial Fellowship (University of California, Davis, 1981-82);

Highly cited scientist, Plant & Animal Science category, <http://isihighlycited.com/>;

Fellow, World Innovation Foundation, 2004; and

Fellow, American Association for the Advancement of Science, 2004.

## Tammo Steenhuis

BS, State Agricultural University of The Netherlands, 1969

MS, State Agricultural University of The Netherlands, 1972

MS, Agricultural Engineering, University of Wisconsin, 1975

PhD, Agricultural Engineering, University of Wisconsin, 1977

Professor of Biological and Environmental Engineering

Specialization: Water management

Dr. Steenhuis joined the Cornell faculty in 1977. His research interests relate to the interaction of water and agricultural toxic flow, and the use of microcomputers in water-management design.

The primary focus of his research is on the management of soil and water resources as they relate to landscape processes. This requires an understanding of the complex interrelations among morphology, water flow, plant growth, and fertility. The research proceeds, therefore, from basic processes governing these relationships, and leads to fundamental and universally applicable solutions to engineering design problems in water management and pollution control.

The research program currently emphasizes the fate of agricultural nutrients and pathogens on the land. The objective is to model the movement of water and associated contaminants over the land and through the soils in undulating landscapes.

Work is done in conjunction with the USDA, USGS, and NYDEP to intensively monitor the movement and fate of phosphorus and Cryptosporidium in the Town Brook Watershed, which is part of the catchment that provides New York City with drinking water. In this process, models have been developed that simulate the variable source areas (wet spots) in the watershed that contribute both runoff and pollutants to the stream.

Another area of research is the rapid contamination of groundwater with chemicals shortly after they are land applied. Conditions allowing the occurrence of wetting front instability and macropore flow are being studied, as well as the water quality of tile drain effluents in nonhomogeneous soils. These studies are leading to mathematical models to describe realistically the movement of toxics and water to aquifers under field conditions.

A final interest of his research group involves applying soil and water engineering practices to developing countries in such a way that they fit within their social contexts. Currently, there are projects in Mali, Ghana and Ethiopia.

The research group produces 20 refereed publications per year on the average. Annual research expenditures are over $400,000. Currently there are 20 graduate students, two postdoctoral fellows and three research associates involved in the program

## Michael B. Timmons

BSAE, Agricultural Engineering, The Ohio State University, 1971

MSAE, Agricultural Engineering, University of Hawaii, 1972

PhD, Agricultural Engineering, Cornell University, 1979

Professor of Biological and Environmental Engineering

Specialization: Aquacultural engineering

After receiving his doctorate from Cornell, Timmons was an assistant professor at North Carolina State University, and later joined the Cornell faculty in 1983. He is a member of the American Society of Agricultural and Biological Engineers and the World Agriculture Society.

His research has been focused on the design of the microclimate affecting farm animals and fish. Animals and fish can be viewed as biological systems that convert energy in the form of feed into energy in the form of meat, eggs, and milk, and his concern is with the overall efficiency of this process as affected by the animals' environments and with methods of environmental control. Topics of interest include environmental engineering, ventilation and structural design, animal bioenergetics, and aquaculture.

Timmons has worked in aquacultural engineering for 20 years as a researcher and extension specialist. He has published widely and served as primary editor on many of the Aquacultural Engineering Society meeting proceedings and for the series of biannual meetings sponsored by Virginia Tech on Water Recirculation Systems in aquaculture.

He was one of the founders of the Aquacultural Engineering Society, and has served in several officer positions, including president. Dr. Timmons currently holds the J. Thomas Clark Professorship of Entrepreneurship and Personal Enterprise, Biological and Environmental Engineering Department, Cornell University. He has been a principal in the design, construction, and operation of a commercial recirculating fish production system and thus provides the viewpoint of a commercial aquaculturist in addition to his experience as a researcher and extension specialist. His research has broadened to include an international focus on aquaculture and economic development, with the research/outreach in the context of environmental sustainability and appropriate technology, and has developed an inter-country program that resulted in a virtual outreach center for aquaculture, available at <http://www.cetra.org.mx/>.

Timmons teaches BEE 489 - Engineering Entrerpeneurship, BEE 435 - Principles of Aquaculture, and BEE 533 - Engineering Professionalism.

He is a registered professional engineer in the states of New York and North Carolina, and holds several patents.

## Larry P. Walker

BS, Physics, Michigan State University, 1974

MS, Agricultural Engineering, Michigan State University, 1975

PhD, Agricultural Engineering, Michigan State University, 1978

Professor of Biological and Environmental Engineering, and

Director, Northeast Sun Grant Institute of Excellence

Specialization: Agricultural and environmental bioprocess engineering

Dr. Walker is a national leader in industrial biotechnology: the application of biotechnology to industrial production. The type of research projects that intrigue him are found at the interface between engineering and the life sciences, and excited by the challenges and opportunities of integrating industrial biotechnology activities into the cause of global sustainable economic development. Dr. Walker has been involved in a number of biomass to energy and chemical projects including an assessment of New York State biomass resources available for ethanol production, farm-scale methane production and co-generation, the application of nanotechnology to discover and study important biocatalysts for industrial biotechnology, and the optimization of solid-state fermentation for the production of natural products.

His nanotechnology research is focused on using single molecule detection methods to study cellulase adsorption and hydrolysis mechanisms and the application of these methods to molecular ecology. He is the current Program Coordinator for the Biomolecular Devices and Analysis Program of the National Nanobiotechnology Center (NBTC). Some of Dr. Walker's extramural activities include past membership on the National Biomass Research and Development Technical Advisory Committee, current Co-Editor in Chief for the journal, *Industrial Biotechnology*, and a member of a recent National Academy of Science committee that reviewed the Department of Energy's Genomics: System Biology program. He has also been active with the Biotechnology Industrial Organization (BIO) in planning the last three world conferences on industrial biotechnology and Bioprocessing.

Dr. Walker is a recent recipient of a New York Science, Technology and Academic Research (NYSTAR) faculty development award focused on integrating nanobiotechnology with his industrial biotechnology research and development activities. He believes that growing capabilities for nanostructure-based optical confinement for observation of single molecule events is an important enabling technology. The two research projects that are to be developed under this NYSTAR program are: (1) integration of single molecule detection with protein engineering methods to "engineer" a more effective cellulase cocktail; and (2) development of nano-devices for molecular ecology and prospecting for novel industrial microorganisms.

Walker played a leadership role in developing the federal Sun Grant Initiative (SGI) that created five Centers of Excellence, with Cornell leading the Northeast Sun Grant Initiative (NESGI), and Walker as the Director of the Northeast Sun Grant Institute of Excellence.

## Michael F. Walter

BS, Agricultural Engineering, University of Illinois, 1968

MS, Hydrology, University of Illinois, 1970

PhD, Water Resource Engineering, University of Wisconsin, 1974

Professor and Chair of Biological and Environmental Engineering

Specialization: Agricultural water management

Dr. Michael Walter joined the faculty at Cornell University in 1974. He has spent his career in agricultural water management, with much of the last 25 years focused on water and land management in developing counties. He was one of the first to participate in the USAID Joint Career Program of the 1980s when he worked with the USAID mission in India in 1984-85 and again in 1988-89. He was also the Research Director for the USAID sponsored Irrigation Support Project for Asia and the Near East for 1985 to 1990.

