Guelph alumnus
THE UNIVERSITY OF GUELPH MAGAZINE
UNIVERSITY of GUELPH
Fall 2003

ARTICLES

feature Stories

Thinking Outside the Box

Geneticists Ann Gibbins and Manish Raizada frame their careers with a shared desire to benefit humankind

Story by Andrew Vowles
Photos by Dean Palmer

In the capital of a former Soviet republic, gunfire crackles within earshot of Guelph animal and poultry scientist Ann Gibbins as she participates in a meeting of an international science committee designed C rather ironically in light of the coup attempt taking place outside C to achieve "peace through science."

Years earlier, nascent plant geneticist Manish Raizada, now a faculty member in Guelph's Department of Plant Agriculture, sees a young girl in his ancestral India beaming over her find C a half-rotted head of cauliflower scavenged from a market C and thinks: "At the dawn of the 21st century, no one should have to live like this."

Today, Gibbins and Raizada are still separated in other ways. She's nearing retirement after 35 years spent in studying, teaching, research and administration at U of G. He's setting up a new research laboratory using federal and provincial funding intended to launch talented young scientists. Her recent research has seen her probing at the genetic roots of farm animals, particularly chickens and pigs. His genetic studies are designed to tease apart the mysteries of plant regeneration.

As a respected senior scientist, Gibbins serves on a global advisory panel intended to help bridge gaps between researchers in NATO countries and less-developed nations C and, not incidentally, to help foster peace among peoples. Impelled by an idealistic fire lit as a high school student just over a decade ago, Raizada hopes to help feed the world.

Where both scientists meet, at least metaphorically, is here at the University of Guelph, where their different paths within the Ontario Agricultural College have led them toward a common goal: making a difference in billions of lives in less-developed parts of the world.

The call from NATO headquarters just four years ago was unexpected, even for an animal geneticist who had already followed a varied career path. After studying biochemistry in her native England, Gibbins lived in Saskatoon and New Zealand before coming to U of G in 1967 when her late husband, Norman, joined the faculty of the Department of Microbiology. At Guelph, she completed graduate degrees in microbiology and genetics in the College of Biological Science, earning a master's degree in 1971 and a PhD in 1980.

Eager to apply her education, she embarked on independent research, initially in a post-doctoral position in biomedical sciences in the Ontario Veterinary College, then as a faculty member in OAC. Reflecting on the twists and turns that led almost a decade ago to her current appointment as chair of the Department of Animal and Poultry Science, she describes herself as the proverbial jack of all trades.

Despite that varied experience C or maybe because of it C she fielded a query for her CV on behalf of NATO as just another routine request. "It seemed rather bizarre," she concedes, adding that she sent off the information, then promptly forgot about the call. "The next thing I knew, I got a call from NATO headquarters telling me I was the Canadian representative on the NATO Life Science and Technology Committee."

Coincidentally, Gibbins's Canadian career parallels the lifespan of the Brussels-based North Atlantic Treaty Organization. In 1960, around the time she first arrived in Canada from England with her husband, then foreign minister Lester Pearson was helping to found the NATO science organization under the guiding principle of "peace through science." Says Gibbins: "This was a visionary move in an attempt to help stabilize nations through co-operative science programs, leading to improved food production and health and improved economic growth."

watershed year for NATO's entire science program. Originally established to foster collaborative projects between scientists in NATO countries only — Gibbins herself had held a four-year collaborative NATO project with a Dutch colleague— the program was altered that year.

"After the breakdown of the former U.S.S.R., there was a real effort on the part of NATO to establish links with countries in the former Soviet Union, as well as with a handful of nations bordering the Mediterranean Sea," she says.

Today, the program supports only collaborations between NATO-country scientists and their counterparts in two groups of developing nations: "Partners" in Eastern Europe and Central Asia and the so-called

Her own appointment to the advisory body in 1999 came during a watershed year for NATO's entire science "Mediterranean Dialogue" countries.

Partnerships under the umbrella science program now take one of four main forms: science fellowships, research infrastructure support, science for peace (involving industrial research and development), and co-operative science and technology. Gibbins's involvement has been with co-operative science and technology collaborations intended to foster personal links between scientists of NATO and partner countries. She was invited to join the Life Science and Technology Advisory Panel, which reviews project applications in biology, agricultural and food sciences, medicine and the behavioural sciences.

Gibbins has helped develop and review applications for various initiatives, including study institutes and research workshops that bring together scientists investigating everything from environmental challenges in the Caspian Sea to risk assessments following the Chernobyl nuclear accident to remediation of former military sites.

Among the projects:

- Studies of fox populations in Siberia to zero in on a possible single gene governing aggressive canine behaviour. "The science behind behavioural traits is still in its early stages," she says, calling the proposed collaboration between scientists in Novosibirsk and Cornell University "an unusual opportunity to determine the scientific basis for aggressive behaviour in mammals in general."
- Investigations of camel production in Central Asia, where camel and desert sciences are economically important in many countries, such as Turkmenistan. "It's absolutely fascinating. I didn't realize there was such expertise in camel biology worldwide."
- Recording heart activity of Mediterranean sandhoppers to monitor environmental problems. Fitting these tiny insects with diodes and phototransistors allows scientists in Poland and the United Kingdom to test relationships between heart rate and environmental stress factors, both natural (humidity, temperature) and human-induced (pollution).

