

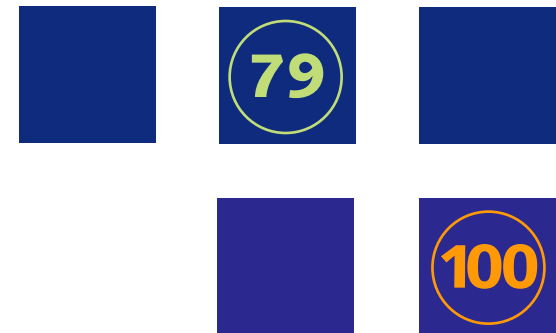
THE BETTER WORLD REPORT *PART TWO*

Technology Transfer Works:

100 Innovations from Academic Research
to Real-World Application



2007 Edition
www.betterworldproject.net



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Acknowledgements

AUTM extends its thanks to Nikki Borman for spearheading the 2007 Edition of the Better World Project; all members of the AUTM Board of Trustees for their ideas, feedback and participation; the National Venture Capital Association; National Business Incubation Association; National Association of Seed and Venture Funds; and the Licensing Executives Society – USA & Canada for their support of this project; Dr. Lee Elliot Major and the Universities UK project team (Alex Bols, Sam Hall and Simon Wright) for allowing AUTM to include innovations and ideas presented in June 2006 edition of EurekaUK, and all of the institutions and companies who told their stories.

The Better World Report is a testament to the efforts of institutions' technology transfer offices, their directors and staffs, who gathered and submitted these stories and more. These contributions tell the story of how institutions are doing their part to improve the world we live in not only through education but through innovation. And it is the Return on Innovation that we bring to light in this report.

Editors and Staff: The stories in the Better World Report were researched and written by The Blue Waters Group, a communications consultancy serving the knowledge industry. The Better World Report was produced by The Sherwood Group Inc., a nonprofit association management firm serving science, technology and health care specialty fields. AUTM's management staff and the communications department at The Sherwood Group provide strategic, editorial and design support for The Better World Project.

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Welcome to a Better World



Introduction

Stories are like doorways. They open before us and we step into someplace new, someplace we haven't been before, and we are the better for it. And so it is with the stories in the AUTM Better World Report™. That's why the Association of University Technology Managers is so proud to bring them to you.

This 2007 edition of the Better World Report tells the story of how the translation of academic research into products and services is contributing to a better world. These are stories about the outcome — the benefits — of moving academic discovery from the lab to the daily lives of people.

We began this communication program in 2006 with the publication of our first Better World Report and its companion piece, Reports from the Field. These two reports put a human face to the complexities of technology transfer by focusing on the social and economic benefits of the process.

This year our two-volume edition of the Better World Reports expands on last year's effort. It is a direct response to the overwhelmingly positive feedback we've received from AUTM's members, as well as from leaders in government, business, finance, public policy and the media, for providing these real-life vignettes.

Part One, "Building a Stronger Economy: Profiles of 25 Companies Rooted in Academic Research" focuses on examples of the phenomenon of new business spin-offs from university

research in the United States, Canada, the United Kingdom and the Netherlands.

Volume Two of the 2007 Better World Report is called "Technology Transfer Works: 100 Innovations from Academic Research to Real-World Application" and presents a collection of 100 vignettes of academic research-based products that are playing a role in a healthier, safer and more convenient world today. From Coumadin blood thinners to QUIKLOT® blood clotting agents, new flower hybrids to a redder cranberry, university researchers solve problems and, more importantly, create

opportunities. All of our stories reflect the fact that the transfer of knowledge knows no boundaries in today's global economy.

The underlying message of all these stories is the importance of support for academic research, as the very foundation of our own work at AUTM to connect research discoveries with the world around us, save lives, improve the quality of life, and increase competitiveness and productivity.

Elected officials and policy makers increasingly recognize the many ways in

which academic research can be tied to economic performance, as well as to the health and safety of people everywhere. AUTM is recognized as a reliable source of objective information about the relationship of research to the marketplace. In addition to our new communications initiative in the Better World Report, we

**The underlying message...
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Introduction

publish the widely-recognized AUTM Licensing Survey™, containing a depth of information and statistical data underscoring the impact of our work.

How the process of technology transfer works — the patents borne, the licensing and royalties granted — can vary from university to university, but it is always carefully and expertly managed by people who are passionate about the science, research, law, finance, regulatory policies, and, in the end, the marketplace. These are the members of AUTM, who over its 30-year history have become recognized as some of the most reliable sources of information about — and some of the prime movers in — today's global, knowledge-based economy.

The stories in the Better World Report are just one way we have of offering an insight into the researchers, the investors, and the owners of new businesses who are creating a new world. In the end, these are stories about ROI — whether it's Return on Investment, or Return on Imagination — and like all good stories, we will let you interpret them as you wish.

On behalf of all the people who make up the Association of University Technology Managers, thank you for sharing our enthusiasm for a better world.



New, Colorful Hybrid Flowers Brighten Gardens Across America

University of Connecticut

Millions of home gardeners have beautified their yards with colorful flowers developed by Professor Ron Parker, Ph.D., at the University of Connecticut-Storrs. Parker's plant-breeding work was highly unusual in that he made extensive use of naturally growing wild plants from around the world — most notably *Catharanthus* and *Impatiens*.

Catharanthus is an annual flower that can withstand extremes of heat and sunlight, making it a favorite among gardeners. Although hardy, it was available in only two or three rather bland colors. In 1991, after 12 years of plant development at the University of Connecticut, Parker released three varieties with striking pink and rose-colored blossoms: "Pretty in Pink," "Parasol" and "Pretty in Rose." All three won All-America Selection awards, the horticultural equivalent of winning an Oscar. The flowers feature glossy green foliage and large pink, deep rose, magenta or bright white blossoms. Annual sales of seeds for these varieties of *Catharanthus* have reached as much as \$1 million a year.

Impatiens, another top-selling bedding plant for commercial growers and home gardeners, was also known for its limited color options. With funding from the Bodger Seed Co., Professor Parker and Maryke Cleland developed *Impatiens* hybrids with pale yellow to gold-yellow petals and profuse branching. These hybrids were transferred to

Bodger Seed under a development and sales agreement, and four of the University of Connecticut hybrids are the subject of separate U.S. plant patents. Bodger used the new plants as the foundation for developing a colorful series of *Impatiens* that was introduced to the market in 1998 that included yellow, apricot, peach and tangerine hues. These plants continue to be sold in 2007.



Put Away the Lawnmower and Water Sprinkler — Buffalograss May Bring Relaxation Back to Your Summer

University of Nebraska-Lincoln

For hundreds of years, hearty, drought-resistant buffalograsses have thrived on the Great Plains of America. The search for improved, urbanized buffalograsses that could be used for lawns, golf courses, parks, and other commercial turf applications throughout the country was accomplished when scientists at University of Nebraska-Lincoln (UNL) developed new and improved turf buffalograsses.

The urbanized buffalograsses are as tough as their prairie ancestors, but they require up to 50 percent less water than the commonly used Kentucky bluegrass. The grasses, which also require far less mowing and fertilization than traditional turf, can grow successfully in poor soil and are especially useful in water-short areas.

The UNL research team developed the environmentally friendly buffalograsses over 18 years. Research was first headed by Terrance Riordan and now by Robert Shearman, both professors of agronomy and horticulture at the university. Ten improved turf buffalograss cultivars have been released since the research began. Major research funding has come from the United States Golf Association (USGA), which has provided more than \$1 million to support this research. Cultivars developed through this research have generated more than \$1 million in royalties.

Turf buffalograsses are sold as seed, sod or as the UNL-developed, pre-rooted plugs, which allow the grass to become established faster than by seeding. UNL has licensing agreements with several companies for various turf buffalograsses.

While different UNL turf buffalograss cultivars grow best in differing climates and conditions, all share some important characteristics. They are easy on the eye as well as the environment. All are darker green and denser, and maintain their color longer than conventional buffalograsses, making them well suited for home and commercial turf applications.



Agriculture



Photos courtesy of University of Nebraska-Lincoln

University of Nebraska-Lincoln Turf Scientist Terry Riordan (left) and Wayne Thorson, owner of Todd Valley Farms check growth of buffalograss plugs at Todd Valley's greenhouse near Mead, Neb. Todd Valley is one of several companies that have licensing agreements with the university to produce and sell UNL's improved turf buffalograsses.



Agriculture

3 Ultrasound Technology Helps Maximize Beef Production

Kansas State University, Manhattan

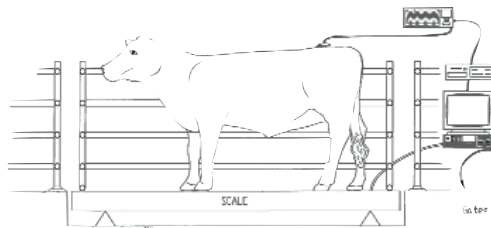
A more efficient and profitable form of beef production became possible with the invention of the innovative carcass ultrasound technology invented by Kansas State Professor John Brethour. The technology offers beef producers a fast, non-invasive way to predict and measure cattle carcass characteristics in live cattle. In 1995, the university licensed the technology to Cattle Performance Enhancement Co., based in Oakley, Kan.

The technology revolutionized the beef industry by allowing producers a cost efficient way to measure intramuscular fat in livestock. Using Brethour's technology, which estimates fat, muscle and body composition, beef producers can produce premium beef without producing over-fed cattle, a cost savings for producers and a healthier end product for consumers.

Achieving a premium grade of beef is typically linked to overly fat cattle, but with Brethour's ultrasound technology, the selection and management of livestock helps predict carcass yield and quality. Brethour's technology is based on two U.S. patents. The first is for a system that accurately allows breeders to measure the intramuscular fat in live cattle. The second patent provides an assessment of how long cattle should be maintained on feed for maximum profit by projecting future carcass merit.

In 2003, when the Kansas State Agricultural Research Center-Hays (ARCH) entered 80 Angus steers in the Best of Breed Angus Challenge at the National Cattlemen's Beef Association annual convention and trade show, they came away with the \$100,000

top prize. Illustrating that the university's livestock research is top notch, ARCH steers were graded 100 percent Choice beef or better and 91 percent earned the prestigious Certified Angus Beef® award.



4 HyRed Gives Cranberry Growers a Competitive Edge

University of Wisconsin-Madison

Color and yield are everything if you're a cranberry farmer. Traditionally, farmers have relied on the deep red pigment of ripe cranberries to signal that it was time for harvesting. But in cold weather states like Wisconsin, the world's largest cranberry producer, the intense red color may not develop until late fall. That delayed ripening can damage cranberry crops if winter weather sets in.

Now, after 10 years of development by University of Wisconsin-Madison plant breeders Eric Zeldin and Brent McCown, Midwest growers can better compete with growers in other areas of the country who have longer growing seasons.

The new, intense red cranberry named HyRed, ripens two to three weeks earlier than the leading Stevens cranberry cultivar, and early tests show the new cranberry produces a larger yield. Development of HyRed was supported in part by the Wisconsin Cranberry Board and Ocean Spray, Inc.

UW-Madison scientists developed HyRed by crossing the Stevens variety with the Ben Lear cranberry. In 2001, when HyRed was released to growers, it was the first cranberry hybrid available to the public in over 30 years. The patent on HyRed was issued in 2003 to the Wisconsin Alumni Research Foundation.



Photos courtesy of the Wisconsin Alumni Research Foundation



Pioneering Researcher Plants Seeds of Biotechnology Success

University of Calgary

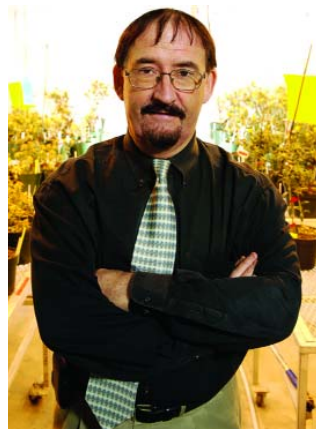
For more than two decades, University of Calgary Professor Maurice Moloney, Ph.D., has focused on the molecular biology of plant development. But it was his research on seeds and oilbodies — the protein-covered spheres within seeds that are involved in seed oil storage — that has led to further biotechnological developments, and ultimately, the creation of a successful company.

Moloney discovered a way to genetically engineer oilbodies and oilbody-related proteins, called oleosins, which have a wide range of therapeutic and industrial applications. With support from University Technologies International, the University of Calgary's technology transfer and commercialization arm, Moloney and others formed SemBioSys Genetics Inc. in 1994. Based in Calgary, SemBioSys utilizes Moloney's oilbody-oleosin technology to develop and commercialize various pharmaceutical and non-pharmaceutical products.

One of its first products was DermaSphere®, an oil-in-water emulsion that can be used in a variety of personal care products, from sunscreens to lotions to eye-care products. SemBioSys also has developed ImmunoSphere™, a feed additive that encourages disease resistance in shrimp. The company currently is developing and testing a safflower-based form of insulin that could cut capital costs by up to 70 percent and product costs by more than 40 percent.

With shares trading on the Toronto Stock Exchange, SemBioSys had a market capitalization of more than \$80 million in late 2005. That same year, it was named company of the year by BIOTECanada, Canada's leading biotechnology association.

It is work like Moloney's that gives new (and literal) meaning to the phrase "planting the seeds of success."



University of Calgary Professor Maurice Moloney, Ph.D.



Chemical-Free Technology May Help Control Crop Diseases

University of Arizona

Research on fungal plant diseases by scientists at the University of Arizona has led to a chemical-free technology that may soon help farmers control destructive crop diseases.

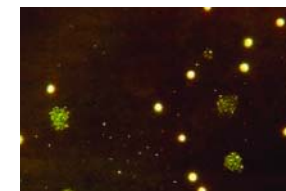
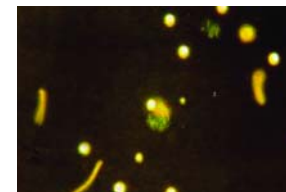
Mike Stanghellini, Ph.D., formerly a plant pathologist at the university's department of plant pathology, accidentally discovered the key to this process in 1995.

Stanghellini's work focused on trying to find the most efficient way to control zoosporic fungal pathogens — which attack everything from grapes to cucumbers to potatoes — using the only means then available: chemical fungicides.

During an experiment, he was perplexed when a routine check of pathogen-injected plant specimens showed that some had not died. Even odder, he saw that the nutrient solution was foaming extensively in the unit where the plants continued to thrive.

Working with Raina Miller, Ph.D., a microbiologist in the university's department of soil, water and environmental science, the pair isolated the bacterium *Pseudomonas aeruginosa*. They discovered that it was making a biosurfactant — a kind of naturally occurring soap — that was protecting the plants.

Their research showed that rhamnolipids, a type of biosurfactant, destroyed the zoospores by slicing through their membranes and exploding them. The technology was patented by the university in 1998, and has been licensed to a company in the Midwest which hopes to have its product on the market soon. The rhamnolipid biosurfactants can be used in contact lens cleaning solutions, consumer cleaning products and to help remove heavy metals from soil and clean up sludge.



Biotechnology



Biotechnology



Bloodchip® Technology Could Change the Face of Blood Testing

The Bloodgen consortium, led by University of the West of England, Bristol

Bloodchip® is a new approach to testing blood groups that could save many lives and significantly improve patient care in Europe and worldwide.

The new test is intended to replace traditional methods of blood grouping with a highly accurate genetic test, giving a much clearer picture of the many different and often small variations in blood types. This will enhance the accuracy with which blood donors are matched with recipients (patients). The Bloodchip® testing solution will be particularly beneficial to patients who are receiving multiple blood transfusions and require perfectly matched blood types. Over time these patients develop antibodies that reject imperfectly matched blood transfusions, a process known as alloimmunization, which can lead to serious illness and life-threatening side effects.

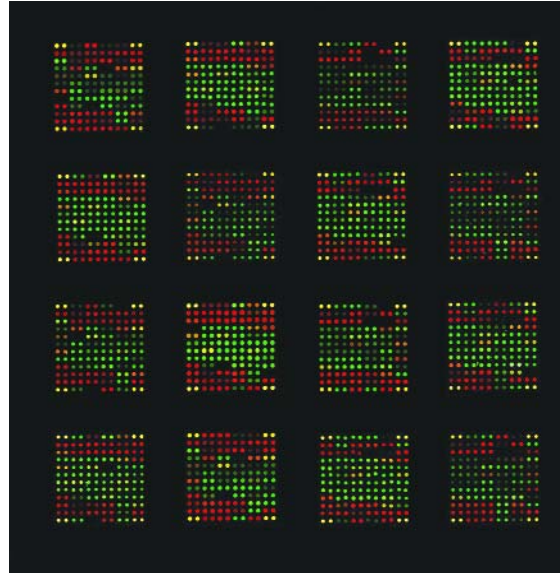
Particular beneficiaries of Bloodchip® include those affected by sickle cell disease and thalassemias, which are hereditary disorders involving defective hemoglobin production, and result in low production and destruction of red blood cells. The Bloodchip® test will help ensure people with these disorders receive perfectly matched blood to enable them to better manage their conditions.

