H o r t i c u l t u r a l E n g i n e e r i n g

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Website: www.cook.rutgers.edu/~roberts/

KC Ting co-authors Robotics Book

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Our colleague and chair of the Department of Bioresource Engineering, Dr. KC Ting is co-author with Dr. N. Kondo of a new ASAE monograph, ***Robotics for Bio-Production Systems.*** The book provides a systematic overview of robotics technologies applied to bio-production tasks. The special design considerations and unique features of the robots used in various bio-production systems are discussed. Robotics fundamentals are presented in logical sequence, including the major components of manipulators, sensing elements, traveling devices and reasoning algorithms. Examples include robotic systems developed for the open field, within controlled environments and in the food industry.

Bio-production activities range from traditional farming and food processing practices to those that relate to bio-technical research. In many of these systems the efficiency of materials handling is an important factor that influences system productivity. In addition to robotics fundamentals and examples of applications, the authors present methodologies related to a systems approach and economic evaluation.

The hardbound 325 page book is priced at $57.00 ($47.00 for ASAE Members) plus $4.25 for handling and shipping for the first book, $1.00 for each additional book. This monograph can be ordered from

American Society of Agricultural Engineers,
2950 Niles Road, St. Joseph Michigan 49085-9659
telephone 616 429 6324

Programs of Importance

Greenhouse Design and Environmental Control Short Course

January 11-12, 1999

This short course features one and one half days of technology transfer and a one-half day tour to several state-of-the-art greenhouse operations. Topics for study and discussion include, greenhouse heating and cooling, space utilization, glazing choices, crop production systems, irrigation systems and design of floor heating systems. There may still be time to apply.

Additional information is available from your editor or from **Kirsten Olsen** at The Office of Continuing Professional Education 732 932 8451.

New Jersey Annual Vegetable Meeting

January 19-21. 1999
Trump Taj Mahal
Atlantic City, New Jersey

This popular grower meeting traditionally attracts more than 1500 people each year. The tradeshow is a highlight of the program. In addition to traditional sessions there will be three special sessions on Thursday afternoon. These include the New Technology Session, the Plasticulture Session and the Life After Harvest, Post-harvest session. Trade show and registration information is available from:

Phil Traino Secretary Vegetable Growers Association of N.J.
377 N. Locust Ave. Marlton, NJ 08053.
tel 609 985 4382

Special CCEA Symposium ACE-SYS III

On July 23, 1999 at the Cook College Center at Rutgers University in New Brunswick New Jersey a special symposium will be held. The Center for Controlled Environment Agriculture will present **"From Protected Cultivation to Phytomation" ACE - SYS III.**

Dr Gene Giacomelli is the meeting Chair and **Dr Tadashi Takakura** of Nagasaki University and **Dr. KC Ting** of Rutgers will be session chairs. The program will feature the following:

Topic	Speaker
♦ Automation	Naoshi Kondo Japan
♦ Culture	Merle Jensen USA
♦ Culture	Toyoki Kozai Japan
♦ Environment	Lou Albright USA
♦ Environment	John Sager USA
♦ Systems	Haruhiko Murase Japan
♦ Commercialization	Irwin Chu Taiwan
♦ Epilogue	David Mears USA

Dr Naoshi Kondo is from Okayama University and has just co-authored a book with **Dr. KC Ting**. (see column one page one). **Dr Merle Jensen** is well-known as a pioneer in Controlled Environment Agriculture. **Merle** is Associate Dean at the University of Arizona. **Dr Toyoki Kozai i**s an authority on plant propagation and Chairman of the Horticultural Engineering Department at the University of Chiba in Tokyo Japan. **Dr. Lou Albright** is a professor at Cornell University and an authority on environmental control. **Dr. John Sager** is an engineer with the NASA/Kennedy Space Center in Florida. **Dr Murase** of Osaka Prefecture University in Japan is an outstanding systems expert. **Dr Irwin Chu** is president of Taiwan Flower Biotechnology Inc in Taiwan. **Dr David Mears,** is world class expert in greenhouse design and distinguished professor of the Bioresource Engineering Dept. at Rutgers University.

In addition to the Forum, the program will include the annual CCEA business meeting and conclude with a retirement banquet in honor of Professor **William J. Roberts.**

For more information call Ruth Novak
1- 732 932 9534

The American Society for Plasticulture announces 28th National Agricultural Plastics Congress.

May 19-22, 1999
Ramada Inn, Tallahassee, Florida

The program will feature three concurrent industry tours on the 20th and research presentations on Friday and Saturday. The congress also features a trade show.