She says a key partnership mechanism is a system of collaborative linkage grants that provide several years' worth of funding to help scientists establish joint research projects. They're particularly aimed at enabling young researchers from the partner nations to spend a period working in NATO countries, learning about ideas and methods they can take back home.

"We believe collaborative linkage grants foster the integration of these young people into major scientific programs in North American or European countries and make a difference to individual lives as well as to their countries."

This fall, Gibbins will complete her four-year term on the international advisory panel, which she currently chairs. She's one of three women sitting on the committee and its first female chair. Its 15 members include eminent clinical psychologists, cancer specialists, immunologists, cell biologists and plant physiologists, all hailing from different countries, including Germany, the United States, the United Kingdom, Jordan, Ukraine, Portugal and Romania.

"It was a completely novel experience for me," says Gibbins, who is as well-known internationally for her straightforward, no-nonsense demeanour as for her own genetics research. "I've been on international committees before, but not one with this range of expertise and cultural background."

Earlier, she had chaired federal panels in Canada as well as a U.S. Department of Agriculture major program review of genetics and genomics research across the United States. "The NATO committee has been the pinnacle of my scientific career in my own eyes because I've been privileged to work with an extraordinary group of people," she says.

If Gibbins was surprised by the turn her career was taking only four years before retirement, Raizada sees his current research path as a natural progression from his earlier humanitarian efforts. Horrified by television images of famine-stricken Ethiopians during the early 1980s and angered at the apparent apathy in his Brampton, Ont., high school, he ran successfully for school council president, then led fundraising efforts for UNICEF and to sponsor foster children in Mali and India. Later at the University of Western Ontario, he encouraged his residence mates to adopt a foster child. "I knew I wanted to do something to help the developing world," Raizada says.

Maybe it was in his genes. His great-grandfather had started two schools in India during the early 1900s. One early student was Raizada's maternal grandmother, who now runs one of the schools — actually a college called Kanya Gurukul for 300 girls ranging from Grade 5 students to adults. Shortly after Raizada's birth, his family left for Nigeria, then moved to Canada when he was three.

Still, he's no stranger to the desperation born of poverty and hunger in the continents left behind. "Sub-Saharan Africa is in desperate need," he says. "It's the only place in the world where agricultural production has gone down

in the past 20 years."

A turning point came during the visit to India when he encountered that enduring image of the young girl in the marketplace. Raizada had considered becoming a doctor, but realized the problem was less a health issue than one of economics. "If they had more income, they could afford health care. I decided my interest in international development was to get at the root of this." He hopes to do that by untangling the genetic mysteries of how plants regenerate.

Fascinated by the process that enables a plant to grow a new part, he's convinced that finding the gene or set of genes responsible for regeneration will ultimately help improve plant breeding and agricultural practices. He believes genetic manipulation of food crops based on his work will enable farmers to grow food more cheaply and easily for quickly expanding Third World populations.

"Our biggest goal is to eliminate the need for farmers to plant seed each year," he says, adding that the technology might also help reduce the need for tilling and attendant soil erosion and help farmers conserve scarce resources such as nitrogen and water.

Raizada hopes to see farmers using the results of his research in five to 10 years, especially in corn, wheat, rice and soybeans. Key to that technology transfer would be working through international research breeding institutes such as the International Maize and Wheat Improvement Centre in Mexico. Known by its Spanish acronym, CIMMYT, the centre is considered by many as the birthplace of the Green Revolution. Raizada did a post-doctoral fellowship there in 2000 after completing a doctorate in plant molecular genetics at Stanford University. He sees himself one day serving on a board or advisory committee of a biotech company or a worldwide agency such as the International Rice Institute. "These institutes are the direct conduits to the developing world," he says.

Gibbins says her experience on the NATO advisory committee has given her a bird's-eye view of development issues, although there have occasionally been unsettling close-ups. In late 2001, she was in Tbilisi attending one of the committee's thrice-yearly meetings when political unrest boiled over in Georgia. "There was an attempted coup while we were there. We heard gunshots right outside our hotel."

Despite the proximity of the firefight, she and her colleagues remained calm. "When you've been chair of a department for about 10 years, you're prepared for anything," she quips.
Even so, she's often been shocked by the conditions endured by local people and some of the scientists in these countries. In Georgia, for example, she visited a microbiological institute with a "fantastic collection" of microbial cultures that she says would be the envy of any biologist. Although that material needs to be kept cool, the institute has only enough electricity to run the refrigerators for up to three hours a day. From research infrastructure to access to chemical reagents or the Internet, the circumstances are "absolutely dire" in many countries, she says.

Paradoxically, many of those same nations offered better working conditions and travel opportunities for their scientists before the fall of the Iron Curtain in 1989. "It's a sad thing to see such talented and committed people struggling," she says. Hoping to lessen the struggle, her advisory panel has helped in everything from bringing scientists together to advising on the development of intellectual property rights to avoid exploitation.

