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Research for Connecticut by the Storrs Agricultural Experiment Station

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Recommended Citation

"Research for Connecticut by the Storrs Agricultural Experiment Station" (1977). *Storrs Agricultural Experiment Station*. 72.
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Research for Connecticut



by the Storrs Agricultural
Experiment Station

Research Report 47 September 1977

COLLEGE OF AGRICULTURE AND NATURAL RESOURCES
THE UNIVERSITY OF CONNECTICUT, STORRS

OUR AGRICULTURAL SCIENTISTS OFFER A BETTER WAY.....

The Agricultural Experiment Station at Storrs, Connecticut, is now in its 90th consecutive year of seeking to develop knowledge for the betterment of society. It operates under the provisions of the Hatch Act passed by the U.S. Congress in 1887, which ensured scientific research in agriculture through establishment of experiment stations in each of the nation's Land-Grant Universities.

W.O. Atwater, Station director, ably expressed its purpose in his first annual report to the people of Connecticut. "... is both to investigate and to teach; that its duty is to select for study such questions as are of the most immediate and practical importance in the State..." "... that the most valuable results will be obtained by selecting a small number of questions for investigations, by making them narrow and specific, and by studying them with the greatest possible thoroughness." This purpose is as valid now as it was in 1887, although today our program is much more extensive than in the first years of the Station's existence.

The range of studies has extended beyond those of traditional production agriculture and now include investigations that serve the social, environmental, and economic needs of the rural and urban areas. Our research projects are under constant review in an effort to respond to the changing needs of consumers, farmers, and agricultural related business enterprises in Connecticut.

This report describes some of the current research projects at the Storrs Agricultural Experiment Station. We hope that you will enjoy reading it.

E.J. Kersting
Dean and Director
College of Agriculture and Natural Resources

J.J. Lucas
Assistant Director, Storrs
Agricultural Experiment Station

Lower Food Costs In New England Linked to Connecticut Study

By William J. Hanekamp
Research Associate and
Dr. Stanley K. Seaver
Professor of Agricultural Economics

A unit-train elevator transshipment approach has been proposed for New England's grain marketing system, with the use of multi-storage sites by the authors of this article. Our approach could help in lowering the high rail costs of shipping feed grains from the Midwest to New England farmers and result in cheaper prices consumers would pay for dairy and poultry products.

Support for this study comes through a competitive grant of \$80,000 from the U.S. Department of Agriculture's Cooperative State Research Service and another \$25,000 grant from the New England Regional Commission. The latter is an organization of the governors of the six New England States.

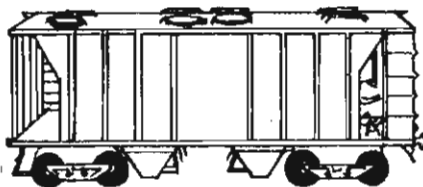
Over the years, the economic burden resulting from the financial decay of the Eastern railroads has weighed heavily on New England agriculture. Efficient and reliable service to the rural districts of the region deteriorated, while the cost of rail service rapidly spiraled. Together these two factors have contributed to the high cost of agricultural production in New England.

The dairy and poultry farmers were the agricultural producers most affected by rising cost of railroad service. As the principal income-earning sector of agriculture, the financial position of the livestock sector was and still is important to New England. In 1975 alone gross farm income from the sale of milk and egg products amounted to 700 million dollars.

But with the escalating of transportation costs, the future profits to the region's livestock farmers are in jeopardy. The Connecticut economists noted that during the decay of rail service, rail rates to move bulky agricultural products into the northeast are the highest in the nation.

For example, in April 1975 it cost farmers \$13.78 to have a ton of corn shipped from East Lansing, Michigan, to Manchester, Connecticut. The shipping distance was 724 miles. At a similar distance -- 709 miles-- it cost farmers only \$8.36 to have a ton of corn shipped from Cincinnati, Ohio, to Valdosta, Georgia. This is 60 percent below the northeastern rate!

Competition for the eastern markets is intensifying and the further decline of New England's market share seems evident, due in part to existing rail service



and tariff pricing policies. Clearly, then, reform and modernization of the transportation and marketing system of New England agriculture is now needed to keep existing farmers in business.

The Connecticut Proposal for Reorganization: 1977

The general solution proposal entails the use of a unit-train grain elevator transshipment approach for the reorganization of the grain marketing system of New England.

Under the existing grain marketing system, small car lots of grain (generally 3-cars) are shipped to individual feed mixing plants. Movements in small lots make rail delivery extremely costly. The

cost of shipping grain in 3-car lots is 30 to 50 percent higher than the bill to transport grain in 50 to 100 cars in these large unit-train shipments.

With the construction of grain elevators designed to receive unit-train shipments of grain, the cost economies of rail delivery can be enjoyed by the regional feed processing industry and the livestock sector it serves. To realize such cost efficiencies, reorganization of the delivery, storage, and distribution patterns of grain stocks in New England is also a necessity.

The Plan for New England

A multi-site framework seems optimal for implementing the unit train-grain elevator system in New England. Subterminal sites would ideally include establishment of grain elevators in northern Vermont, Maine, Massachusetts, and Connecticut. For each site, the proposed elevator operations would become the principal receiving point of all shipments of grain, the district grain storage facilities, and the distribution centers for the delivery of raw grain to surrounding grain dealers and feed mixing plants of the district.

The cost to underwrite this grain subterminal program involves both the capital investment in facilities and the financing of annual operating expenditures. Funds totaling 5.85 million dollars will be needed to construct new grain elevators. In addition, capital outlays of 3.2 to 3.8 million dollars will be needed for operating expenses for the quadterminal system.

Feasibility of Implementation

Identification of the financial, locational, and structural parameters to institute a rail delivery plant to move trainload lots of grain represents only the first stage in developing a modern grain marketing system for New England.

Also important to the success of the plan is the establishment of a rail rate structure that offers grain receivers and users of the region an economic incentive to adopt the direct trainload program. Without an economic incentive, the program is destined to fail.

According to research data in the University of Connecticut plan, a net rate reduction of 25 percent is the break-even

position of the unit train program. But for the agricultural sector of New England to accept the risk of financing the plan, additional savings will be needed to supply the economic stimulus for implementation.

The break-even level for implementation is noteworthy, since it falls within rate reductions resulting from unit train programs in other regions of the United States. Although such rate reductions are not guaranteed by the rail carriers of New England, it still adds a measure of creditability to the proposed unit train-grain elevator reorganizational plan. If rate reductions are comparable to those of other U.S. regions, the Connecticut plan becomes a viable alternative worthy of consideration by grain users in New England.

What's more, results of the Connecticut study would fill a void in the information needed by ConRail to implement an equitable service and pricing plan.



Agricultural Economists Study Rural Land Use In An Urbanizing Society

By Dr. Irving F. Fellows
Professor of Agricultural Economics

A conflict of interests has arisen over the use of land in the Northeast. Should private goals expressed through the market place determine the land use policy of the Northeast, or does the public have important objectives of land usage that should be recognized?

To try and answer this question, researchers at agricultural experiment stations in seven northeastern land-grant universities have coordinated efforts to study rural land use in an urbanizing society. They believe that wise use of open space land in rural areas can accommodate both private and public goals for land use. Moreover, not only can the local population be assured of a substantial nearby source of healthful foods through wise land use but also essential physical

and aesthetic aspects of an improved environment can be realized.

This project began in 1973 in an effort to evaluate selected land use policies to achieve orderly development of rural land. Various alternative methods were identified, their legal and administrative feasibility were identified, and the social and economic impacts of these methods were estimated. Existing techniques and new methods and institutions were studied.

Research in Connecticut centered upon two new institutions: use-value assessment of rural land for property taxation purpose and the purchase by the state of development rights easements on land plots.

Historically, real property assessments for taxation were based upon market value as determined by comparable sales between a willing buyer and a seller in a

freely developed transaction. In an underdeveloped area, the market value typically reflected the economic productivity of the land in agricultural use.

In an urbanizing society, market value typically reflects the economic productivity in residential or commercial use. Market value assessment procedures tend to force open land into intensive use and hasten the destruction of a food production base and of environmentally desirable usage.

Once the problem area was researched, use-value assessment techniques were developed and applied on farm, forest, and open space land in Connecticut. The procedure, which relates assessment to the earning capacity of the land in specific uses, reduced the pressure to shift rural land into urban development, and stimulated land use in the area of broad social goals.

Revised assessment procedures can coordinate public and private land use goals over a short-term period of about 5 to 30 years, but more powerful techniques are needed to achieve long-term coordination. The separation of development rights from the group of rights conveyed by deed to the current owner of rural land is one promising technique. If a local or state government were to purchase development rights easements from the owner, intensive use of the land could be prevented and the owner would not be penalized by having the value taken away.

Research was conducted to determine the social and economic feasibility of an easement-purchase program to preserve prime agricultural land -- a scarce, non-renewable natural resource and one subject to the greatest development pressure. Through this work, an area in Connecticut was selected as a place to study on-site problems of an easement-purchase program. Criteria were developed to select areas to be preserved, the type and availability of technical information needed to apply such criteria were appraised, and the resultant costs and benefits were estimated. The concepts leading to a proposed statewide program were the result of this research.

Additionally, other techniques were researched by agricultural economists at other northeastern agricultural experiment stations. Results will be presented and comparisons will be made upon completion of the regional project in 1978. At that time, citizens and their governmental agencies will have a better basis from which to make decisions on rural land use policy in an urbanizing society.

Can Leaf Lettuce Be Grown Under A Controlled Environment ?

By Ralph P. Prince Head,
Department of Agricultural Engineering,
and John W. Bartok, Jr., Research
Associate in Agricultural Engineering

FOR THE PAST THREE YEARS AGRICULTURAL ENGINEERS AND PLANT SCIENTISTS AT THE UNIVERSITY OF CONNECTICUT HAVE BEEN INVESTIGATING A LEAF LETTUCE GROWING SYSTEM WHICH UTILIZES THE BEST OF MANY GROWING SCHEMES.

"Controlled" and "environment," when used in relation to growing vegetables, mean that the atmosphere surrounding a plant is being maintained. Romans controlled growing conditions to some degree, and so has every generation since. The environment is modified to obtain better yields, accelerate growth, improve quality, decrease space needs, and provide uniformity of product. The objective is to provide optimum conditions for the best plant growth.

Methods and techniques used to grow vegetables and to maintain temperature, light, and moisture changed markedly with the advent of the greenhouse. This simple structure made it possible to grow some vegetable crops year-round. Cultural and management technologies have, in general, kept up with advances in greenhouse design.

Agricultural engineers and plant scientists at the University of Connecticut have carried the plant culture and environment control concept one step further. For the past three years, they have been investigating a leaf lettuce growing system which utilizes the best of many growing schemes. In this system light, temperature, moisture, carbon dioxide, and plant nutrients are controlled. Timers, switches, thermostats, and pumps are used to regulate these growth parameters.

Three growing shelves, each 4 by 24 feet, are spaced vertically 2 feet apart. Fluorescent lamps mounted over each shelf provide light for the plants and heat for the entire system. The nutrient solution is pumped to and distributed on each shelf continuously. This system attempts to fit the plant to the space it needs for optimum growth. The plants are advanced along a sloping shelf each day. At first the plant needs little space but as it grows, the space it requires increases exponentially. A spacing mechanism is used to advance the plant accordingly.

Lettuce is grown from seed in 2-inch diameter plastic cups filled with pea stone. These cups are spaced 6 inches apart in a rack that spans the width of the shelf. These racks are spaced close together during the initial growth period and then further apart, as the plants increase in size. The plants occupy little space until they are 24 to 26 days old. They are harvested at 34 days. Each plant occupies an average of 12 square inches of shelf space during its growth period. In a greenhouse, about 36 square inches of space is required per plant.

To date all of our work has been accomplished in a growth room environment under artificial light using a continuous liquid nutrient flow technique. This has enabled us to develop the cultural practices, environmental controls, and the mechanical spacing devices necessary for increased plant growth.

Performance of the growing system can be measured in terms of production rate and cost per unit or weight per unit of shelf area per year. Our records show for one controlled experiment, an average yield of 0.45 pound per plant in 34 growing days from seed to harvest. Light level was maintained at 16,000 lumens per square meter during the 16 hour day and the atmosphere was enriched with 1,000 ppm of carbon dioxide. Day and night temperatures were 75 degrees F and 65



Lettuce on shelf is being grown in the gravel substrate and is being watered continuously from below.

degrees F, respectively.

This variable spacing soilless culture growing system could be adapted to other crops and to greenhouses with minor modifications. Because of varying light levels and changing day length in greenhouse operations, adjustable spacing devices will be required.

A preliminary feasibility study has shown that combining the growth room with an energy efficient greenhouse may prove to be more economical than either unit operating alone. Based on this study and results obtained using the controlled environment technique, we propose to construct a growth room and a greenhouse as an integral unit orienting the structure East-West to allow the double, plastic-covered greenhouse to face South. To conserve heat all walls around the growth room will be insulated heavily and nighttime heat retaining curtains will be used in the greenhouse.

The combined unit will be sized so that the heat given off by the fluorescent lamps in the growth room will maintain the proper temperature in the greenhouse. Additional heat that may be required will be furnished by an inexpensive solar collector, with warm water storage beneath the greenhouse floor. Such a system may also be used to help cool the



Ralph Prince, left, and John Bartok make reading of light intensity on a shelf containing lettuce plants.

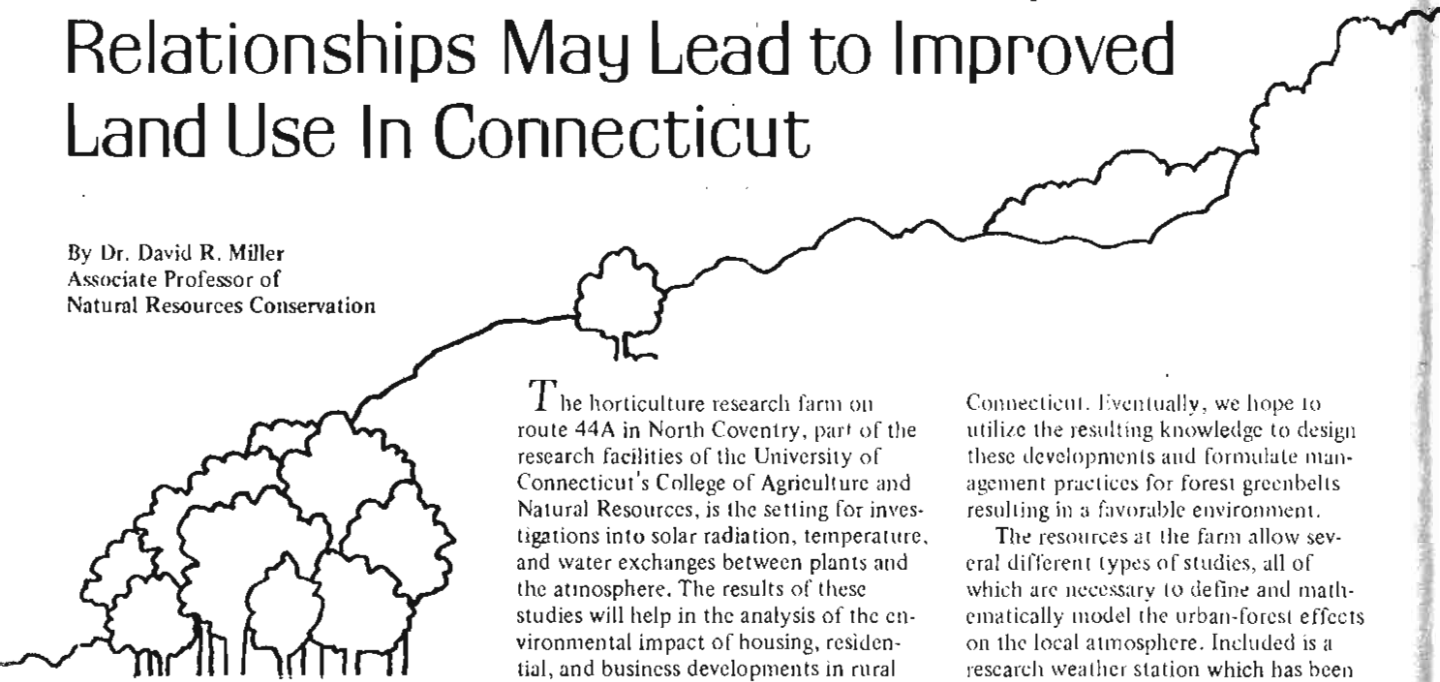
unit during the summer.

Although some plants will be grown to maturity in the growth room, most will be transferred to the variable spacing benches in the greenhouse at about 18 days of age where they will be grown to maturity.

We need to explore further all of the heat-conserving measures and assess the contribution each makes to the total. This will provide us with production costs and the amount of nonrenewable energy resources actually required for the system.

UConn Studies of Plant-Atmospheric Relationships May Lead to Improved Land Use In Connecticut

By Dr. David R. Miller
Associate Professor of
Natural Resources Conservation



The horticulture research farm on route 44A in North Coventry, part of the research facilities of the University of Connecticut's College of Agriculture and Natural Resources, is the setting for investigations into solar radiation, temperature, and water exchanges between plants and the atmosphere. The results of these studies will help in the analysis of the environmental impact of housing, residential, and business developments in rural

Connecticut. Eventually, we hope to utilize the resulting knowledge to design these developments and formulate management practices for forest greenbelts resulting in a favorable environment.

The resources at the farm allow several different types of studies, all of which are necessary to define and mathematically model the urban-forest effects on the local atmosphere. Included is a research weather station which has been

operating at the farm continually for more than 20 years. Continuous records are taken on solar radiation, wind speed, wind direction, precipitation, evaporation, and air and soil temperature.

Solar Radiation Study

Solar energy is the most important climactic factor, and we are interested in its availability in Connecticut to replace conventional sources of energy. Optimum use of solar energy requires knowledge of the amount of radiation on various slopes, direction of slopes, and geographic latitudes.