On Wednesday the 19th the Southeastern US Greenhouse Vegetable Growers Conference will be held with trade show as a preliminary program to the ASP congress. The program includes the following topics. Gene Giacomelli will talk on '**What's new in Greenhouse Covers and Glazing materials'** Bill Roberts will talk about '**Managing the Greenhouse Environment.** Dr. Merle Jensen will talk about **'Greenhouse Vegetables in the Global Marketplace'** as it applies to Mexico and Southwestern United States**.** Rick Snyder of Mississippi State University will talk about the same topic from the Eastern United States perspective. Shalin Khosla will discuss the topic from a Canadian point of view and Europe and the Mideast will be discussed by Itzhak Secker, Ministry of Agriculture in Tel Aviv, Israel.

The afternoon topics include the resurgence of Greenhouse vegetables in the marketplace, postharvest quality evaluations and a panel to discuss current challenges and solutions to problems for greenhouse tomatoes, cucumber and pepper and lettuce and herbs. Organic Greenhouse Production will be covered by Dr. Mary Peet of North Carolina State University.

Info on Congress: Pat Heuser Executive Sec
526 Brittany Drive, State College PA 16803
tel 814 238 7045

On Vegetable Growers Meeting:
Bob Hochmuth County Agent
Suwannee Valley REC, 7850 Cty Rd 136
Live Oak, Florida. 32060 tel 904 362 1725

A Cord of Three Strands is

Solomon writing over 3000 years ago said that; "Two are better than one, because they have a good return for their work: If one falls down, his friend can help him up. But pity the man who falls and has no one to help him up! Though one may be overpowered, two can defend themselves. **A cord of three strands is not quickly broken.**

Without taking this too much out of context I think that this can be applied admirably to the Land-Grant system of education of which we are a part. The cords of Teaching, Research and Extension or Public education have held together for these many years and have produced a food delivery system which is without equal in the world.

Currently there are less than 2% of the American population classified as farmers involved in actually producing the food we eat, the ornamentals that we grow and the fiber we wear. There are others who work on farms but their number is small. In the West it is not uncommon to have one family farming 2500 acres of wheat by themselves with no others to help them.

Numbers change but it is estimated that each American farmer feeds himself and about 80 others in this country and 20 more around the world. Needless to say he is an important person, because as each one disappears 100 people need to find a new source of food. In the People's Republic of China, it is estimated that 2 out of 3 people who work are involved in food production.

At present in America we spend approximately 12-15% of our income on food. That is, if you are an average American about 12-15 cents of each dollar you earn goes to buy food. The remainder of your income can

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Cord of Three Strands continued

be used to pay taxes, go to college, attend the theater, drive a Yamaha or 280ZX, travel to Europe, enjoy TV and live in a comfortable home.

In other parts of the world the same is not true. For instance in Germany, Scandinavia, Japan and other highly developed countries, the average person spends about 30% of their disposable income for food, twice the United States average. In Russia the number has been reported to be 50% and in the People's Republic of China 60-70%. These numbers change and are only presented here to show the differences in cultures and the fortunate situation for us as Americans.

The tragedy is that in some parts of the world, particularly in desert areas and 3% or 4% world countries (Haiti has just been so designated) and areas of low rainfall people spend all they have, 100% on food and still are unable to find enough food to eat and are starving. This is currently true in North Korea because of weather-related crop failures. Ethiopia and Chad are examples of such countries.

What causes these inequities and these dramatic differences? Distribution of food is the big problem along with ability to pay for the food. We have abundance in our country but unfortunately, even if we limit ourselves to two meals a day it will not automatically feed the people who are only able to eat once a day or not at all.

Why are we so fortunate? We are not smarter. We certainly do not work harder! Perhaps our climate and natural resource base is more favorable but I feel that **the three strands,** the educational system - the Land Grant System has had the most to do with it.

The Land Grant University System has three components, Teaching Research and Extension or Outreach. It can be viewed

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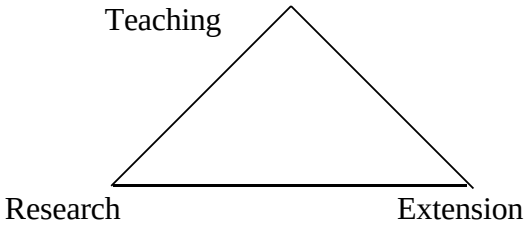
Cord of Three Strands continued

as a triangle with each leg giving strength to the organization. The Land Grant University System had its beginnings in 1890 and was originally intended for Agriculture and Mechanic Arts but the Mechanic arts or engineering function was never funded. In 1914, the Hatch Act completed the triangle and established the Cooperative Extension Service. The Rutgers Agricultural Experiment Station was founded in 1880 and became part of Rutgers University as the complete land-grant institution in 1945.