Bloodchip® has been developed by the pan-European Bloodgen consortium led by scientists at the University of the West of England, Bristol. The consortium is a mixture of academic institutions, national blood transfusion services and commercial organizations involving the following participants:

- University of the West of England, Bristol
- Progenika Biopharma S.A.
- Sanquin, Amsterdam
- Bristol Institute for Transfusion Sciences
- University Hospital Blood Centre, Lund
- Transfusion Centre and Tissue Bank (CTBT), Barcelona
- Institute of Haematology and Blood Transfusion (UHKT), Prague
- Biotest A G

The European Union's Fifth Framework Program, which promotes research and technological development, funded the consortium's work. Widely acknowledged by the medical community, the patented

Bloodchip® testing technology will undergo intensive clinical trials. Visit www.bloodgen.com or www.science.uwe.ac.uk/crib for more information.



Bloodchip® offers a new approach to testing blood groups.



Stanford and Columbia Researchers Pioneer Antibody Production Methods

Stanford University and Columbia University

Monoclonal antibodies play a key role in diagnosing and treating various diseases. These man-made antibodies are derived from a single cell, and can be tailor-made to locate and attach themselves to specific substances, such as cancer cells, in the body.

A significant milestone in the development of monoclonal antibodies came in 1984 with the invention of functional antibody technology. Professor Leonard Herzenberg and Dr. Vernon Oi of Stanford University in Stanford, Calif., and Professor Sherie Morrison, formerly of Columbia University in New York City, developed the technology involving a molecular method for producing “humanized” or chimeric antibodies — a unique genetically engineered fusion of certain portions of antibodies in mice with those of humans. This was a significant development because it overcame the obstacle of the human body rejecting the mouse antibody, otherwise known as the HAMA (human anti-mouse antibodies) response.

In the years since, this technology has benefited thousands through its use in developing therapeutic antibodies for treating Crohn’s disease, rheumatoid arthritis, cancer and multiple sclerosis. It also has been used to develop an anti-clotting agent.



Professor Leonard Herzenberg Stanford University in Stanford, Calif.

In 2002, the functional antibody technology was cited as one of Stanford University’s top 10 inventions from 1975 through 2002, having generated \$30.2 million in royalties at that time. It is also one of Columbia’s top three revenue-earning inventions to date.



Cell Biology Tools Offer Unique Benefits

University of South Florida

Cell proliferation assays are widely used in cell biology research, in academia, and in the burgeoning global biotech and pharmaceutical sectors. Assays, or scientific tests, are used to measure the impact of a given substance or environmental treatments on cells (such as sunlight, temperature, and other factors) by detecting whether the impacted cells proliferate, stay the same or die. Whether they’re used to test new cancer drugs or anti-dandruff shampoos, cell proliferation assays are critically important scientific tools at the heart of the cellular fact-finding process.

In the past, these assays typically involved radioactive methods that included the following sequence: adding radioactivity to the cells, incubating for several hours or overnight, harvesting the cells, washing the cells, applying the cells to a special filter in a vial, adding a hazardous reagent (a substance used in a chemical reaction) and finally reading the results. But this all changed, due to University of South Florida’s Professor Terence C. Owen, who worked in conjunction with Promega Corp.’s assay development group.

Owen, now a retired professor emeritus, devised a new chemical compound for use in cell proliferation analysis methods that has made it easier and faster to conduct experiments since it involves a simpler and shorter sequence of actions: adding the reagent to cells, mixing the cells and the reagent and reading the results. By reducing the number of steps and thereby reducing variability, Owen’s new chemical compound technology used in the cell proliferation assay helps researchers obtain more reliable data.

An added benefit is that the non-radioactive process reduces the cost of waste disposal. This technology was licensed to Promega Corp. and is the cornerstone in the assays now known as the CellTiter 96® AQueous product line of cell proliferation analysis tools.

The CellTiter 96 AQueous One Solution Cell Proliferation Assay remains widely used throughout the academic community, largely due to ease-of-use and speed with which research data may be generated.



Biotechnology



Biotechnology

10 The Yeast Two-Hybrid System— An Important Tool for Identifying Proteins That Interact

Stony Brook University

Virtually every biological process — including DNA replication, cell growth, key metabolic reactions and disease states — depends upon protein-protein interactions at the cellular level.

In the late 1980s two Stony Brook University School of Medicine researchers, Stanley Fields and Ok-Kyu Song, developed a way to use the yeast transcriptional activator protein for the GAL4 gene to easily detect the interaction of proteins within a cell. This method — the “yeast two-hybrid system for determining protein-protein interactions” — was first published in *Nature*. Initial funding for the research was provided by the National Science Foundation.

Transcription is the process through which genetic information is copied from DNA to RNA, ultimately producing a functional peptide or protein. The DNA-binding domain and activation domains from GAL4 are separately fused to the proteins being studied. If the proteins of interest interact, the two domains are brought together and transcription results. This transcription can be easily identified through the use of a marker gene. The system can also be used to discover compounds that inhibit specific protein interactions.

Understanding and detecting proteins that interact is a fundamental area of inquiry in biology. The yeast two-hybrid system provides an elegant and useful method for carrying out this research. The technology has been licensed nonexclusively to more than one hundred companies, including large pharmaceutical companies and a wide range of biotechnology companies. As a result, hundreds of scientists around the world have used this method, in both corporate and university laboratories.



11 Proteopure *Carnegie Mellon University*

Unraveling the complexity of the cell structure is a vital but challenging task on the pathway to understanding cellular function. Proteins used for proteome analysis are retrieved from isolated cells, whole tissues or bodily fluids and each of these protein sources is comprised of many more components — salts, nucleic acids, lipids and a wide variety of small molecules for instance. The discovery process introduces unwanted elements, such as salts, buffers and detergents to aid in breaking open the cells to release proteins and to otherwise prepare a sample for investigation. But these non-protein components, or contaminants, often interfere with protein separation methods.

The mission of Proteopure is to help proteomic scientists achieve superior results in their research by making each proteomic experiment simpler, faster, and more reliable. Proteopure’s revolutionary technology is made available through a family of sample preparation kits for protein isolation and recovery, which uses a protein-specific hook to immobilize any protein sample on a resin. The binding of proteins to the resin is reversible, allowing protein recovery following the removal of contaminants.

ProteoHook™ 2DE Sample Preparation, their first kit, isolates all proteins from contaminants without the need for precipitation and resolubilization. It removes more than 95% of salts, nucleic acids and detergents, including sodium dodecyl sulfate (SDS) an anionic agent commonly used to separate proteins. This enables the use of harsher methods, such as boiling in SDS, for more complete extraction of proteins from cells.

ProteoHook™ is now for sale. More information is available at www.proteopure.com.

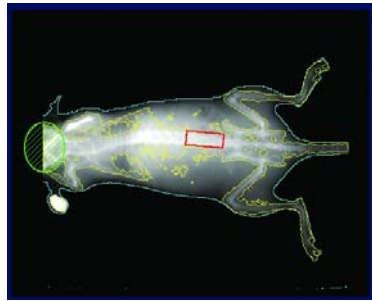
Of Mice and Women: Chemically Altered Rodents Help Researchers Study Diseases in Postmenopausal Women

University of Arizona

It took 12 years, an interdisciplinary collaboration between University of Arizona professors from physiology and pharmacology, and the professional nurturing of a post-doctoral fellow to discover a way to cause premature ovarian failure in female mice without surgically removing their ovaries.

What the Physiology Department's Patricia Hoyer has accomplished, along with post-doc Loretta Mayer, is the creation of a mouse model that can be used to study postmenopausal conditions such as cardiovascular disease, Alzheimer's disease, osteoporosis, and a number of other conditions that increase in women after menopause. The research was funded by grants from the National Institutes of Health, March of Dimes and the Arizona Disease Control and Research Commission.

The method developed by Hoyer and her team uses a chemical called 4-vinylcyclohexene diepoxide (VCD), an industrial solvent normally used in the manufacture of tires, plasticizers and insecticides. When administered to a female rat or mouse they found that it destroys oocytes (eggs) in their ovaries. Furthermore, it is selective for the smallest form of oocyte containing particles, so it does not produce extensive effects within the ovary. By destroying the eggs in the mouse and rat ovaries, VCD accelerates a natural process called "atresia." As a result, the ovaries become depleted of eggs and the animals go into a state of premature ovarian failure, similar to menopause in women.



Hoyer says she and her team determined early on that except for causing ovarian failure, VCD causes no other adverse effect in animals.

Hoyer has moved the discovery beyond the University of Arizona campus through collaborations with La Jolla Institute of Molecular Medicine, Northern Arizona University and the University of California, Davis. The research group disclosed the technology in October 2001. And with help from the

university's Office of Technology Transfer and Arizona's Technology and Research Initiative Fund have worked to move the Mouseopause™ mouse model into broader availability through patenting and licensing. The VCD mouse model has been used in studying important human diseases and may also be applied to the study of wild animal population control and "neutering" of pets without surgery. These new applications of the technology are being developed in a startup directed by Dr. Mayer at NAU in Flagstaff, Ariz., called Senestech.

Excerpted from *University of Arizona's Report on Research Special Edition – TRIF*



Biotechnology



Biotechnology



Researchers Help Make Cellular Therapies a Reality

The Johns Hopkins University

For many years, some cancer patients have received an aggressive treatment using state-of-the-art stem cell transplantation techniques developed from monoclonal antibody technology pioneered at The Johns Hopkins University. And in the future, as a result of continuing research, that technology may also play a role in the treatment of cardiovascular and other diseases.

High doses of chemotherapy can change the interior of bones where bone marrow is produced and resides. Cancer patients who have received high doses of chemotherapy drugs may have a diminished ability to fight infection because their white blood cell counts are lowered; likewise, their bone marrow may be unable to make sufficient new red blood cells. Now there is a way to get around the effects of chemotherapy on bone marrow.

Patients who receive stem cell transplants using Baxter Healthcare Corp.'s Isolex[®] Magnetic Cell Selection System have their own hematopoietic (blood-forming) progenitor bone marrow cells removed or harvested before high dose chemotherapy is administered. With the Isolex[®] Magnetic Cell Selection System, the anti-CD34 monoclonal antibody is used to enrich the patient's CD34+ hematopoietic progenitor cells. Through this enrichment process any tumor cells present in the product are passively depleted. After chemotherapy, the patient's enriched CD34+ cell population is reinfused into the patient to rescue the blood-forming system.

This stem cell selection system was developed by Baxter employing monoclonal antibody technology licensed from The Johns Hopkins University. The anti-CD34 monoclonal antibody technology was developed by Dr. Curt Civin, a pediatric oncologist at The Johns Hopkins University School of Medicine, whose original research on the technology was sponsored by the National Institutes of Health.

The Isolex[®] Magnetic Cell Selection System has been commercially available since 1998 for use in cancer treatment. Currently, Baxter is conducting research with the Isolex[®] Magnetic Cell Selection System, investigating the efficacy, tolerability and safety of blood-derived selected CD34+ stem cells to improve symptoms and clinical outcomes in subjects with chronic myocardial ischemia (CMI), a severe form of coronary artery disease. The National Institutes of Health and other research institutions are using the Isolex system in their own research today, studying the use of selected CD34+ stem cells in the treatment of a variety of medical conditions.

14

Pronuclear Microinjection Produces Transgenic Animals for Research

Ohio University

Research facilities throughout the country are benefiting from the work of Ohio University's Thomas E. Wagner, Ph.D., and Peter C. Hoppe, Ph.D., from the Jackson Laboratory in Bar Harbor, Maine. In the early 1980s, the scientists made groundbreaking history when they were among the first to demonstrate successful gene transfer in laboratory mice and transmission of the "transgene" to offspring.



The process has since been applied to animals outside the laboratory, from rabbits to cattle, for a wide variety of purposes. Development of the technology was initially funded through the support of Ohio University and the state of Ohio.

Two U.S. patents were issued on the technology (U.S. Patents 4,873,191 *Genetic Transformation of Zygotes* and 6,872,868 *Transgenic Mammals*), which were exclusively licensed to a succession of licensees and extensively sublicensed to biotechnology and pharmaceutical companies, among other commercial users. At least 242 U.S. patents cite the first patent, a dramatic measure of its impact on other patentable inventions.

The Wagner-Hopper work showed that genes could be transferred through the injection of DNA when an animal was still a one-cell embryo, which then could lead to the production of a functional protein and ultimately be passed on to subsequent generations. The innovative platform technology, called *Pronuclear Microinjection*, has produced transgenic animals, especially mice, for academic research as well as for commercial applications. The technology has been used to make transgenically produced biopharmaceuticals, proteins and xenografts, and literally thousands of research models of benefit to society.

Transfer of the technology spawned one of the early examples of a startup company based on university technology and was the foundation for the creation of the Edison Biotechnology Institute at Ohio University. The institute retains this early emphasis on technology development and transfer and has been the source of platform technologies for a number of companies and products currently on the market.

15

De-inking Technology Enhances the Value of Recycled Material

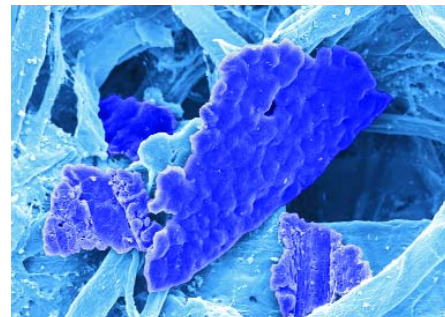
University of Georgia

Adequately removing ink from wastepaper pulp has always been a challenge for the paper industry. De-inked pulps that appear dirty and dark are less in demand and have fewer markets, especially for high-quality printing, writing and tissue paper grades.

Karl-Erik Eriksson, Ph.D., a Swedish researcher who joined the University of Georgia faculty in 1988, conducted extensive research on the use of enzymes to treat recovered wastepaper fibers. He discovered that the application of certain mixes of enzymes to wastepaper enhanced the detachment of inks and contaminants, making them more easily removed during the de-inking (recycling) process. The technology works through a variety of mechanisms that treat the fibers, coatings, inks and sticky contaminant materials.

Enzymatic treatments of recovered fiber results in cleaner and brighter de-inked pulp stock, which translates into better-looking final recycled paper sheets. Making cleaner wastepaper pulp enables mills to use cheaper and dirtier wastepaper, which reduces the use of virgin pulp, lowers the costs of production, opens up more outlets for low-grade wastepaper and ultimately raises the incentives for broader wastepaper collection and use.

In 1994 Eriksson's process of enzymatic treatment of recovered fibers was licensed exclusively to Enzymatic Deinking Technologies, LLC (EDT). EDT now has more than 40 applications running this technology worldwide and has made considerable advances in tailoring the technology for mill-scale use. The technology is being used globally to treat more than three million tons of wastepaper annually.



Biotechnology

Chemical



Chemical

16

Stargazing Leads to Process for Making a New Class of Carbon Compounds

University of Arizona/

Max Planck Institute fuer Kernforschung

In 1990, physicists W. Krätschmer and D.R. Huffman opened the door to commercial uses of a new form of carbon, C₆₀ Buckminsterfullerene or “fullerenes,” by producing a process for creating isolable quantities of C₆₀ for the first time, a process now known as the Krätschmer-Huffman process. On sabbatical with his colleague Wolfgang Krätschmer at the Max Planck Institute fuer Kernforschung, Donald Huffman was pursuing work to answer a long-standing question in astronomy: “What is the nature of the dust and gas that fills the void between stars?”

The answer was not resolved, but the fullerene production process they developed to try to do so enabled scientists around the world to rapidly advance the world’s knowledge of this new class of carbon compounds; by 1995 more than 3,000 fullerene articles had been published. In 1996, Harold W. Kroto, Robert F. Curl and Richard E. Smalley won the Nobel Prize for their significant discovery of fullerenes.

While Huffman and Kratschner’s eyes may have been on the stars, their discovery paved the way to developments in an entirely new branch of carbon chemistry.

Research Corporation Technologies (RCT) of Tucson, Ariz., manages commercialization of the original technology for both the University of Arizona and the Max Planck Institute. With partners Mitsubishi Corporation of Japan and Materials and Electrochemical Research Corporation of Tucson, Ariz., RCT has formed a joint venture called Fullerenes International Corporation (FIC) to commercialize fullerene materials based upon the Krätschmer-Huffman production method and other patented technology made available by the partners. Honjo Chemical Co. in Japan and under license from FIC, makes production quantities of fullerenes available for applications in areas as diverse as batteries, flat panel displays, gas storage, diamond-like cutting tools, electric vehicle capacitors and pharmaceuticals.

17

Neoprene: Notre Dame’s Early Discovery

University of Notre Dame

Generations of neoprene-clad surfers, scuba divers and anglers have stayed warm in the wild and woolly outdoors because of the work legendary University of Notre Dame priest-botanist-chemist, Rev. Julius A. Nieuwland, began almost exactly a century ago.

Nieuwland, a Belgian-born organic chemistry professor, obtained several patents for his unique method of making the chemical divinylacetylene — a jelly which firms into an elastic compound similar to rubber when passed over sulfur dichloride — and its polymerization products.