A cooperative study with a forest meteorologist from Yale University is in progress at the weather station. Here, we are using standard solar radiation data which has been collected over a ten-year period, together with new information derived from periodic field experiments. These experiments involve field measurement of diffuse, reflected, and direct solar radiation at various topographic slope angles (Figure 1). Several different types of radiation instruments are being used (Figure 2). The information obtained will be used to test mathematical models and to calculate the atmospheric transmission of solar radiation from space to the earth's surface in Connecticut.

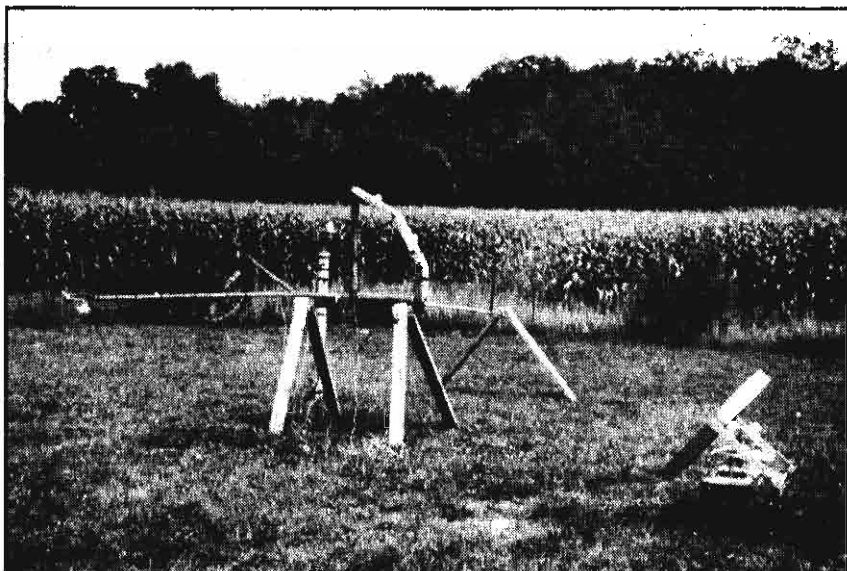
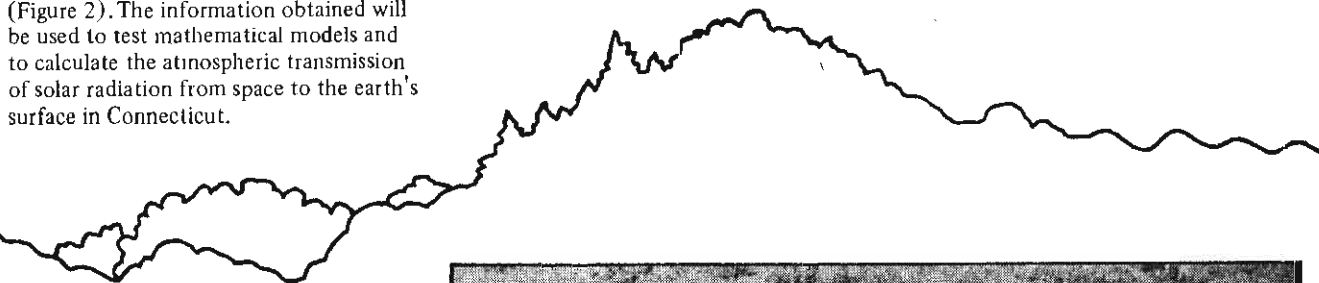


Figure 1 - An array of solar radiometers is being used to study atmospheric transmission of solar radiation.



Frost Pockets and Cold Air Drainage Studies

Connecticut's frequent calm, clear nighttime conditions together with its topography produce extreme local climactic conditions, such as intense valley inversions which increase air pollutant concentrations, frost pockets, and fog intensities. The farm's historical weather records let us study these various weather phenomena.

The long-term nighttime temperature records from the farm, which is at the bottom of a valley (elevation 485 feet), are being compared to the temperatures recorded at the UConn agronomy research farm, which is on a hilltop (elevation 670 feet), a few miles away in Storrs. The valley minimum temperatures range up to 18 degrees F colder than the hilltop temperatures on occasional nights

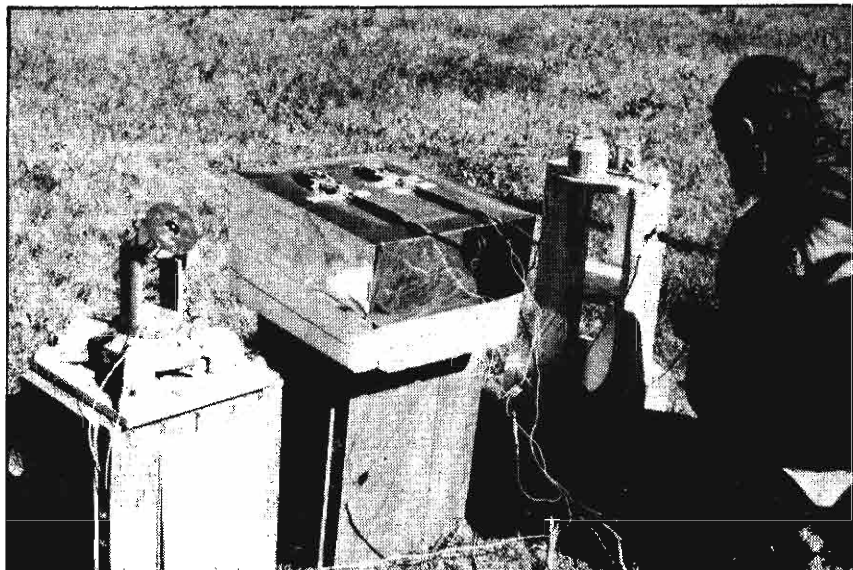


Figure 2 - Various kinds of solar radiation instruments are being calibrated to insure their accuracy at the horticulture research farm.

and averages 4.5 degrees F colder. Annually, this is equivalent to approximately 15 percent higher heating requirements for buildings in the valley.

The intensity of the frost pocket is related to wind speeds, overall air temperatures, the intensity of radiational cooling, and nighttime cold air flow off surrounding slopes. A study on the east side of Horsebarn Hill in Storrs supplies information on the effects of vegetation on the hillside's cold air flow. This will be analyzed with the horticulture farm data to determine if hillside vegetation and man-made structures can be managed to control the cold air flow processes and change the frost pocket temperatures and growing season lengths.

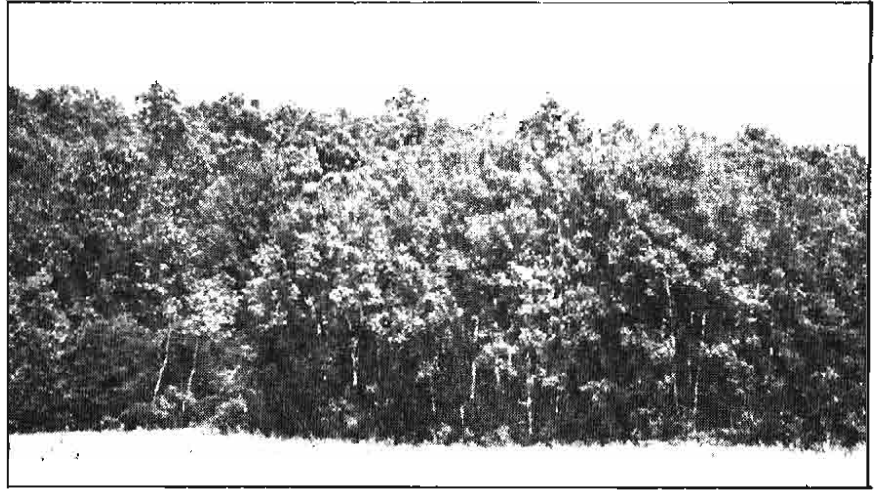


Figure 3 -- Pictured is the mixed Hardwood experimental forest at the horticulture research farm.

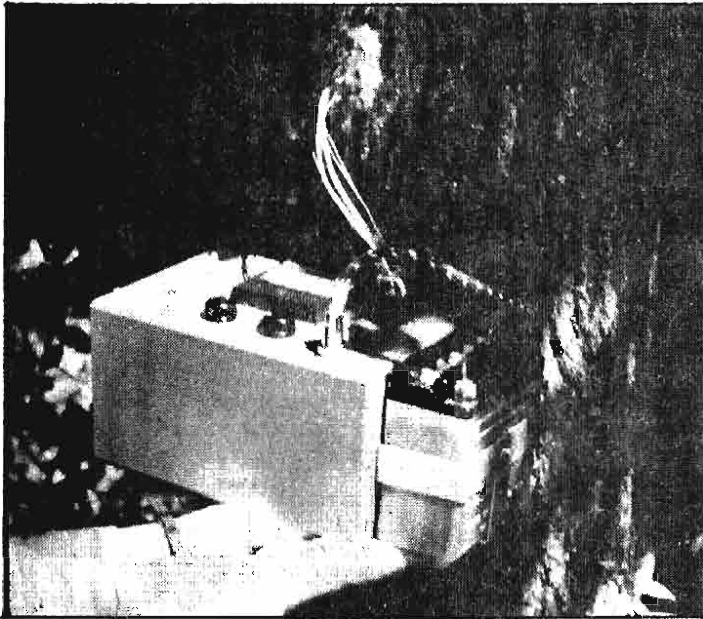


Figure 4 -- Sap movement is measured in a mature Black Oak to determine transpiration rates.

Figure 5 -- A tank is constructed around a 20-inch diameter, 80 foot tall experimental Black Oak from which water and dye tracers are taken up by the tree in the transpiration studies.

Water Use by Large Trees Studies

We suspect that trees and blocks of trees play a major role in the urban climate and hydrological cycle. In order to determine these roles the transpiration (water use) characteristics of the mature trees are being studied, in cooperation with scientists from the Northeastern Forest Experimental Station of the U.S. Forest Service and the University of Arizona, at the horticulture farm.

The large area of mixed Hardwood forest at the horticulture farm (Figure 3) provides an excellent selection of exper-

imental trees to carry out the investigations. Tree sap movement (Figure 4), and water use and dye tracers from specially designed tanks (Figure 5) are used to test models of transpiration in large trees.

Once we can measure the transpiration

(water use) rates of mature trees, we will be able to determine water vapor movement in the urban forests. Then mathematical models will be used to determine the best designs for urban-suburban developments and forest greenbelts.

Recycling Sewage Sludge Can Nourish the Land

Two agronomy professors at the University of Connecticut are studying the utilization of sewage sludge as a source of plant nutrients.

Dr. R. William Wengel, professor, and Dr. Gary F. Griffin, associate professor, state that sludge -- the solids portion from treatment plants -- contains several plant nutrients. The annual nutrient content of sewage produced in the United States is approximately 1.6 billion pounds of nitrogen, 0.7 billion pounds of phosphorus, and 0.8 billion pounds of potassium. It represents an appreciable percentage of fertilizer nutrient consumption in this country.

This research is designed to measure the crop uptake of nutrients and the movement of soluble sludge constituents through the soil. The emphasis is on management of sludge application on agricultural land to prevent potential pollution and on utilization of this resource for plant nutrient content. This project is being conducted under the research program of the UConn Institute of Water Resources.

The application of sewage sludge on agricultural land presents two problems, say Drs. Wengel and Griffin. One concerns the amount of sludge needed per acre to supply the proper amounts of nutrients for crop growth. The other concerns the potential pollution of crops, and ground and surface waters resulting from sludge usage.



Besides the basic plant nutrients already mentioned, sludge contains quantities of micro-nutrients such as copper, manganese, and zinc and other heavy metal elements such as cadmium, lead, and nickel. At the high rates of land application necessary to supply nitrogen and phosphorus for a corn crop, there may be an excess of heavy metals supplied.

An excess of heavy metals may cause toxicity to plants and also to animals consuming them. There may also be downward movement of these metals through the soil and into the water supplies with the same potential effects.

To date, after one growing season, sludge has proven to be a fine source of nutrients for growing crops. No adverse uptake of heavy metals has been found. Soil samples are being analyzed to study movement of metals in the soil, but results are presently incomplete.

It is anticipated that at least four years of study will be needed to answer the question of how to manage soil applications of sludge to prevent buildup of potential pollutants in the soil-plant system.

Mycorrhizal Development Study May Lead to Lower Costs and Better Plant Quality

Most plants that grow in soil environment are living in a symbiotic and even essential relationship with certain fungi. These fungi, growing on and in the roots of plants, provide uptake of nutrients, protection against disease, and stimulation of growth.

The ecology of this fungus -- root, or mycorrhiza system, however, is still poorly understood. A greater understanding would give plant growers the opportunity to cultivate the most efficient fungus-

plant system which would probably result in lower production costs and/or better plant quality.

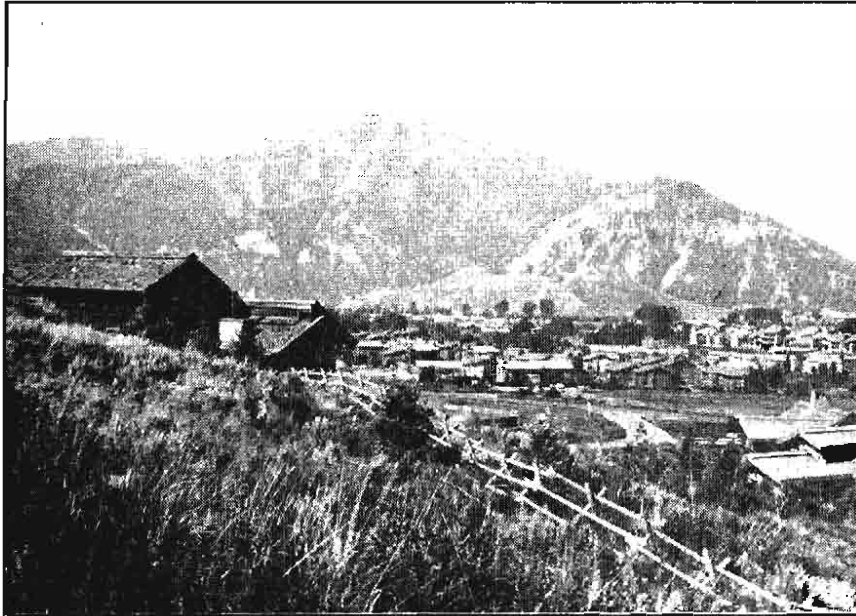
One ecological factor that is controversial in its effect upon the mycorrhiza is the organic matter fraction of the soil. To more fully understand the impact of this factor, Dr. A.J. Robert Guttay, professor of agronomy, devised an experiment to test the effect of three contrasting types of composted plant residues upon the development of mycorrhizae.

Sugar maple leaves and twigs, eastern hemlock leaves and branches, and field corn plants were collected, shredded, and composted in 1974. Sugar maple, eastern hemlock, hybrid field corn, and rhododendron were planted in containers of each compost type in 1975 in a three-year experiment.

The growth rate and height of plants are being measured after each flush of growth. Root samples are collected annually to be microscopically checked for mycorrhizal development. Compost samples are taken at the time of each root sampling and are analyzed for inorganic nutrient status and for changes in the organic constituents.

The data are still being collected and analyzed. Preliminary review of data indicates that a differential effect does occur in mycorrhizal development and plant growth in the different plant residues. Hopefully, new understanding will come from this research. As with all research, however, it is likely to create more questions than answers.

Outdoor Recreation Growth Has Economic Environmental Impacts



Pictured are year-round second homes at Sun Valley, Idaho. Idaho is one of several Western states participating in the University of Connecticut recreational study.



Shown is a typical summer second home in New England.

By Dr. Marvin W. Kottke
Professor of Agricultural Economics

Last year over 28 million Northeasterners took recreational trips to the mountains, lakes, seashores, forests, and rural areas. Approximately 50 percent of the population travels to natural resource environments to participate in outdoor recreational activities yearly.

This annual migration of urbanites and suburbanites to rural areas and back-country causes major economic impacts, both adverse and beneficial, to the transient and destination communities. Jobs and businesses are created while land, water, and forest resources are transformed and sometimes abused, polluted, and "urbanized."

The Department of Agricultural Economics is conducting research on economic problems involving the outdoor recreation market and its use of natural resources by participating in two regional research projects involving 22 Northeastern and Western states.

One project is entitled "Recreation Marketing Adjustments in the Northeast." The major objectives of this study are: (1) to determine the extent to which perceived recreation marketing adjustments are taking place and how they relate to changing socioeconomic conditions; and (2) to evaluate and measure the impact of recreation marketing adjustments on regional economies. A forward-looking approach will be used to anticipate future recreation market trends and to identify the locations most likely to experience imbalances of supply and demand.

In the other study, "Determinants of Choice in Outdoor Recreation," Connecticut has joined 10 Western states in research to estimate the effects of energy-related variables on the outdoor market.

When people travel and congregate in

places away from home they carry their basic needs for food, clothing, and shelter. In varying degrees, all vacation and recreational trips involve a consumer demand for food and lodging. Clothing is usually brought from home, but the majority of tourists and recreationists depend upon restaurants, motels, lodges and second homes to satisfy their food and lodging needs during leisure activities.

These basic needs have a major impact on resource use -- actual participation in recreation activities has a minor impact. For example, it is not swimming itself that affects a natural environment and a local economy -- it is the cottage the swimmer uses for eating and sleeping that makes the impact. It is as important to study the demand and supply relations for recreational lodging facilities as it is to study the changing participation rates in recreational activities.

As a first step in the research, the author conducted a mail survey of 4670 households in the Northeast in Fall 1976. The purpose was to obtain representative data for estimating the time people spend doing various outdoor recreational activities, the type of lodging used on trips, the cost of travel and lodging, the locations visited, and relevant socioeconomic characteristics.

Information derived from this survey



will be used to establish a base period representation of the Northeastern outdoor recreation market structure. Then mathematical programming will estimate the projected recreation participation level and the spatial distribution of lodging facilities for a future target date. The projected information will then be used to identify the locations most likely to experience significant economic and environmental impacts.