In her own eyes, Gibbins's main achievement during her career has been helping young people, both through her international work and through her research and teaching at Guelph. "Promoting young people has been the most meaningful part of my career."

Raizada's young career took a twist this spring when he left behind his lab in U of G's Crop Science Building to begin a research leave in chemistry and chemical engineering at the California Institute of Technology in Pasadena. Working in what he calls a pioneering lab in the field, he is learning about protein engineering in order to make materials that might help plants conserve water and essential nutrients.

"Water is the biggest problem in agriculture in the developing world. I want to gain skills to produce certain materials that will save water and nitrogen."

His early experiences have already taught Raizada that helping to feed the world will involve more than genetics or engineering alone, or even any clever combination of the two. Beyond science, he says, the complex problems of hunger and poverty in the developing world will require expertise in a wide range of fields, from political science to sociology to health care to economics.

Similarly, Gibbins says achieving international co-operation and peace will mean not just partnerships in science but also understanding of disparate and ever-evolving political and cultural agendas, all of which come together in NATO's science program.

There are more changes afoot. Even as Gibbins prepares to chair her last meeting in Kyrgysztan this fall, NATO is working on merging the science program into a new public diplomacy division. By then, she'll be back in Guelph to wrap up her tenure as department chair, then retire to her 100-acre farm, where she hopes to have the time and space to contemplate the world through new eyes. "I'll be very happy to be anonymous in Rockwood."

Bacon and egg genetics

From studies of camel biology to recording the heart activity of Mediterranean sandhoppers, Prof. Ann Gibbins says her four-year term on a NATO scientific committee has framed her own genetics research with a new global perspective.

Since completing her doctorate at age 40 here at Guelph C delayed somewhat by the arrival of her three sons C she has studied the genetics of domestic animals, notably poultry and swine. Her signature research with chickens has involved engineering changes in the genetic makeup of developing embryos to make useful products that are deposited in the egg. She and her colleagues developed a groundbreaking technique now used widely for getting past the eggshell to alter the embryo's DNA.

Most recently, Gibbins and her students have used genetic engineering to promote production of various useful types of lysozyme, a natural antibiotic that protects the embryo from bacteria during development. Canada produces about a fifth of the world's supply of natural lysozyme extracted from egg white, and Gibbins's research opens the door for the production of variations of the lysozyme gene that will code for antibiotics with greater stability and effectiveness against pathogens.

During the past four years, Gibbins has also collaborated in genomics research aimed at discovering major genes involved in improving meat quality and reproductive success of pigs.
Beyond bacon and eggs, she's seen plenty of other research ideas as a review panellist for agencies such as the Canada Foundation for Innovation, the Natural Sciences and Engineering Research Council, Agriculture and Agri-Food Canada and various U.S. organizations. Internationally recognized for her contributions in avian genetics and biotechnology, she has been in demand as a speaker at international conferences and workshops.

Her own curiosity as a researcher has been stimulated by NATO-supported studies of camel reproduction in Central Asia, looking at fox populations in Siberia to zero in on a possible single gene governing aggressive canine behaviour, and using Mediterranean sandhoppers to monitor environmental problems.

"I became a scientist because there are all these intriguing puzzles that need to be solved," says Gibbins, who adds that teaching has kept her grounded in real-world issues and human concerns. "Teaching involves debate, and debate results in these issues being kept constantly at the forefront of our thought processes. This is why it's so useful to marry research and teaching, especially with emerging technologies such as genetic engineering."

Plants that keep on growing
Hack a dandelion out of your lawn and you know it'll be only a matter of time before the weed erupts anew. From roots to stems to leaves, plants and their constituent parts have a resiliency that fascinates Prof. Manish Raizada, Plant Agriculture. His research program, funded over the past year by the Canada Foundation for Innovation, the Ontario Innovation Trust and a Premier's Research Excellence Award, is intended to find the gene or genes that allow plants of all stripes to regenerate themselves.

Recently, his U of G lab mapped its first regeneration gene found on one of the chromosomes of Arabidopsis or the wild mustard family (what Raizada calls the "fruit fly of the plant world"). He plans to continue work on that and other genes, hoping to prove that the same handful of genes governs the regeneration trick in plants from dandelions to wheat, corn and other crops needed to feed growing populations in developing nations.

In what might appear a bizarre connection, he hunts for the regeneration genes by inserting into a plant's genetic material the bit of firefly DNA that makes the luciferase enzyme responsible for allowing the insect to light up. Out of tens of thousands of copies of the plants, he expects the light-up gene will wind up next to the regeneration gene in at least a few plants.
By exposing the plants to different environmental factors — changing temperature or salt concentrations, toxic metals or pathogens, mechanical stress— he hopes to determine which genes are switching on or off by watching for the plants that "light up."

Raizada thinks outside the box when looking for ways to apply his work — helping Third World farmers develop new plants from rootstock rather than buying new seeds each year, turning plants into mini-factories to make industrial or medicinal compounds, helping farmers develop more intensive practices to produce more food with fewer resources.

"In the next 20 or 30 years, we need to produce more food than we have in the entire history of humanity," he says.
TOP