

# Nutrition

## The Role of the New Machine



Proposed by Henry Armsby in 1887 and built in 1902, the Armsby Calorimeter calculated usable energy stored in cattle feed along with components used for weight gain and milk production. The size of a house, it featured a chamber where cattle were analyzed using temperature sensors. Its data remains accurate, although it was later found that digestion and heat production are influenced by variables that cannot be environmentally controlled. In 1910, Armsby released Bulletin 104, "The Respiration Calorimeter."

## Rumen With a View



Known as the cow with the window in her side, Jessie gained worldwide attention in 1928. Jessie allowed for research by James Shigley and Samuel Bechdel, proving that Vitamin B is produced in rumen. Their research had a lasting influence on the new field of research called Ruminology. Penn State continues to conduct studies of dairy cattle nutrition using fistulated cows.

## Forage Testing Lab



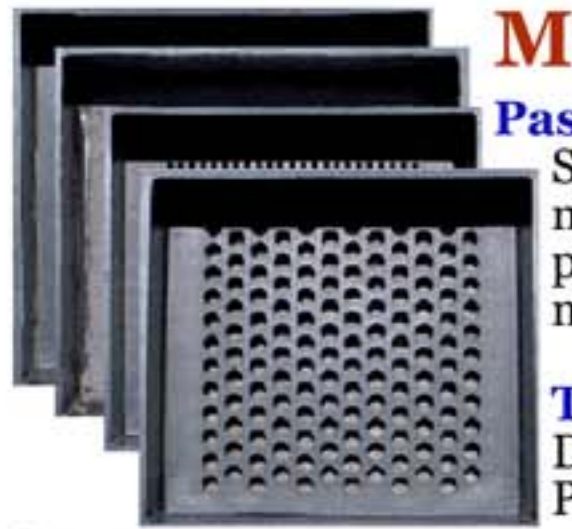
Penn State established the first forage testing laboratory and programming of rations for dairy cattle in the late 1950s. The process, led by Richard Adams, John Baylor, and John Washko, used chemical methods to determine the amounts of protein, fiber, and other minerals.

## Into the Light: NIR Testing



In 1982, the chemical process for forage testing was replaced by a more efficient method. That year, John Shenk, Mark Westerhouse, and Richard Adams began analyzing forages with software that translated the test's light spectrum readings into nutrient values that were collated using a database of forage values from tens of thousands of samples. This new technology, near-infrared reflectance (NIR), meant labs could instantly analyze forage.

## More Modern Concepts



The Penn State Particle Size Separator

**Pasture Systems** - In the early 1990s, Penn State researchers established a Pasture Systems Research Program and Grazing Research and Education Center to address the needs of farmers readopting pasture-based systems. Under Larry Muller and others, this program led to more than 30 publications, several book chapters, and extensive information on nutrition and grazing of high producing cows.

**TMR** - In 1993, to help dairy farmers evaluate forage and TMR particle size distribution, Dennis Buckmaster and Jud Heinrichs created the portable, easy-to-use Penn State Particle Size Separator. For more information, see [das.psu.edu/dairynutrition/](http://das.psu.edu/dairynutrition/).

