NEW YORK STATE

AGRICULTURAL EXPERIMENT STATION

GENEVA, NY

2000 The Year in Review

From Molecules to Markets . . .

The GENEVA EXPERIMENT STATION
Means Business for New York

CORNELL

From the Director . . .

If the last 100 years are any indication of the pace of future change, the world at the end of the next millennium will be vastly different from anything we envision today.

Why did change occur so rapidly in the last century? And what has it brought? Stable governments, freedom, and the financial support to conduct research in the physical, biological and social sciences brought a higher quality of life enjoyed by many throughout the world.

Changes in agricultural technologies in the past 100 years have resulted in increased yields and major demographic shifts. Nearly everyone in the United States lived on a farm in 1900. Today, very few are involved in agricultural production. Educational levels improved as people were freed from farm labor. Some researchers applied their talents to medicine and public health issues. Other researchers worked to improve agricultural practices and increase productivity.

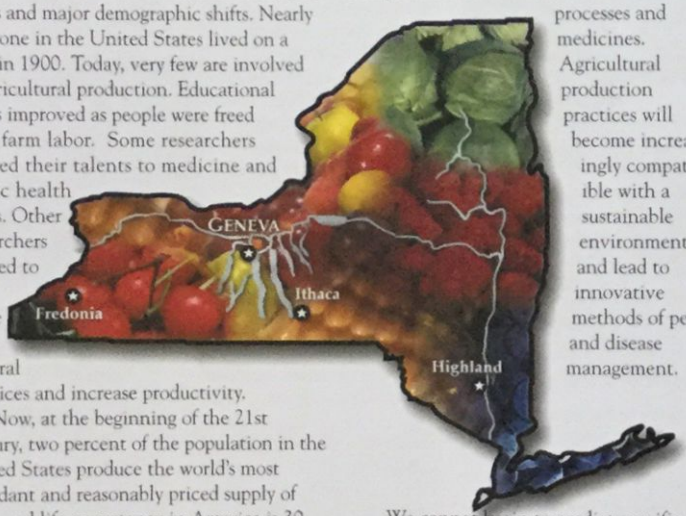
Now, at the beginning of the 21st century, two percent of the population in the United States produce the world's most abundant and reasonably priced supply of food, and life expectancy in America is 30 years longer than in 1900.

Too few understand these success stories and the supporting role played by public investment in research, education, and technology.

Along with our peers at the College of Agriculture and Life Sciences at Cornell University, we at the Geneva Experiment Station take great pride in our contributions in helping the world achieve a standard of living unimaginable 100 years ago. Nor have we reached the end of what advancements are possible in agriculture and public health.

Further investment in public and private sector research—often in cooperation with state and federal governments—will continue to benefit society.

In the next century, citizens of the world will benefit enormously from the revolution that is occurring in agriculture and the life sciences, and the close integration of biology, chemistry, physics, and mathematics. Foods will be more nutritious; plants will deliver health-benefiting substances like nutraceuticals and vaccines; and plants, animals and microorganisms will act as biological factories to produce complex molecules needed for industrial processes and medicines. Agricultural production practices will become increasingly compatible with a sustainable environment and lead to innovative methods of pest and disease management.



We cannot begin to predict specific advances any more than our predecessors could anticipate the progress that has led to our standard of living today. But, experience gained since the Geneva Experiment Station opened its doors in 1882 tells us we cannot rest on achievements of the past.

Concerns about the globalization of agriculture, climate change, biotechnology, sustainable food systems, and other challenges mean we cannot take agriculture and the food supply for granted. Implementation of wise public policies and further investment in research and education will result in an even better future for us all.

James E. Hunter, Director
New York State
Agricultural Experiment Station
Geneva, NY

Our Vision

To advance a sustainable plant agriculture and food system through state-of-the-art research and extension programs that address local and worldwide needs.

Our Mission

GENEVA supports New York's agricultural and food industries with research, extension and education programs. We:

- Use the best-suited scientific tools and systems to solve both fundamental and applied scientific questions pertaining to plant agriculture and food science;
- Improve competitiveness and profitability of growers and processors of fruit and vegetable crops, turf, and other expanding horticultural industries;
- Develop biologically and environmentally sound practices to produce, protect, and process horticultural crops and commodities;
- Develop and implement technologies to ensure the wholesomeness of foods;
- Serve the diverse clientele of the state and support emerging opportunities to enhance and expand plant-based agriculture and food systems;
- Help create, attract, and retain agricultural, food, and biotechnology enterprises within New York.