This innovative work led to the creation of synthetic rubber by DuPont, which is used in countless products, ranging from water-faucet washers, to fuel-pump hoses to the adhesive strips on disposable diapers. Its insulating properties make it ideal for material such as fishing waders, keeping people warmer as they stand for long periods in often cold streams. Its strength and flexibility has made it a popular material for laptop and iPod™ cases.

Nieuwland’s work was lucrative for Notre Dame. According to the university, total income from his patents amounted to around \$2 million. At its peak in 1944, the royalties his patents brought Notre Dame are estimated to have been able to pay 75 percent of the school’s faculty salaries.





Research Yields New Chemicals for Pharmaceutical Development

University of Nebraska-Lincoln

Located in Lincoln, Neb., Rieke Metals, Inc. derives its competitive advantage from technology developed at the University of Nebraska-Lincoln. The technology is a patent protected method for producing new organo-metallic reagents (chemicals comprised of an organic molecule and a metal atom).

For approximately 100 years chemicals known as Grignard reagents have been used in chemical reactions with other organic molecules to form new chemical compounds. Grignard reagents contain a magnesium atom, are highly reactive and have been used to produce many pharmaceuticals. Grignard reagents, however, prove to be too reactive with a large number of organic molecules because of their specific chemical structure. For these molecules, a Grignard reagent's reactivity destroys the organic molecule during the reaction.

Rieke Metals, Inc. produces reagents similar to Grignard reagents, known as organo-metallic reagents, which contain zinc metal in place of magnesium. The use of zinc in place of magnesium creates a reagent that will undergo much more mild reactions with organic molecules. Rieke organo-metallic reagents do not destroy the organic molecules that would be destroyed by Grignard reagents.

In other words, the reagents produced at Rieke Metals allow the synthesis of a massive number of organic compounds which could not be produced previously using Grignard reagent technology. These organic compounds have special chemical structures (functional groups) that allow pharmaceutical researchers to create new drugs with new biological functions within the body.

Developed from 1991–1994 by Dr. Reuben Rieke, the funding for the research and development for this technology came from the U.S. Department of Health and Human Services Small Business Innovation Research grant programs. Rieke Metals, Inc. has been producing high quality compounds since 1992 having supplied more than 350,000 molecules to clients under research contract.



Bovine Intervention: Sleeping Sickness a Thing of the Past

University of Greenwich

One of Africa's most harmful pests, the tsetse fly, has been all but eradicated from parts of the continent thanks to a novel artificial cow developed by an international group of researchers, including scientists from the University of Greenwich.

Today, sleeping sickness is virtually unheard of.

The artificial cows attract tsetse — which can infect humans and cattle with fatal sleeping sickness — by emitting chemicals (kairomones) to mimic the smell of real cattle. The fake cattle are impregnated with insecticides that kill the tsetse attracted to them.

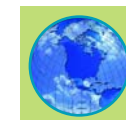
The cows were introduced to Zimbabwe in the mid-1980s, when thousands of cattle were infected with nagana (the equivalent to human sleeping sickness), transmitted by tsetse.

Cases of nagana in Zimbabwe have plummeted to practically zero and have remained at this low level for the last five years, largely due to the use of artificial cows, of which there are now about 60,000 in use. The fake cows also act as an effective barrier to stop tsetse re-invading areas cleared of flies.

Not only are artificial cows highly successful in controlling tsetse, but their use also results in a dramatic reduction in the amount of insecticide necessary to control the pest.

With only four artificial cows needed per square kilometre to ensure effective pest control, the use of insecticide is far more targeted than conventional widespread aerial and ground spraying, resulting in a greatly reduced environmental impact.

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Chemical



Computer Science



Computer Scientists Create New Routing Software for Web-based Companies

Boston University

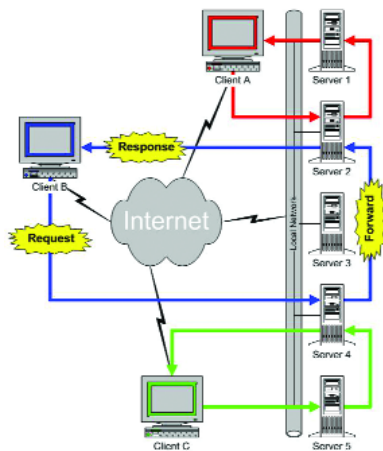
Large Internet sites tend to require a cluster of expensive equipment to handle customer queries. Typically a customized centralized router — a computer networking device that forwards data across a network toward its destinations — is required to direct each caller to the appropriate server. The server, in turn, is a computer system that provides services to other computing systems over a computer network.

Researchers at Boston University wanted to improve on the Internet-based customer service process by developing software that allows each server to act as an individual router, thereby enabling quicker response times to more people. With initial funding from the National Science Foundation, Professor Azer Bestavros, Ph.D., and Professor Mark Crovella, Ph.D., of Boston University's department of computer science developed the "distributed routing" prototype in 1997–1999.

In 1998 they co-founded a spin-off company, Commonwealth Network Technology (CNT) with Boston University's New Ventures unit and venture capital fund Community Technology Fund. CNT then developed a commercial application of distributed routing for Windows NT. CNT was sold to WebManage Inc. in 1999 and, after

further research and development, the i-Scaler™ product was launched in 2000.

i-Scaler enables each server to be used as a router, allowing information to be routed more quickly to multiple clients from multiple servers simultaneously. Instead of facing possible bottlenecks at one central router, i-Scaler opens up more pathways for information exchange. WebManage Inc. was acquired by Network Appliances in 2000.



Looking Back in Time: Powerful Telescopes Tell Us More About the Universe

University of Cambridge

In the early 1950s, scientists were busy looking at galaxies 1,000 million light years away and debating whether the Big Bang or Steady State theories described the nature of the Universe.

Like many scientists, Martin Ryle, an astronomer at the University of Cambridge, knew that the development of more powerful telescopes would hold the key to solving the puzzle. Looking at the light that has travelled to Earth from far away objects is like looking back in time, right to the beginning of the Universe.

In general, the bigger the telescope, the more powerful it is. So to see further into space — and hence further back in time — astronomers usually build bigger devices. But Ryle chose a different approach.

He created hugely powerful telescopes by carefully constructing and arranging a number of smaller ones that worked together.

By 1958, thanks to the development of a powerful computer built at Cambridge by Maurice Wilkes, Ryle could analyse data from many telescopes working within 5km of each other, just as if he had covered the whole area by a single vast device.

Ryle's methods are now used all over the world. They even take advantage of the rotation of the earth to look at different parts of the sky. The approach, now known as the 'aperture synthesis technique,' has created devices that are so powerful they can see a postage stamp on the moon. Observations made with these instruments have been crucial to the study of the stars and the study of the development of the Universe.

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Software Helps Professionals Design Highly Energy-Efficient Buildings

Lawrence Berkeley National Laboratory

In the 1990s the federal government was eager to replace its outdated software for calculating heating and cooling loads in the buildings it constructed. The U.S. Army Construction Engineering Research Laboratory, the Department of Energy's Office of Building Technologies, University of Illinois at Urbana-Champaign and Lawrence Berkeley National Laboratory teamed up to design EnergyPlus, a stand-alone simulation program.

Launched in 2001, EnergyPlus allows users to calculate the impacts of different heating, cooling, and ventilating configurations and various types of lighting and windows to maximize energy efficiency and occupant comfort. The software can save companies millions of dollars in operational costs over the life of a building, compared to more traditional approaches. EnergyPlus is also being used to evaluate designs for future construction at the World Trade Center site.

Berkeley Lab has developed several different types of licenses to encourage the improvement and widespread adoption of EnergyPlus in the private sector. In addition to 24,000 end-user licensees, nearly 100 universities, research organizations and private-sector companies are acting as collaborative developers, contributing their software improvements to EnergyPlus. EnergyPlus may be freely downloaded from www.energyplus.gov. The U.S. Department of Energy's Drury Crawley manages the development project.



Fluxless Soldering Method Eliminates Expensive, Environmentally Hazardous Cleaning

University of North Carolina, Charlotte

In most soldering methods, the first step involves pre-cleaning and deoxidation of surface oxides, usually involving a liquid flux material. While this method gets the job done, fusing of traditional lead-tin solders leaves flux residue that has to be removed, often by an expensive, environmentally hazardous cleaning method.

But Stephen M. Bobbio, Ph.D., and his research team at the University of North Carolina, Charlotte, invented a soldering method that doesn't require the use of pre-soldering flux nor the once necessary cleanup associated with flux bonding deposits.

The technology, developed at the university in 1997, uses strong bonding fluorine that contains gas such as hydrogen fluoride, which allows for the solder to be reflowed on the surface for as long as two weeks. The efficient and cost effective fluxless soldering can be used to bond together two parts or as a preparation technique to join together one or two parts for soldering.

Funding for the original research came from the U.S. Army Research Lab. The patented technology was first licensed in May 1998.



Construction



Education



Animating Organic Chemistry

University of New Brunswick

For Professor Ghislain Deslongchamps, organic chemistry is a way of life. As the son of a renowned chemistry professor, Deslongchamps himself became a professor of chemistry at the University of New Brunswick with impressive research credentials and experience, including the invention of a new method of manufacturing anticancer drugs.

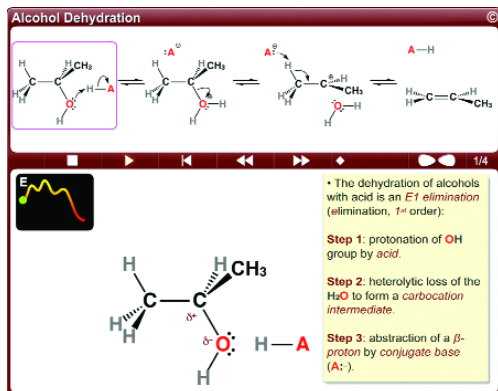
When teaching his students in the classroom, though, Deslongchamps found that certain students had difficulty grasping the concepts of chemical reactions. Indeed, mentally visualizing chemical activity at the molecular level is no easy task, even for the brightest of students. With this in mind, Deslongchamps took it upon himself to develop a solution. While on sabbatical, he mastered a computer animation program and began to build an extensive series of interactive multimedia animations to help students “visualize” and better understand organic chemistry.

Within six years, he had developed more than 130 multimedia learning modules, which were hailed by students and teaching colleagues alike. With a \$20,000 award from Springboard Atlantic, a network of 14 Canadian universities, he was able to hire a programmer, purchase equipment and complete a beta prototype. The Canadian educational publishing company, Thomson Nelson, became keenly interested in Deslongchamps’ multimedia creations. Ultimately, Thomson Nelson and the University of New Brunswick

signed an exclusive, global licensing agreement for the technology, which is now known as *Organic Chemistry Flashware*.

Deslongchamps is developing the platform even further to include general chemistry. In the future, it may also encompass biology, biochemistry and other physical sciences.

As the saying goes, a picture paints a thousand words. In this case, moving pictures of organic chemistry can paint tens of thousands of words, illuminating complex scientific concepts. For more information, visit <http://flashchem.nelson.com>.



Parlez-vous Francais?

A Unique Video-Based System Could Make It Easier

Yale University

In an effort to break away from traditional “classroom French,” Yale University language professor and researcher Pierre Capretz created “French in Action,” a video-based curriculum that teaches French syntax, vocabulary and culture. Students are not required to memorize grammatical rules and vocabulary lists; instead they are led to learn French from the situations presented in the videos.

This series of programs was developed at Yale University between 1960 and 1983, in cooperation with Wellesley College. Funding was provided by the National Endowment for the Humanities, Annenberg/Corporation for Public Broadcasting, Mellon Foundation, Gould Foundation, Cox Foundation, French Ministry of Culture and French Ministry of Foreign Affairs.

French in Action is an integrated system based on 26 hours of video, 60 hours of audio recordings and related text. It’s organized to let learners discover lexical meanings and structures on their own through the presentation of a continuous story, accompanied by hundreds of examples taken from French films, television programs, advertisements, interviews and cartoons.

The entire program is based on a video story filmed in France, with French actors and a French crew. The movie keeps learners interested, which accelerates their pace of comprehension, learning and retention.

Today more than 2,000 educational institutions in the United States have used “French in Action,” which is also broadcast on television stations around the world. Students who complete both levels (52 lessons) can go to any French-speaking country and communicate fluently with the native population.





Electronic Career Portfolio Reports Skills, Not Just Jobs

Florida State University

Oftentimes what makes or breaks students' success in getting a job is their ability to demonstrate that they have obtained knowledge, skills, and abilities necessary for the required position throughout their college experience. The standard resume showing work experiences may not necessarily reflect what they are now able to do or how they are able to think critically or strategically.

To keep up with the growing demand of capturing and tracking this experience, Jeff Garis, Jill Lumsden, and the Career Center team at the Florida State University (FSU) developed a Web-based application called Career Portfolio. This career resource enables students to showcase the skills they have developed by allowing them to input information into five experience categories — coursework, memberships and activities, volunteer work, jobs and internships.



This online portfolio serves both the students and the prospective employers. Students can see which skills they have developed so far and which skills they may want to concentrate on in the future. By keeping all of the information centralized,

employers can gain access to additional electronic information that is not included on a typical resume or curricula vita and use it to more effectively direct their decision making process.

More than 40,000 students have used the Career Portfolio system since its inception and it has become part of the academic and student service culture at FSU. In fiscal year 2005, Career Portfolio was licensed to three major colleges — University of California, San Diego, Montclair University and Georgia Technical Institute — and a private company based in Japan. The invention of the FSU Career Portfolio changed the national landscape regarding how college students prepare for their careers and apply for jobs. The FSU Career Portfolio is recognized nationally as a new leading innovative career service and is contributing to an international trend in the development of ePortfolios.

For more information visit www.career.fsu.edu/portfolio.



CaseNEX Brings Research to Life in Classrooms Everywhere

University of Virginia

The University of Virginia developed CaseNEX in early 2000 — a research-based methodology that educators apply during case study analysis. The CaseNEX methodology represents the type of job-embedded professional development required by the federal “No Child Left Behind” legislation.

The technologically blended, case-based approach provides educators the opportunity to read cases, view streamed video and follow links to a virtual library of current research. The expectation is that teachers and administrators who can perform the steps of case-based analysis are likely to repeat the process when faced with similar situations in their classrooms.

The CaseNEX problem-solving model is engaging, collaborative and effective, offering more than 150 multimedia, Web-based cases, or “slices of life,” that form a bridge between best practices and the complex school environment.

School district and university partners across the country integrate the CaseNEX learning model and access the library of case studies to enhance, enliven, and extend their existing programs. Teachers can join the collaborative online learning cohorts to satisfy professional development requirements, earn graduate credits, and complete master's degree programs.



Education



Electronics



MPEG-2 Technology Sets International Standard for Digital Audio and Video

Columbia University

The next time you marvel at the detail on a high-definition TV, consider the fact that some of the key technology that created those sophisticated television signals originated at Columbia University in New York. Dimitris Anastassiou, Ph.D., professor of electrical engineering at Columbia led the team that developed one of the important MPEG-2 algorithms of the early 1990s.

Professor Anastassiou's groundbreaking research has been incorporated into the international video compression-coding standard.

The MPEG-2 technology (the acronym stands for Motion Picture Expert Group) algorithm, is really a set of mathematical manipulations that send and compress quality video and audio over limited bandwidth channels, and then decompress it for display.

MPEG-2 is now used in countless forms of digital technology including high-definition TV (HDTV), DVD disks, Video on Demand, personal computing, direct satellite TV and digital cable systems.

Columbia was the only academic institution involved in the development of the MPEG-2 technology, but it has spurred a prolific research area. Anastassiou's pioneering work has led to a patent pool of nearly 800 patents held by 23 companies, representing a market of \$700 million of royalty income and a total market in the billions of dollars. As long as consumers continue to demand large TV screens with sharp details, Columbia's technology will contribute to making this popular pastime a more stimulating experience.



Body Sensor Networks Monitor Physical Data Wirelessly in Real Time

Imperial College London, England

Professor Guang-Zhong Yang and his team at the Department of Computing, Imperial College London has developed Body Sensor Networks (BSNs) that effectively monitor readouts of heart-rate, blood oxygen levels, temperature and physical activity with relative ease. These BSNs utilize miniature wearable microsensors and wireless communication technology, and can be used wherever real-time monitoring is required, from managing patients' chronic diseases in medical facilities to monitoring the health of people living on their own.

The e-AR (ear-worn activity recognition) sensor developed by the team has been tested with patients recovering from surgery at St. Mary's Hospital in London.

Beyond medical applications, a team from Imperial College's Tanaka Business School demonstrated BSNs also could be used for personal fitness monitoring. So the Royal College of Art was tasked with designing a wearable sensor directed at the elite athlete and fitness sector. The end result: a device that can monitor an athlete's performance and transmit the information to his or her mobile phone, personal digital assistant device or computer.

Professor Yang and his team are now working with the Engineering and Physical Sciences Research Council, which is the United Kingdom's governmental agency for funding university research grants for engineering and physical sciences projects, and UK Sport, the leading government agency promoting sports in the United Kingdom, in piloting the e-AR sensor for training potential UK medallists.