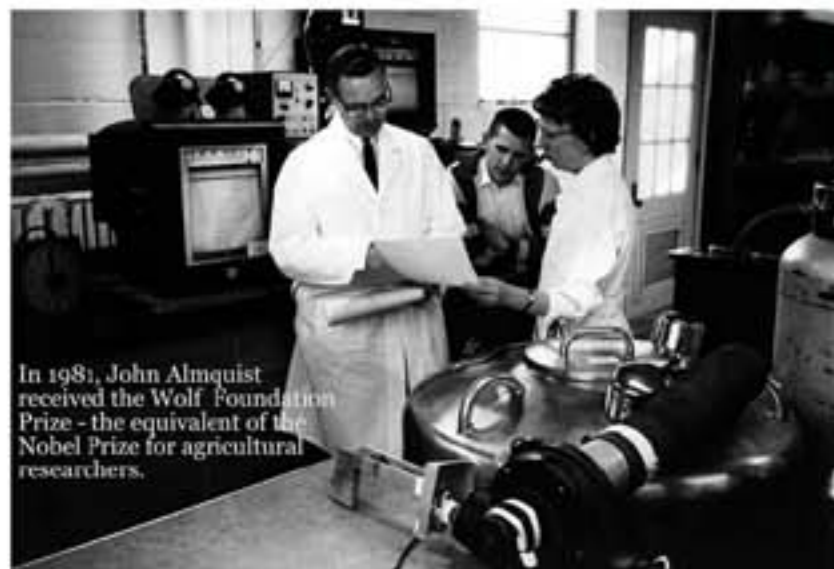
**Transition-Cow Nutrition** - The research of Gabriella Varga led to improved performance of transition cows. Using nonforage fiber sources, fermentable carbohydrates, and other glucogenic precursors in rations resulted in substantial increases in dry matter intake prepartum and better prepared cows for lactation. This research also showed that producers could feed rations for the entire dry period while maintaining the body condition of cows, reducing feeding labor, and providing a more consistent ration.

PENNS STATE

# PENNS STATE

# the Second Land Grant University

## Physiology and Genetics



In 1980, John Almquist received the Wolf Foundation Prize - the equivalent of a Nobel Prize for agricultural scientists.

## Fertile Minds

Dedicated in 1949, the Dairy Breeding Research Center was established to study artificial insemination and dairy cattle fertility. It was renamed in 1999 after John O. Almquist, who spearheaded Penn State's dairy cattle breeding research program. Other notable researchers at the center include T.Y. Tanabe, Rupert Amann, Robert Flipse, Phil Senger, Dan Deaver, and Gary Killian.

The John O. Almquist Research Center has provided major contributions in the following areas:

- bull management, nutrition, and behavior
- sperm harvesting, preservation with milk extender, addition of antibiotics, and coloring to distinguish breeds
- sperm metabolism
- characterization of the cycle of the seminiferous epithelium
- methods of quantifying sperm production rates
- male endocrinology
- estrous behavior
- male fertility factors
- characterization of oviductal environment
- repeat breeding syndrome
- classical images of normal and subfertile reproductive organs and gross genital abnormalities
- the role of progesterone in maintenance of pregnancy
- documentation of fertilization rate and embryonic mortality in normal and repeat-breeding cattle
- use of radiography to evaluate AI techniques

For more information about the center, see [das.psu.edu/almquist/](http://das.psu.edu/almquist/).

# Milk Secretion, Quality, Harvest, and Manufacturing

## Milking Management and Quality



**Taking Managed Milking on the Road** - In 1960, instead of holding formal meetings to show how to control mastitis by management, Steve Spencer and Sam Guss took milking technology on the road.

To facilitate this, they had a special trailer constructed and equipped with vacuum pumps and bucket milkers.

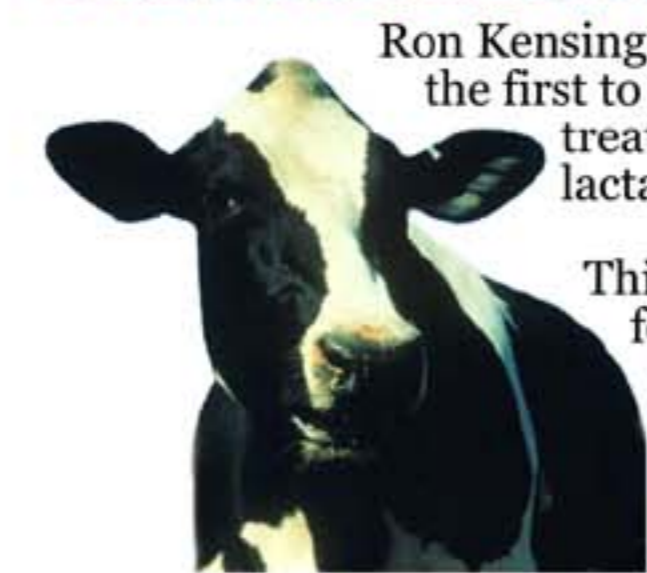
Guss and Spencer's road show put on demonstrations in each county in the state, as well as in Philadelphia and Pittsburgh.