Vital Statistics

- **Established in 1880**
- **Four academic units; five support units**
- **Outlying labs in Fredonia and Highland**
- **303 employees (186 on state funds):**
  - **50 professors and program leaders**
  - **35 other Ph.D.-level scientists**
- **28 graduate students**
- **28 visiting scientists in residence**
- **900-acre campus, including:**
  - **850 acres of farm land for research**
  - **1 acre of greenhouse space**
- **623,000 square feet of buildings**
- **Annual budget of $21.1M ($11.3M funded through SUNY)**

Partnerships with Industry

GENEVA technology can be licensed from the Cornell Research Foundation for commercial development.

Patent Activity: Jan. 1 - Dec. 31, '00

- **1 Foreign patent filed**
- **2 Foreign patents issued**
- **9 US patents filed**
- **8 US patents issued**

New Hires - 2000

Dr. William Turechek, assistant professor in plant pathology, conducts research and extension on the epidemiology and control of diseases of tree fruit and berry crops.

Martin Schlabach, librarian at the Geneva Experiment Station, ensures that this important resource center meets the information needs of the Station community.

Dr. Peter Cousins, adjunct assistant professor in horticultural sciences, conducts research on grape rootstock breeding, genetics, and evaluation. He works for the United States Department of Agriculture's Agricultural Research Service Plant Genetics Resources Unit at GENEVA.

Award Winners - 2000

Dr. Terry Acree, Food Science & Technology, Institute of Food Technologists' Stephen S. Chang Award for Lipid Chemistry and Flavor Science.

Dr. M. Anandha 'Andy' Rao, Food Science & Technology, American Association of Cereal Chemists' G.W. Scott Blair Memorial Award for Excellence in Food Rheology.

In Passing - 2000

Dr. Nelson J. Shaulis, professor emeritus of viticulture and one of the world's preeminent authorities on grapes, passed away in January 2000. The Nelson J. Shaulis Advancement of Viticulture award was established in his honor.

Special Gifts and Endowments - 2000


Dr. Frank Lee

Dr. Frank A. Lee made a $2.3 million bequest to the Geneva Experiment Station Library to purchase information resources. Dr. Lee, who worked at GENEVA from 1936 until his retirement in 1967, conducted pioneering research on the freezing of fruits and vegetables when those industries were in their infancy and was an ardent proponent of the library. When Dr. Lee died in September 1999, at the age of 98, he stipulated that his estate be used to purchase scientific journal subscriptions, modern scientific books and important back issues of scientific journals for the GENEVA collection. Because of the electronic nature of modern library resources, Dr. Lee's gift will benefit researchers throughout the Cornell Library system. In his honor, the library at GENEVA was named the Frank A. Lee Library.

For More Information

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ACCOMPLISHMENTS WITH IMPACT: 2000

GROWING CROPS COMPETITIVELY

Beetle Mania: Identified the sex attractants that control mating behavior in four species of scarab beetles that feed on cranberry roots. Larvae of the Oriental beetle, the cranberry white grub, the cranberry root grub, and *Hoplia equina* weaken cranberry

Entomologist Paul Robbins (inset) was one of several GENEVA staff that collaborated with the Massachusetts Cranberry Experiment Station and Ocean Spray Cranberries, Inc., to identify and utilize sex attractants to control beetle larvae that feed on cranberry roots

root systems, thereby reducing yield and vine density, and predisposing cranberry bogs to invasion by weeds. Turf beetle specialists and chemists at GENEVA collaborated with entomologists at the Massachusetts Cranberry Experiment Station and Ocean Spray Cranberries, Inc., to identify the sex attractants and explore management options utilizing them. In Massachusetts, cranberries are a $200 million industry. In New York, cranberries are a fledgling industry with significant potential.

Protecting Grapes: Determined a reasonable economic threshold, established an effective sampling method, and evaluated control methods for a new grape pest. *Lygocoris inconspicuous* feeds on the clusters and florets of grapevines, and significantly reduces grape yield. The research conducted at GENEVA and the Vineyard Research Laboratory in Fredonia will help prevent damage to New York's expanding grape industry, which produces 175,000 tons of grapes valued at $40 million each year.