Some preliminary results are available

from the 1976 Northeast Outdoor Recreation Survey. The data indicates that people who take recreational trips (about 50 percent of the households), take 3 to 4 trips a year and spend about 15 days a year on such trips. Half of the people use motels or lodges on recreational trips; the other half is split almost evenly between using second homes or camping equipment.

Naturally, there are advantages and disadvantages to each type of recreational lodging facility. Second homes offer privacy and accessibility to recreational resources but are relatively expensive. Motels offer flexibility and convenience but are moderately expensive and heavily booked during the peak recreational periods. Campgrounds offer flexibility, accessibility to recreational resources, and inexpensive lodging, but are frequently over-crowded and lack privacy and conveniences.

Perhaps the most important difference between the three types of recreational lodging is the intensity at which they use natural resources. Campgrounds, for example, use land resources much more intensively than second homes.

In 1976, there were approximately

1,150,000 second homes located in the Northeast. In contrast, there were only an estimated 3200 campgrounds in the Northeast with a total capacity of 235,000 campsites in 1976 -- almost five second homes for every campsite in the Northeast.

Yet, the number of families using campgrounds in the Northeast runs more than 2,750,000 a year, while the number using (owning and renting) second homes

runs about 2,500,000 per year. In other words, the rate of use is about 12 families per campsite, compared to 2 families per second home. Not only is the turnover greater in campgrounds but the "days-used" is also longer than for second homes. Obviously, these differences in use-intensity mean that the impact on natural resources and the local economy varies.

In these two regional projects, Connecticut's researchers are studying all forms of recreational lodging, but are giving special attention to second homes because they have not been analyzed extensively in the past. Second homes are a more capital-intensive form of lodging than the other two types. They increase the real estate tax base in a community but they also require additional public services. They stimulate the local economy through a demand for secondary services, such as fuel, electricity, repairs, and maintenance. However, the magnitude of such demand is limited by relatively short stays of the second-home occupants.

The 1960's and early 70's boom in second home construction has slowed in recent years. Will the growth trend resume its course again if and when investment conditions become more favorable? Will new developments in recreational condominium and time-sharing ownership methods change the way in which land resources are used? What effect would more renting out of second homes have on a recreational community? What are the prospects of second home communities becoming primary home communities?

Is accessibility to natural environments by the public inhibited by the private ownership of second homes? What are the prospects that future second homeowners will seek locations that minimize time and distance between residence and second homes if energy constraints become more severe?

These are some of the questions that have led to giving special attention to second homes in these two research projects. Definitive answers to all these questions can hardly be expected. Answers to some of the questions are highly dependent upon probable events and uncertain developments. But this research is designed to estimate a benchmark situation and a projected situation which would make it possible to draw implications about second home developments from the differences between the two situations.

Town Zoning Regulations Often Disregard Appearances

Zoning regulations are designed by law to protect the health, safety, and welfare of citizens. However, these same regulations may contribute to the deterioration of visual appearance of a town. In an effort to achieve zoning goals, appearance oftentimes is neglected.

To show how the town plan and related zoning ordinances have affected the development of some Connecticut towns, Rudy J. Favretti, professor of landscape architecture in the Department of Plant Science, has undertaken an in-depth case study of four selected towns. He will then assess how the development has affected the town's appearance.

His study will be documented with photographs and written descriptions. He will use such criteria as scale, proportion, relationship of open space to building bulk, buffer areas, circulation control, and roadside development to assess the town's visual appearance.

He chose Connecticut for his study because Southern New England is a rapidly growing region, and most towns within this region have zoning regulations, but these often do not consider the appearance of a town or community. Instead, says Favretti, they deal with the individual site, and even then they do not consider on-site appearance adequately.

As towns have grown since World War II, lands on the outskirts have been developed for shopping centers, schools, industries, and other essential developments. These developments have occurred rapidly, and the results show massive pavement without relief, poor relationship of scale between buildings, or between buildings and surrounding terrain, lack of adequate buffers between land uses or within uses as well as many other related factors. The results have been entire strips of visually unattractive developments. These developments have been proceeding at a very rapid pace. Little has been done to help planning and zoning boards concerning the visual appearance of their communities as these

developments proceed. Through this research, usable principles will emerge that will help decision makers and planners in the future.

The objectives of this research will be to:

1. Utilize standard and objective design criteria in assessing the effect of zoning regulations on community appearance.
2. Utilize standard case study procedures to select the towns to be studied and to record data.
3. Record data in usable photographic form as well as maps and drawings.
4. Draw conclusions from the case

studies that will assist other towns in writing their zoning regulations, and publish them in handbook form.

The towns and communities selected for this study will be selected on the basis of their visual appearance, as according to objective 1 above.

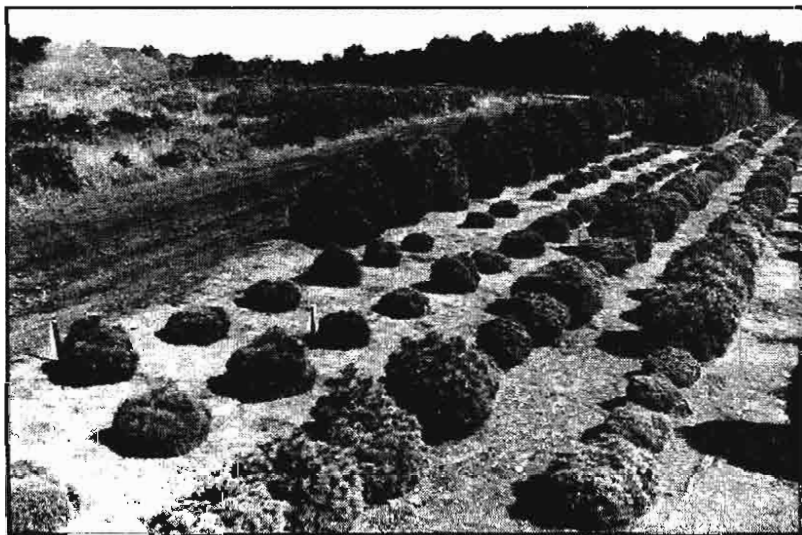
Two types of communities will be studied: Those that exemplify good or adequate consideration for design and appearance in their development, and those that do not. Planning and zoning records and regulations are being case-studied to compile data indicating what was required of the developer by the approving board or commission.

The Development of New and Unique Dwarf Evergreens

By Dr. Sidney Waxman
Associate Professor of Ornamental Horticulture

New and unique dwarf forms of native coniferous evergreen trees are being developed through the selection and propagation of peculiar plant growths that had undergone mutation.

These growths, which are called Witches' brooms, arise from a single mutated bud. They occur only rarely and appear as a shrub-like growth on a portion of the tree. The growth differs from the remaining parts of the tree by its dense branch and needle arrangement.



Variability is exhibited among a group of White Pine seedlings obtained from a Witches' broom.

Stems taken from a Witches' broom, propagated, and grown independent of the parent tree retains the broom's dense characteristics and develop into attractive dwarf shrubs. In fact, several named dwarf pines, which have been available for many years, originated as grafts taken from Witches' brooms during the late 1800's.

Witches' brooms unfortunately are rare and do not exhibit very much variability; otherwise, many more dwarf forms would certainly have been named and propagated. On occasion some brooms have been found to develop seeds and, here, significant variation among them has been found.

The author, on his collecting trips throughout the northeastern states, often resorts to the use of a rifle to obtain seeds that are otherwise inaccessible. There are now at the Horticulture Research Farm at the University of Connecticut several thousand Witches' broom seedlings of White Pine, Red Pine, Pitch Pine, Scot's Pine, Norway Spruce, and Canadian Hemlock.

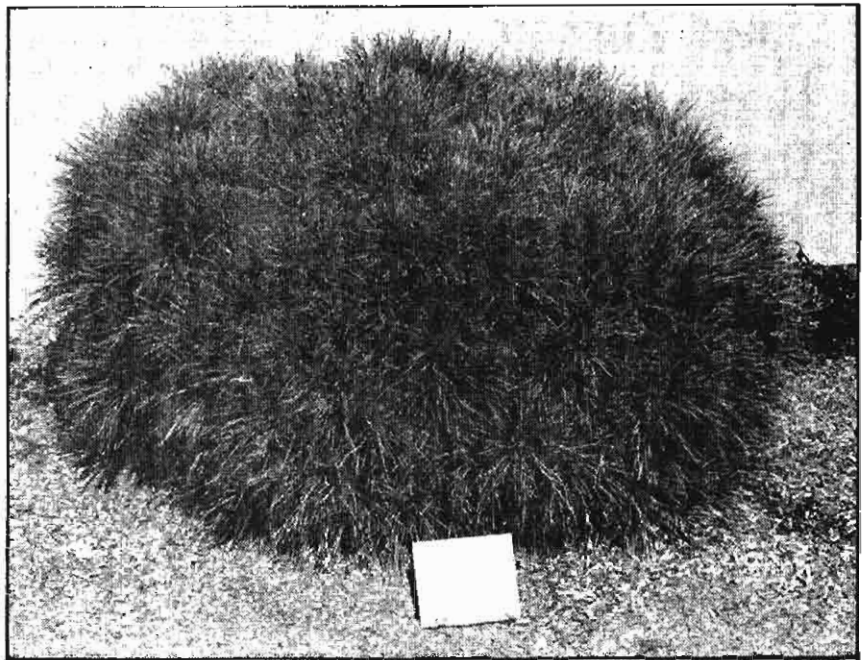
Within most of these species are wide differences in growth; they vary in texture, growth rate, color, needle length, and stem length. Shape also varies widely among Witches' broom seedlings. A system of seven loosely defined categories has been developed to describe the many forms these plants may assume.

These categories include:

1. Mounded -- White Pine, Norway Spruce
2. Flat topped -- White Pine, Red Pine
3. Conical -- White Pine, Scot's Pine
4. Prostrate -- Pitch Pine, Canadian Hemlock
5. Weeping -- Canadian Hemlock
6. Spreading -- Canadian Hemlock
7. Grotesque -- Pitch Pine

Dwarf White Pine after 11 years attained a range of growth in height from one-half to one-fiftieth of normal trees the same age. Norway Spruce after three years grew one-tenth to one-half the normal rate. Thus, variation offers an incredible choice of shapes and sizes one may select.

To perpetuate the selected plants one has the choice of rooting cuttings or grafting. The first alternative -- rooting cuttings -- is only occasionally successful because of the considerable differences in the ability different seedlings have to form roots. Grafting, which is the most dependable method of propagating these trees, is time-consuming and very expensive.



A dwarf White Pine seedling selection from a Witches' broom.

Another approach in the propagation of the Witches' broom seedlings is by tissue culture; a technique that is relatively new and revolutionary to the field of plant propagation.

This method has proven to be successful in the propagation of chrysanthemum, orchid, daylily, gerbera and certain other herbaceous species. It involves the aseptic culture of small bits of plant tissue in test tubes on a specific medium, containing mineral and organic nutrients along with vitamins and hormones which encourage the development of myriads of small plantlets. Potentially, a single piece of plant tissue could be induced to constantly proliferate, producing masses of cells each of which could develop into a complete plant.

The development of an optimum medium utilizing the required balance of hormones is highly complex and must be derived at for each species and, perhaps, for individual varieties within a species.

Interest in dwarf and slow growing evergreens is growing rapidly. There always has been a need for native, low maintenance ornamental plants that remain in scale for a long time.

There are two major objectives of this research. The first is to select aesthetically appealing distinct forms of pine

spruce and hemlock. These evergreens, according to their growth habit and resistance to air pollutants, will fill the needs of the following:

--Provide barriers to screen out sound and sight pollution including highway median barriers.

--Make available plants for the city streets' landscape that will not quickly outgrow their assigned space in the overall design. They would be very appropriate for large street planters, shopping malls, and for plantings in industrial developments.

--Present plants that would help fill the needs for small places such as mini-parks, rock gardens, and small planters.

The second major objective of this research is to determine methods of vegetatively propagating these difficult-to-root selected corfs by tissue culturing or by rooting cuttings. Subsequently, these selections as well as methods for their propagation will be offered to commercial plant propagators for further propagation and distribution.

Recently, selections were made and distributed to cooperating propagating nurseries in Connecticut. They will be named and made available to the public within several years.

UConn Trains Adult Volunteers in Horticulture as Therapy

By Dr. Edward J. Duda
Director, Bartlett Arboretum

THIS PROGRAM IS DESIGNED TO TRAIN TRAINEES TO USE HORTICULTURE IN THE REHABILITATION PROCESS OF DISABLED, DISADVANTAGED, PERSONS, INCLUDING THE ELDERLY.

Twenty-four volunteers and public service agency employees are learning to use horticulture as a therapeutic instrument in a year-long program being offered at the Bartlett Arboretum in Stamford, Connecticut.

This program is specially designed to provide an educational, action-oriented service not otherwise available to communities in the state. A similar program conducted in 1974-75 was so well received and generated so much interest that demands for more of the same literally "snowballed."

The Connecticut Commission on Higher Education again provided a \$15,000 grant to the University of Connecticut to help support the program. It is being conducted by the College of Agriculture and Natural Resources' (CANR) Bartlett Arboretum in cooperation with the Easter Seal Rehabilitation Center of Southwestern Connecticut (ESRCSC), Stamford, It is innovative in that persons trained under the first program are now serving as workshop leaders and consultants for the new group of trainees.

The trainees have attended various lectures and participated in numerous workshops on how to use horticulture as a therapeutic tool. They, in turn, will train the disadvantaged and the physically handicapped, the elderly, the poor, the mentally retarded, people with learning and emotional problems, and drug abusers.

Instruction has been given by a battery of plant scientists in UConn's CANR. Also assisting in the training have been several guest lecturers, community consultants, and students majoring in environmental horticulture at UConn's CANR.

Healing Properties

Institutes have long recognized that non-involvement, inability to return to gainful employment, and lack of purposeful daily activities are some of the major negative characteristics of the present rehabilitation process. And they are striving to lessen it through horticulture.

The Meninger Foundation has for many years used gardening therapy in the rehabilitation of over one-half of its patients. As these patients shared their knowledge about various aspects of horticulture with people less fortunate, they felt a real sense of achievement. Even some of the training extended to these people has resulted in their pursuing vocations in some facet of horticulture such as floriculture, landscape gardening, and greenhouse work.



Mrs. Germaine Shapley, seated, and Mrs. Louise Franko plant narcissus during potting bulbs workshop.

Man's early interest in plants was centered on their healing properties, and many of the earliest horticulturists were physicians who sought to grow plants of medical value. For centuries people have used gardening as preventive medicine and for therapy.

Horticulture, both as a science and as an art, has proven to be therapeutic to many people. Working with plants has a healing quality that is relaxing and satisfying.

The answers as to why working with plants has a beneficial effect upon people are many and often quite complicated.

According to Howard Brooks, former director of the horticultural therapy program at New York's University's Institute for Rehabilitation Medicine, "many of the therapeutic blessings of horticulture to the physically and mentally handicapped, to the aged, and to many other people can be explained by the psychological concept that such persons feel plants and flowers need them to grow and survive. Knowing that something or someone depends on you for growth and continued life is often an incentive to your own health and fulfillment," he explains.

Dr. Damon Olszowy, horticulturist in the Arboretum's hort-therapy program, and James L. Sherin, executive director of the ESRCSC in Stamford, and a planner

from September through December 1976, took place at the ESRCSC in Stamford. Also, one session was held at Shoreline Training and Employment Services (STEM) in Guilford and another at The National Witherell Home in Greenwich.

Lectures and workshops included: psychological aspects of hort-therapy; the rehabilitation process and meaning of disability; plants-people interactions; horticultural therapy for the psychiatric and stroke patients, the mentally retarded, and the elderly and senior citizens; elements of botany; basic materials and equipment for plant growth; and analysis of planting routine.

Also, plant propagation; growing vegetables and flowers; insects and disease; plant nutrition; forcing winter bulbs; building terrariums; window gardening; and use of plant material in arrangements.

Center in New Canaan, the Nathaniel Witherell Home in Greenwich, Fairfield Hills Hospital in Newtown, Jewish Home for the Elderly of Fairfield County in Fairfield, and at the Greater Bridgeport Mental Health Center in Bridgeport.

"Working with plants has a healing quality that is relaxing and satisfying."

Patient's Activities

Their activities with patients include: garden site preparation; flower and vegetable gardening; growing plants indoors; making window gardens and terrariums; kitchen gardening; drying plants for dried arrangements; and making plant arrangements.

Once training is completed in June, it is expected that the volunteers and agency personnel will continue to implement horticulture programs for the disabled/disadvantaged, including elderly, in southwestern Connecticut.

The highly successful program conducted in 1974-75 and the present program have led to the accomplishment of another objective: the establishment of a new relationship among UConn, the Bartlett Arboretum, ESRCSC, other agencies, and the various communities.

Program planning and development have been carried out among representatives of ESRCSC, Bartlett Arboretum staff, and members of the Board of Directors, Bartlett Arboretum Association.

Implementation of the program is being made possible through the cooperative efforts of UConn's CANR faculty and the Cooperative Extension Service; Institute for Rehabilitation Medicine, New York University Medical Center, ESRCSC; STEM; The Nathaniel Witherell Home, City of Stamford; and private citizens.

Hort-Therapy Handbook

A horticultural therapy handbook based on program content is being prepared and will be made available so that similar programs can be developed elsewhere.

Already, hort-therapy has been formally recognized by many hospitals and institutions throughout the United States.

Moreover, Michigan State University pioneered in the development of a mas-



Howard Brooks, retired horticultural therapist from the Institute of Rehabilitation Medicine at New York University Medical Center, conducts workshop in horticulture for the physically handicapped.

of the program, firmly believe that "reaching people with plants is a unique form of appeal and can be very rewarding."

Phases of Training

Training of the volunteers and agency personnel consisted of three phases.

The initial phase provided the participants with a basic understanding of horticulture and its role as a therapeutic tool from April through June 1976 at the Bartlett Arboretum. This facility is administered by the Plant Science Department in UConn's CANR.