**Quality Monitoring** - Due to improvements in homogenization, separation, and cooling developed by Ivan Parkin and Sidney Barnard from the late 1950s through the mid-1990s, the shelf life of milk products, previously measured in days, could now be measured in weeks. Practical application of these principles was disseminated through Sid Barnard's monthly columns in *Hoard's Dairyman*.



**Linking Somatic Cell Counts with Mastitis** - In 1979, Robert Eberhart, Herb Gilmore, Larry Hutchinson and Steve Spencer, using one of the first Fossomatic somatic cell counters in the United States, demonstrated that herds using monthly somatic cell count (SCC) test results for individual cows significantly lowered the herd average SCC compared to control herds. In 1981 William Heald established the SCC calibration standards currently used by most DHIA labs in the United States. Eberhart and Heald also moved the industry to conduct routine daily testing and validation of DHIA somatic cell counts - accuracy and monthly reporting of DHIA SCC is critical for acceptance of SCC as a valid mastitis detection method.

## Induced Lactation



Ron Kensinger, Larry Muller, and Mike O'Connor and associates were the first to quantify the increase in milk production that occurs when bST treatment is added to estrogen-progesterone methods to induce lactation.

This group was the first to report survival analysis or herd life data for a large group of animals induced into lactation.

These researchers were also the first to perform a full economic analysis demonstrating the merit of this approach to dairy farming.

## Dairy Chemistry and Milk Synthesis



Stuart Patton

Stuart Patton and colleagues were the first to use gas-chromatography to resolve both major and minor fatty acids in milk. He was also among the first to develop an interest in lipids as a factor in heart disease and to study milk and lactation in humans.

Patton authored a book titled *Biomedical Aspects of Lactation*, which clearly delineated underappreciated nutritional merits of dairy foods. Other research by Patton demonstrates the critical role of microfilaments and microtubules in the milk secretion process.

Patton continues his fundamental research by publishing papers that characterize the mucins in both bovine and human milk. In 1966, he became the first faculty member of the College to be named an Evan Pugh Professor, the highest faculty honor at Penn State.



**Ice Cream Short Course** - Begun in 1894, Penn State's Ice Cream Short Course is the oldest food technology and technical course in the world.

Now entering its 113th year, the course draws more than 100 ice cream industry professionals each year, from foreign countries and companies such as Ben and Jerry's and Turkey Hill.

In the beginning, students learned how to manufacture butter, pasteurize milk, and make ice cream. Farmers and others took the course via correspondence.

## Chocolate and Ice Cream



F. J. Doan instructing students on the fundamentals of condensing milk (circa 1949)

Its modern era began in 1924 when C.D. "Chet" Dahle reorganized the concept of the agricultural short course. It continued as two separate short courses under Phil Keeney. Bob Roberts currently oversees the course.

**Chocolate** - The mutual benefit that the chocolate and dairy industries are to each other is well known.

In recognition of the importance of both industries to the Commonwealth, Keeney and Paul Dimick devoted a major part of their careers to teaching and research on chocolate and its uses to enhance the value and sales of dairy products, especially milk and ice cream.



# Management and Education

## Better Barns



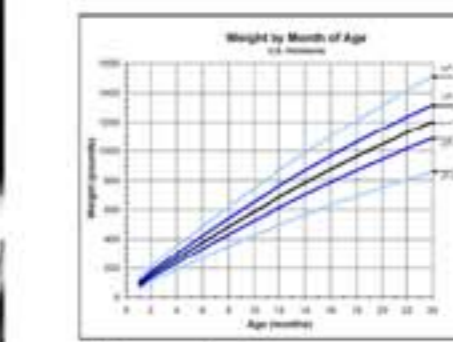
Prior to the 1950s, barn design had not improved significantly since World War I. Dairy cows often were housed with horses and other animals, creating labor-intensive and often unsanitary conditions. In the 1950s and 1960s, Penn State drive-through barns and heifer barns were developed by Roger Grout to provide safer, healthier, and more efficient housing and feeding of dairy herds. Today, drive-through barns are the standard throughout the dairy industry.