DEVELOPING AND SELECTING NEW CROP VARIETIES

Evaluating Apples: Helped evaluate new apple cultivars as part of multi-state cooperative project NE-183. Researchers from 21 states and three Canadian provinces work to identify which cultivars are least susceptible to injury by insects, fungi, and bacterial diseases. They also compare the cost of production and profitability. Their objectives are to determine which cultivars are most precocious, which are superior in texture, firmness, and storage potential, and which are most 'grower friendly'. This information helps growers select more sustainable production systems. Cornell faculty manage the three NE-183 test plots in New York—one in Ithaca, one in Geneva, and one in the Hudson Valley.

GROWING HEALTHY CROPS AND SUSTAINING THE ENVIRONMENT

Reducing Pesticides in the Environment: Increased pesticide application efficiency by as much as 50 percent by improving the design of deflector plates on airblast sprayers. Biologists and agricultural engineers analyzed spray deposition and its effects on pest control. Inefficient spray technologies result in over-use of pesticides and reduced pest control. In addition to saving money, more efficient sprayers reduce the levels of pesticides introduced into the environment in vineyards and orchards.

Controlling Pests Organically: Tested multiple methods for organic production and control of pests and diseases of several crops. Methods included: a sprayable pheromone to disrupt mating of grape berry moths; the use of tydeid mites to control grape powdery mildew; the fungus *Beauvaria bassiana* to control caterpillars on cabbage; lime sulphur and fish oil to thin apples; and organic, biological, cultural, and chemical approaches to manage tarnished plant bugs in strawberries. Entomologists are also working directly with an organic apple grower to test organically approved insecticides and other innovative ways to protect apples without using conventional insecticides.

Horticultural scientist Susan Brown directs GENEVA's apple breeding program and helps manage New York's NE-183 test plots.

Fighting Plum Pox: Spearheaded the New York component of a multi-state task force to conduct a nationwide survey for Plum Pox. This highly feared viral disease affects 100 million stone fruit trees in Europe and has nearly decimated some parts of the European Union's stone fruit industry. In the US, the disease was first discovered in Pennsylvania in October 1999. The New York team was trained in collection and sampling techniques at GENEVA. They surveyed 9,050 nursery trees, 4,560 orchard trees, and 1,500 foundation trees in New York—samples that represented a broad cross-section of the state's commercial peach, apricot and plum crops. The ELISA test for the virus was also conducted at GENEVA. No sign of the virus was found in New York, but educational programs were conducted among New York fruit growers to teach them the steps needed to prevent invasion through infected nursery trees or cuttings.

Agricultural engineers at GENEVA improved deflector plates on airblast sprayers. This reduces pesticide use and increases efficacy in vineyards and orchards

APPLYING BIOTECHNOLOGY

Avoiding Resistance to Bt Crops: Developed and evaluated a model system for managing Bt crops to reduce the likelihood of insects developing resistance to Bt. The research provided the first empirical evidence demonstrating the need for and placement of non-Bt plants within a field of a transgenic Bt crop. Bt, or *Bacillus thuringiensis*, is a natural bacterium that produces a chemical lethal to important caterpillar pests of major crops. In 2000, farmers in the US planted more than 21 million acres of transgenic Bt crops. Bt plants can greatly reduce the use of broad-spectrum insecticides, but the development of insect resistance must be controlled if the technology is to remain viable.

Understanding the Impact of Biotechnology: A volunteer at GENEVA conducted an extensive survey of 93 Hawaiian papaya farmers to assess adoption of transgenic papayas by farmers in Hawaii's major papaya growing area of about 2,000 acres. The survey provided information on how their livelihoods were impacted by the papaya ringspot virus (PRSV) and the subsequent introduction of transgenic PRSV-resistant papaya. This research is one of the first to critically measure the impact of a genetically engineered crop on farmers' lives. Hawaii's fresh papaya production fell from 55.8 million pounds in 1992 to 35.6 million pounds in 1998 because of PRSV. Transgenic papaya developed at Cornell and the University of Hawaii was commercialized in 1998, allowing farmers to replant the transgenic virus-resistant variety on land previously infected with the disease. In 1999, papaya production increased for the first time since 1992.