Imperial Innovations, a technology commercialization and investment company based at Imperial College London, has formed the company Sensixa to commercialize the many applications of BSNs. Various government grants were used to fund the initial research underlying the patented BSN technology. Additional information is available at www.sensixa.com.



Heart rate monitoring on PDA

30

New Oxide Technology Improves the Efficiency of Semiconductors

University of Illinois at Urbana-Champaign

The effectiveness of a semiconductor greatly depends on the chemical properties of its conductive materials — especially for some purposes the purity of the oxide layers grown or deposited on it. Native oxides (those that are formed on the material) tend to be better matched, more stable, and perform better than deposited oxides (which are mechanically applied directly to the chip). Although native-oxide technology already exists for the silicon chip, no such technology has been available until recently for non-silicon-based semiconductors.

Professor Nick Holonyak Jr., Ph.D., and graduate student J.M. Dallesasse of University of Illinois's electrical and computer engineering department, remedied this problem in 1989–1990 by inventing the process called "Forming a Native Oxide from Aluminum-Bearing Group III-V Semiconductor Material." Initial funding was supplied by the National Science Foundation and the U.S. Army.

By immersing aluminum-bearing Group III-V semiconductor material in a hot "wet" gaseous environment, a smooth, solid layer of aluminum-bearing native oxide is generated. As in this case, native oxides are preferred for semiconductors because they are more dense, stable and defect-free compared to deposited oxides.



Professor Nick Holonyak Jr., Ph.D.

Optoelectronic and microelectronic devices that utilize native-oxide technology are more efficient, lower cost, and longer-lasting than those that use deposited oxides. Native oxides also improve the performance of lasers and light-emitting diodes (LEDs). This technology has been licensed by the University of Illinois to companies around the world who manufacture electronic products that utilize this unique, advanced material.

31

Rapid Optical Screening Tool Detects Petrochemical Contaminants

North Dakota State University

Leaking petroleum-based compounds such as fuels, oils, and coal tar frequently contaminate the soils and groundwater near underground storage tanks (gas stations/truck stops), pipelines, refineries, fueling areas, fire-training facilities, automobile service locations, surface spills, lagoons, waste ponds, tank bottoms, and wood treatment sites. Historically the extent of contamination has been visually determined in the field, which is subject to error or outlined by tedious sampling at many depths and locations.

In 1993–1994 Greg Gillispie, Ph.D., and Randy St. Germain of North Dakota State University developed the Rapid Optical Screening Tool (ROST), the world's most advanced subsurface petroleum-screening tool. ROST uses laser-induced fluorescence (LIF) to detect and characterize subsurface contaminants. The U.S. Air Force provided the original funding for both the prototype development and field testing.

Based on the successful field tests, a consortium consisting of the university spin-off company Dakota Technologies, Unisys (prime contractor), and Hogentogler & Company was formed to commercialize the technology. ROST became the world's first commercially available LIF logging service in 1994.

ROST helps identify contamination using "machine vision," which eliminates the geologist's often-subjective results. The device provides extremely high vertical resolution, enabling pinpoint detection of narrow "seams" of contamination. Numerical results can be easily transformed into 3-D models that can be readily merged with existing drawings or maps for the "big picture." Because the better models or maps lead to a better understanding of the contamination, geologists can put together a much more effective remediation plan. Not only does ROST save time and money, it also makes contamination testing more reliable.

ROST has been used extensively throughout the U.S., Japan, and Europe and is standard equipment for nearly every major environmental consulting firm or agency.



Electronics

Environment



LIF system in operation on a frozen lake in Minnesota



Environment



Photo courtesy of Lawrence Berkeley National Laboratory

Carbon Explorers are ocean floats with carbon sensors, enhanced communications, and remote programming capacity. They are enabling scientists to track variations in the ocean's carbon cycle year-round with unprecedented accuracy.



Carbon-Monitoring Device Helps Shed Light on Climate Change

Lawrence Berkeley National Laboratory

The scientific community around the world is increasingly focusing its attention on a serious environmental issue affecting us all: global climate change. A significant component of global climate change research entails observing and measuring carbon emissions, which are linked to global warming. Given that roughly 70 percent of the earth's surface is covered by oceans, it stands to reason that understanding their carbon cycles and how those interplay with atmospheric carbon is key to this research.

In response to the need for reliable oceanic data, a researcher at Lawrence Berkeley National Laboratory in Berkeley, Calif., created a remarkable device to measure carbon levels in the far-flung reaches of the world's oceans. The Carbon Explorer was developed by James K. Bishop, a senior scientist at the Lawrence Berkeley Lab, in collaboration with the Scripps Institution of Oceanography in La Jolla, Calif., and WET Labs Inc. in Philomath, Ore. It was funded by the U.S. Department of Energy's Office of Science, the U.S. Office of Naval Research and the National Oceanic and Atmospheric Administration.

This cost-effective robotic ocean float measures carbon concentrations in the ocean, utilizing a system of optical sensors, advanced communications and remote operating capabilities. Thanks to the Carbon Explorer, researchers have, for the first time, the ability to continuously track the biological processes of oceanic carbon cycles.

So far, Carbon Explorers have been sent to some of the most remote and extreme ocean environments in the world, gathering data that previously had not been generated. The Carbon Explorer already has helped reveal shortcomings in our current understanding of climate change. The data provided by this intelligent device will be key to developing effective strategies to curb global warming in the future.



EnviroFlux Offers a Better Way to Assess Groundwater Contamination

University of Florida

Tracking contaminated groundwater is no easy feat.

When groundwater is contaminated, the traditional approach has involved obtaining random "grab samples" that gauge concentrated contamination levels at and around the contamination site.

While this method can determine localized concentration levels of contaminants, it offers no clear picture about how much or how fast the contaminants have spread to other areas via groundwater. It's kind of like looking out the window on a rainy day: you can see the precipitation in your own neighborhood, but you have no way of knowing whether rain has spread throughout the rest of the county or state.

But in 1999, a trio of University of Florida scientists devised a clever technology that would change all of that.

Michael Annable, Ph.D., Kirk Hatfield, Ph.D., and Suresh Rao, Ph.D., developed what is called the "Passive Flux Meter" (PFM), nylon tubes filled with absorbent materials, also known as sorbents and tracer materials. PFMs are inserted into monitoring wells near the contaminated areas, where they intercept the flow of groundwater. The sorbents retain the dissolved contaminants in the groundwater, while the tracers gradually leach out of the nylon tube. After one to four weeks, the PFMs are removed and analyzed. The contaminants can be analyzed to determine the time-averaged flow of contaminants, while remaining tracers are analyzed to determine the overall flow rates of the groundwater that has been contaminated.



In 2005, a privately held company, EnviroFlux, was founded by the three inventors, as well as entrepreneurs Jared Kennedy and Matt Tilman. Based in Gainesville, Fla., EnviroFlux secured an exclusive license from the University of Florida to commercialize the technology. EnviroFlux markets its products and services to environmental consulting firms, and it plans to license its PFM technology to environmental firms around the world. For more information, visit www.enviroflux.com.

34

Researchers Create the Succulent SunCrisp® Apple

Rutgers University

Just as inventors are forever trying to develop a better mousetrap, orchardists are constantly attempting to create tastier, longer-lasting, more aromatic and colorful apples.

Back in 1963, Fred Hough, Ph.D., and colleagues at the Rutgers University Horticultural Research Farm in New Brunswick, N.J., crossed the Cortland apple with a highly aromatic Cox's Orange Pippin. They then crossed that hybrid with the well-known Golden Delicious.

The result, which was patented by Rutgers, is the highly productive, tasty and mildly aromatic NJ 55 apple, which is now grown around the United States as SunCrisp®. It is especially popular with operators of u-pick operations and roadside stands.

A yellow apple with a pretty red blush, firm flesh, a mild subacid taste, the SunCrisp typically stores for up to six months. Best of all, apple lovers say it has a more complex and interesting flavor than its parent, the Golden Delicious, and is less likely to bruise.



35

New Antimicrobial Agent Kills Food-Borne Pathogens Safely

University of Arkansas for Medical Sciences and University of Arkansas, Fayetteville

Deadly microbes such as *Salmonella*, *E. coli*, and *Listeria* are a big concern for food-processing plants. Despite the food industry's efforts to maintain clean work environments, these organisms still enter the food chain and sicken thousands of people every year.

To tackle this problem, a team of scientists at the University of Arkansas for Medical Sciences (UAMS), led by Danny Lattin, Ph.D., in collaboration with Michael F. Slavik, Ph.D., at University of Arkansas, Fayetteville (UAF), researched cetylpyridinium chloride, or CPC, and discovered it to be a highly effective antimicrobial treatment for killing food-borne microbes.

Initial funding for this work came from the Food Safety Consortium, a group of researchers from UAMS, UAF, Iowa State University and Kansas State University.

Further research and development of the CPC application, sold under the Cecure® brand name, was completed by Safe Foods Corp., which has licensed the technology from UAMS BioVentures.



Significant kill rates of pathogens can be accomplished with Cecure® without altering the taste, texture, odor and appearance of the food product. Many of the largest U.S. poultry processors are now treating their products with this biocide. With additional U.S. Food and Drug Administration approvals for more food applications soon to come, and keen international interest, Cecure® is expected to be used in the largest food-processing countries within the next several years. The development of Cecure® has created more than 50 technical, high-paying jobs in the U.S. — a number that is expected to double by 2010.



Food



Food

36 Food Storage Technology Improves Consumer Satisfaction *North Carolina State University*

To provide consumers with the freshest, highest-quality fruits and vegetables, researchers have long been interested in managing the production of ethylene, which is a naturally occurring hormone in fruit that causes ripening, and eventually, softening and rot. Effective quality control methods would mean benefits to consumers such as improved overall tartness and taste.

North Carolina State researchers from the College of Agriculture and Life Sciences, Edward C. Sisler, Ph.D., and Sylvia M. Blankenship, Ph.D., have discovered the secret to keeping fruits and vegetables juicy, crisp and harvest-quality-fresh through storage and the trip to the marketplace. They uncovered 1-MCP (1-methylcyclopropene), a patented technology that provides a method of inhibiting the ethylene response of fruits and vegetables, thereby regulating the ripening process and lengthening the shelf life of produce.

Rohm and Hass Company recognized the commercial potential of the university's discovery and worked with the Office of Technology Transfer to license the ethylene-inhibiting technology. Rohm and Hass formed AgroFresh to develop its product platform. Based on this successful union, AgroFresh developed a product called SmartFresh®, a synthetic produce enhancer. Ethylene-sensitive crops such as apples, avocados, bananas, broccoli, cucumbers, leafy vegetables, mangoes, melons, pears, plums and tomatoes are now candidates for longer life spans and fresher taste. SmartFresh® helps drive growth in the produce industry by ensuring that fresh food crops get to market, which means consumers can expect fresher fruits and vegetables year-round.



37 Jersey Giant Hybrid Proves Bigger is Better *Rutgers University*

Researchers at Rutgers University made a major breakthrough for asparagus production when they developed Jersey Giant — the first all-male asparagus hybrid. Asparagus is dioecious, which means a plant is either male or female. Because male plants do not produce fruits that drain nutrient resources they out-yield female plants over time. Male plants also do not produce unwanted volunteer seedlings that contaminate the field. They also do not bear the weight of the fruits, therefore are less likely to suffer stalk breakage in a windstorm.

Jersey Giant is highly productive. Its introduction led to doubling of yields for the growers and helped to make this vegetable affordable to consumers.

Jersey Giant has vigorous growth habit and very good resistance against asparagus rust, a damaging disease that reduces yield and weakens the plant. It also has enhanced tolerance to crown and root rot diseases caused by *Fusarium* fungi that can shorten the lifespan of asparagus. Hence, Jersey Giant has been known to produce for up to 20 years from Washington State eastward to New England and south to the Carolinas. Since its introduction, Jersey Giant has become the most cultivated of the all-male hybrids.

Rutgers University has one of the most active asparagus breeding programs in the world, and continues to develop many other unique varieties of asparagus since succeeding with Jersey Giant.



38

Visual Acuity Test Helps Determine Vision Problems in Young Children and the Intellectually Impaired

Cardiff University

When people cannot express in words what they see, it is difficult for health care professionals to determine the nature of visual problems they may have. That's why Professor Maggie Woodhouse, Ph.D., at the Cardiff University School of Optometry and Vision Sciences, with university funding, designed the Cardiff Acuity Test.

Announced in 1993, the Cardiff Acuity Test measures acuity in toddlers ages one through three, as well as individuals with intellectual impairment. Historically this is considered a hard-to-test group because these individuals cannot communicate well enough to describe the familiar symbols and images they are shown.

Children do not need to name, or even recognize, the images used during the test. Instead the observer relies on the technique of "preferential looking" and records the subject's eye movements to determine how much of the image is actually being seen.

The Cardiff Acuity Test comes in a simple, quick, durable, and easy-to-use format, which is important when dealing with toddlers and individuals with intellectual impairment.

Users find it is easy to interpret the results.

To date about 2,100 test kits have been sold in the United Kingdom and the United States.

The royalty income has allowed Woodhouse to develop the Cardiff Near Test and the Cardiff Contrast Test, both of which are near the manufacturing and marketing stage. For more information, see www.cardiffacuity.co.uk/acuity.htm.



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eTriage Helps Emergency Rooms Prioritize Patient Care

University of Alberta

The eTRIAGE® technology, developed in 2002 by a research team led by Michael Bullard, M.D., at the University of Alberta, is improving triage efficiency in emergency rooms across North America.

Triage methods prioritize a patient's need for urgent care based on information provided to emergency room staff. Since emergency rooms are constantly overcrowded, triage nurses are forced to make fast decisions about when a person is seen and this can lead to inappropriate assignment of a patient's need and inadequate emergency care.

The University of Alberta's technology, eTRIAGE, is a Web-based tool that provides decision support to health care workers in emergency rooms. The software program helps triage staff classify a patient's need for urgent care by processing information gathered by a registered nurse and automatically assigning each patient a score from 1 to 5 based on his or her need of immediate care (Canadian Triage and Acuity Scale). While the tool is designed to avert triage problems, it allows nurses to override it and use their own judgment as appropriate.



Registered Nurse Rhonda Garipey uses the eTRIAGE program developed by David Meurer (left) and Dr. Michael Bullard.

Development of the triage tool became possible primarily through funding by grants from the Alberta Medical Association and Alberta Health and Wellness.

eTRIAGE®, which was first licensed in 2003, is protected by copyright and trademark. It was implemented in all emergency rooms in the Edmonton Capital Health region in 2003 and now it is being used at the British Columbia Children's Hospital and the Winnipeg Regional Health Authority. The program is now undergoing a significant enhancement that will take it into the emergency departments of two major eastern Canadian health regions.



Health Services



Health Services



Researchers Invent an Intelligent Hemofiltration System

Cincinnati's Children's Hospital Medical Center

Patients waiting for a kidney transplant usually depend on dialysis to stay healthy until an organ donor can be found. They spend hours in a hospital or dialysis center several days a week so the machine can clean the toxins from their blood because their own kidney can no longer do the job. Medical personnel carefully monitor and adjust the equipment throughout the process because even a small error could be very dangerous.

As John J. Bissler, M.D., a nephrologist at Cincinnati Children's Hospital, cared for patients in the intensive care unit, he became frustrated by the limitations of the monitoring equipment. He recognized the need for a system that accurately monitored, measured and regulated dialysis treatments. He envisioned a system to replace kidney function that would automatically adjust when it recognized a problem instead of simply beeping. In 1990, he assembled a team of doctors and engineers and began to develop an intelligent hemofiltration system.

Traditional dialysis equipment works by diffusion across a membrane. On one side is the patient's blood; on the other side is a fluid composed of sterile water and dialysate that supplies needed salts. Moving from an area of high concentration to an area of low concentration, toxins in the blood diffuse across the membrane and are washed out, while the fluids and salts diffuse into the blood. Dialysis requires a greater frequency of system adjustments by hospital personnel who must monitor the fluid removed from the patient on a regular basis. This activity leads to a significant increase in nursing care and raises the cost of the therapy.

The technology Dr. Bissler invented augments adjustments to an ongoing hemofiltration system. This hemofiltration technology uses highly accurate scales, pumps, filters and pressure transducers to remove a predetermined amount of fluid from the blood in a predetermined period of time. "Fluid balance is critical," Dr. Bissler explains. "Even a small error can be very dangerous. We were looking for stunningly accurate filtration. Tracking weight as the measure solved the problem. What we invented was a way to control the volumes so it is safe."

The whole system is computer-controlled, using sophisticated software invented by Dr. Bissler and his team. It notices changes and makes automatic adjustments to the operation of the machine. If the pump is going too fast or too slow, the computer automatically adjusts the rate of flow. If the filter is going bad, the computer gives a warning and tells you how much time you have to fix it. And it pays attention 100 percent of the time. It reduces the need for medical supervision and the possibility of human error.