The second part of this training, lasting

Phase III training, which started in January 1977, under supervision of the program horticulturist and program director, involves the implementation of knowledge and expertise gained under Phase I and II into useful therapeutic activities. These horticultural activities are designed to reinforce physical success being made in other therapy areas deriving social, psychological, and intellectual benefits.

The volunteers and agency personnel now are working with patients in introducing horticulture as part of their therapy program. They are working with patients at the ESRCSC and Quintard Center in Stamford, The Waveny Care

ter's degree in Horticultural Therapy for Occupational Therapists.

In 1971 the first undergraduate program in horticultural therapy in the country was offered at Kansas State University in cooperation with the Menger Foundation.

A National Council for Therapy and Rehabilitation through Horticulture was established in 1973.

Conditions in several states, including Connecticut, appear feasible for the establishment of hort-therapy teaching programs for college students.

Interest in hort-therapy continues to grow. Based on the large number of inquiries received at the Arboretum, it is quite apparent more and more agencies and institutions wish to get programs started. Few even are seeking persons with

hort-therapy training to fill newly created positions.

Construction of a greenhouse for therapeutic use has just been completed at ESRCSC. The greenhouse idea was spawned during ESRCSC's involvement in the Arboretum's initial training program, and patients and volunteers alike are now enjoying the practical facility.

Nutritionist Studies the Relationship of Blood Lipids to Heart Disease

By Alexander R. Gavitt, Jr.
Agricultural News Editor

Heat attacks and strokes are major public health problems in the United States, causing about 700,000 deaths per year and untold suffering, loss of income, and emotional trauma for those having nonfatal attacks. The most frequent victims of heart attacks and strokes are males 45 to 60 years of age.

Heart disease (atherosclerosis) is a blood vessel disease characterized by soft fatty deposits called atheromas or plaques on the inner layer of the artery. It is a slow progressive disease, possibly starting in infancy. There may be no clinical manifestations for 20 to 40 years or longer.

The plaques, which appear as a gray or yellow mound on the arterial wall, contain a core of cholesterol and other lipids and are covered by a layer of fibrous tissue. As the plaques increase in size, they may slow or cut off the flow of oxygenated blood in the diseased arteries, causing damage to the associated tissue. Without a continuous supply of oxygenated blood, muscle, including that of the heart and brain tissue, will die.



Dr. Robert G. Jensen, professor of nutritional sciences at the University of Connecticut, checks the printout from the gas chromatograph for determining the composition of human plasma fats. He received a three-year grant of \$157,225 from the National Institutes of Health to study the lipid (fat) relationship to the development of heart disease (atherosclerosis.)

The events which initiate the formation of plaques are unknown, but many investigators believe that plaques start as a yellowish fatty streak early in life. These fatty streaks, particularly in the coronary arteries, may develop into enlarging plaques in later years.

Although the origin of the fatty streak has yet to be unraveled, scientists have published data suggesting that the cells of the plaques are transformed. That is, they arise by mutation and the likely causes are mutagenic agents or viruses.

The growing plaques cause severe nar-

rowing or stoppage of the arteries, thereby reducing or stopping the flow of oxygenated blood to a particular organ or tissue. As a result, heart disease or death may occur.

Extensive research has revealed that one of the factors associated with a high risk of heart attacks is increased quantities of fats, known as triglycerides, and cholesterol, in the blood of affected individuals. These compounds are members of a larger group of natural substances called lipids and both are synthesized in all humans.

Triglycerides and cholesterol combine with proteins to form large particles called lipoproteins which transport these lipids in the blood plasma. High levels of plasma lipids are associated with elevated quantities of lipoproteins -- a condition known as hyperlipoproteinemia (HLP.)

Among the many studies on heart disease is one being conducted by Dr. Robert G. Jensen, professor of nutritional sciences in the College of Agriculture and Natural Resources. He is studying the lipid (fat) relationship to the development of heart disease.

His three-year project is being funded by a grant of \$157,225 from the National Institutes of Health.

The University of Connecticut nutritionist said it has taken five years of persistent efforts to get this project funded.

"We had to resolve our methodology procedures and answer other questions from reviewers about the accuracy of the lipid analysis work done in our laboratory," he said.

This was done through sending some of our staff people to laboratories to learn accepted procedures in the analysis of lipids.

Actually, this new research project is an outgrowth of an earlier one by Dr. Jensen. He studied the structure of fatty substances in the plasma of 2 subjects selected from 69 volunteers who worked at UConn.

Dr. Jensen reported: "We found a significant difference in the structure of fats from a person who had high levels of plasma cholesterol as compared to a person who was classified as normal. We think that the difference might be related to the defects initiating the cause of heart diseases."

In the new UConn study, Dr. Jensen

notes that he is receiving medical support from the lipid research clinic at the Baylor College of Medicine in Houston, Texas.

Antonio M. Gotto, M.D., is director of the clinic which provides Dr. Jensen with information on identifying types of HLP.

Blood plasma from patients is shipped daily in insulated containers from the laboratory in Houston to the Bradley International Airport in Windsor Locks, Connecticut.

Dr. Jensen states that the plasma is being used to separate out fats that are carried in lipoproteins. Its structure then is determined -- a process that takes six weeks. Says Dr. Jensen: "We are the only laboratory in the world to do this kind of research work involving the determination of structure of fats (lipids)."

Dr. Jensen goes on to say: "Then plasma from normal people is compared with plasma from patients known to have HLP and suspected of having heart disease.

"If there is a difference in structure, then we know more about how fats are handled and can make some guesses about the defects. Then, when results of the tests for HLP are known, medical doctors can prescribe proper treatment."

"At present, we have two methods at our disposal in the treatment of HLP -- drugs and diet. However, we usually don't know what the basic defect is that started arteriosclerosis leading to heart disease."

"In our research," Dr. Jensen states, "we are trying to find out what the specific defect is that is causing heart disease. Then we can provide specific drugs to cure it."

Connecticut Group Supports Study on Colitis in Felines

Veterinary medical researchers in the Department of Pathobiology have undertaken a study on colitis in cats. It was initiated in response to requests from practicing veterinarians for new information about feline diarrheas.

The project is supported through funds provided by the Charter Oak Feline Fanclub, Inc. This organization has donated \$16,000 since 1973 as part of its proceeds from an annual two-day cat show held in February in Hartford, Connecticut. Dr. Herbért J. Van Kruiningen has been the faculty advisor for the study, and Neal M. Shindel, graduate assistant, has conducted much of the research.

The investigators have been concerned with an acute bloody diarrhea of cats, thinking that this colitis might be related to feline distemper. In working with feline distemper virus, Shindel established that cats with distemper (feline panleukopenia) do develop a low grade colitis, but aspects of this colitis were dissimilar to the spontaneous colitis of concern. In collaboration with Dr. Fred W. Scott of Cornell University, it was established that the new colitis is apparently related to infection with the feline leukemia virus.



Additional studies of naturally occurring forms of disease have now established the existence of at least 12 distinct enteric diseases which result in feline diarrhea. The names of the diseases and the causes are as follows:

Tyzzler's disease, Salmonellosis, and Histocytic mucosal colitis, all caused by bacteria; Candidial enterocolitis, fungus; Panleukopenia, Leukemia virus - associated colitis, and Colitis associated with feline infectious peritonitis, all caused by virus.

Also, Colitis associated with reticulo-endotheliosis, Ischemic colitis, Submucosal colitis, Giant cell granulomatous colitis, and Mucosal colitis, all causes are unknown at present.

Continuing research will seek to further understand these diseases, sharpen definitions, seek causative agents, and discover treatments.

Nutrition Education Works for School Children

By Linda Gacoin
Nutrition Writer

You can teach kids about nutritious foods but you can't get them to eat any ... right? Wrong.

Nutrition education can help improve eating habits, according to the results of a recent pilot project conducted by the University of Connecticut Department of Nutritional Sciences in the Farmington school system. Children participating in the project finished more of the fruit, vegetables, and milk on their school lunch plates and ate more nutritious foods at home for meals and snacks.

The pilot project, "Peer Group Influence on Acceptance of Child Nutrition Programs," was funded by the Connecticut



icut State Department of Education, Child Nutrition Programs. One of their concerns was the large amount of food wasted daily in school cafeterias. Could children be influenced by their peers in some way to help cut down on school lunch plate-waste? It was worth trying

Dr. Janina Czajkowski, UConn professor of nutritional sciences and Extension nutritionist, served as project director and worked with five graduate students in community nutrition to develop a nutrition education curriculum for the project. Kathy Shaskan, one of the graduate students, served as project coordinator and worked on the project as part of her degree requirements to investigate a community nutrition problem.

The cross-age approach to nutrition education was used. Thirty-eight students from Farmington High and Irving Robbins Junior High were trained by the UConn graduate students to teach younger elementary students about nutrition. In this way, both groups of students could benefit. Results of the project indicate that the older students did increase their nutrition knowledge and put their new learning into practice.

Four hundred and fifty elementary students from East Farms and Union Elementary schools participated in a ten week "mini-course" in nutrition from February to May 1976. A team of nutrient characters developed by the UConn project staff helped introduce nutrition concepts to the children. Each nutrient discussed during the lessons was represented by an appealing cartoon character — Powerful Protein, Go-Go Carbohydrate; Vita-Vitamin; Vitamins A and C; Minerals, Calcium and Iron; Water; Fickle Fat; and the Type A Lunch. The children learned that all of these nutrients are part of the Type A lunch served at school and that each plays a special role in the healthy body. The characters were printed in two sizes — large for classroom displays and small for puppets the children could make to take home. Games, films, and other puppets also livened up the nutrition class.

To determine whether the nutrition education had any effect on consumption of school lunch, plate-waste studies were conducted before and after the "mini-course." Changes in plate-waste were measured at the two elementary schools receiving nutrition education and at a control school, West District Elementary, where no nutrition education classes were conducted.

Food left on the student's plates after lunch was collected and weighed. The total was divided by the number of students eating lunch on a particular day to give an average amount of waste per student. The greatest decrease in plate-waste was at East Farms with a 72 percent decrease in fruit waste and a 64 percent decrease in vegetable waste. Both East Farms and Union School had lower amounts of food waste per student than did West District School.

But how much did the kids actually learn? A test of nutrition knowledge was

given before and after the elementary school children participated in the nutrition education "mini-course." Pre-test scores were extremely low for most of the students, indicating a definite need



for nutrition education at all levels.

When percentages of correct responses on the pre-test and post-test were compared, it was obvious that substantial increases in nutrition knowledge did occur in practically all cases. For example, in February none of the children in the first grade at East Farms could identify a food source of iron, but in May, 98 percent were able to.

Questionnaires were sent home to the parents of all participating children, including the teen-age teachers to determine what effect the project had on their eating habits at home. About 75 percent of the parents of the student teachers reported that the program had favorably influenced their children's food choices at home and that their children were choosing fruits, vegetables, and milk for snacks more often. Sixty-three percent of the parents of the children from the participating elementary schools (Union and East Farms) reported that their children were more willing to try new foods as a result of the project. These parents also indicated no increase in demand for cupcake-type snacks, while 13 percent of the parents of the children from the

control school indicated an increased demand for these types of foods. Parents seemed enthusiastic about the project and they all said they would be willing to have their children participate another time in a similar project.

Children were also asked what kinds of foods they would like to see added to the school lunch menu. Children from the

control school preferred foods such as cupcakes, cream-filled cakes, soda and candy five times more often than did children from the project schools who had participated in the "mini-course."

The pilot project lasted only ten weeks, but it accomplished plenty. There were actual decreases in plate waste and improvements in food habits at home among the participants. They learned

of the importance of including all members of the nutrient team in their daily diets. An increased awareness of nutrition can help children choose foods for better health the rest of their lives.

For more information and details of the project, write to Dr. Czajkowski, Box U-17, The Department of Nutritional Sciences, Storrs, Ct. 06268.



Iron is the third most abundant metal found in the earth's crust and has been selected in molecular evolution to carry out a wide range of biological functions. In man, iron is responsible for many things. Among them are the transporting of oxygen by way of the hemoglobin molecule in red blood cells and serving as a constituent of enzyme systems. Iron is also one of many substances found in food and is needed in varying amounts for proper functioning of the body.

How much iron is necessary to keep a person healthy? Well, the Recommended Daily Allowance for iron in an adult male is 10 milligrams per day, while in the adult female it is 18 milligrams per day. The difference arises from additional iron needed because of blood loss occurring in a woman due to menstruation.

An important question which has been unanswered for many years is how a person is to get this amount of iron each day? If the use of supplements was excluded, the person's intake of iron must come from the food he eats. Iron, like all nutrients, is found in all foods but in widely different amounts. Some of the better sources of iron come from liver, meat, and whole grains; some poorer sources are milk, milk products, and unenriched, highly refined cereals. But, on the average, iron occurs in food at a level of about 6 milligrams per 1,000 kilocalories.

Many years ago an iron fortification program was instituted in this country to improve the iron nutriture of the population. Bread was chosen as the food item by which added iron would be incorpora-

Is the Iron in Fortified Cereals Biologically Available?

ted into a person's diet. This was done by adding a certain amount of iron, as an inorganic iron compound, to flour during the milling process. However, national nutritional surveys undertaken in the early 1970's have revealed the persistence of iron deficiency anemia in many segments of the U.S. population.

Furthermore, it is becoming more apparent from the results of nutritional experiments that the types of iron compounds used in the fortification have markedly different biological availabilities and that many factors within a person's diet may further affect this utilization. This means that even though a person may get what would appear to be enough iron in the diet, this may not be adequate, since much of it may be unabsorbed and is thus biologically useless.

Therefore, knowing the "bioavailability" of a particular iron source would be of great help in estimating a person's needs. Unfortunately, those sources of iron, which are readily absorbed by the body, are also much more chemically re-

active in a food system and lead to a decrease in shelf-life and the development of unacceptable aesthetic properties.

On the other hand, iron compounds, which are relatively chemically inert, are in some cases totally useless from the standpoint of maintaining iron status within an individual. Thus, one can see the dilemma of such a situation. A source of iron must be found which is both chemically nonreactive when incorporated into foodstuffs, yet biologically available. This problem is currently an area of active research in the nutritional field.

Dr. Paul E. Stake, assistant professor of nutritional sciences, and Richard J. Wood, graduate student, are currently investigating this problem of iron supplementation in cereal-based foods. For the past two years they have been studying the effects of heat and pressure processing methods on the biological availability of various iron compounds commonly used to fortify food.

They have found that there is, in fact, a wide variability in the relative availability of these compounds. In all cases a method of processing, using both heat and pressure, will improve the relative biological availabilities of these supplemented iron sources.

However, some compounds, such as ferric orthophosphate, despite processing, still remain relatively poor iron sources. Its relative biological availability in comparison to the most available iron source, ferrous sulfate, is only increased from 0 to 11 percent. On the other hand, some, which were inadequate in their unprocessed state, became quite acceptable after processing, such as ferric pyrophosphate, where the relative biological availability was increased from 40 to 95 percent by processing.

This finding may prove to be very useful in improving the iron nutriture of the population. Dr. Stake is currently expanding his studies in this area by examining additional iron sources as well as starting studies to identify the mechanism by which the beneficial effect is achieved.

Programs and Studies Are Varied in Northeastern Research Center for Wildlife Diseases

By Alexander R. Gavitt, Jr.
Agricultural News Editor

For the past seven years the University of Connecticut's College of Agriculture and Natural Resources has served as the headquarters of a cooperative facility that studies wildlife diseases in the northeastern part of the United States.

Known as the Northeastern Research Center for Wildlife Diseases, the facility is housed within the college's Department of Pathobiology. Dr. Svend W. Nielson, UConn professor of veterinary pathology, is director of the center and Dr. Robert D. McDowell, professor of wildlife ecology, is the assistant director.

The center serves the six New England states, New York, New Jersey, and Pennsylvania. Each participating state is asked to contribute \$5,000 annually as its share to help defray cost of operation. In addition to these financial contributions from fish and game departments and conservation commissions of the northeastern states, the center receives support from the UConn College of Agriculture and Natural Resources and from grants and gifts.

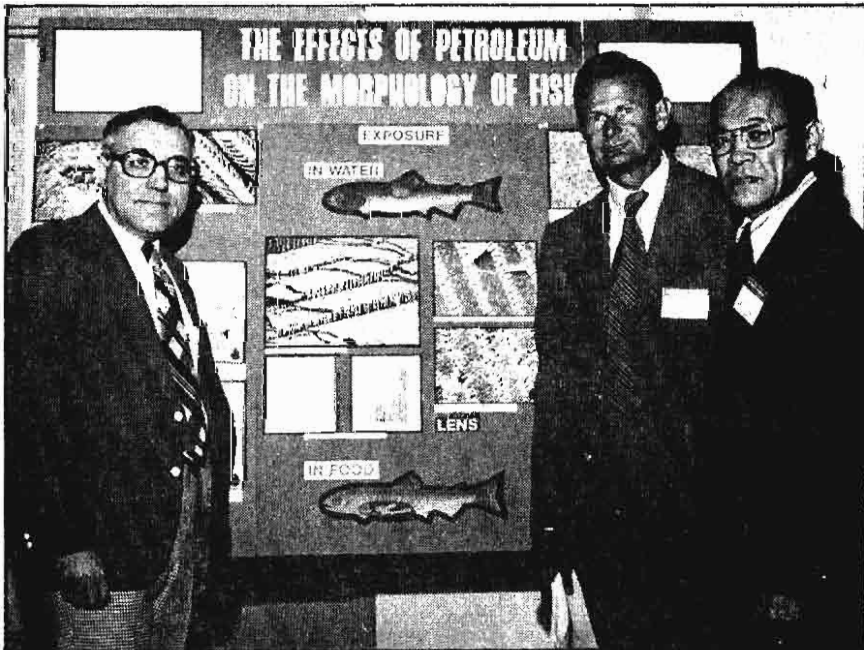
The center has three main functions: (1) to conduct research on new or poorly understood diseases in wildlife; (2) to provide a consultation service on diagnosis of diseases in wildlife; and (3) to carry out educational programs for undergraduate and graduate students, and wildlife biologists in the recognition, control, and prevention of diseases in wildlife.