His academic career started with a focus on hydrologic water quality modeling, particularly as associated with watersheds and non-point source pollution. His work included co-authoring a chapter of the USDA-NRC Handbook related to water quality and animal waste management. Recently, he has served as part of an interdisciplinary team partnering with the New York City Department of Environmental Protection and farmers in the New York City Watershed to find cost effective ways of improving both the economic viability of farmers and water quality.

Walter's primary research has focused on water management in developing countries. He has supervised more than 40 graduate students, most of whom did their research in developing countries in Asia, Africa, or Latin America. Many of the graduate student-associated studies were interdisciplinary action research involving farmers, local leaders, government agencies, and in-country researchers.

Dr. Walter has served as the chair of the department for the last twelve years. During that time the department took major steps to redefine its mission and programs. He has led the department to focus on contemporary biological and bioenvironmental engineering and created a new undergraduate major in Environmental Engineering. During his tenure as chair the undergraduate enrollment has grown to over 350 students and the graduate field program has increased to nearly 80 students. Active research projects in the department have a combined budget of over 12 million dollars. Consistent with these changes in emphasis, the department changed its name from Agricultural and Biological Engineering (ABEN) to Biological and Environmental Engineering (BEE). The graduate field name was also changed from ABEN to BEE. The undergraduate major underwent a significant realignment to a more fundamental biology-based engineering program called Biological Engineering (BE). This BE major has three areas of concentration including Bioprocess Engineering, Biomedical Engineering, and Bioenvironmental Engineering. A new Environmental Engineering major was developed jointly with Civil and Environmental Engineering especially appropriate for students interested in practicing as professional engineers.

## M. Todd Walter

BS, Agricultural and Biological Engineering, Cornell University, 1990

MEng, Civil and Environmental Engineering, Cornell University, 1991

PhD, Engineering Science, Biosystems Engineering: Hydrology, Washington State University, 1995

Assistant Professor of Biological and Environmental Engineering

Specialization: Hydrology and environmental fluid mechanics

Dr. M. Todd Walter joined the faculty in 2001 and is enthusiastic about both research and teaching, striving to keep these two activities balanced, and, as much as possible, combined.

Although his specialization is hydrology and water resources, his interests are much broader and interdisciplinary. As such, he seeks opportunities to collaborate with ecologists, microbiologists, and biogeochemists to investigate interactions between hydrological and ecosystem systems. This work is typically physically-based or mechanistic in nature and spans spatial scales from raindrops to watersheds and sometimes larger.

His research and courses address both natural and managed systems, usually with an emphasis on understanding how humans have impacted the environment and an eye toward developing sustainable solutions to associated problems. His research typically involves laboratory experimentation, field monitoring and mechanistic modeling activities. Examples of his current research topics include:

Hydro-microbiological processes controlling phosphorus transport in agricultural watersheds.

Solving the "nonpoint" problem by using nanotechnology to develop the next generation of hydro-environmental tracers.

Quantifying the spatial distribution of denitrification in rural landscape.

Developing new, scientifically defensible, user-friendly tools to assess environmental risks, e.g., point-and-click Internet based tool to map hydrologically sensitive areas.

Modeling particulate wash-off from urban environments.

Modeling the transfer of solutes and sediment between soils and overland flow.

Watershed biogeochemistry in temperate and high-latitude (cold) regions.

Alterations of landscape-river connections by human activities and the consequences to aquatic ecosystems.

Impacts of forest-field boundaries on hydrological and ecological systems in mixed land use regions.

# *Current Non-Professorial Faculty*

Lindsay Anderson, Senior Research Associate
Lois E. Chaplin, Extension Associate
Bicycle Safety and Cornell Local
Roads Program
Wenlong Cheng, Post Dr. Assocociate
Dan Luo Research Laboratory
Thomas J. Cook, Lecturer
Teaching
Stephane Corgie, Research Associate
Larry Walker Research Laboratory
Faping Duan, Research Associate
John March Research Laboratory
Zachary Easton, Post Dr. Associate
Tammo Steenhuis Research Laboratory
Katie Edwards, Post Dr. Associate
Antje Baeumner Research Laboratory
Hisakage Funabashi, Post Dr. Associate
Dan Luo Research Laboratory
Bin Gao, Research Associate
Tammo Steenhuis Research Laboratory
Larry D. Geohring, Senior Extension Associate
Extension and Teaching
Curt A. Gooch, Senior Extension Associate
PRO-Dairy Program, Dairy Facilities Engineering
Peter E. Hillman, Senior Lecturer
Teaching and Research
Ding Liang, Post Dr. Associate
Dan Luo Research Laboratory
David P. Orr, Senior Extension Associate
Cornell Local Roads Program
Nokyoung Park, Research Scholar
Dan Luo Research Laboratory

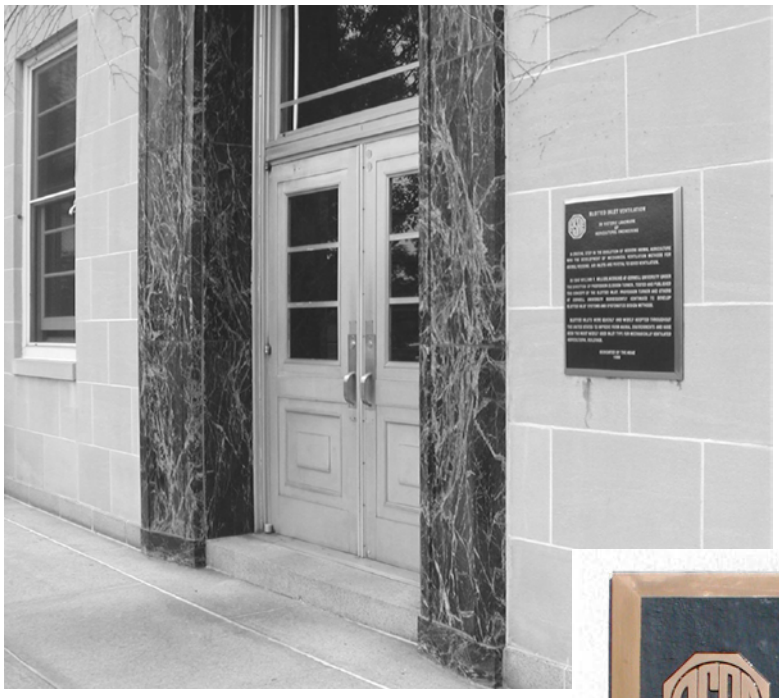
Brian K. Richards, Senior Research Associate
Tammo Steenhuis Research Laboratory
Corinne F. Johnson Rutzke, Senior Research Associate
Controlled Environment Agriculture, Larry Walker Research Laboratory
Olga Singurindy, Post Dr. Associate
Tammo Steenhuis Research Laboratory
Yajun Wang, Post Dr. Associate
Dan Luo Research Laboratory
Jianfeng Xu, Research Associate
Dan Luo Research Laboratory
Natalya Zaytseva, Research Associate
Antje Baeumner Research Laboratory