"What sets this new device apart is the level of accuracy attained, allowing for safe and effective treatment, combined with the ease of use and portability," says Dr. Bissler. "While this technology is critical for the intensive care unit patient, it also offers new therapeutic promise for families with children affected by renal failure. It represents a major leap forward in the area of home care, and an opportunity for these patients to lead more normal lives."

In the near future, many of the 250,000 American children and adults currently on dialysis may no longer have to go to a hospital or dialysis unit to receive treatment but can get it at home — at lower cost and with greater safety.

Working with Dr. Bissler, the Office of Intellectual Property & Venture Development at Cincinnati Children's Hospital Medical Center licensed the technology to British Technology Group (BTG), a world leader in the commercialization of new health care technologies. Through a sublicense agreement with Gambro AB, the technology has found a commercial outlet. It is estimated that Gambro comprises 60 percent of the worldwide hemofiltration market. A second sublicense is being finalized and will increase worldwide distribution of this technology.



Breast CT: A New Alternative to Mammography

University of California, Davis

Computed tomography (CT) is used extensively to identify tumors and other abnormalities in the brain, abdomen and pelvis. In contrast to medical X-rays, which produce a single-layer 2-D image, a CT scan records hundreds of images of multiple tissue layers and assembles them into a 3-D representation. A team working at University of California Davis Cancer Center has developed a breast CT device they believe provides a more comfortable and potentially more sensitive alternative to X-ray based mammography to detect breast cancer.

The breast CT device, currently in a Phase II investigational trial, is the invention of Drs. John Boone, professor of radiology at UC-Davis, and Thomas R. Nelson, professor of radiology at University of California, San Diego. CT has not typically been applied to breast cancer detection because of concerns over the radiation dose required. The inventors solved this problem by designing a CT device that scans each breast while the patient lies face down on a special table. The radiation exposure in the breast is equivalent to that of a traditional mammogram, and the thoracic cavity is not irradiated at all, as it would be in a conventional CT scanner.

The first 21 patients in the ongoing clinical trial reported that the CT breast scan, which does not require breast compression, caused them less discomfort than mammography. The CT detected 19 of the 21 tumors initially identified by mammography, and Dr. Lindfors believes the prototype machine and method of scanning can be modified to improve on this detection rate. Once the Phase II trial is complete, a trial directly comparing breast CT and mammography will be the next step in moving the technology forward.



Tissue-Tek® Xpress™ Brings Biopsy Results Faster

University of Miami

Like most pathologists, the chief of pathology at the University of Miami Miller School of Medicine worked his whole career with a system that was basically unchanged throughout the 20th century. Surgeons would deposit tissue samples into a preservative solution and then technicians would put it through a chemical process that took 12 hours and irreversibly destroyed any hope for molecular analysis. Azorides Morales, M.D., and some colleagues wondered whether there might be a better and faster way to process tissue samples, knowing that it could revolutionize pathology. They found one.

In 1997, Dr. Morales began refining a new technique with Ervin Essinfeld, M.D., and his son Harold Essinfeld, M.D., both pathologists in Caracas, Venezuela. They found a more efficient way to use an existing technology to expedite the processing of tissue — microwaves.

The system is a Rapid Tissue Processing (RTP) instrument. Previously, patients were forced to wait for 3-5 days to get the results of a biopsy. With the RTP, an anxious patient can get biopsy results on the same day, within hours. Not only do patients have their results much faster, but physicians can begin treatment even sooner.

RTP uses a specially-designed microwave that allows for uniform heating of tissue within an automated system that does not dry out or damage the tissue. Now, the fully automated RTP system, reagents and accessories are for sale for the first time to hospitals around the world by Sakura Finetek USA, Inc. under the name Tissue-Tek® Xpress™ Rapid Tissue Processor.

The patents were exclusively licensed to Sakura, which is manufacturing and selling the instrument, reagents and accessories to other pathology departments. The product was introduced in early 2004. University of Miami continues to work with Sakura on novel tissue processes, reagents and accessories.

More information is available at www.sakura-americas.com/products/xpress01.html.



Health Services



Health Services

43 Intravenous Catheter Design Eliminates Risk of Potentially Dangerous Needlesticks

City of Hope

Health care workers who suffer accidental needlestick injuries are at significant risk of contracting life-threatening diseases including hepatitis B, hepatitis C and HIV-AIDS. It has been estimated that 600,000 to 800,000 needlesticks and other sharp injuries occur among health care workers every year. Not only do these injuries cause anxiety and concern, the follow-up blood testing that is required is expensive and time-consuming,

To alleviate this problem, Dr. J. Martin Hogan, M.D., of the City of Hope, a leading cancer hospital and biomedical research center in Duarte, Calif., invented an intravenous catheter with safety features that protect health care workers from accidental needlesticks. City of Hope was awarded a U.S. patent for the device in 1992.

The catheter's inner needle is passively covered as it is withdrawn from the catheter after insertion into a patient's vein. The device shields the health care worker from accidental needlestick injury and potential exposure to blood-borne diseases such as hepatitis and HIV-AIDS.



44 Dental Carrier Device Makes Advancements In Oral Health

Louisiana State University

Patients may not know it, but they and their dentists are benefiting from a dental carrier device invented by Ron Lemon D.M.D., and Raymond Luebke, D.D.S., at Louisiana State University Health Sciences Center in New Orleans.

A new generation of filling material called mineral trioxide aggregate or MTA, was developed to be more biocompatible for dental patients. There was, however, no efficient way to manipulate, deliver, and place this new material, which required very different handling from the previous generation of dental material. The slurry MTA substance was clogging traditional tools, maddening dentists and failing to create proper seals in patients' mouths. Poor seals can lead to bacterial leakage, recurrent decay, and tooth hypersensitivity — all bad news for the patient.

Dr. Lemon and Dr. Luebke invented and funded the development of the initial prototype devices that could handle this revolutionary new dental material. With the carrier technology reduced to practice, it was greeted with great acclaim in the dental world and was quickly commercialized. An exclusive license was granted to DENTSPLY International in 2001.



Dentists now have access to technology that allows maximum use of the new generation of filling material and patients can be more confident that their current dental procedures will not be the cause of even more dental work.

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Cytokine Intervention Shows Promise for Fighting the Painful Inflammation of Rheumatoid Arthritis

University of Glasgow

New methods of modifying the immune response are showing great promise in the treatment of rheumatoid arthritis. One of these methods is “cytokine blockade,” best shown by the success of tumor necrosis factor (TNF) blockers. Cytokines are small proteins that control the immune system. Interleukin-15, or IL-15, is a cytokine created by white blood cells that stimulates the immune system to attack an inflammation site such as the joint.

Supported by funding from the Medical Research Council, the Wellcome Trust, and the Scottish Office and Health Department, Dr. Iain McInnes and Dr. Foo Yew (Eddy) Liew of the University of Glasgow's Centre for Rheumatic Diseases, Division of Infection, Inflammation and Immunity began to research the role of IL-15 in the late 1990s. They discovered that IL-15 activity in the joints of patients with rheumatoid arthritis actually stimulated the production of TNF-alpha, a molecule known to contribute to inflammatory damage because of the existing drugs referred to above.

Further work with a European biotechnology company that manufactured human antibodies to IL-15 showed that the antibodies blocked the activity of IL-15 in the laboratory. The next step, phase I/II clinical trials with 30 sufferers of rheumatoid arthritis, revealed that antibody injections reduced the pain and inflammation in most subjects, with some showing dramatic improvement.

Currently, one in every hundred people develop painful rheumatoid arthritis. Research continues to show that cytokine intervention can be used to regulate the immune response, which has exciting implications for the treatment of inflammatory diseases.

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New Sunscreen Ingredient Protects Against UVA Light and Free Radicals

University of Oxford

Dismayed by the chemical reactivity and inconsistent protection provided by commercial sunscreen products, Professor Peter Dobson, and Drs. Gareth Wakefield and John Knowland at the University of Oxford in England created “Optisol™ UV Absorber” in the late 1990s.

In addition to protecting against ultraviolet B radiation, Optisol™ also protects against ultraviolet A radiation, which has only recently been recognized as another contributor to skin damage. The active ingredient in Optisol™ is titanium dioxide with added manganese. The manganese also absorbs UVA light and helps stop the formation of free radicals in the titanium oxide when it is exposed to sunlight. This makes Optisol™-based sunscreens more stable when exposed to light than traditional sunscreens, as well as more effective in protecting against cell damage and premature aging.

With the help of the University of Oxford's technology transfer company, Isis Innovation Ltd., Dobson founded Oxonica in 1999. The company is based in Oxford and currently employs 56 people. Oxonica develops and manufactures other innovative nanotechnology-based products, such as a nanocatalyst that improves fuel economy and lowers emissions. For more information, go to www.oxonica.com.



Health Services



Information Services



Wireless, Mobile Access to Medical Data Means the Doctor Is Always In

University of California, Los Angeles

Doctors are expected to respond quickly and appropriately as their patients' medical needs dictate. In an ideal world, physicians would have access to all medical data for a patient at their fingertips, but in the real world information must be retrieved from several different sources. Now, under an agreement with Sprint, a new technology developed at University of California, Los Angeles (UCLA) will offer physicians mobile wireless access not only to patient records, including X-ray and CT images, but also to real-time data from ICU monitors, bedside charts, and even live video feeds.

The Integrated Clinical Information System Mobile (ICIS Mobile) solution will make this comprehensive medical information available on handheld devices and smart phones, even when doctors are away from the hospital.

Mobile access to existing clinical information systems through wireless networks is expected to improve the quality and safety of patient care, avoid errors, increase cost-effectiveness, and increase physician productivity and responsiveness. The system will make it simpler and faster to retrieve patient information, leaving more time to care for patients.

The digital data retrieval and storage system behind ICIS Mobile is already used in many departments of the UCLA David Geffen School of Medicine, where it was invented and developed by Neal A. Martin, chief of neurosurgery, Valeriy I. Nenov, director of the Brain Intensive Monitoring and Modeling Laboratory (BIMML), and Farzad Buxey, a systems architect and research specialist working at BIMML. The team of inventors founded a privately held software company, Global Care Quest, Inc. to commercialize the technology through deals, including the agreement with Sprint.



ILLiad Makes Interlibrary Operations More Efficient

Virginia Polytechnic Institute & State University (Virginia Tech)

The interlibrary borrowing process became less labor-intensive and more customer friendly thanks to Virginia Tech's development of ILLiad, a groundbreaking interlibrary loan automation software system.

ILLiad, an acronym for InterLibrary Loan Internet Accessible Database, was developed at Virginia Tech in 1997 by Jason Glover when he was a programmer in the InterLibrary Loan Department. Licensed to Atlas Systems, the software was developed under funding from Virginia Tech.

The innovative technology allows librarians to perform many interlibrary functions involving the complete process of borrowing. Functions range from searching for lending libraries that have the requested material to sending overdue notices to customers.

Virginia Tech's technology streamlines the entire borrowing system and generates a higher level of customer satisfaction and service. The labor-saving software helps libraries by eliminating paper records and manual record keeping. Library patrons benefit from ILLiad's efficiencies, too, since they can track the progress of their requested library materials online.

Harry Kriz, Director of Interlibrary Loan Services at Virginia Tech points out ILLiad is more than a management system since it not only helps library staff accomplish their day's tasks, it benefits customers by helping them accomplish their research and reading goals. ILLiad is now in use by nearly 800 libraries, including about 80 percent of U.S. research libraries.





In the Pipeline: Measuring Wall Thicknesses to Detect Corrosion

Imperial College London, England

Measuring the wall thickness of pipelines that transport natural gas and petroleum is key to detecting corrosion and defects. But this can be challenging when pipelines possess high temperatures. Standard ultrasonic transducers — devices used to measure pipeline wall thicknesses — can be destroyed by excessive heat.

Professor Peter Cawley of the department of engineering, Imperial College London, England, invented a cost-effective means to attach ultrasonic transducers to pipelines without risking their destruction due to high temperatures. The product resulting from the development program uses a wireless data transmission capability, thereby removing the risk of damage to the measurement tools.

Funding for the original research came from the Engineering and Physical Sciences Research Council, the United Kingdom's governmental agency for funding university research grants for engineering and physical sciences projects. The patented technology was first licensed in 2006 and will be deployed extensively.



HANDY HELPER: One Robot Could Transform the Lives of People with Disabilities Across the World

Staffordshire University

Even the most basic tasks such as shaving, cooking or cleaning can be a struggle if you are disabled or elderly, forcing you to rely on others just to get through life's daily chores. But a robotic caterpillar developed by scientists at Staffordshire University allows people to perform the basic tasks of day-to-day living by themselves, with the privacy and dignity that the able-bodied take for granted.

'Flexibot' is the world's first robotic arm that can propel itself like an inchworm from one socket to another across a room. It takes the form of an arm, jointed in the middle and at either end, which can clamp itself to socket on a wall or ceiling. By plugging one end into a socket and then reaching over and plugging into the next one, it can move around on its own accord. Taking instructions from each 'intelligent' socket, it performs different tasks using its three-fingered hand to grip and manoeuvre objects.

Several multi-national companies are currently discussing how the robot could be mass-manufactured to transform the lives of people with disabilities across the world. Its benefits are simple: it is cheap, accurate, and flexible. It also works: Flexibot is based on the same principles as 'Handy one', currently the most successful rehabilitation robot in the world.

Sheffield Hallam University meanwhile have developed artificial arms that work and move like real limbs. The results of the 'Analogous Artificial Arm' project are already being used by the National Aeronautics and Space Administration (NASA) to help develop a robot skeleton with plastic muscles for future space missions. Other future applications include elbow implants, and machines controlled by computers that can be used to mimic surgical operations.

Researchers at Leeds Metropolitan University are using computers to help people with autism and Asperger's Syndrome learn how to deal with potentially problematic social situations. The simulations ask computer users for example to choose where they should join a queue and illustrate the consequences of their choices. The software is being designed to make it easy for parents, teachers or carers to write new simulations aimed at their young people with autism.

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Machinery



Machinery

Medical

51 University Professor Develops Promising Hydrogen Sensor Technology

Niigata University

Some of the best inventions are the ones that are the least expected.

Just ask Shuji Harada, Ph.D., a professor in the Institute of Science and Technology at Niigata University in Niigata, Japan.

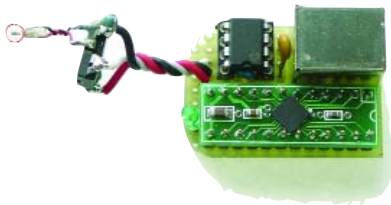
Harada has focused much of his research on metal-hydrogen systems, an increasingly important field relating to energy storage (think rechargeable nickel metal hydrate, or NiMH batteries) and hydrogen fuel storage cell development. Several years ago, one of his students suggested that he purchase a hydrogen sensor for his laboratory, but at the time, Harada could not afford it. So, he took it upon himself to develop one himself, using funds from his annual research budget along with grant money from the Japanese government.

The end result was an extremely small, simple yet versatile hydrogen sensor device. It had an extraordinarily quick response speed — within nanoseconds — and was highly selective, picking up only hydrogen, and not other gases. It also was very sensitive, able to trace miniscule amounts of hydrogen in the air. And finally, it required no external power source.

Having created this marvelous device for use in his student's lab, it dawned on the professor that it could be used to detect hydrogen gas leaks in a variety of other settings, for example, the chemical and power generation industries, the space industry, and potentially in the future fuel cell vehicle market. With this in mind, Harada patented the device, and plans are under way to develop a business that will manufacture and market these hydrogen sensors in the future.

Harada received significant royalties from a three-year licensing agreement arranged through the Niigata Licensing Organization. Yet he donated all of the royalty money to Niigata University, so that the funds could be used to support younger researchers engaged in related fields of research. In recognition of his outstanding invention, Harada received an award from Japan's Ministry of Education, Culture, Sports, Science and Technology in June 2006.

Harada's devices may one day help protect, and perhaps even save the lives, of those who may be exposed to the dangers of hydrogen gas leaks in their daily work.



52 Wound-Closure Device Helps Speed Healing After Serious Wounds

Wake Forest University

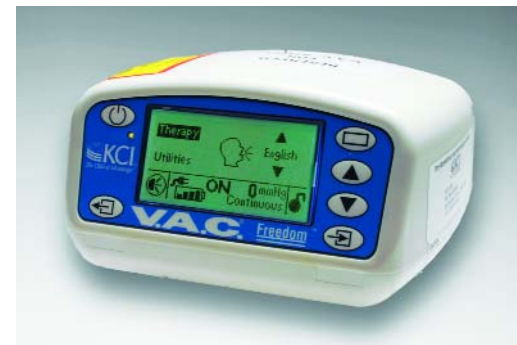
Smooth recovery from physical trauma or surgery depends a great deal on how quickly the wound or incision heals. For some patients, especially those who are at high risk for infection, slow healing can be a life-threatening situation.

Wake Forest University Health Sciences Professor Louis C. Argenta, M.D., and associate professor Michael J. Morykwas, Ph.D., both in the university's department of plastic and reconstructive surgery, disclosed the "Vacuum-Assisted Closure (V.A.C.)" device in 1990.