The triangle is a very strong geometric shape. It is used for bridge construction, building trusses and in nearly all types of steel construction. It makes a good metaphor to discuss the strengths of the land-grant University System.

The function of the Teaching component is well know to students. College students are trained in the areas they choose to study, originally in Agriculture but now in Environmental and Life Sciences, including Engineering. The teacher makes up one component of the triangle. Their function is well known and understood.

The Research component is to do basic and applied research and gain new knowledge for society in all areas of study. One of the most famous research projects done here at Rutgers was performed by Dr. Selman Waksman, a soil microbiologist on the faculty of the College of Agriculture (now Cook College). He was tucked away in his laboratory in obscurity seemingly working in areas

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Cord of Three Strands continued

which were unimportant and unrelated to Agriculture. Ultimately, his work led to the discovery of sulfa drugs used during World War II, streptomycin, penicillin and other members of that family. His discovery has benefited mankind in inestimable ways. The Waksman Institute, world famous in Microbiology is a tribute to his genius and the royalties of his discoveries. The researcher on the triangular team is responsible to gain new knowledge.

The purpose of the Extension component or outreach leg is to take or **EXTEND** (hence the name extension) the knowledge gained by the Researcher and apply it to the production and preservation of food in the growing and harvesting process of the agricultural community. The extension worker digests the information, presents it in usable form to the public who will use it to improve their lifestyle. Traditionally this information was in the area of agricultural production but currently this information highway has grown to include information for the homeowner, youngsters, through the 4H program and the general public through the Family and Consumer Sciences faculty.

In each county of New Jersey, except Hudson, there is a County Agricultural or Resource Management Agent who is responsible to give to members of their counties all agricultural information developed at Cook College and other land-grant Institutions. There are also agents working directly with consumers who are responsible for information on consumer sciences and 4H agents who deal with youth-related scientific projects.

In the agricultural food delivery system, the information gained by the researcher is normally immediately available to the public who paid for the research through the cooperative extension faculty and normal channels of communication. In some cases

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Cord of Three Strands continued

industry is a participant, such as the development of agricultural chemicals for pest control or the development of a new robotic system for harvesting crops. In the industrial development the basic information is available to all and the normal channels of competition keep the prices in line. This is essentially the thesis of the paper and answers the question asked earlier, why do we have such an efficient food delivery system. It is the opinion of the author that the reason is found in the Land Grant System, **the cord of three strands.** Technology transfer of vital information used in the food production system is efficiently and rapidly made available to the community. This guarantees that agricultural production makes use of the latest technology and becomes an efficient producer of food. Although the producer benefits initially, ultimately all of us benefit because we are all end users. We all eat.

Not only is the College triangular in concept but individual faculty members normally occupy two of the three components and in some cases their job description represents all three components of the triangle, teaching, research and public education. For instance, your editor's major role is extension or public education. I am responsible for taking to the public information about agricultural or horticultural engineering, particularly the agricultural public. This Newsletter is an example of this technology transfer. The audience is fellow engineers, horticulturists, county agricultural agents in New Jersey, around the country and throughout the world. Other recipients include greenhouse growers, greenhouse suppliers and manufacturers and greenhouse publications who in turn send the information to their clients.

I also have responsibility for research and for teaching. My expertise is in the greenhouse design area and we have developed techniques here at Rutgers which are now used

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Cord of Three Strands continued

around the world in greenhouse technology. My teaching responsibilities are primarily in the horticultural engineering area and in particular, greenhouse design and environmental control.

The advantages of the land-grant System carry over for the individual faculty member. The teacher has opportunity to apply his latest research to the teaching curriculum. The researcher has to leave his ivory tower and face the questions of probing students. Both of these opportunities make the teacher a better researcher and the researcher a better teacher. Adding public education into the mix allows the teacher to bring all the latest innovations of the industry into the classroom and take the students on field assignments which instruct them in the actual happenings in the real world.