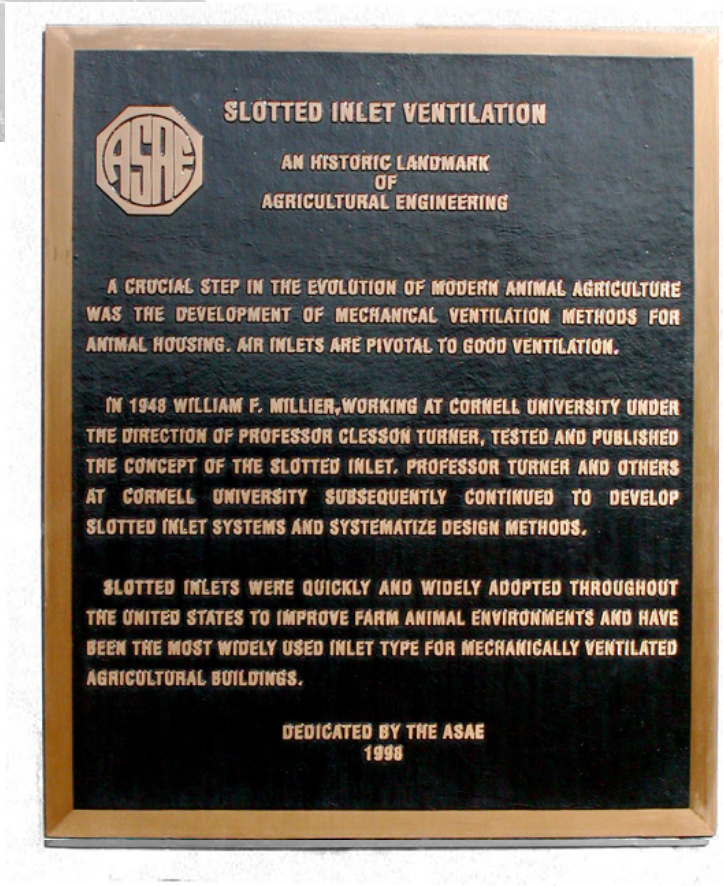
## *Current Professional Staff*

The department simply could not function without a knowledgeable, dedicated staff, and scores of full- and part-time staff members have supported the faculty and their programs during its first century. In addition, both graduate and undergraduate students assisted in a variety of roles, including serving as Teaching Assistants, beginning as far back as 1909. An alphabetic listing of the department staff for the 2006-2007 academic year follows.

Daniel L. Atkins, Research Support Specialist
Lori Ann Budd, Program Coordinator, LTAP
Douglas Caveney, Technician
Mary Helen Cornell, Administrative Assistant
Valorie E. Craven, Administrative Assistant
John Enright, Information Technology Support Assistant
Magda Eddleman, Administrative Assistant
Edward Evens, Technician
Nancy S. Fairchild, Department Business Administrator
Susan Anne Fredenburg, Program Manager, Sun Grant Institute
Kimberly M. Gabriel, Accounts Representative
Deborah L. Higgins, Administrative Assistant
Scott Fredrick Inglis, Research Support Specialist

Barbara L. Leonard, Research Support Specialist
Liping Li, Programmer/Analyst
Brenda Lee Marchewka, Administrative Assistant
Tamara L. Payne, Administrative Assistant
Allison K. Pelletier, Administrative Assistant to the Chair
Francis J. Peters, Information Technology Support Assistant
Randi Rainbow, Information Technology Area Manager
Donna M. Simons, Administrative Assistant
Richard T. Strickland, Information Technology Support Assistant
William J. Tifft, Communication Specialist






A Historic Landmark Plaque from the American Society of Agricultural and Biological Engineers (ASABE) on Riley-Robb Hall near the main entrance, presented in 1998 honoring the work of Professor William F. Millier. For more details, see pages 150 and 151.

# Recognition

## Bricks and Mortar

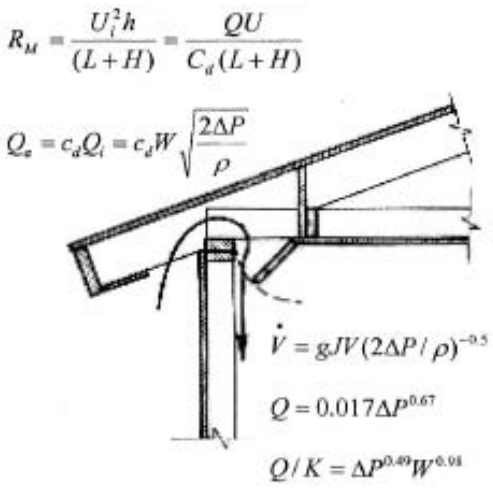
The current home of the department on Wing Drive is appropriately named after the founding fathers, Howard W. Riley and Byron B. Robb. In a letter to Department Head O. C French dated August 1, 1955 regarding the naming of the new building, former faculty member H. S. "Si" Pringle wrote, "I like the idea of using the names of both Riley and Robb. This would be unusual but not unheard of as there are some college or university buildings that bear the names of two men. In my opinion the two of them deserve equal credit for the development of the Department. Robb was very conservative and cautious, probably too much so, while Riley was too practical but the two of them worked together, in fact I don't believe that either one of them ever made an important decision without consulting the other one.

"I first became acquainted with the Department in 1923 and I found that Robb actually ran the Department. When Riley got interested in a project he devoted all of his time, energy and thought to it and I can think of several research projects that are good examples of this. In later years when Riley's interests were outside the Department we saw him rarely. Robb was actually head of the Department for years but did not have the title. The two of them practically 'fetched me up' in Extension and in agricultural engineering as they did many others and they never failed to take the time to help me when I needed help and to give me the guidance and training that I needed.

"... The important thing is that we have a new building and that the Department continues to grow. I guess I never will cease to feel that I am a part of it. I am very proud of it and of the progress that you have made since you took over." A subsequent vote by the department's faculty and staff also supported the dual name proposal. College of Agriculture Dean W. I. Myers wrote that "although the hyphenated name is a little awkward, it seems to me that it is the most appropriate way of doing honor to the two men who worked together to establish agricultural engineering on a sound basis here at Cornell."

The name "Riley-Robb" actually falls off the tongue rather easily, but early on there was insightful discussion concerning which founding father's name should be placed first. It was agreed that Robb(ing)-Riley was not the way to go, so Riley-Robb it is! The name aptly commemorates the two men who jointly developed and nurtured the new department for four decades.

Professor William F. Millier (center) received the ASABE Historic Landmark Certificate for his development of the slotted inlet ventilation system. Millier is joined by Michael Kelly, Head, Building Design Department, Scottish Agricultural College (left) and Andrew Landers (right) of Cornell University.




Schematic representation of a conventional adjustable baffled slotted air inlet with analytic variables, by Professor L. D. Albright. A variety of means to achieve continuous air inlets have been used in practice depending on building geometry and use. The methodology has also been extended to non-agricultural structures.

# Historic Landmark

The American Society of Agricultural and Biological Engineers, ASABE (formerly the American Society of Agricultural Engineers, ASAE), has been recognizing historic developments in agricultural engineering in the United States for over 75 years. ASAE was formed in 1907, the same year that the predecessor to the Department of Biological and Environmental Engineering, i.e., the Division of Rural Engineering and Architecture, was established at Cornell. By 1993, 41 of the most significant events in agricultural engineering had been commemorated by ASABE, and one such development, by William F. Millier and Clesson N. Turner, is recognized on a plaque installed on the exterior wall immediately to the right of the main entrance to Riley-Robb Hall (page 148).