Approved by the U.S. Food and Drug Administration in 1995, V.A.C. Therapy is widely accepted as the treatment of choice for a variety of wounds, especially head and leg injuries and troublesome, slow-healing wounds such as burns, bedsores and diabetic ulcers.

V.A.C. Therapy rapidly heals wounds with fewer complications and infections compared to traditional wound treatment. By using V.A.C. Therapy to apply negative pressure to a wound or incision, doctors can easily and gently remove fluids and infectious materials, which reduces the chances of infection. A special, open-cell foam dressing promotes healing and helps draw the edges of the wound together.

Today V.A.C. Therapy is dramatically changing the standard of medical care around the world, both on the battlefield and in the hospital. More than a million Americans also use V.A.C. Therapy in their homes, reducing the time they spend in hospitals and clinics, as well as their need for in-home nursing visits.





Coagulation Technologies Help Treat Blood Diseases

University of Vermont

University of Vermont scientists have isolated high quality, plasma proteins that are used for diagnosis and treatment of diseases of the blood. Kenneth Mann, Ph.D., professor emeritus of biochemistry, and an international expert in the field of blood clotting, led the research that resulted in seven patents related to the diagnosis and study of functions that are critical in normal blood coagulation.

Among Mann's most notable inventions is a synthetic "plasma" mixture that is made up of proteins and membranes, and is designed to provide a clearer understanding of the regulation of blood coagulation.

Adding to the university's leadership in the fields of coagulation research and protein biochemistry are the groundbreaking discoveries of Richard Jenny, Ph.D., and his colleagues. Original funding for much of the work came from grants from the National Institutes of Health. Jenny, whose career in coagulation research spans 25 years, co-founded Haematologic Technologies Inc. (HTI), located in Essex Junction, Vt., along with four of his colleagues. The company specializes in the isolation and characterization of high quality proteins for *in vitro* research worldwide.

Jenny has helped guide HTI from its initial two-person startup operation to its current status as an internationally recognized company.



Adenocard® Helps Patients with Abnormally Rapid Heartbeats

University of Virginia

Paroxysmal supraventricular tachycardia (PSVT) can best be described as an abnormally rapid series of heartbeats that can last anywhere from a few minutes to a few hours. It typically surfaces for the first time in childhood or early adulthood, although the first episode may manifest itself at any age, and it is not indicative of an abnormal heart condition.

While the number of people affected by this heart disturbance is not known, its consequences can be serious. Since the heart is beating so rapidly, it cannot rest between beats, and as a result, the heart's chambers cannot contract sufficiently or become filled with enough blood, leading to inadequate supplies of blood to the body. When this occurs, the patient experiences dizziness and/or breathlessness, in addition to the disturbing sensation of a heart pounding from 140 to 200 beats or more per minute.

Research conducted at the University of Virginia yielded an effective treatment for PSVT: Adenocard®. By slowing down the heart's electrical conduction, Adenocard® — an injection-based treatment — in turn slows the heart rate. It was developed by the late Robert M. Berne, M.D., a professor emeritus of physiology, and Luiz Belardinelli, M.D., and was first patented in 1982. Today, Adenocard® is used widely in hospitals and emergency vehicles around the world.



Medical



Medical



Researcher Improves Life-Saving Blood Clotting Agent

University of California, Santa Barbara

Marines deployed in Iraq carry what looks like a container of sand but is actually a novel agent used to stop severe bleeding. The granular substance, a product called QUIKLOT® brand hemostatic agent, is manufactured by Z-Medica Corp., which recently licensed intellectual property originating at University of California, Santa Barbara (UCSB) to improve their product.

Originally developed in cooperation with the U.S. military and approved by the FDA in 2002, QUIKLOT® is a novel blood-clotting agent that is helping emergency response personnel and soldiers save lives at home and abroad. Researchers in the laboratory of Galen Stucky, a professor with joint appointments in materials science and chemistry, studied the molecular properties of QUIKLOT® and used their insights to develop a new formulation.

QUIKLOT® employs mineral material derived from volcanic rock, generically termed a zeolite, to solve the problem of excessive bleeding. The zeolite acts like a sponge to absorb water from blood by funneling and trapping it in tiny pores. Unlike a sponge, however, QUIKLOT® is selective, leaving clotting proteins in blood behind. Because these proteins and platelets are too large to enter the pores in the zeolite, they become more highly concentrated, speeding up the process of clot formation. The UCSB inventors discovered that zeolite surface chemistry also enhances clotting by activating platelets, binding phospholipids, and providing calcium ions, a cofactor for clotting enzymes.

The original formulation of QUIKLOT® generates heat when it comes into contact with water, which can produce unwanted effects. The UCSB team found this exothermic reaction was due to hydrogen bond formation between positively charged atoms in the zeolite and water in the blood. By altering the mix of positively charged atoms in the formulation they were able to eliminate the problem. The new formulation discovered at UCSB includes silver ions, which have known antibiotic activity, further enhancing the product's usefulness in wound treatment. It is currently undergoing testing in animals and is expected to be approved and released in summer 2006.



EZ-IO® — Using the Bone When the Veins Won't Do

The University of Texas Health Science Center – San Antonio

More than six million emergency room patients annually cannot have intravenous (IV) therapy started successfully when they need it. In situations in which the patients' veins collapse due to shock, low blood pressure, cardiac arrest or other complications, IVs prove extremely difficult to start, often resulting in no access or significant delay in access to the blood vessels, and subsequently thousands of deaths every year.

The intraosseous space, where bone marrow resides, is a specialized area of the human body's vascular system where blood flow is rapid and continues even during shock. Drugs and fluids injected into the bone marrow reach the central circulation at least as quickly as those administered through standard IV access. While the medical community has long recognized that bone marrow acts as a non-collapsible vein through which any drug or fluid can be rapidly and safely administered, it has, until recently, been faced with the problem of how to safely penetrate the hard part of the adult bone with a catheter to gain access to the bone marrow.

Vidacare® in conjunction with The University of Texas Health Science Center – San Antonio developed the EZ-IO® product system. The system consists of a small, battery-powered intraosseous (IO) driver and needle set that provides fast, safe and controllable intraosseous access, safely penetrating through the bone in seconds. This unique design alerts the user when the needle has entered the intraosseous space providing greater control, even in the most challenging cases. Studies have shown that insertion using the EZ-IO® system usually takes less than 10 seconds, while IV insertion takes an average of eight minutes.

Technologically advanced and designed for maximum patient tolerance, the EZ-IO AD for adults was the first power-driven FDA-cleared IO access product and has been successfully used in the field since late 2004. Similarly, the EZ-IO PD for pediatric patients, recently cleared by the FDA, was designed with a modified needle for safe access into smaller patients and is now available throughout the United States.

For more information visit www.vidacare.com.

57 Intravenous Busulfan Offers Hope to Leukemia Patients

University of Texas

Back in 1990, Borje S. Andersson, M.D., Ph.D., recognized that lethal liver failure in one of every four to five patients undergoing stem cell transplantation for leukemia was unacceptable.

He traced this to the unpredictable effect of high-dose busulfan given by mouth while preparing the patients for their transplant. He came up with the idea of giving this “insoluble drug” directly into the blood, something thought to be impossible, since busulfan is chemically unstable and thought of as truly insoluble. He suggested that an intravenous busulfan formulation would be easier and safer to administer. Not accepting that busulfan would be insoluble, Dr. Andersson set out to create an intravenous formulation.

This project led to the filing of a patent application for “intravenous busulfan” three years later, and in 1995 clinical studies were initiated to better prepare leukemia patients for stem cell transplants. The clinical trials spearheaded by The University of Texas M. D. Anderson Cancer Center were carried out at seven different U.S. transplant centers, and in 1999 the U.S. Food and Drug Administration (FDA) granted regulatory approval for intravenous busulfan (IV Busulfex™).

This was the first, and so far the only, time that the FDA approved a chemotherapeutic agent or technology for use in pretransplantation preparative therapy. Since then, the transplant group at M. D. Anderson has conducted a series of clinical trials using IV Busulfex™, combined with either cyclophosphamide or with Fludarabine as part of conditioning therapy for patients with chronic and acute myeloid leukemia and for patients with myelodysplastic syndrome. They have firmly established IV Busulfex™ as a safer alternative to existing pre-transplant preparative regimens for patients with myeloid leukemia; the risk of a lethal complication in an adult undergoing a transplant for leukemia is now below eight percent in the first year after the transplant. IV Busulfex™ is now successfully used in more than 40 countries around the globe.



58 Sensor-Enabled “Smart” Surgical Technologies

Imperial College London, England

There have been many advances in keyhole, or laparoscopic, surgery — the whole process of carrying out a medical operation without having to make a large incision in the patient. Yet most surgical instruments used in keyhole surgery are “passive” mechanical devices, which offer the surgeon little feedback.

To overcome this, a team of researchers led by Professor Sir Ara Darzi at St. Mary’s Campus, Imperial College London, have integrated new sensor technologies into surgical devices to make them “active.” These potentially smart devices can reduce patient trauma and the time involved in operations, which in turn could lead to lower health care costs as well.

Imperial Innovations, a technology commercialization and investment company based at Imperial College London, has obtained patents on the “Smart Bougie,” a sensor-enabled dilator. The device is like a flexible metal basket that can be used to safely open blockages in the esophageal tube during laparoscopic surgery. The Bougie actively gives feedback at the site of the surgical procedure, providing doctors with information from the repair site. Currently, blockages are opened using passive devices like balloons, which offer no active feedback to the surgeons conducting the surgery.

The product development process took two years, and a design team, led by the Royal College of Art and supported by the Helen Hamlyn Foundation, designed the prototypes. Imperial Innovations is funding further prototype testing, and is considering the formation of a company to commercialize this and other “smart” devices developed at Imperial College London.



Smart Bougie allows pressure feedback leading to better surgical procedures.



Medical



Medical



Researchers Improve Storage for Transplant Organs

University of Wisconsin-Madison (UW-M)

In 1986, University of Wisconsin scientists Folkert Belzer M.D., and James Southard, Ph.D., developed the gold standard for organ preservation techniques. Backed by funding from the National Institutes of Health, they developed a synthetic solution that allowed organs to be safely stored outside the body for longer periods of time. The advancement, known as the UW Solution, was a major breakthrough in preserving organs for transplant surgeries.

Prior to the UW-Madison scientists' discovery, organs such as livers could only be stored for six hours and kidneys could be preserved for up to three days. The beauty of the Wisconsin Solution was that due to its extended preservation time, fewer organs were wasted and, consequently, more lives were saved.

Since the UW Solution was originally invented, UW-Madison veterinary surgeon Jonathan McAnulty, D.V.M., along with his colleague, veterinary ophthalmologist Christopher Murphy, D.V.M., have



The UW Solution, a synthetic solution enriched with proteins, can safely store transplant organs like this canine kidney contained in a beaker, for longer periods of time with less risk of tissue damage. Photo by: Jeff Miller and UW-Madison University Communications.

improved on the original UW Solution by developing a totally natural solution that includes proteins called trophic factors. The modified UW Solution increases organ quality and length of storage time possible.

This modified UW Solution has not only led to greater improvement in preventing damage to organs during storage, it has a positive, direct affect on donor pools and successful organ transplant surgeries.



Smith-Lemli-Opitz Syndrome Detection Possible Using Safer Prenatal Testing

Children's Hospital Oakland Research Institute

Smith-Lemli-Opitz Syndrome (SLOS) is a congenital multiple anomaly syndrome caused by an abnormality in the production of cholesterol. SLOS affects the development of about 1 out of 20,000–60,000 children and is associated with multiple birth defects and mental retardation.

The challenge in prenatal diagnosis has been the identification of a non-invasive early-pregnancy test that involves detection of definitive and SLOS-specific components. The established SLOS prenatal test involves detecting increased levels of an essential enzyme by testing either a small tissue sample from outside the sac where the baby develops or amniotic fluid samples, each of which involve invasive procedures and pose a risk to the fetus. Typically these tests are performed between 12 to 18 weeks of gestation. Prenatal testing, including molecular genetic testing has only been performed if the parents are "at-risk" for having an SLOS child because of a previous affected pregnancy and/or child, or based on abnormalities detected by ultrasound. A considerable proportion of SLOS cases are not identified until birth.

The new SLOS, developed at Children's Hospital Oakland Research Institute (CHORI) by Dr. Cedric Shackleton, in collaboration with Drs. Li-Wei Guo and William K. Wilson of Rice University, provides a reliable and non-invasive procedure for the detection of SLOS by analyzing maternal urine for characteristic components produced by SLOS affected fetuses as early as 11 to 13 weeks' gestation.

Early detection of a SLOS fetus can offer parents the option of making family planning decisions in the most severe cases. In addition, preliminary research on dietary cholesterol supplementation has yielded some promising results for prenatal treatment of SLOS rendering early prenatal diagnosis essential.

Quest Diagnostics, the nation's leading provider of diagnostic laboratory testing, information and services, has entered into a non-exclusive license agreement with CHORI for the SLOS technology.

For more information visit www.questdiagnostics.com.

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Predictive Gene Testing Lets Women Know if They Are at Risk for Developing Breast Cancer

University of Utah

Each year, nearly 200,000 women are diagnosed with breast cancer. Research has shown that about 10 percent of these cases occur in women who have inherited higher-risk factors from their parents. Knowing this early in their lives can help them take a preventive approach to their health care, including more frequent screenings.

Two genes, BRCA1 and BRCA2, normally help the body fight off breast cancer. But an inherited mutation of these genes can make women more at risk for developing breast cancer. In fact, by age 70, women who carry the BRCA1 or BRCA2 mutation are nearly 10 times more susceptible to developing breast cancer.

BRCA1 and BRCA2, and their mutations, were discovered in the mid-1990s by a research team led by Mark Skolnick, Ph.D., a professor in the department of medical informatics at the University of Utah in Salt Lake City and executive vice president of research and development for Myriad Genetics. The research was conducted in collaboration with the University of Utah and others.

Since that time Myriad has become an international leader in preventive medicine and discovering disease-related genes. The number of women being tested for BRCA1 and BRCA2 is growing by 40 percent every year. In 2007 Myriad Genetics expects to analyze more than 70,000 tests, which have become an accepted part of medical care among women.

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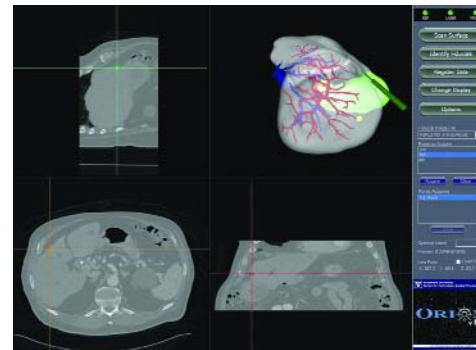
Researchers Revolutionize Soft Tissue Surgery

Vanderbilt University

For more than a decade, image-guided technology has been used successfully for brain, skull, spine and joint surgery. These rigid anatomy applications have helped surgeons do more complicated procedures. Research led by Bob Galloway, M.D., of Vanderbilt University should similarly transform soft tissue surgery.

Galloway, an industry pioneer for more than 15 years, has worked closely with Vanderbilt's Office of Technology Transfer to ensure the commercialization of the image-guided soft tissue surgery platform through the creation of Pathfinder Therapeutics, founded in 2004.

Rigid anatomy applications have the advantage of being relatively easy to identify, image and track. Soft tissue, like the liver, is very difficult to image and track. Galloway and other researchers at Vanderbilt have solved the problem by developing a method to collect dense surfaces of internal organs and merge those with the computerized tomography or magnetic resonance image for the patient, using a system similar to a global positioning system. Surgeons can now plan complex surgery and ensure that their surgical tools avoid key blood vessels and reach their targets quicker.



Medical



Medical



Scanned CT Imaging System Aids Surgeons During Delicate Procedures

Dartmouth College

In the late 1980s researchers at Dartmouth College, led by David W. Roberts, M.D., a neurosurgeon at Dartmouth's Hitchcock Medical Center, invented a reference display system that receives information from an imaging system, such as a computerized tomography (CT) scanner, and converts the three-dimensional anatomical or pathological images into digitized signals, which are then recreated in the focal plane of an operating microscope. The "Reference Display System for Superimposing a Tomographic Image onto the Focal Plane of an Operating Microscope" was patented in 1988.

Conventional CT scans are oriented transversely to the body axis and the operative approach is rarely along this axis. Dartmouth's reference display system reconstructs a scanned image to match the surgical perspective and superimposes the reconstructed image over the field of view of the operating microscope.

In order to create the image within the microscope, digitized data from a scanning procedure is sent to a computer that reformats the data into a coded electrical signal. That signal is then processed through an imaging system, which reformats the data into an image with an orientation matching the surgical perspective, and the image is projected by an optical display system onto the focal plane of the operating microscope.

This allows the surgeon to see, for example, the outline of a tumor (reconstructed by a computer) and to use the superimposed image as a map to accurately guide operative procedures with greater precision than was previously possible.