Carol Gonsalves (left) conducted a survey of Hawaiian growers like William Julian (right) about adopting transgenic papaya on their farms.

ENSURING A SAFER FOOD SUPPLY

Making a Safer Cider: Tested additives to eliminate *E. coli* from apple cider. *E. coli* O157:H7 is the pathogenic form of the bacterium *Escherichia coli* and can cause sickness or, in extreme cases, death. Research showed that a 100,000-fold reduction in *E. coli* O157:H7 in cider is feasible with the addition of sulphur dioxide and dimethyl dicarbonate.

Food scientist Randy Worobo examines microbiological plates for fluorescent proteins and pathogenic bacteria associated with food safety.

Following Fluorescent Proteins: Genetically engineered production of a green fluorescent protein in pathogenic strains of *E. coli* and *S. typhimurium* for use in studying the survival of these human bacterial pathogens in manure and foods. Results indicate that the holding time of 60 days suggested by the EPA is not adequate to achieve the required 100,000-fold reduction in either of these pathogens.

ASSURING HIGH QUALITY FOODS

Improving Red Wine in the Northeast: Hosted the New York Wine Industry Workshop, attended by grape growers and wine producers from across the Northeast. In 2000, Cornell researchers and extension educators focused on red wine in the Finger Lakes, particularly Pinot Noir. The workshop covered wine tasting, production methods, business advice and presentations of new research into wine color, taste, diseases, and vineyard location specific to New York.

Increasing the Quality of Processed Fruit: Studied several methods for improving the shelf-life of fruit. A series of different organic acids, ascorbic acid derivatives, cysteine derivatives, and phenolic acids were evaluated for their ability to prevent browning in fresh-packaged apples. A combination of ascorbic acid and heat-shock treatment improved the color and firmness of fresh-cut apple slices and shelf-life. Pre-canning processes to maintain firmness in canned plums were also evaluated. Low temperature pasteurization produced the best quality plums. Osmotic dehydration was studied to improve the quality of dehydrated sweet cherries. Immersing the cherries in concentrated sugar solution for

initial water removal produced plumper, tastier fruit.

No Hazing Allowed: Characterized proteins responsible for the formation of haze in apple juice and determined their amino acid composition. Haze activity was found to correspond to the proline percentage. Also developed a practical method for the determination of haze-forming protein in beer.

Food chemist Karl Siebert evaluates beer for clarity and haze activity.

Fostering Economic Development

Cultivating New York Cider: Hosted the Northeast Cider Producers' Workshop on "Approved Processing Options for Safe Apple Cider Production." Hands-on demonstrations of the proper sanitation practices at each stage of cider production included the different processing options currently available to cider marketers to ensure a safer and more wholesome product. Over 70 cider makers learned about new processes like the treatment of cider with UV light—a procedure developed at GENEVA in cooperation with an engineer in the private sector. UV achieves the same results as pasteurization without affecting taste.

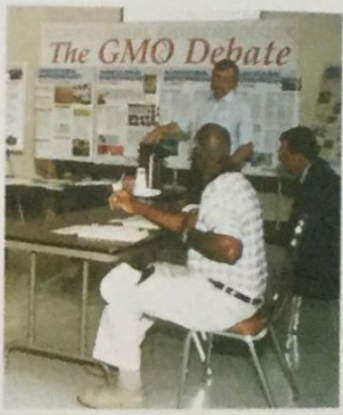
Founding a Northeast Center for Food Entrepreneurship (NECFE): Funding was provided by the USDA Fund for Rural America to establish a $3.8M center that augments the activities of the NYS Food Venture Center at GENEVA, and the Center for Food Science at the University of Vermont in Burlington. NECFE's mission is to provide comprehensive assistance to beginning and established food entrepreneurs and promote sustainable economic development of rural communities. NECFE offers assistance in business and product/ process development, product safety, process/product technology transfer and product commercialization.

Developing Value-Added Products and Processes

Ribbon Cutting at the New V&B Lab: Opened Cornell University's Vinification and Brewing Technology Laboratory—the latest in university/ industry partnerships on the part of GENEVA. The 2,000 sq. ft. facility is specially designed for wine making and brewing studies. Previously, the 10,000 sq. ft. Fruit and Vegetable Processing Pilot Plant at GENEVA was used for fermentation studies. The Cornell Enology Program outgrew the Pilot Plant because of increased demand for applied research and education. In the last 25 years, over 150 farm wineries have been established in New York. In 2000, they attracted over 2.7 million visitors. The V&B Lab will enable GENEVA to properly serve this rapidly growing industry.