A symposium honoring Professor Millier and the 50th anniversary of the development of the slotted inlet was held in Riley-Robb Hall on November 23, 1998. The slotted inlet was rapidly adopted throughout the United States and is the most widely used air inlet type for mechanically ventilated agricultural buildings, especially animal structures.

# Faculty Service and Awards

Department faculty members have served in numerous civic capacities, in the military, on academic accreditation teams, scientific and engineering review panels, and in a host of other professionally related involvements, including special short and long term assignments in foreign countries. Many are members of Alpha Epsilon, Alpha Zeta, Chi Epsilon, Epsilon Sigma Phi, Eta Kappa Nu, Gamma Sigma Delta, Kappa Mu Epsilon, Phi Eta Sigma, Phi Kappa Phi, Sigma Tau, Sigma Xi and other honoraries, along with a wide representation in professional societies and organizations, both national and international. The honors and awards received are numerous, and in many cases records are not available to fully designate that recognition, especially for the department's first half century. The following listing illustrates the range of that recognition, rather than its totality.

## ASABE Fellows

The ASABE defines a Fellow as "An engineer of unusual professional distinction, with outstanding and extraordinary qualifications and experience in the field of agricultural, food, or biological systems engineering, a minimum of 20 years in active practice in the profession of engineering or teaching of engineering and a minimum of 20 years as a Member-Engineer in ASABE."

Eleven individuals were elected to ASABE Fellow status while members of the Cornell Faculty. ASAE did not record dates for those elected before 1937.

Louis Demont Albright, 1994
James Robert Cooke, 1989
Orval C French, 1964
Ronald Bay Furry, 1992
Wesley Winfred Gunkel, 1980
William J. Jewell, 1996
Gerald Edwin Rehkugler, 1988
Howard Wait Riley,
Life Fellow, 1947
Norman Roy Scott, 1986
Edwin Stanley Shepardson, 1973
Life Fellow, 1978
Michael Faivre Walter, 2003

**American Geophysical Union Fellow**

Jean-Yves Parlange, 1996

**American Association for the Advancement of Science Fellow**

Orval C French
Roger M. Spanswick, 2004

**American Institute for Medical and Biological Engineering Founding Fellow**

Gerald E. Rehkugler, 1992
Norman R. Scott, 1992

**American Society of Heating Refrigeration and Air Conditioning Engineers Fellow**

Norman R. Scott, 1996

**Gledden Senior Fellow (UWA)**

Jean-Yves Parlange, 1991

**Pye Fellow (CSIRD)**

Jean-Yves Parlange, 1971

**Weiss Presidential Fellow**

Louis D. Albright, 2004

**World Innovation Foundation Fellow**

Roger M. Spanswick, 2004

**ASABE McCormick Case Gold Medal (Highest ASABE Award)**

Orval C French, 1950

Norman R. Scott, 2002

**ASABE Presidents**

Howard W. Riley, 1912-13

Orval C French, 1966-67

Norman R. Scott, 1993-94

**ASABE Blue Ribbon Awards**

Includes many multiple awards to the same individual.

Louis D. Albright

Joseph K. Campbell

Richard C. Derksen

Edward O. Eaton

Edward W. Foss

Ronald B. Furry

Kifle G. Gebremedhin

Eric M. Hallman

Elgin B. Hundtoft

Richard W. Guest

Wilmot W. Irish

John W. Layer

Fred G. Lechner

Robert T. Lorenzen

David C. Ludington

Everett D. Markwardt

Ronald E. Pitt

Donald R. Price

Norman R. Scott

Michael B. Timmons

Michael F. Walter

Carl S. Winkelblech


Founding members of the North Atlantic Section of the American Society of Agricultural Engineers (ASAE) at its organization meeting at Cornell, April 10-11, 1925: First row, first from the right, B. B. Robb; third, F. L. Fairbanks; fifth, H. W. Riley; and second row, first from the right, J. C. McCurdy; seventh, L. M. Roehl.

The first annual meeting of the North Atlantic Section of ASAE, held December 10-12, 1925. F. L. Fairbanks from Cornell is in the top row, fourth from the right; H. W. Riley is in the center of the second row, directly behind the man in the front row who is holding the brim of his hat with his right hand at belt height.

Howard W. Riley, left, and Byron B. Robb on June 24, 1959 reminisce at the ASAE annual meeting in Cornell's Statler Hall. Riley had been a founding member of ASAE 52 years earlier in 1907, and attended its first annual meeting in 1908.

**ASABE Paper Awards**

Louis D. Albright, 1977, 1980, 1990, 1992
Ashim K. Datta, 1988
Kifle G. Gebremenhin, 1993, 1994, 1988, 2000, 2006
Wesley W. Gunkel, 1974
Burton A. Jennings, 1945
Ronald E. Pitt, 1983, 1984, 1991
Gerald E. Rehkugler, 1965, 1975, 1979, 1987
Norman R. Scott 1971, 1980, 1983, 1987
James Throop, 1991
Michael B. Timmons, 1985, 1989, 2001
Michael F. Walter, 1980
Forest B. Wright, 1949

**ASAE Annual Meeting Host**

Cornell Department of Agricultural Engineering, 1959 (opposite)

**ASABE Henry Giese Structures and Environment Award**

Louis D. Albright, 1994
Kifle G. Gebremedhin, 1999
Norman R. Scott, 1989

**ASABE National Food and Energy Council Electrification Award**

Clesson N. Turner, 1977

**ASABE President's Award**

Michael F. Walter, 1994

**ASABE Young Extension Man Award**

Donald R. Price, 1980

**ASABE Young Researcher Award**

Louis D. Albright, 1979
Ronald E. Pitt, 1992

**AGU Horton Award/Medal**

Jean-Yves Parlange, 1997, 2002

**American Public Works Association Award for Meritorious Service**

Lynne H. Irwin, 1990

**American Society for Engineering Education Centennial Award**

Ronald B. Furry, 1993

**Charter Member of the American Association of Housing Educators**

Ruby M. Loper

**College of Agriculture and Life Sciences Faculty Senate**

James A. Bartsch

**College of Agriculture and Life Sciences Outstanding Alumni Award**

Gilbert Levine (Class of 1949), 1989
Alfred D. Longhouse (Class of 1937), 1991
E. Stanley Shepardson (Class of 1947), 1987

**College of Agriculture and Life Sciences Professor of Merit Award**

Ronald E. Pitt, 1995

**College of Engineering McCormick Award for Advising**

James A. Bartsch, 2004
Michael F. Walter, 2004

**Cornell Faculty Council of Representatives (FCR)**

Louis D. Albright, term date 1992, CALS Representative
Joseph K. Campbell, term date 1982, CALS Reprenstative
J. Robert Cooke, Speaker of the FCR 1975-1976, 1976-1977
Ronald B. Furry, term date 1978, CALS Reprenstative
Kifle G. Gebremedhin, term dates 1990, 1996 CALS Representative
Wesley W. Gunkel, term dates 1990, 1986, 1982, At Large Member 1979, CALS Representative
Wilmot W. Irish, term dates 1989, 1986, CALS Reprenstative

Gerald E. Rehkugler, term date 1976, CALS Reprenstative
Norman R. Scott, term date 1979, At Large Member
Larry P. Walker, term date 1982, CALS Reprenstative
Michael F. Walter, term dates 1994,
At Large Member 1979, CALS Representative