Tumor Marker Assay Helps Identify the Recurrence of Breast Cancer

Dana-Farber Cancer Institute

The monitoring of breast and other types of cancer with blood tests is critical for improving the odds of successful treatment. Discovering cancer markers that identify the progression of cancer at early stages is a research goal for many medical institutions.

Based on their research conducted in the late eighties and early nineties, Dr. Donald W. Kufe, M.D., and colleagues at the Dana-Farber Cancer Institute in Boston, developed a monoclonal antibody that recognizes the MUC1 glycoprotein. MUC1 is aberrantly overexpressed by most carcinomas of the breast, lung, ovary and other sites. Dr. Kufe's research showed that MUC1 is released by tumor cells into the blood and that the level of MUC1 in the circulation reflects the extent of disease.

Today the blood test, also known as the CA15-3 radioimmunoassay, is commercially available to the clinical community under a license granted by the Dana-Farber Cancer Institute. This highly accurate blood analysis is regarded as one of the most sensitive tests for detecting breast disease that has spread. Measured over time, CA15-3 can detect the recurrence of cancer, more quickly than standard methods of follow-up testing, especially for patients already treated for Stage II or Stage III breast cancer. CA15-3 is supported by more than 2,000 peer-reviewed studies and is one of the most widely used cancer detection markers in the world.



Natural Folates Help Battle Major Diseases

University of South Alabama

Although for many years folate has been used to treat anemia and prevent birth defects, it is now clear that deficiency in this critical vitamin is also related to the risk of colon cancer, Alzheimer's disease and vascular diseases. Folate can be obtained from dark green leafy vegetables and many fruits, but until now supplements have incorporated folic acid, a synthetic form that does not occur to a significant extent in fresh natural foods.

Scientists at the University of South Alabama have discovered that the folates found in nature have many advantages over synthetic folic acid, and have developed technologies to further the health-promoting benefits of this vitamin. For example, before synthetic folic acid can support any functions of the body, it must first be converted into the fully reduced natural folates.

Research at the University of South Alabama has shown that humans have very low levels of the enzyme that performs this role. As a result, folic acid doses greater than the U.S. Food and Drug Administration's Daily Value of 400 micrograms (and even the DV for some individuals) are not efficiently converted into active folate. Conversely, 5-methyltetrahydrofolate, the form that is most abundant in blood and many tissues, is very rapidly absorbed from the intestinal tract and is already active. Moreover, this folate (but not folic acid) can be transported into the brain.

The South Alabama Medical Science Foundation has licensed some of this technology to Merck, KGaA, and major products are now available in the U.S. and Europe in the areas of cardiovascular disease, cognitive function and prenatal vitamins. In addition, recent research has demonstrated that the natural folates can protect against damage by ultraviolet and ionizing radiation. These technologies are being further developed and licensed.



U-plate Eases the Pain of Broken Ribs

Oregon Health & Science University

Patients with rib fractures often suffer a slow and painful healing process, generally treatable with only oral narcotics and painkillers. Convinced that a surgical method could alleviate pain and speed recovery, surgeons at the Oregon Health & Science University (OHSU) have begun a pilot study to question the traditional practice of "not fixing" rib fractures.

Researchers are working to establish a reliable method to accurately measure the pain and disability of rib fractures and develop a surgical technique and standard criteria for treatment. A key component is the U-plate — a device made of titanium which is implanted during a minimally-invasive surgery. It bridges the fracture, helping to speed healing and prevent further injury.

The U-plate was designed by Thomas Ellis, an associate professor in the Department of Orthopaedics & Rehabilitation at the OHSU School of Medicine, and mechanical engineer Joel Gillard. It has been approved by the FDA and is licensed to



Acute Innovations, which was launched using OHSU technology. Acute Innovations is committed to providing innovative solutions to challenging thoracic surgical procedures. The U-plate has been on the market for a year, and Acute Innovations estimates over a dozen patients (outside of the study) have benefited from the device.



Medical

Nanotechnology



Nanotechnology



Magnetic Imaging Identifies Microchip Failure Quickly and Accurately

Brown University

When microchips fail in semiconductors and electronic devices, the root cause can be difficult to diagnose. Complex circuits and equipment often have to be painstakingly disassembled piece by piece, and even then the reason for the system failure might never become clear. As wires in such microchips grow smaller and denser, failure caused by atom migration within the wires is becoming more common.

Along with colleagues at the Brown University Nanoscale Physics and Devices group, physics professor Gang Xiao, Ph.D., developed magnetic imaging technology that allows the visualization of electric current flow within microchips. Xiao formed Micro Magnetics, Inc., in 1998 to pursue the commercial application of the technologies he was developing at Brown. Based in Fall River, Mass., Micro Magnetics obtained an exclusive technology transfer license with the university, and created the Circuit Scan 1000 (CS1000), a highly sensitive diagnostic microscope for the semiconductor and electronic industry.

The CS1000 uses the technology developed at Brown to produce high-resolution visual maps of electrical current in microchips. Non-invasive and brief (less than two hours for a high-resolution scan), the magnetic imaging can diagnose short circuits, hot spots, leakage and other problems not visible through less advanced microscopic techniques. Since the CS1000 doesn't have to touch the equipment it's scanning, there is no risk of damage, and semiconductor owners can isolate and analyze problems more efficiently than ever before. For more information, visit micromagnetics.com/index.html.



Nonexclusive Licensing Pays Off for MEMS Actuator

University of California, Berkeley

Gaining exclusive access to a new invention or idea is a common and important business strategy for technology companies. Many inventions lend themselves to this licensing approach but others have broad application or offer such a clear advantage that a better strategy for the inventor is to offer non-exclusive licenses to many adopters. Using just such an approach, the University of California, Berkeley (UCB) Office of Technology Licensing has licensed a new microelectromechanical systems (MEMS) actuator design to a broad range of companies, including Honeywell, Toyota, Bosh and Discera.

MEMS is a cutting-edge technology that uses the tools and techniques developed for the integrated circuit industry to build microscopic machines. These machines are built on standard silicon wafers. Actuators are devices that convert an electrical control signal to a physical action.

The novel actuator arose from work done in the 1980s by Roger Howe, then a professor at UCB, and a graduate student, William Tang, as part of a larger interdisciplinary research project to create MEMS, which combines electronic circuit design with complementary metal-oxide-semiconductor (CMOS) fabrication technology. Berkeley researchers have been at the forefront of this investigation, and the Berkeley campus is the source of many MEMS inventions spearheading the commercialization of this technology.

The actuator invented by Howe and Tang resembles two tiny combs with their tines intertwined. One comb is fixed and the other pivots when a small voltage is applied, resulting in activation. While previous MEMS actuators were perpendicular to the CMOS chip, the novel actuator is fabricated lateral to the chip surface. This design enables reliable, precise MEMS actuation that is commercially feasible in high-volume, low-cost applications.

The advent of this MEMS actuator and the non-exclusive licensing of the associated patent rights have resulted in the proliferation of the technology in devices from disk drives to gyroscopes to network routers and optical switches.



A Promising Tool Against Prostate Cancer

University of Maryland, Baltimore

Prostate cancer is the most common type of cancer in America (skin cancers excluded) affecting one in six men. In fact, more than 234,000 men in the United States will be diagnosed with prostate cancer this year, according to the Prostate Cancer Foundation. Prostate cancer can cause pain, difficulty in urinating, erectile dysfunction and other symptoms.

Now, a team of researchers at the University of Maryland, Baltimore, offer a promising weapon in the fight against prostate cancer. Angela Brodie, Ph.D., and Vincent C. O. Njar, Ph.D., both researchers at the university, developed a cadre of proprietary compounds that functionally inhibit the growth of prostate cancer cells.

These inhibitors block the interaction between androgen, a steroid made by the body, and its receptors. Because androgen receptors are thought to play a critical role in prostate cancer growth, Brodie's and Njar's androgen synthesis inhibitors offer patients a much-needed potential therapy for this devastating disease.

The research was supported with a grant from the National Institutes of Health.

Tokai Pharmaceuticals, Inc., located in Cambridge, Mass., is the exclusive licensee of the androgen synthesis inhibitor technology.



Preventing Parasitic Infection in the Developing World

University of Minnesota

Amoebiasis is not what you'd call a commonly known disease, at least in the industrialized world.

But unfortunately, it is all too familiar to many people in Africa, Asia and South America, where up to 20 percent of the population is infected and as many as 100,000 die from the disease each year. Amoebiasis is among the most serious parasitic infections in the world, affecting anywhere from 50 million to 100 million people. Among those who are infected, 10 percent experience colitis, liver abscesses and other serious symptoms.

Amoebiasis is caused by a fairly common parasitic amoeba, *Entamoeba histolytica* that leads to the breakdown of body tissues in infected people. It is typically transmitted through contaminated water or food; overcrowding and poor sanitation are key factors in the spread of the disease.



However, Professors Jonathan I. Ravdin, M.D., and Mohamed D. Abd-Alla, Ph.D., of the University of Minnesota have made significant progress in combating amoebiasis. The two developed an experimental synthetic vaccine, which stimulates the immune

system to create antibodies against the key protein that enables the parasite to infect the human body. As people are continually exposed to the parasite in geographic areas where it is common, immunized people actually can boost their resistance to the parasite.

Phase one clinical trials for the vaccine are planned. Additionally, the University of Minnesota is working toward licensing the rights to market and further develop the technology. The goal is for the eventual development of low-cost doses for use in affected countries.



Pharmaceuticals



Pharmaceuticals



Rubella and Rabies Vaccines Offer Hope Around the World

The Wistar Institute

In 1963 and 1964, a rubella pandemic took its toll in the United States and Europe. As a result, nearly 12,000 babies were born either deaf or deaf and blind. But due to the efforts of researchers at The Wistar Institute, a non-profit biomedical institute in Philadelphia, a rubella vaccine was introduced in 1969. In the years since, rubella has been virtually eliminated in developed countries.

In the 1960s, Wistar Institute scientists also developed the highly effective Pitman-Moore rabies vaccine, which helps prevent rabies infections in individuals who have been bitten by a rabid animal. The research underlying both the rabies and rubella vaccines was funded by the Department of Health, Education and Welfare.

But rubella and rabies still pose significant health threats in other parts of the world. In developing countries, congenital rubella syndrome, resulting from rubella infections during pregnancy, still accounts for untold birth defects and nearly 700,000 deaths per year. The World Health Organization reports that rabies is the tenth most common cause of death stemming from an infectious agent. In fact, more than 90 percent of all rabies fatalities occur in Asia, and every year approximately 30,000 rabies-related deaths occur in India alone.

In response, Wistar has licensed vaccines for rabies and rubella to companies in China, India and Russia. In order to encourage the production and distribution of these vaccines, the terms of the licensing agreements with these companies are well below market rates. This will enable the companies to develop low-cost vaccines for local use.



Taken in December 1971, the photo shows Dr. Stanley Plotkin injecting Dr. Hilary Koprowski with the then-experimental rabies vaccine, while Dr. Tadeusz Wiktor playfully pretends to restrain Dr. Koprowski. All three men were inoculated with the vaccine that day, and none experienced any negative reactions. All were intimately involved in creating the rabies vaccine, although Dr. Wiktor is generally considered the primary developer. In addition to his contributions to the rabies vaccine, Dr. Plotkin is credited with developing the rubella vaccine. Dr. Koprowski was the director of the Institute during the years in which the two vaccines were created.

Wistar has completed six public health licenses for rubella and rabies vaccines from 1999 to the present. It continues to work with groups in developing countries that want to produce inexpensive vaccines for regional distribution.



ACE Inhibitors Found to Treat Diabetic Nephropathy

Brigham and Women's Hospital

For those with high blood pressure, angiotensin-converting enzyme inhibitors (ACE inhibitors) are a dream come true. By opening arteries, these drugs lower blood pressure and the resultant strain on the heart.

But it turns out that ACE inhibitors yield other medical benefits as well. Barry Brenner, M.D., of Brigham and Women's Hospital in Boston and Ronald D. Smith, M.D., formerly of Merck & Co., Inc. found that ACE inhibitors can benefit those suffering from diabetic nephropathy.

Diabetic nephropathy is one of the potentially serious complications associated with diabetes, and it stems from uncontrolled high blood sugar. High blood sugar levels can damage nephrons — the miniscule tube-like units that filter fluid and other substances from the blood stream. If left unchecked, diabetic nephropathy can lead to kidney failure. It is the leading cause of kidney failure in Americans and it eventually affects up to 40 percent of those with diabetes.

The scientists discovered that by lowering blood pressure, one could also lower pressure in the glomerulus — the cluster of capillary blood vessels that filter blood in the kidney. As a result, kidney life can be prolonged indefinitely in many patients suffering from diabetic nephropathy. Today, kidney patients around the world are treated with ACE inhibitors.



TrophAmine® Plays Critical Role in Treating Premature Babies

Columbia University

While full-term infants are born between 38 and 42 weeks of pregnancy, premature babies or “preemies,” are born in 37 weeks or less. Due to their lack of development, preemies lack the required body fat to maintain their body temperature, and their organs are not developed enough to function properly on their own. Consequently, premature babies are more susceptible to certain infections and may experience health problems such as anemia, low blood pressure and respiratory problems.

Yet modern scientific breakthroughs have made a big difference in increasing the chances of survival for preemies — by as much as 90 percent for those weighing 800 grams or more. Among the medical discoveries benefiting premature infants is TrophAmine®, developed with National Institutes of Health funding by Drs. Ralph Dell, Robert Winters and William Heird at Columbia University in New York. TrophAmine is sold by the pharmaceutical company B. Braun Medical Inc.

Widely used throughout the country, TrophAmine is an amino acid solution that promotes growth in premature babies, and can be administered as early as the first day of life. Known as “the building blocks of protein,” amino acids are essential to growing and breaking down food in the human body. TrophAmine normalizes plasma amino acid levels so that they’re comparable to those of healthy infants who are breast-fed, and it has been clinically proven to match intrauterine growth rates in the third trimester. Additionally, TrophAmine promotes weight gain as well as positive nitrogen balance, the latter of which indicates that sufficient protein levels are being met.

Given that premature births are increasing in the U.S., occurring at a rate of one in eight babies — roughly 1,000 a day — it’s fortunate that TrophAmine is available to increase their chances of survival.



UW-Madison Research Yields the Most Widely Prescribed Blood Thinner

University of Wisconsin-Madison

Coumadin, and its counterpart, Warfarin, together represent one of the first technology transfer success stories emanating from the University of Wisconsin-Madison’s Wisconsin Alumni Research Foundation (WARF), UW-Madison’s patenting and licensing arm, which has supported the university’s scientific research since its establishment in 1925.

The story begins in 1933, when a farmer from Deer Park, Wis., paid an unexpected visit to Professor Karl Paul Link’s laboratory in UW-Madison’s School of Agriculture. The farmer’s cows had been dying, and he suspected it had something to do with the sweet clover hay the cows had been eating. For that reason, the farmer had brought samples of the clover feed and container of non-coagulated blood from one of his cows to Link’s lab.

In 1941, after years of research, Link and his team isolated the anticoagulant in the clover feed. The researchers found that it was highly toxic for rodents and eventually patented it under the name of Warfarin (named after WARF), for use as a rat poison. It ultimately became one of the most widely used rat poisons in the world.

Further research on Warfarin yielded several related compounds, which also were patented and used in medical practice. Coumadin®, a blood thinner for treating heart patients and preventing blood clotting, was among these compounds. In the years since, Coumadin has become the most widely prescribed blood thinner in the world.



Photos courtesy of the Wisconsin Alumni Research Foundation



Pharmaceuticals



Pharmaceuticals



Etanercept Helps Those Suffering from Rheumatoid Arthritis

Massachusetts General Hospital

Rheumatoid arthritis is a debilitating illness that affects nearly two million people in the U.S. alone, mostly women. While its cause is unknown, rheumatoid arthritis causes chronic joint inflammation and potentially can lead to joint destruction, and functional disability. Rheumatoid arthritis is an autoimmune disease, which means that the body's immune system mistakenly attacks its own tissues — in this case, joints and surrounding body parts, including cartilage, bone and sometimes nearby organs.

Research at Massachusetts General Hospital, an affiliate of the Harvard Medical School in Boston, utilizing a special bio-engineering technique developed separately at Columbia University in New York City, led to the development of a medication called Etanercept, used to treat rheumatoid arthritis patients. Etanercept is a protein that reduces the amount of tumor necrosis factor (TNF), which is prevalent at abnormally high levels in those suffering from rheumatoid arthritis.

TNF is a substance produced by the body's immune system, and too much of it can overwhelm the immune system's ability to control inflammation in the joints. Etanercept deactivates TNF before it leads to inflammation.

TNF also is found in excessively high levels in those with other autoimmune diseases, such as ankylosing spondylitis (chronic inflammation of the spine), psoriatic arthritis (an arthritic condition linked to psoriasis) and psoriasis. For this reason, Etanercept also has been used to treat people with these diseases; patients have reported significant, long-lasting relief, often in a matter of weeks.