Are there any examples of how the system has worked? There have been many including the green revolution in India which has been a major example of that. The Rutgers tomato developed at Cook College is world known. A particular example occurred in the 1970's. While the oil embargo was in place, the Department of Bioresource Engineering was intensely involved in alternate energy and energy conservation activities for commercial greenhouse production. We attacked the problem with granting from the USDA and the Department of Energy with solar energy research. During that program we developed many energy saving techniques. These included thermal screens, space utilization and floor heating systems. As a result of our research we were able to demonstrate the energy-saving capability of our system. We had a large demonstration project near campus which exhibited the ideas we had developed through tours and meetings. These developments combined with good grower management yielded significant results, not only for the grower but for the industry. When the project

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Cord of Three Strands continued

started in 1978 the grower oil equivalent use was 278,000 gallons of fuel oil equivalent each

year. In 8 years the energy bill was reduced to 110,000 gallons of fuel oil equivalent per year.

Extrapolating this data to the rest of the country can be interesting. There are approximately 20,000 acres of greenhouse in the United States. Assuming only 20% of those were to incorporate these energy saving techniques into their operation the results would be incredible. We can safely assume that the fuel consumption of those greenhouse who choose to incorporate these ideas into their operation have an annual use of 1 gallon of oil per square foot. At a cost of $1.00 per gallon that translates into a cost of $1 per square foot per year for heating their greenhouses. If the savings achieved by these growers were in a modest 30% range, the savings throughout the United States would be over 520 million gallons of fuel oil equivalent per year.

The land-grant system is over 80 years old. In my opinion it was a stroke of genius to develop and envision such a system since it has resulted in a tremendous information delivery system and ultimately a food delivery system.

A cord of three strings in not easily broken.

In every other nation in the world, the technology transfer function of the information delivery system is in the ministry of agriculture and not at the University. This removes one leg of the triangle from the University and makes it that much more difficult to take the information developed at the University and deliver it to the clientele, in this case agricultural producers. This would mean for us at Rutgers that faculty like myself and other teachers you meet would have their offices in Trenton in the New Jersey Department of Agriculture. I could not walk

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Cord of Three Strands continued

down the hall and visit with my fellow research colleagues and share real world activities. Students would not have the benefit of everyday happenings being presented in the classroom.

Another example of the excellent food delivery system is with egg production in the United States. Although the numbers may be dated, in New Jersey one family can care for 40,000 laying hens although some producers care for 85,000 hens per family.

An example of the efficiency of this production system is as follows. On the average one laying hen will produce 252 eggs or 21 dozen per year. The average American consumes about 250 eggs per year including those in bakery products, restaurants and in the home. The current average American family consists of 4 members who consume 1000 eggs per year on the average. The poultry farmer's family produces 40,000 x 252 or 10,080,000 eggs per year. If the average family utilizes 1000 eggs then the one poultry farmer provides the eggs needed by 10,000 families (one laying hen could provide the eggs you would use for the year). Therefore, if a poultry farmer stops producing eggs then 10,800 families have lost their supply of eggs.

This story can be repeated for many agricultural and floricultural crops. The wealth of our country can be measured by its excellent food delivery system. As a result of it, we have the ability to spend the remainder of our income on so many other enjoyable and worthwhile activities. This good fortune is, in the opinion of the author, a result of the land-grant University system developed so many years ago. One of its primary goals was to transfer agricultural technology directly to the producer. It has succeeded and all of us are the beneficiaries of the vision of those who dreamed and those who carry it on today.

A cord of three strings is not easily broken.

William J. Roberts

New Jersey Farm Bureau a New Partner in CCEA

Recently, Peter Furey, Executive Director of Farm Bureau announced that they had become a partner in CCEA, the Center for Controlled Environment Agriculture at Cook College. Farm Bureau joined the research program investigating the open roof greenhouse design concept and has provided a grant to support the cropping system to be installed. Transplant production in the Spring and and year-round strawberry production will be examined.

The Greenhouse is under construction with the roof panels being currently installed. It is anticipated that data will be collected to authenticate a model being developed by Doctor Sadanori Sase from Japan. It predicts inside temperature under varying conditions of outside temperatures, wind and sunlight.

Growers who currently are using this type of greenhouse are very pleased with this fall's crops. During warm periods in September they were able to keep the open-roof greenhouse (85F) within three degrees of outside temperature (82F) while the conventional greenhouse was operating at 10 degrees higher temperature (95F) with the thermal screen in place. The crop in the conventional greenhouse was receiving one half the available PAR light and growing at a temperature 10F warmer than the crop in the open roof greenhouse, growing at full light and 10F cooler temperatures.

Items of Concern include insect control and initial cost of the open-roof greenhouse. Fan ventilation systems have given good control with insect screening but at an associated cost. These are things we hope to learn in the research greenhouse facility located on Hort Farm #3 in New Brunswick.

HORTICULTURAL ENGINEERING

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