**Cornell ASAE Student Branch Outstanding Faculty Award**

Louis D. Albright
Ronald B. Furry
Wesley W. Gunkel
David C. Ludington
Ronald E. Pitt
Norman R. Scott
Michael F. Walter

**Cornell University Faculty Senate**

Beth A. Ahner, 1999-2002, At Large Member
Louis D. Albright, 2002-2005, At Large Member
Antje J. Baeumner, 2000-2003, 2003-2006, At Large Member
Kifle G. Gebremedhin, 1996-1997, 2000-2003, 2003-2006,
Department Representative
Douglas A. Haith, 2000-2003, Department Representative
Carlo D. Montemagno, 1996-1999, At Large Member
Michael B. Timmons, 2003-2007, Department Representative

**Cornell University Senate**

J. Robert Cooke, Speaker of the Senate (first full-year)
Ronald B. Furry
Kifle G. Gebremedhin
Donald R. Price
Michael F. Walter

**Cornell University Faculty Trustee**

J. Robert Cooke, 1986-1990

**Directors of Cooperative Extension Recognition Plaque**

Everett D. Markwardt, 1981

**EDUCOM Best Engineering Software Award**

J. Robert Cooke, 1989

**EDUCOM Competition Selected for '101 Success Stories'**

J. Robert Cooke, 1992

**Endowment Funds**

Agricultural and Biological Engineering Endowment Fund
A. M. Goodman Memorial Fund
Dr. Alfred and Evelyn Snyder Longhouse Scholarship Fund
Burton A. Jennings Memorial Award
Byron B. and Georgia B. Robb Scholarship Fund
E. Stanley Shepardson Scholarship Fund
John W. Layer Memorial Fund

**First Faculty Member Hired by Howard W. Riley**

Byron B. Robb, 1911

**First Full Time Extension Faculty Member Hired**

W. K. Blodgett, 1918

**First Woman Faculty Member Hired**

Ruby M. Loper, 1946

**First PhD Degree Awarded (in US) by Department**

Earl A. White, 1917

**First MS Degree Awarded by Department**

Byron B. Robb, 1913

**First Five Year Program BS Agricultural Engineering Graduate**

William W. Westervelt, BSAE, 1956

**Friend of Extension Award**

Norman R. Scott, 1995

**Fulbright Lecturer**

Wilmot W. Irish, 1981-82

**Graduate Field/Faculty Representative**

Representatives were not assigned prior to 1964, and prospective graduate students dealt directly with individual members of the graduate faculty.

Louis D. Albright
Daniel J. Aneshansley
James A. Bartsch
Landis L. Boyd
J. Robert Cooke
Ronald B. Furry
Wesley W. Gunkel
William F. Millier
Gerald E. Rehkugler
Michael F. Walter

**Golden Key Outstanding Faculty Award**

Michael F. Walter, 1992

**Henry Darcy Medal, European Geophysical Society**

Tammo Steenhuis, 2005

**Institute of Biological Engineering President**

Norman R. Scott, 2000

**International Water Management Institute Research Fellow**

Gilbert Levine. 1987-Present

**Lambda Chapter of Epsilon Sigma Phi Achievement Award**

Ruby M. Loper

**Minta Martin National Award, Institute of the Aerospace Sciences**

Jean-Yves Parlange, 1962

### National Academy of Engineering Members

Raymond C. Loehr, 1983

For international leadership in research, engineering analysis, education, and management practices for solution of waste disposal problems.

Jean-Yves Parlange, 2006

For fundamental contributions to the formulation of water flow and solute transport in soils and groundwater.

Norman R. Scott, 1990

For pioneering contributions in physiological thermal regulation in animals and for engineering education and research leadership in agriculture and biology.

### National Science Foundation Science Faculty Fellow

Ronald B. Furry, 1963-1965

David C. Ludington, 1965-1967

Gerald E. Rehkugler, 1965-1967

James W. Spencer, 1964-1966

### National Food and Energy Council Distinguished Service Award

David C. Ludington, 1996

### New York State Association of County Agents Special Citation

Everett D. Markwardt, 1980

### New York State Flower Industries, Inc. Recognitions

John W. Layer, Honorary Membership, 1970

Special Citation, 1971

### Philadelphia Patent Office Association Award

Joseph K. Campbell

### Research Awards

Bernon G. Perkins Award, National Frame Builders Association

Kifle G. Gebremedhin, 1992

Cornell ADVANCE Center Research Initiative Award

Beth Ahner, 2007

Daimler-Benz Award, Cambridge University, U.K.

Antje J. Baeumner, 1994

Department of Energy National Award for Energy Innovation Research
William J. Jewell, 1988
Humboldt Foundation Research Fellowship
Antje Baeumner, 2007
National Science Foundation Early Career Development Award
Dan Luo, 2006
New York Association of Conservation District's Special Service Award
Douglas A. Haith, 1990
Reinhard Böehm Award Braunschweig University, FRG
Antje J. Baeumner, 1993
Walter L. Huber Civil Engineering Research Prize
Douglas A. Haith, 1981
Wesley W. Horner Environmental Engineering Award
Douglas A. Haith, 1988

## SUNY Chancellor's Award for Excellence in Faculty Service

Norman R. Scott, 2007

## Teaching Awards

American Society for Engineering Education Excellence in Teaching Materials Award
J. Robert Cooke, 1991
College of Agriculture and Life Sciences Donald C. Burgett Distinguished Advisor Award
James A. Bartsch, 2003
College of Agriculture and Life Sciences Edgerton Career Teaching Award
Douglas A. Haith, 2002
College of Agriculture and Life Sciences Mentoring Students in Research Award
Antje J. Baeumner, 2001
College of Agriculture and Life Sciences Professor of Merit Award
Ronald E. Pitt, 1995
College of Engineering Abraham T. C. Wong Excellence in Teaching Award
Kifle Gebremedhin, 1996, 1999
Douglas A. Haith, 2001
College of Engineering Barger Excellence in Teaching Award
Louis D. Albright, 1999
Beth A. Ahner, 2001
Ronald E. Pitt, 1999

College of Engineering Cowie Excellence in Teaching Award
Louis D. Albright, 1995

College of Engineering Dean's Award for Outstanding Teaching
Douglas A. Haith, 1995

College of Engineering Dean's Prize for Excellence and Innovation in Teaching
J. Robert Cooke, 1993

College of Engineering McCormick Advising Award for Excellence
Michael F. Walter, 2000

College of Engineering Tien Excellence in Teaching Award
Kifle Gebremedhin, 2002
Ashim K. Datta, 2005

College of Engineering Stephen '57 and Marilyn Miles Teaching Award
Larry P. Walker, 1997

Cornell University National Society of Black Engineers Advisor Award
Larry P. Walker, 1990

Distinguished Teaching Award of Kappa Gamma Delta
Louis D. Albright, 1992

Fiona Ip Li '78 and Donald Li '75 Excellence in Teaching Award
Beth Ahner, 2004

Gamma Sigma Delta Distinguished Teaching Award
Louis D. Albright, 1992

Merrill Presidential Scholar Outstanding Educator
Kifle G. Gebremedhin, 1996, 2001, 2003
Jean B. Hunter, 1988

National Association of State Universities and Land Grant Colleges Northeast Teaching Award
Louis D. Albright, 2005