An important aspect of the center is its participation in the Regional Emergency Animal Disease Eradication Organization (READEO) which was recently established by the U.S. Department of Agriculture. Center staff members are on call to assist veterinarians and wildlife biologists in early diagnosis and eradication of outbreaks of any highly infectious disease of animals that may be accidentally or intentionally introduced to the northeastern United States.

Dr. Nielson was recently called upon to assist as a wildlife pathology expert when serious outbreaks of hog cholera took place in New Jersey, Rhode Island, and Massachusetts in the winter and spring of 1976. Approximately 20,000 hogs exposed to the disease were exterminated. The role of seagulls and rats as possible vectors in the spread of the disease from farm to farm was the area of Dr. Nielsen's investigation.

Major Research Projects

Marble Spleen Disease -- On the research level, the center's first funded research project was in 1972 to study marble spleen disease in pheasants. In addition to being found in pheasant flocks in southern New England, the disease has been reported in New York, Pennsylvania, several midwestern states, Ontario, Canada, England, and Italy. This disease is a serious problem in commercial, pen-



Co-chairmen of the First International Symposium on Environmental Pollutants gather together in front of a display which shows graphically the effects of pollutants on fish. Left to right, they are: Dr. Dante G. Scarpelli, chairman, department of pathology, Northwestern University Medical School in Chicago, Illinois; Dr. Svend W. Nielson, UConn professor of pathobiology and center director; and Dr. George Migaki, chief pathologist, Registry of Comparative Pathology with the Armed Forces Institute of Pathology, Washington, D.C.



Dr. Svend Nielsen, center director, examines tissues from wildlife suffering from poisoning by environmental pollutants.

raised pheasants, causing high mortality in four-to-five-month-old birds. It is an economic problem for pheasant breeders and also of great concern to sportsmen, since most pheasants available for hunting in the northeast are stocked birds.

Dr. Stuart Wyand, project leader and Jeffrey P. Iltis, a graduate student, showed that an adenovirus is the cause of marble spleen disease in pheasants as well as in domestic and wild turkeys. This was the subject of Iltis' doctoral thesis.

Iltis' research revealed that the virus was transmitted to domestic turkeys in 1975, producing microscopic lesions identical to those seen in the experimental disease. In this same year, wild turkeys were infected with the marble spleen disease agent and again the same microscopic lesions were produced. This was the first time that the virus was shown to be transmitted to these species.

Work is underway to grow the virus and ultimately to produce a vaccine to control the disease. If successful, researchers can thank Wyand and Iltis for their pioneering efforts in finding the cause of marble spleen disease.

Eastern Equine Encephalitis—A cooperative study has been carried out on an infectious disease known as eastern equine

encephalitis (EEE) which affects horses, pheasants, and man primarily in the northeastern United States. The disease is caused by arbovirus transmitted from animals to man by mosquitos. EEE produces severe neurologic disturbances, with paralysis, sleepiness, blindness, and often death. Small outbreaks have occurred periodically since EEE was first recognized in 1938, and more than 50 persons have died from the disease in Massachusetts and New Jersey.

Risk of human infection by EEE is expected to increase as people move away from city centers and into suburban wooded areas, and as more people participate in recreational activities, such as camping, golfing, hunting, fishing, and boating in rural and coastal environments. Inland wetlands and coastal marshes of the northeast are excellent habitats for the virus-carrying species of mosquitos. It has been believed that migrating birds and mosquitos carried the virus into the region, but recent studies indicate that the virus probably exists year-round in wild birds and in as-yet-unidentified hosts, possibly rodents.

In the project, a search for the virus and antibodies will be made in mosquitos, pheasants, horses, and various species of

wildlife from several parts of Connecticut. Based on findings in the state, studies will be extended into other northeastern states which have frequent EEE epidemics. It is the ultimate goal of this project to identify reservoirs of this serious public health hazard. The study has already resulted in a six-point set of recommendations for prevention of the disease, which has been distributed to game biologists and pheasant breeders in the northeastern United States.

Mercury Poisoning—Another research project concerns methylmercury poisoning in mammals. Thomas S. Davies, a graduate student with Dr. Nielsen, is attempting to find out more about the mechanism of this type of poisoning in animals and man. Severe outbreaks of mercury poisoning have occurred in Japan, Iraq, Canada, and the United States. Symptoms of methylmercurialism are lack of coordination, convulsions, and blindness. Davies reports that mercury compounds have a long biologic half-life and are able to penetrate both blood-brain and placental barriers leading to central nervous system damage and fetal damage.



A major objective is to determine the maximum dose to which an animal can be exposed without producing recognizable signs of mercury poisoning. "This varies from species to species," Davies says. "We compare lesions of these animals with those seen in suspected human cases." The results of this work will aid our understanding of mercurialism and hopefully lead to prevention of poisoning with methylmercury in both animals and man.

Another doctoral candidate, Dennis O'Connor, is conducting a large regional research project on the relationship of methylmercury and Polychlorinated Biphenyl (PCB) and diseases of the two

important fish-eating furbearers, the mink and otter.

The aquatic nature of these long-lived piscivorous mammals render them ideal species to use as monitors for pollutant levels. Mercury and PCB, primarily water-borne pollutants, accumulate in higher concentrations as they move up the food chain (Bioaccumulation.) Other pesticide residues as well as other heavy metals (lead, cadmium, and zinc) will be assayed on animals from areas of suspected contamination.

The ultimate goal is to develop a system by which animals can be used to evaluate the degree of pollution present in a given watershed.

Lead Poisoning in Waterfowl -- A fifth research project centers on lead poisoning in waterfowl. Douglas E. Roscoe, another graduate student with Dr. Nielsen, has created a modified hemato-fluorometer that measures a chemical compound -- protoporphyrin IX -- which accumulates in the blood of lead-poisoned ducks and is used in the detection of lead poisoning in waterfowl.

Two million American waterfowl die each year from eating spent lead shot.

When the bird swallows the lead pellets, it causes derangement of the synthesis of hemoglobin which is a protein in the red blood cells responsible for the transportation of oxygen. This causes a backup of the compound protoporphyrin IX that normally is part of hemoglobin production. This compound gives off a red fluorescence when exposed to ultraviolet light.

The test involves drawing one drop of blood which is placed on a glass slide and inserted into the instrument to determine the amount of its fluorescence. If the level is above 40, then the bird has swallowed at least one lead shot from two days to a month prior to testing. Five to eight pellets can cause death, depending on the diet.

Wildlife biologists will use this machine to test waterfowl for lead poisoning. It is intended that this test will provide more information about proper waterfowl management, and, in particular, whether lead shot use should be curtailed. If too many waterfowl are positive for lead in a certain area, Connecticut wildlife biologists will require the use of steel shot.

Steel shot is non-toxic but costs twice as much as lead shot, and causes damage

to the gun barrel. This research project is supported partly by a grant from the National Rifle Association and the Shikar-Safari Club International Foundation in Racine, Wisconsin.

Diseases of the Muskrat -- A new research study has just been initiated on the naturally occurring diseases of the muskrat, which presently is the most important furbearer in North America. This study is of regional scope and will investigate the interrelationship of population densities and the incidence and types of various diseases. Dr. Michael Ryan is a post-doctoral student in this study under the direction of Professor D. Stuart Wyand.



Other Studies -- In addition to the above mentioned major research projects, Richard Deters, a graduate student in the center, is developing a radiographic atlas of the skull of wild mammals in the Northeast. Other projects involve a pathologic study of the raccoon and a survey of diseases and parasites of the grey squirrel.

Diagnostic Consultation Service On Disease Problems

Three major areas of disease problems which are of immediate concern to the center are noted by Dr. Nielsen.

--Serious infectious and toxicologic diseases affecting several species of wildlife, some of which may threaten and possibly result in extinction of certain species. At present, nearly 30 species of wildlife are considered endangered and over 100 have become extinct in the United States.

--Over 90 diseases transmissible from animals to man. Examples of these are rabies in skunks, foxes, raccoons, and bats; tularemia in rabbits and rodents; eastern equine encephalitis (EEE) in pheasants and songbirds; and brucellosis, tuberculosis, dermatophilosis and leptospirosis of deer.

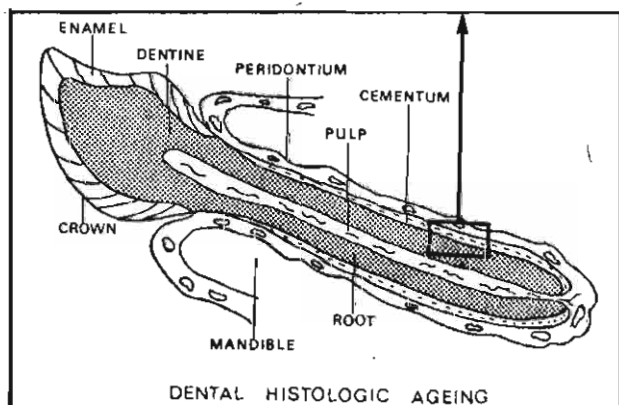
--Diseases of wildlife caused by various environmental pollutants. Some of these substances which enter our environment are disseminated for thousands of miles through the atmosphere or surface water; some deteriorate slowly and exert their toxic effects by accumulation in tissues of several forms of animal life. Since airborne toxic precipitates collect in surface water and vegetation, and since wildlife and fish populations are closely in contact with them, biocidal effects may appear in these species before humans and domestic animals are affected. Predatory species of birds, fish and animals may be the first to show the affects of accumulating pollutants because they are at the end of nature's food chain and, accordingly, concentrate toxic agents from tissues of animals that constitute their prey.

The diagnostic service is being supported by the expertise of three certified veterinary pathologists and several virologists, microbiologists, and other staff members of various specialties in the Department of Pathobiology. Presently, 300 cases are submitted each year to the center for pathologic diagnosis. The center maintains a cross-index file of a total of 4,000 cases of wildlife diseases recorded in the files of the Department of Pathobiology since 1930.

Aging of wild animals is another subject of study and a part of the service the center provides to the participating states. Presently, the center's technician is performing histologic sections and staining of 300 teeth per year to determine the age of deer, bear, raccoon, mink, and other mammals. This is done by counting the rings formed by the cement layers of their teeth. The project has involved 1,350 white-tailed deer from New York, 300 from New Jersey, 300 from Pennsylvania, and 200 from Connecticut. By accurately determining the age, Dr. Nielsen says we can better understand the habitat of these mammals and relate it with nutritional status and naturally occurring diseases and parasites.



Cross section of front (incisor) tooth is shown from four-year-old white-tailed deer, showing four annular rings of the cement layer.



Sagittal section is shown through mandible and first incisor of white-tailed deer. The rectangle, outlined in black to the right, is the area taken for histologic sectioning for age determination.

Information and Education Activities

Highlighting the center's activities in June 1977 was its cosponsorship of the first International Symposium on Environmental Pollutants - Animal Models and Wildlife as Monitors. Approximately 130 laboratory scientists, wildlife biologists, and environmental conservationists from 16 states, Canada, Scotland, England, and India attended the three-day conference. It provided an interchange of recent information on currently important environmental pollutants, especially heavy metals and polychlorinated hydrocarbons.

Thirty-five research papers were presented. Seventeen exhibits depicting various effects of pollutants on wildlife were on display in a special poster session. The results and conclusions of the papers

and of the exhibits will appear in a book to be published by the National Academy of Sciences, which will serve as an up-to-date reference text on environmental pollutants. Other cosponsors of the symposium were the Registry of Comparative Pathology of the Armed Forces Institute of Pathology and the Institute of Laboratory Animal Resources of the National Research Council, National Academy of Sciences, both based in Washington, D.C.

In August 1973 the center was the organizer and host of a four-day annual national Wildlife Disease Conference. Sponsored by the Wildlife Diseases Association, it was attended by some 180 biologists and pathologists from the United States, Canada, and the Philippines. The first day's program cen-

tered on current disease threats to wildlife and diseases communicable from animals to man under natural conditions. These included EEE and rabies. Also, a session was held on diseases caused by environmental pollutants such as DDE, parathion, and heavy metals, including lead and mercury poisoning in various animal species. The remainder of the conference was devoted to presentation of 72 research papers on diseases of mammals, birds, and fish.

Educational activities have included establishment of a cross-indexed collection of teaching slides of wildlife diseases and the offering of academic programs leading to the granting of M.S. and Ph.D. degrees in the pathobiology of wildlife diseases. In addition, a program of continued education is carried out for game biologists from cooperating states. Three workshop sessions have been conducted during the past four years with a dozen biologists in attendance at each session for a concentrated program of lectures and laboratory demonstrations.

Steering Committee

A five-man steering committee, appointed by fish and wildlife directors of cooperating states, is responsible for policy-making decisions and approval of research projects. Theodore B. Bampton, deputy director of the Connecticut Department of Environmental Protection, serves as chairman. Members are: Herbert Doig, director, Fish and Wildlife Division of the New York State Department of Environmental Conservation, Albany; Edward Kehoe, director, Fish and Game Department of Vermont, Montpelier; Howard Larsen, director, Northeast Region, U.S. Bureau of Sport Fisheries and Wildlife, Boston; and Dr. Edwin J. Kersting, dean of the UConn College of Agriculture and Natural Resources.

Dean Kersting's duties are to assist the center's director in formulating research and educational programs in diseases of wildlife. He also acts as the university's representative in financial negotiations with participating states, other public agencies, and private groups.

The dean feels "wildlife deserves as much protection as the forests of our country." As an example of wildlife as a commodity, he notes that the deer population in this country is worth some four billion dollars. In short, Dean Kersting says, "A healthy wildlife adds additional interest and enhances the quality of man's environment."

Are "Health Eggs" All They're Quacked Up To Be?

Are Araucana eggs more nutritious than regular store-bought eggs?

This is but one of the questions being asked by Dr. Ralph G. Somes, Jr., professor of animal genetics, as part of his continuing studies on inherited metabolic variations of domestic poultry.

One such study was conducted with the Araucana, a South American chicken breed. The Araucana has become very popular and famous in recent years because of the blue-shelled eggs it lays.

Because of the uniqueness of these eggs, a folklore of special attributes has been built up around their nutritional value. Some press reports have quoted claims that Araucana eggs are 20 percent higher in protein and much lower in cholesterol than store-bought table eggs. In some areas of the country, high prices are being charged for these so-called "health eggs."

To see if these "health eggs" were really more healthful than store-bought eggs, Dr. Somes and his co-workers analyzed the blue-shelled eggs from three strains of Araucana over a two-year period. These eggs were compared with those normally found in stores: the white-shelled eggs from the White Leghorn, and

the brown-shelled eggs from the Sex-linked Cross.

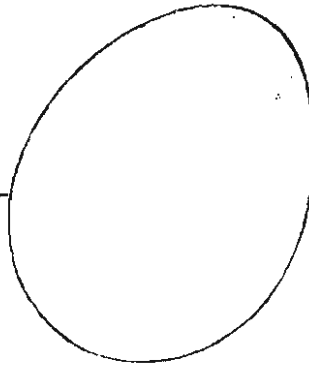
In studying these test groups, they found no significant differences in either percent protein per gram albumen or percent protein per gram yolk that could be related to the egg shell color. However, in the 8 comparisons made, the Araucana

eggs had from 2.8 percent to 6.5 percent lower total egg protein content than either the white or brown-shelled eggs. The researchers attributed the lower total protein content in the Araucana eggs to the fact that yolks from these eggs are larger relative to albumen content than those found in white or brown-shelled eggs.

It appears that during the egg formation process, a lesser amount of albumen is secreted on any particular size yolk. This shift in the yolk-albumen relationship results in a reduction in the amount of the high protein containing albumen relative to the lower protein containing yolk. These proportionality shifts result in an average decrease of 4.3 percent in total protein content of Araucana eggs.

The eight analyses on cholesterol were also consistent. In all comparisons, the Araucana eggs had a higher cholesterol level on a milligram of cholesterol per gram of yolk basis. These increased concentrations ranged from 2.0 to 6.9 percent, averaging 4.9 percent for the whole study.

Based on the now verifiable scientific data derived from these studies, we can answer the question "Are Araucana eggs more nutritious than regular store-bought eggs?" with a one word answer "No."



Embryos grow and develop in an organized manner even before regulators of cellular activity such as hormones are available. The possibility that nutrients -- particularly nutrient proteins -- may serve as regulators in such early embryos is the major concern of this project. It is being supported in part by the U.S. Energy Research and Development Administration, Hatch Funds, and the University of Connecticut Research Foundation.

Dr. Norman W. Klein, professor of animal genetics and principal investigator of this research study, found that cultures of early chick embryos required nutrient proteins for growth. Proteins could not be replaced by mixtures of amino acids which make up proteins.

Furthermore, the protein requirement was found to be specific. Embryos could not be grown on milk, colostrum or serum, but they required two distinct types of protein: a transferrin and a second was provided by either ovalbumin from egg white or lipovitellin from egg yolk. When either protein was provided alone, the embryos did not grow as well

Proteins Regulate Early Development of Chick Embryo

as they did when provided with both proteins.

Subsequently, Dr. Klein was surprised to learn that these proteins did not reach the embryo proper, but were degraded in

the yolk-sac -- a placental-like structure. It was hard to reconcile the response of embryos to proteins with the fact that they did not reach the embryo. Turning to the function of the yolk-sac, Dr. Klein learned that serum proteins were synthesized in this structure and that changes in nutrient protein altered their synthesis.

At present, the Connecticut researcher is testing the hypothesis that agents causing embryos to grow and develop in an abnormal manner, such as nutrients, drugs, environmental pollutants, and gene mutations, do so by altering the synthesis of serum proteins rather than by directly acting on the cells of the embryo.

Two types of studies are involved. First, it is being determined if these various agents alter the synthesis of serum proteins in the yolk-sac of chick embryos.

Second, it is being determined if these alterations do indeed affect the growth and development of chick as well as rat embryos in culture to purified serum proteins.