Reaching Out to Educate

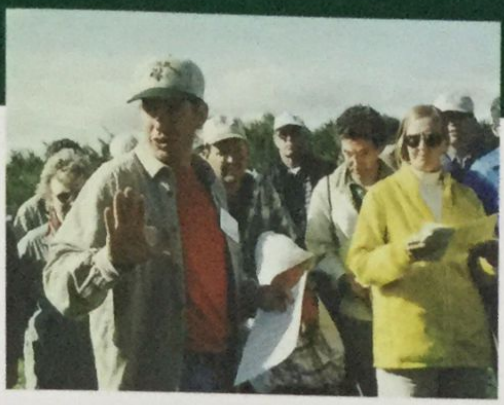
GMOs on Tour: Eight two-hour discussions were held at GENEVA in July with local community leaders and staffers from legislative and budget offices in Albany to increase their understanding of biotechnology and genetically modified organisms (GMOs). After a tour of a local apple



Plant pathologist Herb Alduinckle talks to local community leaders and legislative staffers about GMOs.

orchard severely damaged by a bacterial disease called fire blight, the groups learned how genetically engineered crops could solve long-standing agricultural problems like fire blight that have defied all conventional solutions. Posters and a booklet about the issues involved in the current debate were produced and distributed.

The establishment of the Cornell Vinification and Brewing Technology Lab at GENEVA was the result of support from the Station, Cornell, statewide wine and beer industries, state legislators and Governor Pataki. Represented at the facility's ribbon cutting on March 30, 2000, were: (l-r) Station Director James Hunter, Ann Martini of the Seneca Lake Wine Trail, Senator Mike Nozzolio, Kathy Russell of AFTEK Filters, and Dean Daryl Lund.



Entomologists, plant pathologists, food scientists, and horticulturists like Courtney Weber (center) explain their work with fruit to growers and visitors during Cornell's Fruit Field Day.

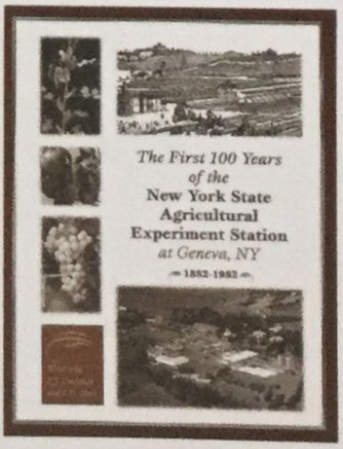
Fruit Field Day: Hosted the Cornell Fruit Field Day and equipment show in August. More than 425 fruit growers, consultants, and industry personnel toured field plots at GENEVA to learn about the latest research and extension in fruit production. The focus was on key commodities in New York's $300 million fruit industry—apples, grapes, raspberries, strawberries, peaches, pears, cherries and nectarines. The event also included demonstrations of farm equipment, including pesticide sprayers that maximize spray effectiveness while reducing overall volume and waste.

Helping High School Students Conduct Scientific Research: Mentored research by Emily Postner, a sophomore from Suffern High School. Starting in 1998, an entomologist at GENEVA helped Posner with a three-year applied research project on pheromone trap placement for the European cornborer moth. Posner's paper earned her a semi-finalist position and $1,000 in Intel's Science Talent Search in 2000. She was also selected as a finalist to present her research at the NYS Science & Humanities Symposium. Posner is now a Cornell student, class of '04.

Turfgrass 'Bible': Wrote the second edition of *Turfgrass Insects of the United States and Canada*. The first edition, written by a GENEVA entomologist and released in 1987, is the "bible" of the turfgrass industry and the manual of choice among golf courses from Pebble Beach to Silver Creek. Original author Haruo Tashiro, along with his successor at GENEVA, Michael Villani, and their counterpart at the University of Massachusetts, Patricia Vittum, updated information on integrated pest management, principles of biological control, sampling techniques, setting thresholds, the ecology and biology of turfgrass pests, and chemical control strategies.