State University of New York Chancellor's Award for Excellence in Teaching
Douglas A. Haith, 1998
Louis D. Albright, 2000
Kifle G. Gebremedhin, 2002

Tau Beta Pi Teaching Award for Field of Agricultural Engineering
Louis D. Albright, 1984
Ronald E. Pitt, 1987

Tau Beta Pi/Cornell Society of Engineers Outstanding Faculty Award
Douglas A. Haith, 1998
Antje J. Baeumner, 2007

The Howard University Outstanding Achievement Award

Larry P. Walker, 1996

## University and College Administration

Acting Director of the Center for Environmental Research

Gilbert Levine, 1988

Acting Director of the Center for International Studies

Gilbert Levine, 1988-1999

Acting Director of the Mario Einaudi Center for International Studies

Gilbert Levine, 2002-2003

Acting Executive Director of the Mario Einaudi Center for International Studies

Gilbert Levine, 2002

Acting Vice Provost for Computing

Norman R. Scott, 1988-1989

Acting President, Cornell Research Foundation

Norman R. Scott, 1998-1999

Associate Dean for Undergraduate Programs, College of Engineering

Gerald E. Rehkugler, 1990-1996

Associate Dean, College of Agriculture and Life Sciences

James W. Spencer, 1973-1978

Associate Director of the Center for International Studies

Gilbert Levine, 1970-1971

Associate Director of Cornell University Agricultural Experiment Station

Raymond C. Loehr, 1975-1978

Associate Director for Research, College of Agriculture and Life Sciences

Raymond C. Loehr, 1975-1978

Dean of the Cornell University Faculty

J. Robert Cooke, 1998-2003

Deputy Director, Center for Environmental Quality Management

Raymond C. Loehr, 1972-1974

Director for Research, College of Agriculture and Life Sciences

Norman R. Scott, 1984-1989

Director of the Center for Environmental Research

Gilbert Levine, 1976-1983

Director of the Environmental Studies Program, College of Agriculture and Life Sciences

Raymond C. Loehr, 1972-1980

Director of the Office of Energy, College of Agriculture and Life Sciences and the College of Human Ecology

Donald R. Price, 1984-1987

Director of the Water Resources and Marine Science Center

Gilbert Levine, 1974-1976

Director of Cornell University Agricultural Experiment Station

Norman R. Scott, 1984-1989

Director of Occupational Health and Safety

James W. Spencer, 1988-1999

Director of Resident Instruction, College of Agriculture and Life Sciences

J. Robert Cooke, 1976-1981

Interim Director of the Mario Einaudi Center for International Studies

Gilbert Levine, 1994-1996

Interim Director of the Center for Environmental Research

Gilbert Levine, 1990-1991

Special Assistant to the President

James W. Spencer, 1978-1979

Special Assistant to the Provost for Computing

J. Robert Cooke, 1979-1980

Vice Director of Cooperative Extension

James W. Spencer, 1970-1973

Vice President for Research and Advanced Studies

Norman R. Scott, 1989-1998

Vice Provost

James W. Spencer, 1979-1987

## University Macebearer

J. Robert Cooke, 1978

## University Marshal

J. Robert Cooke, 1980-2005

**United States Chamber of Commerce Distinguished Service Award**

Fred G. Lechner

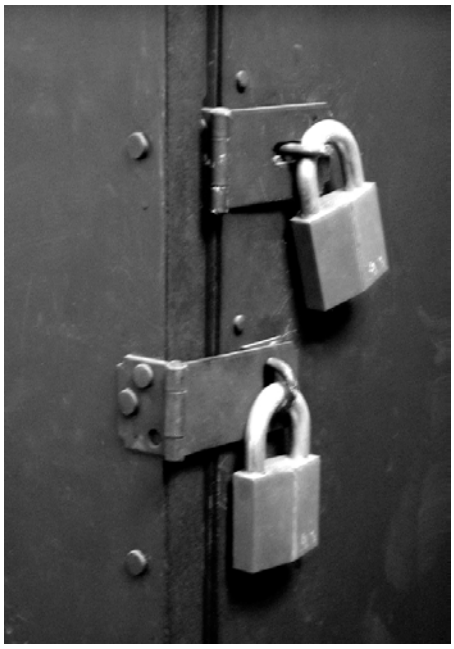
**Washington State University Alumni Achievement Award**

Norman R. Scott, 1991

**4-H Key Award**

Howard A. Longhouse, 1991

The safely locked safe.



Yale locks guard the wall-mounted cabinet.


The cornerstone time capsule of Riley-Robb Hall awaits the future.

# The Mystery

In the southwest corner of the basement room in which the department's archival files are stored in Riley-Robb Hall are two items (opposite page) placed there shortly after the building was occupied in 1956. One is a heavy, gray fireproof safe on rollers having a key lock for a hinged lid. The other is a large jet black riveted metal cabinet mounted well above floor level having overlapping doors, each secured with a very substantial Yale lock. It is obvious that the construction was designed to be tamperproof.

Unfortunately, the true reason for the existence of these repositories and what they contain are no longer known. Institutional memory has lapsed with the passing of their originators, and one can only speculate about the contents. Do they contain time capsule type information concerning the department's history, the original as-built plans for the building, special instrumentation from a bygone era, or merely confidential records of the department's early operation?

The year 2007 marks two interesting events, the first being that the Department of Biological and Environmental Engineering at Cornell began 100 years ago. The second is that the department occupied Riley-Robb Hall 51 years ago. The anniversaries of these historical events beg the question, "Where are the keys?" Opening the storages would perhaps light an interesting candle on the anniversary cake of the department's founding. On the other hand, perhaps another 49 years should pass so that Riley-Robb Hall can uniquely celebrate its own hundredth anniversary with such a revelation. And, of course, if the building is ever razed, there is also the cornerstone time capsule to explore (opposite).

# The Twentieth Century Reprised

According to the World Factbook, 2006 <https://www.cia.gov>, "Globally, the 20th century was marked by: (a) two devastating world wars; (b) the Great Depression of the 1930s; (c) the end of vast colonial empires; (d) rapid advances in science and technology, from the first airplane flight at Kitty Hawk, North Carolina (US) to the landing on the moon; (e) the Cold War between the Western alliance and the Warsaw Pact nations; (f) a sharp rise in living standards in North America, Europe, and Japan; (g) increased concerns about the environment, including loss of forests, shortages of energy and water, the decline in biological diversity, and air pollution; (h) the onset of the AIDS epidemic; and (i) the ultimate emergence of the US as the only world superpower.

"The planet's population continues to explode: from 1 billion in 1820, to 2 billion in 1930, 3 billion in 1960, 4 billion in 1974, 5 billion in 1988, and 6.5 billion in 2006. For the 21st century, the continued exponential growth in science and technology raises both hopes (e.g., advances in medicine) and fears (e.g., development of even more lethal weapons of war)..." and "the rapid depletion of nonrenewable mineral resources, the depletion of forest areas and wetlands, the extinction of animal and plant species, and the deterioration in air and water quality (especially in Eastern Europe, the former USSR, and China) pose serious long-term problems that governments and peoples are only beginning to address...

"Dominated by the onrush of technology, especially in computers, robotics, telecommunications, and medicines and medical equipment; most of these advances take place in OECD (Organisation for Economic Co-operation and Development) nations; only a small portion of non-OECD countries have succeeded in rapidly adjusting to these technological forces; the accelerated development of new industrial (and agricultural) technology is complicating already grim environmental problems."