If these experiments are successful, Dr. Klein hopes to find out how serum proteins regulate cellular activity.

Rapid Changes in Poultry Plant Operations Are Studied

A University of Connecticut agricultural economist is cooperating in a north-east regional research project to help poultrymen estimate the effect of the changing costs of energy, labor, money, plant, and equipment on their investment decisions in order to become as efficient as possible. Dr. Donald G. Stitts said that having this information will help poultrymen determine the optimal size operation for their farms.

According to Dr. Stitts, egg production in Connecticut has undergone considerable changes in recent years. The total number of birds has increased; the number of producing farms has decreased.

The U.S. Census of Agriculture reports that in 1964, a total of 1491 egg producing farms housed 3,842,906 birds of laying age. In 1974 there were only 551 egg producers but they housed 4,340,191 birds of laying age. Thus, while the number of birds had increased 13 percent, the number of farms had decreased 37 percent. This implies an average increase in farm size of 206 percent.

This increase in bird density was accomplished through changes in the capital-labor ratio employed on farms. Birds are increasingly being reared under more capital-intensive methods, and the resultant efficiencies are enabling farmers to reduce the amount of labor employed per flock of birds. Results of California poultry management studies show that on the average .8 labor hours were needed per hen in 1958, whereas that figure decreased to .3 labor hours per hen in 1964. This illustrates substitutions of capital for labor, with farmers being able to in-

crease production at a lower cost per dozen eggs.

Advances in increased efficiencies have also come to egg farms. This includes increases in the number of eggs produced per bird, increases in the average flock size per square foot of building space, and increased feed efficiency.

Although increasing capital intensity means substituting capital for labor, it also signifies higher investment costs per bird. This means that the farmers' decision to invest will depend upon current interest rates.

Similarly, since increased capital intensity signifies a heavier reliance upon electricity and/or fossil fuel use, the cost of energy will significantly affect the farmers' investment decisions. When energy was cheap and readily available, farmers did not consider this as a serious problem. However, today, with rapidly escalating energy costs, the picture is not quite as clear cut. In fact, in this era of high interest rates and of rising equipment, building, labor, and energy costs, a complete rethinking of the economic implications of continued capital intensity may be in order.



Poultry Registry To Be Published by UConn Geneticist

Since joining the University of Connecticut faculty as a poultry geneticist 15 years ago, research into the inheritance and gene action of poultry mutations has been an interest of Dr. Ralph G. Somes, Jr., of the Department of Nutritional Sciences.

Dr. Somes has published over 25 scientific papers and presented 14 more at scientific meetings on this work. He has discovered and described six new mutant genes in the fowl and has added to a better understanding of other mutant traits in both the chicken and the Japanese quail.

Because of his interest in avian mutations, it was only natural that he would also be interested in the conservation of poultry genetic stocks. During the last eight years, he has been very active in this area. In 1969, Dr. Somes received a three-year grant from the National Institutes of Health to facilitate the publishing of a registry of avian mutant genes. This initial grant was but the first of three such grants.

The first registry was published in 1971 as Storrs Agricultural Experiment Station Bulletin 420. It dealt solely with chicken genetic stocks in the United States. In 1975, a second bulletin, No. 437, was published. This registry was an

expanded version of the first one and included chicken stocks as well as turkey and Japanese quail stocks maintained in both the United States and Canada. In 1978, a third edition of the registry will be published, and stocks from countries such as England, Spain, France, and the Netherlands may be included.

The purpose of these registries has been two-fold. Firstly, they have been a means of informing scientists and others of the availability of poultry stocks with specific genes which could be used in biological studies of development and disease control. The chicken, readily available and easy to raise, can be used as a proxy for humans in a variety of laboratory studies. In diseases such as the genetic muscular dystrophic mutant, which occur similarly in humans and chickens, they are an invaluable source.

Secondly, the registry has served as a vehicle of communication among poultry geneticists and between poultry geneticists and other scientists on the availability of various stocks and their relative variety. It has helped to make those concerned about the conservation of poultry stocks more aware in this area.

Dr. Somes' poultry registry is like a genetic encyclopedia. Not only does it list mutant traits, breeds and lines and their sources, it also includes a description and literature citation in the case of mutant traits.

Because of his interest and work in this area, Dr. Somes was invited to talk at two international conferences on poultry breed conservation in 1974. He has also been asked to summarize the mutational knowledge of the chicken into tabular form for inclusion in a biological handbook entitled, "Inbred and Genetically Defined Strains of Laboratory Animals." This handbook will be published by the Federation of American Societies for Experimental Biology.

Vaccination Can Control Costly Chronic Respiratory Disease in Poultry

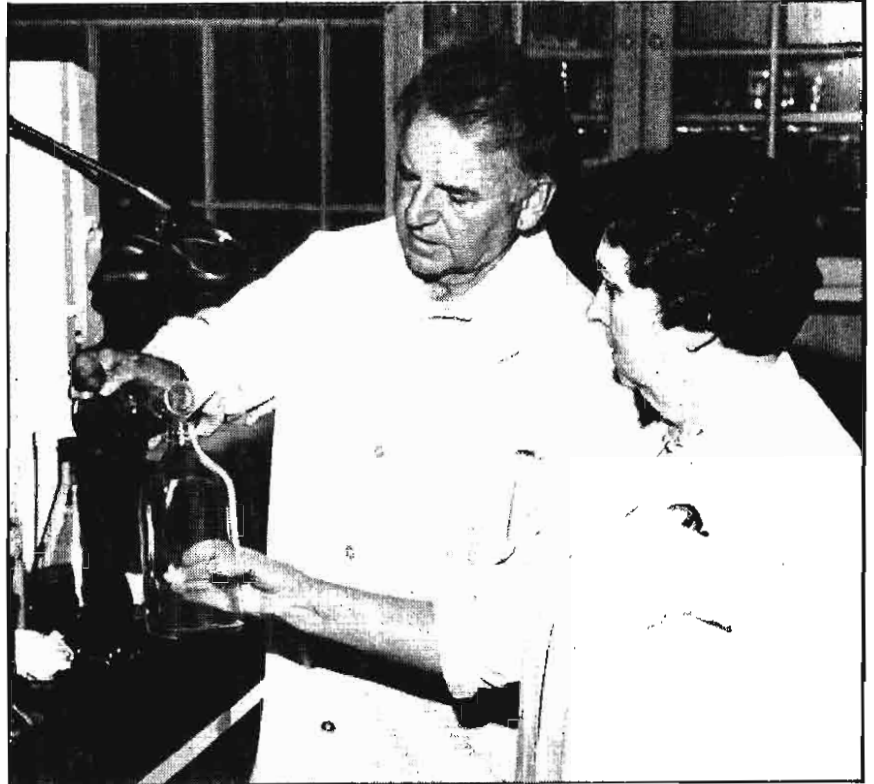
Chronic respiratory disease (CRD) is a serious respiratory disease in poultry caused by a microorganism known as *Mycoplasma gallisepticum* (MG) which resembles bacteria but it is much smaller.

CRD causes large economic losses to the poultry industry each year because of broiler condemnations at slaughter and loss in egg production. But thanks to the efforts of many researchers, including those in the University of Connecticut's Department of Pathobiology, the disease has nearly been eradicated in America's broiler industry.

The near-eradication of CRD was made possible by the development of a reliable serological test for this disease by a group of scientists in the University's pathobiology department. They were Dr. Mark E. Tourtellotte, professor; Dr. William J. Parizek, associate professor; Dr. Roy Luginbuhl, retired emeritus professor; and Dr. Monte Frazier, now a veterinarian with Arbor Acres in Glastonbury, Connecticut. For several years the UConn pathobiology department was the only source of the CRD antigen, but antigen production was subsequently given to the U.S. Department of Agriculture and private laboratories.

Despite advances made in eradicating CRD in the broiler industry, the disease still causes considerable losses to egg producers.

Because of this problem, the UConn



Mrs. Esther C. Fabian, institutional laboratory aide, and Dr. William J. Parizek, associate professor of pathobiology, prepare to grow the CRD vaccine in order to develop immunity of CRD in poultry flocks.

pathobiologists embarked on a vaccination program several years ago using killed and attenuated (low virulence) strains of MG. Unfortunately, neither gave immunologic protection to poultry flocks.

The UConn pathobiologists then turned to a vaccination program of "controlled exposure" to a virulent strain when the chickens were 10 to 12 weeks old. They did this based on the theory that the birds would have the CRD disease, develop antibodies, and when they became egg producing would be immune to CRD. Chickens are most susceptible to CRD infections when they start to lay eggs, and when infection occurs, it causes a marked decrease in egg production.

After several years of field trials, the pathobiologists found that vaccination with virulent MG was effective in preven-

ting CRD when laying flocks came into production. It is estimated that in the past 5 years this program has saved Connecticut egg producers 7 to 14 million dollars.

Evidence of this program's success has been the acceptance of UConn's program and the establishment of it in neighboring states and throughout the nation. It is rapidly extending to many foreign countries as well.

Although total eradication of CRD is the goal of the UConn pathobiologists, they indicate that during the next several years the virulent MG vaccination will continue to be effective in reducing economic loss to egg producers. As a result, eggs can continue to be sold at reasonable prices to consumers.

This research was supported primarily by funds provided by the State of Connecticut.

Detection and Control of Three Economically Important Poultry Diseases

By Dr. Louis van der Heide
Professor of Pathobiology

The poultry industry -- commercial egg production and broilers -- in the Northeast is estimated to have an annual value of over a billion dollars annually. In Connecticut, alone, the income from the sale of eggs is nearly \$50 million, ranking it as the second leading agricultural industry behind dairy farming.

Like in all agricultural industries, the continuing threat of diseases and their accompanying losses amounting to millions of dollars each year are experienced by poultrymen. Accordingly, researchers in eight northeastern states including the author have undertaken a new five-year regional research project designed to eradicate three economically important poultry diseases common to the region. The three diseases are: (1) avian adenoviruses, (2) avian mycoplasmosis, and (3) variant infectious bronchitis.

Avian Adenoviruses

Avian adenoviruses have been recognized for years, since Yates at Rhode Island isolated a virus in 1957 that killed chicken embryos. This virus was subsequently called CELO (Chicken embryo lethal orphan) virus to indicate its effect on chicken embryos and the fact that it did not seem to be associated with any chicken disease (an "orphan" virus). In 1950 Olson at West Virginia found a respiratory disease in Quail to be caused by a CELO-related virus, which he called Quail Bronchitis virus. The two isolates were found to be closely related and belonged to the adenovirus group.

The name adenovirus was originally given to a group of human viruses that were isolated from the glandular ("adeno") tissue of human patients. Fortunately there appears to be no relationship between human and avian adenovirus.

In chickens adenoviruses were subsequently found to be responsible for a severe liver infection which was called inclusion body hepatitis by Winterfield and others at Purdue University in Indiana. In the Delmarva peninsula a severe anemic condition in broilers, called infectious aplastic anemia, was found to be caused by adenovirus by Stein and others. The problem was that neither one of the latter two adenoviruses were closely related to CELO virus, and further research has led to the determination of ten different serotypes of avian adenovirus (Cowen and others). Inclusion body hepatitis and infectious anemia have cost the poultry industry millions of dollars in mortality and condemnation of broilers and loss of life in egg-laying pullets.



Recently, Staples at New Hampshire discovered that chickens with adequate maternal immunity (antibodies derived from the mother hen in the yolk of the chick) against another chicken virus -- infectious bursal disease -- did not get hepatitis or anemia.

It is now thought that chickens without protection against infectious bursal disease will probably get a field infection of this disease. This infection will damage the bursa, a little sack-like organ next to the vent of the chick. This bursa of Fabricius, as it is called, has an important function in the defense mechanism of the bird.

If the bursa is damaged, the chicken will then be more or less defenseless against many other diseases such as the two adenoviruses of hepatitis and anemia. Therefore, rather than develop a vaccine against adenovirus, it is now considered sufficient for practical purposes to vaccinate parent breeder flocks against infectious bursal disease to insure protection of the progeny. Research at Connecticut has centered on detection of new adenovirus infections and finding out how and why the bursal disease immunity protects against other virus infections.

Avian Mycoplasmosis

Of all the efforts to eradicate poultry diseases in the United States, the eradication program of *Mycoplasma gallisepticum* (MG) has been one of the most successful. MG, formerly called PPLO (pleuro pneumonia-like organism), is the main cause of chronic respiratory disease (CRD) in chickens. The MG organism, which is distantly related to bacteria, causes inflammation of the respiratory tract (trachea, lungs, and air sacs). It was a major cause of condemnation of broilers in processing plants until eradication of MG in the broiler industry was completed.

A related organism, *Mycoplasma synoviae* (MS), which causes leg joint swelling (synovitis) and also air sac inflammation, has been included lately in the blood testing eradication efforts, and MS has also been largely eradicated.

The efforts of this regional research project are to make sure that the blood testing of breeder chickens will yield accurate results. Reagents for the tests, so-called antigens, have been found occasionally to yield non-specific results.

Recently, researchers have been able to isolate "variant" mycoplasmas from such non-specific reactor birds. This is a highly disturbing development in regard to the eradication efforts, which will have to deal with these new variant MG strains.

Another problem concerns the existence of MG-infection in commercial egg-laying flocks, especially in multiple age operations which are necessary to insure an even year-round egg production. MG-infections tend to persist in such operations and infect the young new incoming pullets. Such MG outbreaks lower the egg production of layer flocks.

A controlled MG exposure program has been practiced in some of these operations. Growing pullets are exposed at 10

to 12 weeks of age with the low virulence F-strains of MG ("vaccine" strain) in the drinking water or by eye drop route. These pullets will become MG-positive in the blood test but they do not show signs of the disease, and they will resist subsequent MG-infection in the laying house, and not show a drop in egg lay. Regional research will be conducted to follow MG exposed layers to establish the usefulness and/or dangers of such a program.

Variant Infectious Bronchitis

Approximately eight new variant strains of infectious bronchitis (IB) have been found over the years in U.S. poultry flocks. IB is a common respiratory virus disease of chickens. Besides the respiratory signs, such as sneezing and coughing, IB causes a drop in egg production and the formation of misshapen eggs.



Good live vaccines have been used for years to protect poultry from IB. However, it was found that IB-vaccinated chickens were not well protected against the variant strains of IB. Subsequent research in Connecticut determined that a particular variant strain -- the so-called JMK-strain -- was the main cause of IB problems in Connecticut poultry. Dr. Winterfield at Purdue observed that an IB vaccine strain from Holland was better able to afford protection against the prevailing variants than the existing "Massachusetts-Connecticut" vaccines. The Holland strain IB vaccine is now available commercially in the United States, and is used widely in Connecticut poultry with excellent results.

This regional research project will deal with surveillance methods for upcoming new variant IB viruses. Virus isolation from chickens with signs of IB and determining their strain properties are being done in the Department of Pathobiology at the University of Connecticut in cooperation with Professor Johnson at the University of Maryland.

Research in poultry diseases will hopefully continue to be able to shift the emphasis of disease control on poultry farms from treatment of sick birds to prevention and eradication, thus saving the poultry industry millions of dollars annually.

UConn Publishes Ethnic Atlas of Connecticut

A new type of atlas containing information on the composition and concentration of foreign stock in Connecticut has been published by the Storrs Agricultural Experiment Station at the University of Connecticut.

Entitled "Ethnic Atlas of Connecticut, 1970," the book contains 180 pages.

Funded by a grant from the Hartford-based American Revolution Bicentennial Committee, the ethnic atlas is based from information contained in the United States Census Bureau's 1970 Census. All the data presented in the atlas was obtained from the 4th Count Summary Tapes for Connecticut.

Dr. Thomas E. Steahr, UConn associate professor of rural sociology and author of the atlas, says that foreign stock has vastly enriched the texture and variety of community life in the state.

The term "foreign stock" is used to describe first and second generation Americans, without regard to status of nationalization or citizenship, Dr. Steahr says. First generation foreign stock are those Connecticut residents who were born abroad, while second generation foreign stock are native-born Americans with either one or both parents of foreign birth.

In 1970, 32 percent of the state's population, or 969,807, were of foreign stock. Most numerous are the Italians, with 227,782 or 23.5 percent of Connecticut's foreign stock population. Next largest are Canadians (126,305), followed by the Polish (103,820), residents from the United Kingdom (71,532), the Irish (60,366) and the Germans (60,290). Dr. Steahr reports.

But foreign stock is not distributed evenly throughout the towns of the state. Dr. Steahr adds. He notes that Italians are most largely concentrated in Waterbury, New Haven, and Bridgeport, while Canadians are most prominent in Hartford, and the Polish are grouped primarily in New Britain. Irish inhabitants are found most frequently in Hartford, with lesser numbers in Waterbury and the greatest concentration of German stock is in Norwalk, he says.

The ethnic atlas contains a table of the number of foreign stock residents in the top 44 ranking Connecticut towns, and a graphic display of the percent of each generation of foreign stock residing in each of the state's 169 towns. The total number of foreign stock, listed by 38 countries of origin, appears in alphabetical order in the ethnic atlas. A final set of tables and maps present data on the geographic distribution of American Indians and Black Americans. The closing map and table show the distribution of towns by percentage of foreign stock in the town's total population.

For a copy of the "Ethnic Atlas of Connecticut, 1970," send check of \$4.00 payable to 'University of Connecticut' to Dr. Thomas Steahr, Box U-96, UConn, Storrs, Conn. 06268.

Rural Population Growth in Connecticut Is More Pronounced Than National Trend

By Dr. Thomas E. Steahr
Associate Professor of Rural Sociology

Connecticut's rural population grew more rapidly than population in other areas during the 1970-73 period.

Population in entirely rural towns accounted for 49.7 percent (47,309) of the state's growth from 1970 to 1973. And this is consistent with, but more pronounced than, the national trend of non-metropolitan population growth.

From 1960 to 1970, the Nutmeg state's rural growth was much smaller, with only 19.3 percent or 95,990 of the total population growth occurring in rural towns. Table 1 will illustrate these findings.