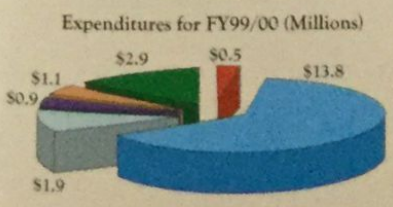
Entomologist Charles Lynn and high school student Emily Posner check a pheromone trap to monitor corn borer infestation.

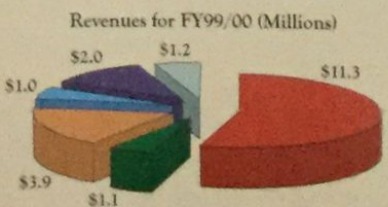
Expanding the History of Agriculture: Published *The First 100 Years of the New York State Agricultural Experiment Station at Geneva, NY: 1882-1982*. The 310-page book represents a substantial contribution to the history of Cornell and the history of agriculture in New York. It is more than the story of seed, hoe and plow. The book details how researchers at GENEVA have worked since 1882 for growers and food processors to develop new varieties and methods of growing crops; address cultivation, disease and pest problems; and solve food processing and safety problems.



Entomologists P.J. Chapman and E.H. Glass completed a history book on the first 100 years of the Agricultural Experiment Station.

JULY 1, 1999-JUNE 30, 2000





Discovering Fundamental Knowledge for Future Applications

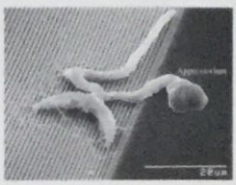
Kathy Poole is a member of a team of entomologists that succeeded in the first interspecies surgical transplant of antennae buds between corn earworms and tobacco budworms. (Circle inset) The head of a corn earworm larva as seen through a dissecting microscope shows the two buds, left and right. (Inset left) The corn earworm as seen with the naked eye shows the head on the left.

Studying Moths to Better Understand the Human Olfactory System: Succeeded at the first-ever interspecies surgical transplant of imaginal disks of two moth species, the tobacco budworm and the corn earworm. The imaginal disk develops into the antennae of an adult moth. After a successful transplant, scientists observe the development of the antenna and glomeruli—a region in the brain used for processing olfactory signals from the antennae—and test the adult moth to better understand how the brain processes the sense of smell. The research is funded by the National Institutes of Health.

Expanding the Apple Gene Pool: Continued to obtain a diverse collection of *Malus* apples for breeding purposes, as scientists collected over 30,000 wild apple seeds during a 3,500-mile trek through Turkey. Six previous trips into the centers of origin for apple were undertaken in the 1990s, including ones to Central Asia, China, and the Russian Caucasus mountains near the Black Sea. The trip to Turkey involved collaborators at the Station and the USDA-ARS Plant Genetics Resources Unit at Geneva. It was funded by the Plant Exploration Fund of the United States Department of Agriculture's Agricultural Research Service. Plant breeders collect wild germplasm in order to maintain genetic diversity that has evolved through natural selection over thousands of years. When a new problem such as a disease or insect attacks commercial apple varieties, scientists search germplasm collections for genes to use in breeding more resistant varieties.

Cornell graduate student Elizabeth Dickson (left) and USDA horticulturist Phil Forsline (right), who is stationed at Geneva, characterize wild apples in Turkey.

Nanobiotechnology Research: Developed nanofabricated surfaces and devices to study how pathogenic fungi interact with cells of their host. Of particular interest are how: 1) fungal spores adhere to the substratum and are signaled to germinate, 2) fungal growth is guided by topography, and 3) fungal infection structures are signaled to form. Methodologies to replicate silicon-based submicron scale features into polymeric materials (e.g., polystyrene) have also been developed. Researchers at Geneva are co-principle investigators in the Nanobiotechnology Center administered by Cornell University. Funding from the National Science Foundation for the Center is more than $20 million over a five-year period.



Scientists are studying the fungus Colletotrichum graminicola *to better understand how infection structures called 'appressoria' develop on plant surfaces and lead to disease. One approach (shown above) is to use micro-fabricated surfaces prepared in silicion in which the surface topography can be precisely controlled, in this case with the fabrication of 1.0 µm diameter 'pillars' spaced 1.0 µm apart to mimic structures on plant surfaces.*

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