The department grew up and developed into a unique institution during these times, and we have the utmost confidence that the faculty and staff of the Department of Biological and Environmental Engineering will not only maintain but accelerate its propensity for pertinent and timely evolution of its programs, and in the Twenty

# *Postlude*

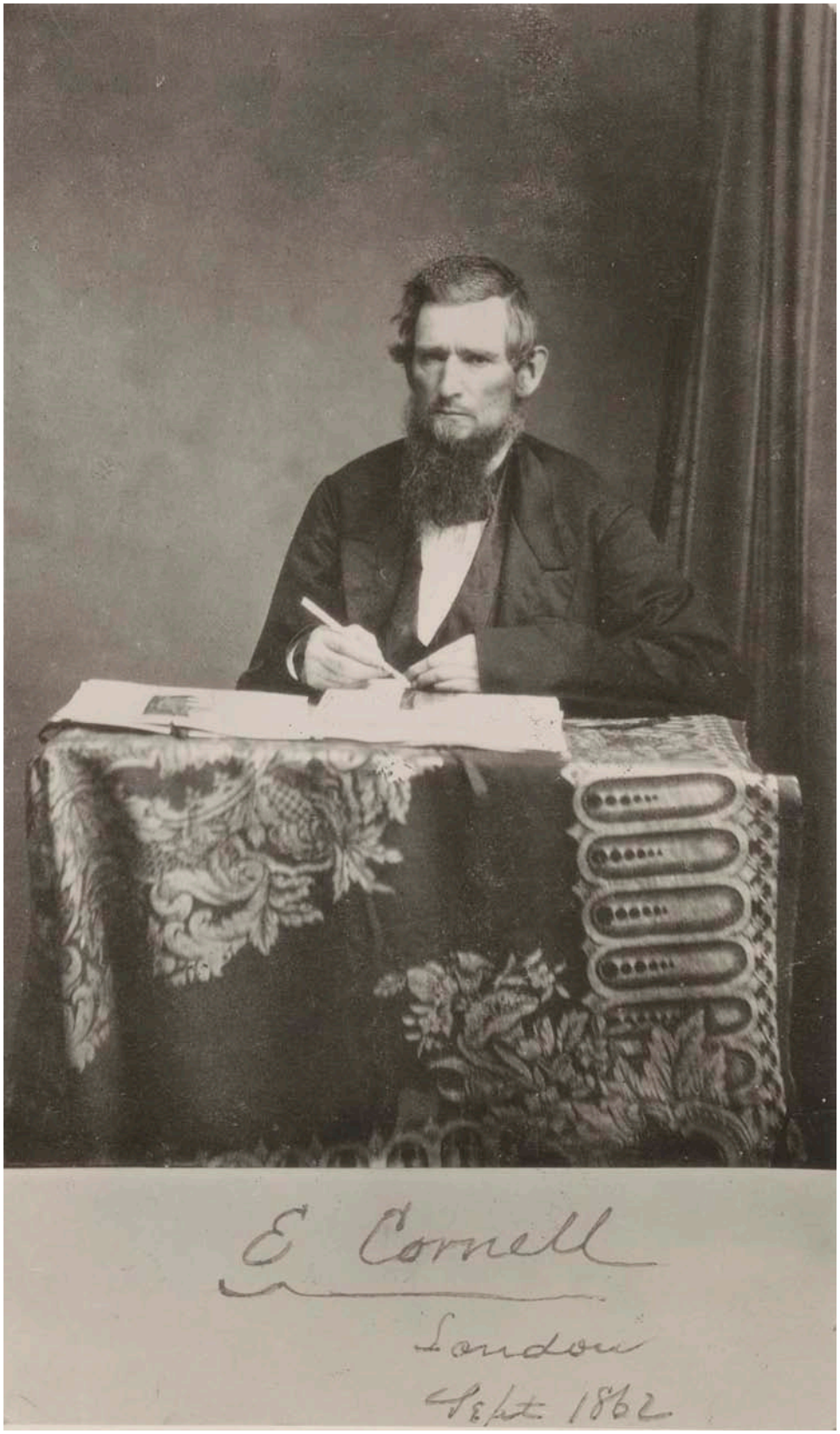
First Century contribute as much or more to society than in its first 100 years. The needs and challenges are great.

Preparation of this document brought back memories, almost too many memories, of what Cornell and this Department were like since 1949, while I moved from undergraduate student to Professor Emeritus over a period of 46 years.

I cannot adequately describe the feeling of hearing the McGraw Tower bells joyfully burst across the campus as a student while on the long trek back to my West Avenue barracks dormitory after class on the upper campus, alone on a cold, still, snowy winter evening, nor how comforting it was to be part of a family of friends later as a member of the department's faculty and staff. Some of us would have the pleasure of knowing the founders of the department and many of their talented colleagues; they were truly superior individuals working for the betterment of humankind. It was a remarkable opportunity and an inspiring journey; I'd gladly go back to do it all over again. Everyone should have the opportunity to delve into the past to see just what their predecessors accomplished. They made life worth living.

*—R. B. Furry*

The author (rear) with student friends Bob Dellers (left), John Kleske and Harry Homola stand at the entrance to the West Avenue barracks dormitory in fall semester 1949, while Furry's roommate, John Chin, takes the picture. The Noyes Community Recreation Center now stands on the site of this dormitory.




Ezra Cornell in London in 1862, president of the New York State Agricultural Society and delegate to the Royal Agricultural Society of England, held at Batersea, England. He contributed his farm on Ithaca's East Hill as the start of the campus of Cornell University.

# Sources


## Books

Bishop, Morris. *A History of Cornell. Ithaca*: Cornell University Press, 1962.

Colman, Gould P., *Education and Agriculture: A History of the New York State College of Agriculture at Cornell University.* Ithaca: Cornell University Press, 1963.

White, Earl Archibald, *A Study of the Plow Bottom and Its Action on the Furrow Slice. Ithaca*: Cornell University Library, PhD Thesis, 1917.

## Periodicals

*Agricultural Engineering Extension Quarterly Narrative Report, Sept. 1, 1964 – Dec. 31, 1964.* Department of Agricultural Engineering (DAE), Cornell.

*Agricultural Engineering News, Ideas, Information*, Vol. 1, No. 1, Jan.-Feb. 1956. DAE, Cornell.

_____, Research 1957, Vol. 2, No. 1, April 1957.

_____, 1958, Vol. 3, No. 1, April 1958.

_____, 1959, Vol. 4, No. 1, April 1959.

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Alumni News, Department of Agricultural and Biological Engineering (DABE), Cornell, Dec. 1993.

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## Documents

Affidavit of Birth, Orval C French, State Board of Health, Div. of Vital Statistics, State of Kansas, July 12, 1940.

*Agricultural & Biological Engineering Research at Cornell University. Ithaca:* Department of Agricultural and Biological Engineering (DABE), New York State College of Agricultural and Life Sciences (CALS), Cornell University, 1994.

*Agricultural and Biological Engineering Academic Review.* DABE, Cornell, April 8-13, 2001.

Agricultural Engineering Committee, summary of meeting, March 31, 1955. DAE, Cornell.