## Penn State Dairy Alliance

Dairy Alliance, an initiative of Penn State Cooperative Extension, worked to enhance development of the state's dairy industry through leadership and focused education. The emphasis of recent educational programming has been in the following areas:

- Nutrient management
- Human resource management
- Information management
- Business management

Innovative programming has included Web-based dairy records training, environmental awareness, Hispanic workforce and dairy women conferences, and the Penn State Dairy Production Skills Certificate Program, which provided basic employee training and management-level training. For more information, see [dairyalliance.org](http://dairyalliance.org).



Heifer growth chart

## Calf and Heifer Management

**Vitamins** - Research on the vitamin requirements of calves began in 1924, and calf-nutrition research continued through the early 1950s. Under the direction of Samuel Bechdel and R.A. Dutcher, this research led to the current documentation of these vitamin requirements.

**Milk Replacers** - Research by Earl Kesler, Clay Knodt, and J.B. Williams in the 1950s investigated the value of plant and animal products in milk replacers. Results of these studies, and studies of feeding calves antibiotics, contributed to enhanced formulations of milk replacers.

**Current Growth Standards** - Penn State developed an extensive set of resources and publications to assist dairy farmers around the world in raising healthy calves and heifers. Topics include health, growth, and nutrition; housing and biosecurity; breeding; budgeting for dairy heifer replacement; and information specific to different dairy breeds. Penn State's calf and heifer information is online at [das.psu.edu/dairynutrition/](http://das.psu.edu/dairynutrition/).

## Dairy Production Medicine



The Dairy Production Medicine Certificate Program was the first continuing educational program in the United States for bovine practitioners that emphasized production management concepts.

Developed in part by Larry Hutchinson in 1991, the 2½-year course enables veterinarians to gain skills and knowledge to help them promote the health and productivity of their clients' herds as well as increase the value of their consulting services.

Initially, Dale Moore coordinated the program. Instruction currently is provided by Penn State and the University of Pennsylvania, along with guest lecturers.

## Our Undergraduate Students

Some of our undergraduates' many notable achievements:

- ASDA-Student Affiliate Division**
- 5 Presidents since 1980
- 5 Outstanding Students since 1980
- 12 First-Place Chapter Awards since 1980
- 10 First-Place Undergraduate Oral Presentation Winners since 1990
- First-Place Dairy Quiz Bowl team each year since 2001

## Northeast ASDA-ASAS Student Meetings

- Top-ranked institution 14 times since 1990
- 10 Outstanding Seniors since 1990

## Other Achievements

- 10 National Dairy Shrine Recognition Award Place Winners, with three First-Place Winners since 1990
- 22 Dairy Cattle Judging All Americans at the National Intercollegiate Contest since 1990
- Platinum Award Winner at the 2006 North American Intercollegiate Dairy Challenge



Emily Yeiser, president of the ASDA Student Affiliate Division

## Current and Former Penn State Faculty who have served as ASDA Presidents

A.A. Borland, 1924  
D.V. Josephson, 1958  
B.R. Baumgardt, 1985  
L.D. Muller, 1999

## Current and Former Penn State Faculty and Alumni who have been ASDA Fellows

**Faculty**  
B.R. Baumgardt, 1997  
D.V. Josephson, 1997  
S. Patton, 1997  
J. Almquist, 1998  
S.B. Spencer, 2000  
P.G. Keeney, 2002  
L.D. Muller, 2005

**Alumni**  
H.M. Farrell, 1997  
J.R. Brunner, 1999  
T.W. Keenan, 1999  
J.W. Fuquay, 2001  
H.D. Norman, 2001  
G.E. Shook, 2005

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