Inmigration and outmigration have played major roles in the state's population distribution. Urban and mixed towns experienced a net outmigration of 27,000 persons from 1970 to 1973, contrasting with a net immigration of 146,000 from 1960 to 1970. Because of this reversal, nonrural town population increased only .9 percent from 1970 to 1973. Entirely rural towns grew by 7.7 percent and net immigration accounted for 77.8 percent of that growth.

Location is an important factor in population growth. As shown by Table 2, rural towns adjacent to Standard Metropolitan Statistical Area (SMSA) boundaries grew faster than nonadjacent rural towns. This pattern substantiates the national pattern, and offers some support for suburbanization interpretation.

Rural towns not adjacent to SMSA boundaries grew by 6.8 percent or 5,269 persons and net immigration accounted for 83.9 percent of that increase. A decentralization interpretation is suggested by this pattern of growth.

If the social and economic forces of suburbanization were responsible for rural population growth, the entirely rural towns within SMSA's would have had the most rapid growth rates. This did

Table 1 -- Population Change by Residence, United States and Connecticut, 1970 and 1973.

Residence	Population			Net Migration		
	1973 (1,000)	1970 (1,000)	Change (Percent)	1970-73 (1,000)	1960-70 (1,000)	(N)
United States	209,851	203,301	3.2	1,632	3,001	(3,100)
Metropolitan	153,252	149,002	2.9	486	5,997	(630)
Nonmetropolitan	56,599	54,299	4.2	1,146	-2,996	(2,470)
Connecticut	3,079	3,032	1.6	-.9	216	(169)
Nonrural ¹	2,752	2,728	.9	-27	1146	(96)
Rural ²	327	304	7.7	18	70	(76)

Source: U.S. Bureau of the Census, U.S. Census of Population: 1970, General Population Characteristics, PC (1) - B8, Connecticut; Beale, C., "The Revival of Population Growth in Nonmetropolitan America," Economic Research Service, U.S. Department of Agriculture, ERS-605.

1. Towns containing entirely urban or urban and rural populations in 1970.
2. Towns whose population was classified as entirely rural in 1970.

Table 2 -- Population Change for Rural Towns by Location to SMSA's, Connecticut 1970 to 1973.

Location	(N)	Population Change		Source of Change		Percent Change Due To	
		Number	Percent	Natural Increase	Net Migration	Natural Increase	Net Migration
Total Rural	(76)	23,499	7.7	5,218	18,281	22.2	77.8
Within SMSA	(15)	6,522	6.9	2,651	3,871	40.6	59.4
Adjacent to Urban ¹							
Town of SMSA	(11)	4,318	7.5	368	3,950	8.5	91.5
Adjacent to Non-Urban							
Town of SMSA	(22)	7,390	9.8	1,350	6,040	18.3	81.7
Nonadjacent to SMSA Boundary	(28)	5,269	6.8	849	4,420	16.1	83.9

1. Towns with 50 percent or more of the residents classified as urban.
2. Towns with less than 50 percent of the residents classified as urban.

not occur in Connecticut, since rural towns within SMSA boundaries increased by 6.9 percent. This was less than the increase for all rural towns and less than that of rural towns adjacent to SMSA's. Net immigration was a relatively less than important factor here, as it accounted for 59.4 percent of the population growth.

If rural communities are changing into residential and employment suburbs, rural towns adjacent to SMSA urban towns should grow more rapidly than those adjacent to nonurban SMSA towns, but just the opposite has occurred in Connecticut from 1970 to 1973. In fact, rural towns adjacent to nonurban towns of SMSA's increased at rates significantly higher than in any other category. This does not conform with suburbanization expectations, because the most rapid population growth occurred in rural towns removed from the direct influence



of urban sections of SMSA areas. Decentralization expectations are also not fully confirmed because the rural towns are adjacent to SMSA boundaries.

As a result of this study, it was found that not only did population of entirely rural towns grow faster than that of mixed urban and rural and entirely urban towns, but rural towns experienced net immigration during this time. Urban or mixed towns reversed their traditional pattern and experienced a substantial net outmigration.

Additional research is underway to clarify the suburbanization versus population decentralization interpretation of these recent trends and to draw out the implications for such growth for rural towns in Connecticut.

Poverty Status of Male Versus Female Headed Families Is Compared

Why are female-headed families in Connecticut so much more likely to be living in poverty than male-headed families?

This question is the subject of a demographic study being conducted by Dr. Kenneth P. Hadden, assistant professor of rural sociology.

According to him, about one-quarter of Connecticut's female-headed families were below the federally established poverty line in 1970 in the nation's third wealthiest state. This means, according to information published by the U.S. Census Bureau, that more than 18,000 families headed by women received incomes -- mainly through work or public assistance -- too low to allow their minimal needs to be met.

In contrast, only about 3 percent of families headed by males (including husband-wife and lone male-headed families) were below the poverty line in 1970. Female-headed families were about seven times more likely to be poor than were families headed by males. In human terms, these figures mean that children reared by their mothers alone are far more likely to be deprived of necessities, such as adequate diets and clothing as well as luxuries, which most of their peers raised in intact or male-headed families take for granted.

A brief discussion follows on the major factors contributing to the poverty of male-headed or female-headed families. First, the amount of formal education one has bears upon the amount of income one is able to earn and, consequently, upon the probability of being in poverty. This widely accepted generalization must, however, be qualified. It holds to a much greater extent for male family heads than for female family heads.

Male and female heads whose families are not poor have rather similar educational backgrounds on the average -- the median number of years of school completed is 12.4 and 12.0, respectively. Female heads whose families are poor, however, have substantially more education than their male counterparts -- the females have median educations of 11.0 years while the males have only 9.6 years.

This clearly suggests that a weak educational background is an important factor in determining whether or not a male-headed family is poor. Male heads whose families are poor have, on the average, almost three years less education than male heads whose families are not poor.

The effect of education on the poverty status of female-headed families is much less clear-cut, however, since women whose families are poor have only one year less education than those whose families are not poor. Put another way, only



2 percent of families with a male head who has graduated from high school are poor, whereas almost 20 percent of families headed by a woman with a high school education are poor. In many cases, families headed by women are poor in spite of adequate educational backgrounds.

Having eliminated educational deficiencies as a major reason for the high incidence of poverty among female-headed families and confirmed it for male-headed families, Dr. Hadden turns to another likely candidate -- the presence of minor children at home. A woman family head has a 1 in 3 probability of being poor if she has one or more minor children living at home; 1 in 16 if she does not. The conclusion is clear: having children living at home increase the likelihood of a woman's family being in poverty. Among male-headed families, the presence of a minor child makes little difference in whether or not the family is in poverty.

A more complete discussion of these and other factors thought to be important in producing a high probability of poverty among families headed by women will appear in a forthcoming Storrs Agricultural Experiment Station bulletin.

Improving Control of Reproduction in Dairy Cattle

By Dr. Charles O. Woody, Jr., and
Dr. John W. Riesen, Associate
Professors of Animal Industries

The average dairy cow only produces three calves in her lifetime, and half of them are bulls. To make better milk producers, each calf should be sired by a superior bull which is usually possible through artificial insemination (AI). The use of AI in turn requires the dairyman to know when the cow is in estrus (heat) for conception to occur. Since the average cow is in heat only 12 to 18 hours, it is necessary to observe them twice daily for about 20 minutes, or more frequently for shorter periods of time.

In a time of high labor costs this has led dairymen into attempting shortcuts in herd management. This has included the use of unproven heifer bulls to breed heifers and inadequate heat detection. The latter leads to poor fertility and sometimes to serious reproductive problems.

For years, scientists and others in the dairy industry have searched for ways to treat a cow or a heifer so that she could be inseminated and would be fertile at a specific time following treatment. The treatment would be set so that this fertile period would be convenient to everyone involved and the animal would be "inseminated by appointment." This system would be economically advantageous to dairymen and to AI organizations and their technicians as well as to families with one or two cows providing a small milk supply and to 4-H members with cattle projects.

Unfortunately, such a technique is not now available in the marketplace. However, two promising systems are under study at various state universities including the University of Connecticut. To get on the market, a system must be: (1) accep-

table to cattlemen; (2) profitable for a pharmaceutical company; and (3) approved for use by the Federal Food and Drug Administration and the U.S. Department of Agriculture.

To be acceptable to cattlemen it must do the job it is claimed to do -- accurately control the fertile period -- without seriously impairing fertility and without requiring too much investment, time or

equipment. The two systems proposed here may meet the first two requirements, but, as yet, not the third requirement.

How does each system work? A cow has an estrous cycle of about 21 days, though it may vary from 17 to 25 days. To cause a cow to be fertile at a time other than her expected normal time requires that the estrous cycle be extended and estrus delayed, or that it be interrup-



Dr. Charles O. Woody places a progestagen-containing implant under the skin of the ear of a Holstein heifer. Helping to control the animal is Dr. John W. Riesen.

ted in some way so that estrus may occur earlier than normal. Since it is assumed that the interval since the last estrus is unknown, the same treatment must work for all treated cows. In early studies the aim was to delay estrus by administering appropriate hormones for nearly the length of an estrous cycle. This, however, lowered fertility excessively.

One system presently being developed involves the use of Prostaglandin, a hormone produced in the uterus as well as in other parts of the body. This hormone was found to be capable of interrupting the estrous cycle of cattle with a new estrus and fertile period occurring in about three days. On the other hand, this hormone proved to be ineffective during the first 5 days of the cycle, resulting in a failure to respond in about 25 percent of the treated cows. Administering two treatments 10 to 14 days apart has overcome most of this problem. Early results were extremely encouraging, but later studies have indicated some problems to be overcome using this treatment.

The second system does not involve



the use of prostaglandins. Instead, this treatment is based on the use of a progestagen and an estrogen -- the same classes of hormones produced by the ovaries and used in birth control pills for women. The authors and others in the Department of Animal Industries have been working on this system to improve breeding results. Several hundred heifers have been obtained over the past several years from a state prison farm and used in experiments at the University of Connecticut. Afterwards, the pregnant heifers were returned to the herd.

If a dairyman, using the system developed from research here and at other institutions, wished to inseminate a group

of heifers on, say, March 12, he would follow a simple procedure. On March 1, he would insert a small plastic implant under the skin of one ear and give an intramuscular injection. The implant contains a small amount of progestagen and the injection includes additional progestagen plus estrogen. On March 10 implant is removed and on March 12, 48 hours after implant removal, the heifer is inseminated.

Recent experiments with Holstein heifers have provided data on the scheme described. The heifers were inseminated with frozen semen 8 to 16 hours after detection of estrus or 48 hours after implant removal. The percent conception was as follows: untreated control heifers with AI 8 to 16 hours after detection of estrus, 70.8 percent; treated heifers with AI 8 to 16 hours after detection of estrus, 61.8 percent; and treated heifers with AI 48 hours after implant removal, 61.3 percent. The level of fertility obtained is thought to be acceptable considering the advantages of the implant treatment.

The future of either method of fertility regulation is unknown at present. However, pharmaceutical companies involved are actively seeking clearance for manufacturing the products and making them available to the dairymen and AI technicians. Other universities such as Cornell, Pennsylvania State, West Virginia and Texas A&M, have active research programs. We have collected samples of blood and milk from lactating beef cattle to allow testing for the presence of residues, and other scientists are conducting similar work elsewhere. It is hoped that one or both methods will prove safe for use and will appear on the market soon.

... And On ...

Bovine infertility is a problem of great economic importance. The known causes of infertility in cattle are many, and they cover a wide range of etiologic factors. Some of the most common causes are infectious organisms, which may directly or indirectly affect the bovine genital tract and the fetus.

Numerous investigations have been conducted to determine the exact relationships between these infectious organisms and their effect upon fertility. As a result, a number of specific bacterial and viral agents have been definitely proved to cause infertility and abortion in cattle. The most important diseases are brucellosis, vibriosis, trichomoniasis, and leptospirosis.

However, even with these important discoveries, the incidence of bovine infertility continues to remain high. A recent survey of 5 northeastern states revealed that of 3,812 bovine abortions examined between 1966 and 1970, a detectable cause was revealed in only 23 percent of the cases.

This points out the obvious need for continued research in this field. Because of the magnitude of this problem, research has been and is still being conducted on a cooperative basis with several agricultural experiment stations in the northeast including Massachusetts, Rhode Island, Vermont, New York, Pennsylvania, West Virginia, and also the National Animal Disease Center in Ames, Iowa.

Research Objectives

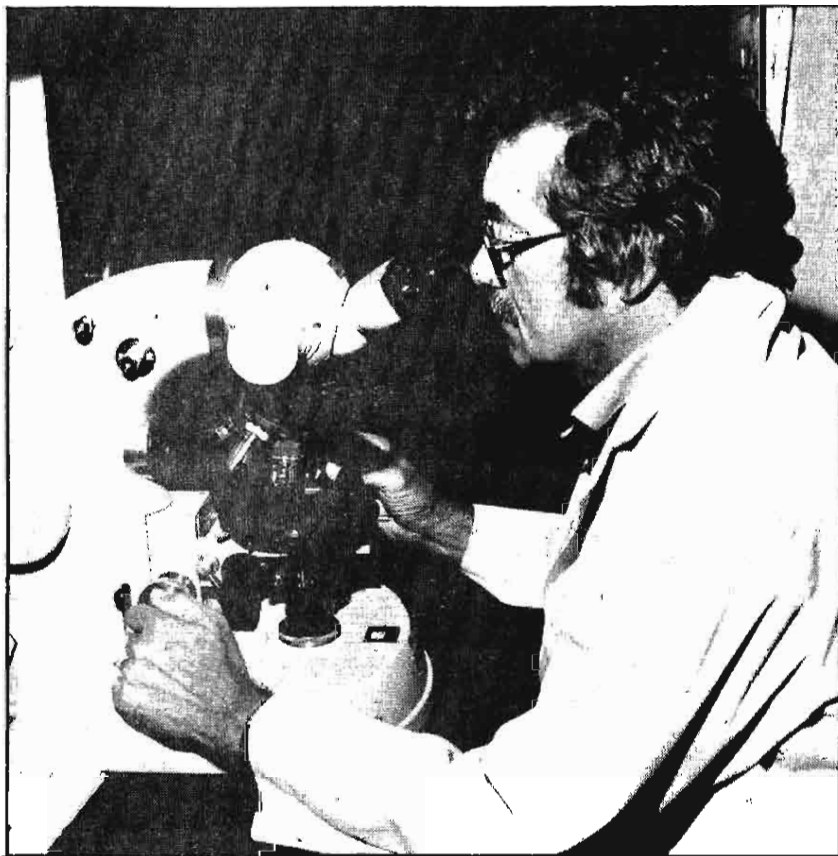
The basic objectives of this cooperative research are as follows:

1. To isolate and classify microbial agents which infect the reproductive organs of cattle and cause failure of conception, embryonic death, abortion, malformation of the fetus, neonatal death, and poor quality semen.

2. To select a few agents for in-depth study, which include host response, pathogenesis of infection, virulence mechanisms, and possible disease transmission from cattle to man. (Many animal diseases present excellent models for making con-

Improving Control of Infectious Diseases That Cause Infertility in Dairy Cattle

By Dr. Mark E. Tourtellotte
Professor of Pathobiology



Dr. Mark E. Tourtellotte looks for lesions of disease on a sample of tissue from the genital tract of a cow.

parative studies of human diseases, thereby contributing to the solution of human ailments. For example, bovine venereal vibriosis, which has been studied as part of the northeast regional project, is currently being used as a model for studying human venereal diseases.)

3. To develop methods for diagnosis, treatment, control, and prevention of the more important infectious causes of infertility.

4. To apply the information gained through the studies toward the acquisition of an increased understanding of the manner in which infectious diseases interfere with conception as well as normal embryonic and fetal development. This knowledge can be utilized for: increasing productivity of cattle by controlling infectious diseases of the reproductive organs; prevention of malformations in cattle and women due to infections

during early pregnancy; and possible applications in fertility control in man.

Abortions in Cattle

Streptococci are one of the six most frequently isolated agents from aborted bovine fetuses in New England. From experimental infection of ewes, it appears that beta hemolytic streptococci may be significant abortifacient agents and further work, especially in cattle, is strongly indicated.

Leptospirosis can be a serious cause of abortions in cattle. Work done with pregnant ewes has provided valuable information regarding the infectious process. Extension of this work by experimental inoculation of pregnant cows should contribute further to an understanding of bovine abortion caused by these organisms.

Several viruses have been shown to be involved in infertility, abortion, and abnormal fetal development in cattle. The development of reliable fluorescent antibody techniques for the detection of viruses including IBR, PI-3, and BVD over the past five years is a major contribution to the detection of these viral agents in aborted fetuses. Continued efforts to develop fluorescent antibody techniques for other viruses and other agents; for example, leptospira and mycoplasmas, are strongly needed.

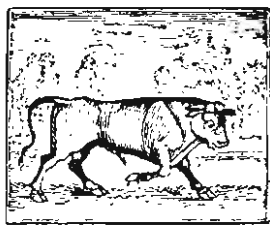
Diagnostic Breakthrough

Another major diagnostic breakthrough has been the detection of antibodies against several viral agents in aborted bovine fetuses. This technique is of great value, since there is considerable evidence that the major damage in cases of abortion occurs early in pregnancy. By the time abortion occurs, the viral (or other) agent is no longer present or detectable by isolation and fluorescent antibody techniques. In most cases, it is

now known whether the presence of antibodies to a specific agent is conclusive proof that the agent was the cause of abortion. More research is needed, including work on the experimental inoculation of pregnant heifers with viruses, leptospires, mycoplasmas, and bacteria whose antibodies have been detected.

Studies of the effect of BVD on the developing bovine have convincingly demonstrated that BVD cerebellar and ocular lesions and has shed some light on the effects of this virus.