*Recent History of Agricultural Engineering.* Agricultural College Hour, WHCU Radio Broadcast, H. W. Riley and F. B. Wright. DAE, Cornell, May 17, 1946.

*Agricultural Engineering Data (Revised)*, Committee on the Advancement of Agricultural Engineering Education, American Society of Agricultural Engineering (ASAE), April 23, 1929.

*College of Agriculture 32nd Annual Report to the NYS Legislature, 1918-1919.* Ithaca: Cornell.

*Cornell Chronicle Online. "Cornell again ranks first in engineering physics in U.S. News rankings, and is called top Ivy by Washington Monthly,"* Aug. 18, 2006.

*Cornell ASAE Student Branch Farm Equipment Institute Report, 1961-62*. DAE, Cornell.

Demonstrations in Rural Engineering: 1920-21 Project 18 by B. B. Robb. Ithaca: Department of Rural Engineering, Cornell, July 1, 1920.

## BEE Department Archives

Various archival Extension, research, and teaching documents, 1907-2007, Cornell Department of Biological and Environmental Engineering (BEE):

Splinter, W. E. *Early History of Agricultural Engineering at the University of Nebraska,* Dec. 2, 2005.

*Environmental Engineering Undergraduate Handbook, Fall 2006-Spring 2007.* Ithaca: BEE and School of Civil and Environmental Engineering, Cornell.

*Extension Plans of Work, Department of Rural Engineering* (DRE) and DAE, Cornell, 1921-1974.

*Extension Reports*, DRE and DAE, 1932-1975.

*Extension Report to the NYS Food Commission*. DAE, Dec. 1, 1943.

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"Grades for New Buildings, Blueprint Drawing No. B-403, Dept. of Rural Eng., N.Y. State College of Agr.," June 27, 1924.

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"Human Resources and Program, DABE, CALS, Cornell," 1991.

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*New York State Dairy Statistics Annual Summary,* State of New York, Department of Agriculture and Markets, Division of Milk Control and Dairy Services, William Francis, director, 2005.

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Silver Service Celebration: O. C French, cassette tape, DAE, January 20, 1973.

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*Undergraduate Programs: Biological and Environmental Engineering*, BEE, 2006-2007.

## Illustrations

All illustrations are from the archives of the Department of Biological and Environmental Engineering at Cornell except as listed below. The sources are abbreviated as:

Division of Rare and Manuscript Collections, Cornell University Library = CUL

Cornell University Photography = CUP

The History Center in Tompkins County, Ithaca, New York = THC

Illustrations other than from BEE: Inside front cover CUL; pages: vi THC; 24 bottom CUP; 31 bottom THC; 48 CUL; 66 CUL; 68 top left and bottom CUL; 76 CUL; 80 top THC, bottom right Cornell Chronicle Publications; 90 top THC; 92 top CUL; 122 left center Dede Hatch Photography; and 170 CUL.

# *Supplemental Resources*

The following supplemental resources, and many others, about this department are online in the Cornell Digital Repository at:

**http://ecommons.library.cornell.edu/handle/1813/7636/browse-title**

## Memorial Statements

*Memorial Statements*, prepared by the Office of the Dean of Faculty, for the following Department of Agricultural Engineering Faculty (1939 through 2004).

Richard Black, November 2, 1926 – September 27, 1998

Joseph Kearns Campbell, October 30, 1927 – August 4, 1997

Hollis Rexford Davis, October 18, 1915 – January 13, 1995

Frank Latta Fairbanks, December 16, 1884 – March 5, 1939

Edward W. Foss, December 4, 1914 – January 28, 1988

Orval C French, January 3, 1908 – March 30, 1999

Alpheus Mansfield Goodman, January 29, 1885 – May 29, 1956

Richard William Guest, July 7, 1932 – February 24, 1997

Wesley Winnfred Gunkel, October 17, 1921 – May 12, 2000

Paul Raymond Hoff, August 29, 1903 – September 4, 1974

Burton Aaron Jennings, March 12, 1895 – March 18, 1964

John William Layer, August 18, 1927 – March 13, 1975

Fred G. Lechner, September 23, 1915 – November 1, 1983

Ruby M. Loper, January 12,1901 – January 17, 1990

John Clarence McCurdy, April 23, 1878 – December 10, 1973

William Frederick Millier II, August 31, 1921 – February 13, 2002

Juan Estevan Reyna, December 26, 1878 – October 7, 1974

Howard Wait Riley, May 2, 1879 – August 19, 1971

Byron Burnett Robb, August 8, 1882 – July 8, 1961

Louis Michael Roehl, October 21, 1881 – September 16, 1956

E. Stanley Shepardson, January 13, 1913 – December 10, 2004

Cryl Waldie Terry, July 15, 1905 – April 25, 1994

Clesson Nathan Turner, September 17, 1908 – October 27, 2001

Carl Seymore Winkelblech, June 28, 1918 – October 30, 1995

Forrest Blythe Wright, October 21, 1896 – June 16, 1991

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*Cooke, J. Robert. 1996. The Publications, Papers, Presentations and Patents (1980-1995) for the Department of Agricultural and Biological Engineering, Cornell University. 331 pages. PDF file. Sorted by year; bookmarked.*

## Theses and Dissertations

*Cooke, J. Robert, Ruth Stanton, Sandy Bates. 1996. CU ABEN Graduate Degrees: 1913 – 1995. (Chronologically and Alphabetically; bookmarked) 113 pages. PDF file.*

## The First Ph.D. Dissertation in Agricultural Engineering in the USA

*White, Earl Archibald. 1917. A Study of the Plow-Bottom and Its Action on the Furrow-Slice. Ph.D. Thesis. 105 pages. PDF file.*

## Social Event

*BEE Picnic at Meyers Park, Lansing, NY. 8 June 2002. QuickTime video. (2 min & 50 s). Prepared by J. Robert Cooke.*

## Construction of Riley-Robb Hall

*Cooke, J. Robert and Ronald B. Furry, eds. 2007. Riley-Robb Hall at Cornell University: Celebrating Its Opening. The Internet-First University Press. 108 pages.*

## Research Experience for Undergraduates

*Todd Walter and Tammo Steenhuis provided a summer Research Experience for Undergraduates, summer 2005, sponsored by the NSF, and included four formal student presentations and three poster sessions. Streaming videos are available online. The DVD was produced by J. Robert Cooke.*

## Audio Recordings

*Riley, Howard W. and Gould Colman. 2007. In Their Own Voices: A [1963] Conversation with Howard W. Riley: Early Agricultural Engineering at Cornell University. IFUP.*

*Orval C French's Silver Service Anniversary celebration on January 20, 1973 commemorating his 25 years of service to the Department of Agricultural Engineering. The surprise program included personal and humorous slides. Voices heard in sequence are Ted Sobel (Recording Identification), Stan Shepardson (Introductions), Don Price (Grace), Ron Furry (Announcer), Wes Gunkel (Life Story Teller), Don Price (Gifts Presenter), Wes Gunkel (Memory Book Presenter), Stan Shepardson (Communications from Absent Friends, and Dedication of the Orval C French Seminar Room), Audience Singing, and Orval C French (Response).*

# Index

## Symbols



## A



## B

## C

## D

## E



## F

## G



## H

## I



## J



## K



## L

## M



## N

## O



## P

## Q



## R



## S

## T



## U