It has been well established that *Mycoplasma* spp., especially *Mycoplasma bovis* and *Mycoplasma agalactiae* var. *bovis*, causes infertility in cattle. Inoculation of bulls with these two strains resulted in acute seminal vesiculitis. The pathogenicity of *M. bovis* was sufficient to interfere with semen production. The persistence of these mycoplasmas in the genital tract of bulls for long periods of time is indicative of carrier states. In addition, the isolation of these two species of *Mycoplasma* sp. from naturally occurring cases in bulls and the isolation of an unidentified *Mycoplasma* sp. from a herd showing 13 percent incidence of neonatal deaths points to the need for continued work in this field. The development of reliable serologic tests in the past two years for *M. bovis* and *M. agalactiae* var. *bovis* should provide an important tool in detecting these mycoplasmas in herds and perhaps more important in bulls used for artificial insemination where undetected infection could lead to wide dissemination of these pathogens.



Mycoplasmas In Cattle

It is obvious that research in improved diagnosis, isolation, treatment, and eradication of mycoplasmas in cattle is sorely needed.

The high percentage of positive serologic reactors (35-40 percent) in cattle with infertility problems strongly suggest that mycoplasmas play an impor-

tant role in bovine infertility, especially since only two strains of mycoplasmas were used in our study. In addition to serologic testing, greater efforts at isolation are obviously needed.

The similarities of pathologic lesions in cattle infected with mycoplasmas compared to some of those observed in human females are striking. With the frequency of isolation of mycoplasma from women with infertility problems, it would appear that more vigorous and intensive studies of urogenital mycoplasmosis in humans are needed. In light of the fact that mycoplasmas produce pathologic lesions and infertility in bulls,

mycoplasmas as causative agents of human male infertility should also not be ignored.

It is tempting to speculate at this point, since infectious agents are detected in only 23 percent of infertility causes in cattle, that the remainder may be due to hormonal or other metabolic causes. However, experience with other "non-infectious" diseases, such as oncogenesis, lupus, Aleutian mink disease, and a host of others, would suggest that many of the remaining problems involving bovine infertility are not primarily metabolic diseases, but may involve as yet undetected infectious agents.

UYA'ers Extend Nutrition Education to Many Groups in Eastern Connecticut

By Dr. Kirvin L. Knox
Head, Department of
Nutritional Sciences

UYA stands for University Year for ACTION. UYA'ers, as they are commonly called, are students from the Department of Nutritional Sciences in the College of Agriculture and Natural Resources. They are spending a year learning and applying their knowledge to help people in a real world.

Like VISTA, RSVP, and the Peace Corp, UYA is a federally supported program under the aegis of ACTION. Over 40 UYA programs are underway at universities throughout the country, but the University of Connecticut's program is the only one with a focus on nutrition.

The Department of Nutritional Sciences offers a unique community nutrition program for both undergraduate and graduate students that provides a practical setting for a University Year for ACTION. Students combine their studies with field work in the community to improve the nutrition of low-income and disadvantaged people with the greatest nutritional problems. It is a chance to learn from experience and to gain experience while learning.

There are 10 students enrolled in the UYA program, but not all of them are

majoring in nutritional sciences. The most important qualification for a UYA'er is an interest, concern, and commitment to improving the health and well-being of the citizens of Connecticut through nutrition.

The University Year for ACTION began at UConn in May 1975, after Connecticut's proposal was accepted in Washington, D.C. The program is now completing its second year and a new class of students was begun in May 1977.

OUR PROGRAM IS THE ONLY
ONE IN THE COUNTRY WITH A
FOCUS ON NUTRITION

Students receive orientation and training from Nutritional Sciences' staff and trainers from ACTION. Following a week of orientation and training, the students began working on their projects in June, and they finish the year in the following May. Some projects continue from year to year, being carried on by incoming



UYA volunteers. Other projects have been completed and new ones initiated since 1975.

This type of ACTION-oriented program has become an integral part of the Department of Nutritional Sciences' undergraduate and graduate programs. It is extremely important for people of Connecticut to have direct relationships with the students from the university to see students helping and serving the community. This program is essential to make the study of nutrition effective in meeting the needs of people. It is also necessary and helpful for students to have reality-based community experiences.

Most UYA'ers work through other agencies in eastern Connecticut, helping those agencies solve problems, develop projects, and provide services related to unfilled needs in nutrition. For example, Constance Cwiek is working with the Putnam-Thompson Visiting Nurses Association, advising patients on prenatal nutrition through counselling and home visits. Ms. Cwiek also has conducted nutrition educational workshops in the Plainfield grammar school.

Cava Korminak, an ex-UYA volunteer, Susan Scalan, and Patricia Gaenzler -- all nutritional sciences majors -- have been working with Dr. Gretel Pelto, an anthropology professor and Ron Johnson, an anthropology graduate student, on a nutritional status survey in northeastern Connecticut. They have surveyed some 300 households selected to represent a cross section of the community to assess dietary patterns, nutrition problems, and cultural factors that effect nutritional status. The study is currently being compiled and analyzed and will be used by various agencies in northeastern Connecticut for documenting certain needs and problems.

William Long, graduate student, has worked with FEAD in the Willimantic area, helping establish farmer's markets in

downtown Willimantic for locally-grown produce. Long also was instrumental in developing the first emergency food bank for Willimantic residents.

Richard Wood, another nutritional sciences graduate student, has been working with several day care centers in eastern Connecticut, studying the possibility of zinc deficiency in children.

Jill Fey, nutritional sciences student, and Michael Diamond, UConn College of Liberal Arts and Sciences student, have established a nutrition counseling service

in Putnam. They have helped extend the food purchasing cooperative developed by Michael Goldman as a UYA project last year.

New projects are being planned for next year. They will include a nutrition program for summer feeding projects and a study of the energy use and alternate food systems for low-income individuals. For more information on the UYA program in Connecticut and for interested potential volunteers, call the Department of Nutritional Sciences at 486-3633.

Horizontal Silo Technology Is Studied by Interdisciplinary Team

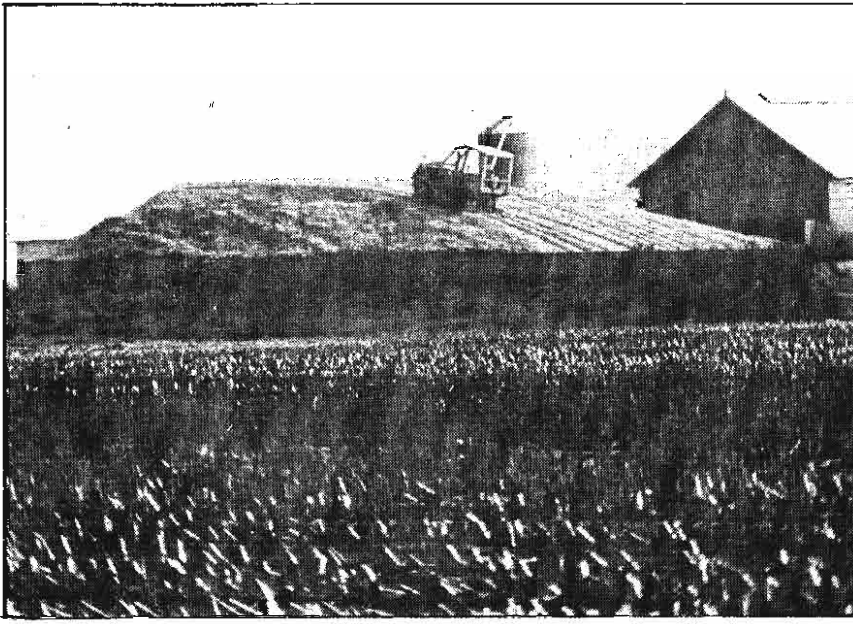
Several professors in the College of Agriculture and Natural Resources have undertaken a project to study horizontal silo technology. Specifically, they have studied the biological, economic, and safety aspects of bunker and trench silos and silage stacks.

Senior research workers in this project include Drs. William Gaunya and W.A. Cowan of the Department of Animal Industries, Dr. Irving F. Fellows of the Department of Agricultural Economics, and Dr. John J. Kolega of the Department of Agricultural Engineering.

The interdisciplinary 3-year project was funded with \$57,000 from the Dairy Chore Reduction Program, a cooperative program of the agribusiness community under the leadership of Agway, Inc. Financial contributions were received from cooperative and proprietary feed companies, and from farm credit agencies.

One of the project's objectives was to study factors influencing the efficiency of preservation and silage quality in commercial size horizontal silos. Another objective was to study the economic parameters of this system of storing and feeding silage in horizontal silos. A third objective was to identify the hazardous aspects of horizontal silo technology and to arrive at a series of recommendations designed to prevent accidents or injury when filling and feeding from horizontal silos.

In 1974, 21 commercial size horizontal silos were studied. These silos were located on the farms of 14 cooperating dairymen. The forage was almost completely corn silage. Five hay crop silos were studied in the summer of 1975, and in the fall of 1975



Shown is a modern 2500-ton bunker silo being filled with corn silage at one of the 14 cooperating dairy farms in the silo technology study. This photograph was taken at the Niemann Brothers dairy farm in Ellington, Connecticut.

an additional 19 corn silos were utilized. Approximately 47,000 tons of silage were involved.

Efficiency of preservation was determined by the buried bag technique. Top spoilage was determined by direct weights on 3 silos in 1974, and by regular representative samples of all corn silos in 1975. Lactic acid, volatile fatty acids, and pH were determined weekly as estimates of silage quality. Data on the 45 silos have been gathered and are now being studied to determine if certain management variables have an effect on the efficiency of preservation and silage quality.

The average mean efficiency of preservation in 40 corn silos was 87.4 percent and for the 5 hay crop silos it was 85.2 percent. Contrary to expectations, efficiency of preservation was greater in smaller temporary stacks than in larger bunker silos, 91.5 percent versus 83.6 percent. The data suggest a negative relationship between density of the silage and efficiency of preservation (r equals minus 0.38). This refutes the long-standing concept that corn silage in bunker silos should be packed as tightly as possible.

Another study compared lactic acid levels in tower and bunker silos. These values were 7.22 percent and 6.95 per-

cent, respectively. A study is currently underway with two silos, investigating the effectiveness of propionic acid as an agent to minimize top spoilage in corn silage in horizontal silos.

Observations of harvesting, silo filling, and silage feeding on cooperating farms have been studied. Total investment and annual costs per cow and per ton have been determined and found to be highly variable. The data are being studied further to determine the optimum combination of machinery, equipment, and labor for harvesting, storing, and feeding of silage in horizontal silos on modern free-stall dairy farms.

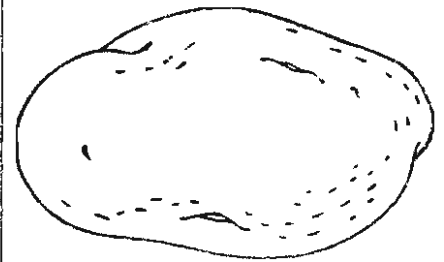
The agricultural community is appalled by the all too frequent reports of fatalities resulting from accidents in filling and feeding from horizontal silos. Observations of filling and feeding operations have been made on cooperating farms. The areas of risk have been identified and a series of recommendations have been drawn up which should minimize risk and help to prevent accidents.

It has been established that the effluent of horizontal silos has severe water pollution potential and that the effluent should not be allowed to contaminate water supplies or waterways.

Potato Metabolites Are Being Tested for Toxicity

By Dr. Louis J. Pierro
Head, Department of Animal Genetics

The potato is one of the world's leading food crops. Per capita consumption in the United States is 120 lbs. per year, with processed potato products accounting for approximately half of the total. Millions of dollars are spent annually on potato breeding programs to improve both product quality and resistance to pests.



Potato consumption has occasionally been associated with toxic effects related to an increase in content of some constituents normally present in only trace amounts. Extremely small amounts of a class of compounds known as glycoalkaloids, for example, are normally present in the potato tuber. Toxicity has been associated with eating tubers containing unusually high contents of glycoalkaloids. Glycoalkaloids may be more abundant in some tubers because of varietal differences, or because of seasonal

differences or even growth location. Chemical treatments intended for disease control or stress factors associated with handling and storage after harvest may also alter glycoalkaloid content.

Although it has been realized for some time that high levels of glycoalkaloids may be toxic to humans and animals, it has only been in recent years that concern has been expressed for the potential toxicity of these compounds for developing embryos. The possibility of interference with normal developmental processes (teratogenesis) is perhaps the most striking aspect of this concern.

A cooperative program has been developed within the past few years to achieve better predictability for safety control of potatoes. The program involves investigators from the Agricultural Experiment Stations of the northeast region and Idaho, the Agricultural Research Service (Eastern Regional) and the U.S. Department of Agriculture. The specific objectives are: (1) to identify and isolate stress metabolites from potatoes; (2) to explain conditions and mechanisms for induction of such metabolites; (3) to evaluate the teratogenicity of these metabolites, and (4) to evaluate the activity of the stress metabolites in disease resistance. At the Storrs Agricultural Experiment Station, we are particularly concerned with the third objective. Potato metabolites isolated and purified at the Eastern Regional Research Center are sent to us for testing.

Mouse is Used As Animal Model

In our laboratory the mouse is the animal model for testing the potential embryotoxicity and teratogenicity of potato stress metabolites. In our usual procedure a single male is placed overnight in a pen of 4-5 females. The male is removed the following morning and the females are examined for evidence of mating (vaginal plug method.) The morning of the day on which mating is detected is taken as time zero of pregnancy. The total pregnancy or gestation period is 19 days. We routinely wait until the end of the sixth day of

gestation before treating the mother in order to allow time for the embryo to implant in the uterine wall. By the end of the sixth day of gestation, maternal tissue virtually surrounds a crypt in which the embryo develops and the ground work for development of the placenta is started. The next few days of gestation are very active ones. All of the major embryonic organ systems are initiated; the placenta which allows the maternal blood to deliver nutrients and oxygen to the embryo's blood and in turn receive waste products for removal is established.

In our experiments each mother is treated by a single injection into the body cavity on a specified day of gestation. Treatment is monitored by interruption of pregnancy at the end of the 14th day of gestation. The uterine tubes are removed, placed under saline, and opened longitudinally. Data collected include number of implantation sites, presence and viability of fetuses, and morphological appearance.

We are currently testing two highly purified potato glycoalkaloids; chaconine and solanine. Chaconine is being tested over a dosage range of 8 mg/kg maternal body weight through 28 mg/kg. On the basis of maternal deaths observed at these dosages, we estimate that half of the mothers will be killed at a dosage of 40 mg/kg b.w. Maternal risk appears to be independent of the stage of pregnancy at the time of treatment. Chaconine treatment also results in embryonic death; risk varies with gestation stage.

Data obtained in our initial experiments indicated that chaconine is teratogenic if



maternal treatment takes place at 8 or 9 days gestation age. A single injection at 16 mg/kg b.w. given at 8 days gestation results in midline facial defects involving clefts in the upper jaw, palate, and nasal tissue. A single injection at 24 mg/kg b.w.

given at 9 days gestation produces abnormalities in the forelimbs and tail. The frequency of abnormal embryos observed in any treatment group has not exceeded 10 percent, but our experimental groups differ significantly from control groups.

Animal Strains

The animals used in our initial experiments were from an inbred strain developed by brother-sister matings over a large number of generations. The advantage of using an inbred strain for testing is the genetic uniformity provided; the animals are considered equivalent to identical twins. The disadvantage is that tests with a single inbred strain may by chance reveal either a particularly sensitive or resistant genetic constitution for any given test substance. In order to minimize this problem, testing programs are designed to include more than one animal strain as well as hybrids produced by crosses between inbred strains.

When our studies with chaconine were extended to a second inbred strain, maternal and embryonic mortality were observed but no defects were seen among the embryos that survived treatment. When hybrid embryos produced by matings between two inbred strains were tested, treatment at 8 days gestation age (16 mg/kg b.w.) again produced embryos with midline facial defects. In addition, some of the embryos showed a condition known as exencephaly. Exencephalic embryos have externalized brain tissue associated with failure of the brain to close over normally during early stages in its development. Exencephaly forms the basis for a defect observed late in gestation or at birth which is referred to in the clinical literature as anencephaly.

Significance for Humans

The significance of these experimental studies for humans is a major question that is not easily answered. Extrapolation from studies with laboratory animals is a risky task. We have a long way to go before we can reasonably relate responses of our mice to anticipated responses of humans. A pregnant woman weighing

130 pounds would require 960 mg. of chaconine to attain a dose of 16 mg/kg b.w.; an expectant mother would either have to eat an awful lot of potatoes or eat potatoes with extremely high levels of chaconine. At this stage, however, we can only speculate about the requirement for similar dosages in humans and mice.

On the basis of data for human birth defects, an hypothesis published by Renwick in 1972 postulated a causal relationship between consumption of potatoes with elevated tuber glycoalka-

loids and the human birth defects anencephaly and spina bifida. Renwick's hypothesis received considerable publicity and has been widely debated. The hypothesis was challenged by other investigators and until recently the preponderance of evidence from experimental animals was either inconclusive or negative.

As described previously, our studies now show that under certain conditions chaconine can be teratogenic in the mouse. Mun and his colleagues at the University of Maine have reported that solanine is

teratogenic in chick embryos. Scientists from Czechoslovakia have recently confirmed their results. Keeler and his collaborators at Idaho have reported that administration by stomach tube of Kennebec potato sprouts from which tuber material was excluded produces exencephaly and spina bifida in hamsters. Although it may be unlikely that the Renwick hypothesis in its original form will survive, it is apparent that some of the basic notions are not ready for dismissal.

Research for Connecticut by the Storrs Agricultural Experiment Station. Research Report 47 September 1977 — A report of progress published by the Storrs Agricultural Experiment Station in the College of Agriculture and Natural Resources at the University of Connecticut, Storrs, Connecticut 06268. Edwin J. Kersting, dean and director, and Joseph J. Lucas, assistant director, Storrs Agricultural Experiment Station.

Editorial Staff: Alexander R. Gavitt, Jr., editor; Karen J. Havens, art and layout.

Photographs: A. Gavitt, David R. Miller, and University of Connecticut Photo Lab.

The authors of articles in Research for Connecticut by the Storrs Agricultural Experiment Station will be glad to answer questions concerning their articles or provide more detailed information about topics.

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