Chemotherapy Drug Offers Hope for Hairy Cell Leukemia Patients

Brigham Young University

Hairy cell leukemia represents about two percent of all forms of leukemia, typically affecting men and women between the ages of 40 and 70. Most patients are white males over 40. In fact, men are four to five times more likely to be affected by hairy cell leukemia than women.

Its name stems from the fact that it is characterized by abnormal white blood cells that appear to have hair-like projections when examined under a microscope. It is a chronic lymphocytic leukemia (CLL), which means it is a form of leukemia that involves the production of too many lymphocytes — white blood cells that are vital to the body's defenses. Symptoms of the disease include increased fatigue, infections and swelling of the spleen.

Yet help for those suffering from hairy cell leukemia eventually came from researchers at Brigham Young University (BYU). In the early 1960s, a graduate student named Morris J. Robins was the first person to make cladribine, a drug which interferes with the growth and spread of cancer cells associated with hairy cell leukemia. In the 1980s, Robins' second cousin, Roland K. Robins, along with fellow BYU researcher Ray Revankar, developed an improved method of making cladribine. The Scripps Research Institute also played a key role in the development of cladribine, performing clinical trials using funding from the National Institutes of Health.

Yet the success story of cladribine is far from over.

In 2006, Morris J. Robins, now a distinguished chemistry professor at BYU, took cladribine a step further improving the method and lowering the cost associated with manufacturing it.

Additionally, the FDA has granted fast-track status to a European pharmaceutical company to test an oral version of cladribine for the treatment of multiple sclerosis.



BYU professor of chemistry Morris Robins led efforts to devise a more effective way of synthesizing the cancer drug cladribine. Photography by Mark Philbrick.



Pharmaceutical Enables Medical Professionals to View Blood Flow in the Brain

University of Missouri-Columbia

As a result of work conducted at the University of Missouri-Columbia, physicians who treat patients with neurological disorders have a pharmaceutical that helps them look at blood flow abnormalities in the brain. Ceretec[®], the first drug of its kind, is able to cross a person's blood-brain barrier and is an important diagnostic tool in brain research and medical treatment.

Subsequent research demonstrated the ability of this drug to label a patient's white blood cells that are then used to image sites of infection or abscesses anywhere in the body. Ceretec[®] was invented in 1983 at the University of Missouri-Columbia and licensed in 1985.

The milestone discovery was invented by Wynn A. Volkert, Ph.D., a curator's professor of radiology, biochemistry and chemistry and director of the Radiopharmaceutical Sciences Institute; and the late David E. Troutner, Ph.D., professor of chemistry. The research leading to this discovery was funded by the National Institutes of Health.

The innovative research by Volkert and Troutner in the area of radiopharmaceutical sciences has impacted thousands of patients' lives. For example, Ceretec[®] has been used in patients with severe epilepsy, to effectively image the precise localization in the brain where the regional blood flow becomes excessively high or low and causes seizures. In addition, white blood cells labeled with Ceretec[®] are routinely used to image the sites of potentially life threatening abscesses in patients that cannot be detected by other diagnostic means.



Lyrice™ Is Music to the Ears of Those Who Suffer from Neuropathic Pain

Northwestern University

While in pursuit of an anticonvulsant agent for possible use in the treatment of epilepsy, Richard B. Silverman, professor of chemistry at Northwestern University, along with postdoctoral fellow Ryszard Andruszkiewicz, invented the novel compound pregabalin, which successfully treats both epilepsy and neuropathic pain. Although there are other drugs for treating epilepsy, Lyrice™, the trade name for pregabalin, is the first and only approved drug to date for the effective treatment of diabetic peripheral neuropathy and post-herpetic neuralgia, two of the most common forms of nerve pain that afflict millions of people.

Lyrice™ was launched in the United States in mid-September 2005 and has been in the European market for more than a year, having received market approval by the European Union in July 2004, for two indications, neuropathic pain and epilepsy. In March 2006 the European Union also approved Lyrice™ for the treatment of generalized anxiety disorder (GAD). So far, Lyrice™ sales in the U.S. are approved for neuropathic pain and epilepsy. Clinical trials continue in the United States with Lyrice™ for GAD.

Lyrice™ is protected by numerous patents covering its composition, methods of syntheses, and clinical use for treatment of various conditions, such as epilepsy, pain and anxiety disorder. A license agreement between Northwestern University and Warner Lambert (later acquired by Pfizer), granted the exclusive rights to Pfizer. Lyrice's acceptance among physicians and patients has made it one of the most successful new drug launches in recent years. Sales of Lyrice™ in 2006, the first full year after FDA approval, is expected to exceed \$1 billion dollars.

More information is available at www.lyrica.com/.



Pharmaceuticals



Pharmaceuticals



OnePump™ Fluid Dispensing System Cuts Drug Production Costs

University of Maryland, Baltimore County

Manufacturing today's pharmaceuticals is a tricky business; the drugs are expensive and extremely fragile thus requiring extremely accurate mixing and dispensing with an eye on cost. A team of researchers at the University of Maryland, Baltimore County (UMBC) and Scientific Products & Systems, Inc. (SP&S) joined forces to engineer a liquid dispensing system platform never before seen in the bio/pharma markets. SP&S is currently marketing its core "OnePump" technology to a variety of markets that rely on precision fluid-handling capabilities.

An initial scientific collaboration between a team of researchers at UMBC, headed by Dr. Muniswamappa Anjanappa, and David Bach, CEO/CTO of SP&S, led to a jointly developed technology and an exclusive license in 2003. A graduate student researcher at UMBC was later hired by SP&S. The company is located in a business incubator affiliated with the university.

The company's goal is to provide proprietary precision fluid handling tools to the pharmaceutical, bioscience, dental, cosmetic and specialty chemistry industries, globally. Key applications include positive piston and peristalsis technologies, which use a piston to force material through a syringe or a tube, respectively. SP&S offers its customers a range of dispensing units based on the patented OnePump™ technology.

With the packaging equipment industry's increased emphasis on ultra-high accuracy, automated and modular low cost systems, the OnePump™ offers unique flexibility allowing users to handle fluid dispensing on the lab bench, in clinical trials and pilot operations, and on full manufacturing lines. In addition, the SP&S OnePump™ has been proven and validated by several of the United States' largest pharmaceutical manufacturers.

For more information visit www.spspump.com/index2.php.



Pure Crystals Aid in Drug Development

Cornell University

X-ray crystallography is a technique in which crystals are analyzed to determine their structure, leading to a better understanding of the crystallized substance being studied. These substances include a wide variety of molecules and compounds, including proteins, DNA and inorganic materials. When X-rays are focused through crystals of purified molecules, diffraction patterns are created, revealing key, molecular-level organizational details of the material in question.

This information can be crucial in a number of areas, particularly in the development of drugs and therapeutic agents, since the structural atomic detail provides answers to essential questions about binding drugs to necessary molecules. However, the pure crystals needed to accurately read and analyze materials are rare and difficult to procure.

Christopher Lima, Ph.D., a Cornell University assistant professor of biochemistry, solved this problem by developing a technique to easily develop pure crystals. SUMO is a small protein that, because of its bonding properties, can be used in various cellular processes. Lima discovered that by using SUMO in a protein expression system, a soluble form of the protein could be created that can be purified and split to provide an active, pure crystal. The rapidly growing crystallography technology also plays a vital role in protein engineering, materials science and structural chemistry.

Invitrogen Corp., a pharmaceutical and biomedical services company, licensed this technology from the Cornell Research Foundation, Inc. (CRF). In 2004, Invitrogen introduced the Champion™ pET SUMO Protein and Peptide Expression System, which produces SUMO fusion to achieve the highest level of solubility for proteins, leading to purified crystals for research purposes.

The CRF is a wholly owned subsidiary of Cornell University. CRF is the title holder of Cornell's intellectual property and the signatory for the university's technology transfer contracts and licenses.



Nasal Delivery of Medicine Allows Faster Absorption and Quicker Relief

University of Kentucky

Developed at University of Kentucky's College of Pharmacy in 1980 by Professor Anwar A. Hussain, Ph.D., the "Method of Administering Narcotic Antagonists and Analgesics and Novel Dosage Forms Containing Same" was a pioneering nasal delivery method for administering medicine. Initial funding was provided by the University of Kentucky.

The invention, marketed as Stadol N consists of a salt of butorphanol, a pain reliever, which is a component of a gel that is applied directly through the nose. This invention provides a method of administering narcotic analgesics such as butorphanol, or other compounds that are adapted for nasal administration.

Nasal administration is as effective as injections because the drug is rapidly absorbed by the nasal membranes. In addition, some drugs that are taken orally are poorly absorbed because they are utilized in metabolic processes in the digestive tract; this is avoided when the drugs are delivered nasally. Patients can more easily treat themselves as needed with nasal delivery, compared to delivery via injection.



Pepcid® Complete

Brigham and Women's Hospital



Pharmaceuticals

Approximately 100 million Americans suffer the pain and discomfort of heartburn. It is commonly treated by over-the-counter medications such as antacids or H2-blockers. Antacids neutralize stomach acid and provide rapid but short-term relief. H2-blockers impede production of acid, generally lasting six to 12 hours but can take up to one-and-a-half hours to provide relief. Intuitively, the combination of the two medications should give quick and long-term relief from heartburn.

But leaders in the medical field had written extensively that simultaneous use of the two products would significantly weaken the benefits of the H2-blocker.

M. Michael Wolfe, M.D., then a gastroenterologist at Brigham and Women's Hospital and Harvard Medical School, believed there was a way to combine the two medications to offer fast and long-term relief for heartburn sufferers. In 1990 Wolfe successfully developed this dual-action drug; his discovery involved finding a way to combine the drugs while retaining their medicinal properties. Pepcid® Complete became the first and only non-prescription combination heartburn tablet that effectively and safely delivered fast and long-lasting relief.

In 1993 Wolfe, presently chief of gastroenterology at Boston University Medical Center, obtained a patent for the medication and the FDA approved it in 2000. As a result of the Brigham and Women's Hospital license, J & J Merck developed Pepcid® Complete, which is distributed over the counter worldwide and provides heartburn relief to millions of people.

In July 2006, *Best Life* magazine voted it the best over-the-counter drug for heartburn.



Pharmaceuticals

Safety



Carbovir Compounds Offer New Alternatives for AIDS Patients

University of Minnesota

When the National Institutes of Health requested that he patent his discovery, Dr. Robert Vince, professor of medicinal chemistry and director of the Center for Drug Design at the University of Minnesota, realized the impact his anti-HIV Carbovir compounds could have on AIDS patients. In December 1998, the Food and Drug Administration approved Carbovir-based Ziagen®, which was developed through a license with a pharmaceutical company. It inhibits HIV's ability to reproduce in the white blood cells called T cells, which regulate the body's immune system.

In order to reproduce, HIV attaches to a protein on a T cell's surface. The virus is then able to enter the cell and replicate. Like other nucleoside analogues, Carbovir interferes with the enzyme HIV uses to manufacture new viral particles within an infected cell. They work by incorporating into the elongating DNA strands and terminating the extension process. Carbovir works earlier in the HIV replication process compared to the well-known protease inhibitors and therefore offer a more attractive option in early treatment.

Today, medications containing Carbovir compounds, including Ziagen®, Trizivir®, and Epzicom™, contribute to the treatment of hundreds of thousands of AIDS patients worldwide. Furthermore, the sale of these medications has generated more than \$200 million in royalties for the University of Minnesota. Portions of this royalty have been re-invested back into the university through the establishment of the Center for Drug Design to do further research in the drug development arena.



Reusable Energy-absorbing Crash Cylinder Saves Lives (and Money)

Vanderbilt University

Professor John F. Carney III, Ph.D., of Vanderbilt University wanted to design a reusable crash cylinder that would survive multiple collisions with vehicles on the highway. Not only would this reduce department of transportation costs, but fewer crash cushions would be discarded in landfills. So Carney did just that.

Working at Vanderbilt's Department of Civil Engineering, Carney developed the "Crash Impact Attenuator Constructed from High Molecular Weight/High-Density Polyethylene" in the early 1990s.

Crash terminals are typically used on highways to shield hazard areas, such as the ends of rigid barriers and fixed objects sitting in the



median, on the shoulder, or between the roadway and exit ramp. The attenuator absorbs the energy of an errant impacting vehicle by dissipating the energy of the hit through a series of cylinders made of high molecular weight/high-density

(HMW/HDPE) polyethylene. After the impact, the cylinders self-recover and return to their original shape and position.

HMW/HDPE cylinders can absorb large amounts of energy and deformation without breaking. The fact that the cylinders self-recover after impact means these crash cushions can remain in place and absorb multiple hits with minimal replacement costs and minimal downtime for maintenance as compared to conventional crash cushions.

Funding for Carney's research was provided by the National Research Council of the National Academy of Sciences, Strategic Highway Research Program, State of Washington Department of Transportation and Vanderbilt University.

The U.S. Department of Transportation approved use of the device on U.S. highways in 1995.

The technology is licensed to Energy Absorption Systems, which markets the REACT (Reusable Energy Absorbing Crash Terminal) 3507 line of products. For more information, visit www.energyabsorption.com.

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Unique Latching System Keeps Wheelchair Passengers Secure During Transit

Queen's University

Q'Straint, the world's leading wheelchair securement company, has its roots in a Queen's University researcher's solution to a significant transportation safety problem: How could wheelchairs and their passengers be safely secured in vehicles that transport the physically disabled? More than 25 years ago, existing securement systems did not provide wheelchair passengers on buses with the same degree of safety as seatbelts provided to automobile passengers.

In response to this safety issue, Professor Henk Wevers, an engineering professor at Queen's, and his clinical mechanics group developed an adjustable, four-point securement system for wheelchairs and their passengers. In the event of a collision or sudden stop, the novel system isolated the forward forces of the occupant from those of their chair by directing the chair's forces to the floor of the vehicle through a common tether.

Initial funding for the technology was provided by the Ontario Ministry of Transportation and Communications.

In 1984 PARTEQ Innovations, the technology transfer office of Queen's University, licensed the system to Girardin Inc. (now Q'Straint), a manufacturer of buses and vans for the physically disabled.



Q'Straint is now headquartered in Fort Lauderdale, Fla., and has become the largest wheelchair and occupant securement company in the world, with additional offices in Canada, the United Kingdom and Australia. The company currently has 85 employees. To learn more about Q'Straint, visit www.qstraint.com.

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Intoxication Tests Help Keep Roads Safe

Indiana University

Indiana University Professor Rolla Hager, M.D., introduced the Drunkometer in 1938, marking the beginning of a long, fruitful relationship between the university and the fight against drunk driving. Patented in 1936, the Drunkometer was the first practical test to measure intoxication levels and involved subjects breathing into a balloon. Hager, then chairman of the Indiana University School of Medicine's department of biochemistry and toxicology, invented the device to combat the growing dangers of drinking and driving.

The Drunkometer led to the creation of the modern Breathalyzer® in 1954 by Robert F. Borkenstein, a professor at Indiana University's department of forensic studies. Later licensed to Smith and Wesson, the Breathalyzer measured blood alcohol content while adding a portability lacking in the Drunkometer, which needed to be recalibrated when moved.

As the Breathalyzer and other tests for intoxication have become commonplace in law enforcement, alcohol-related driving fatalities have decreased steadily. Deaths caused by drunk driving have dropped more than 36 percent since 1982 in the United States, indicating progress is being made keeping the nation's roads safer and more sober.

The Drunkometer also led directly to the establishment of the Indiana University Research and Technology Corporation (IURTC) in 1996. The IURTC is a not-for-profit organization designed to assist in the process of bringing technology and innovations from university researchers into the public sphere. University administrators and faculty began supervising patent and licensing procedures with Hager's invention, forming the beginnings of what would become the IURTC.

The IURTC's mission is to not only enhance the research and development capabilities of the university but also to support economic development in Indiana and the rest of the United States.



Safety



Software



LACE: Innovative Computer Tool Helps Hearing Impaired to 'Train' at Home

University of California, San Francisco

The aging of the baby boom generation is stimulating innovation in many areas of technology important for seniors. Hearing loss is an especially common experience as humans age, and an estimated 28 million Americans currently suffer some degree of impairment. Although hearing aids can help, only an estimated 20% of the hearing-impaired seek treatment. Of those who do wear a device, many are disappointed with the results; hearing aids amplify sound but do not improve other aspects of hearing loss, like impaired frequency and temporal resolution. In addition to a mechanical aid, the hearing impaired need strategies to compensate for the fragmentary auditory signal.

With training, listening and comprehension abilities can improve and even result in changes in neurons of the central auditory system. However, individualized therapy to teach auditory skills has rarely been offered because it is time-intensive. A new interactive computer-based training program called LACE (Listening and Auditory Communication Enhancement) addresses this problem by allowing patients a chance to "workout" on their own to improve their listening skills and increase comprehension, especially in difficult conditions.

LACE is the brainchild of Dr. Robert Sweetow, director of audiology, and Jennifer Henderson-Sabes, a research audiologist, both at the University of California, San Francisco, and software programmers at NeuroTone, a company created by Gerry Kearby, founder of Liquid Audio. Over a four-week training period, LACE users practice understanding rapid speech, speech in a noisy background, or speech delivered simultaneously with a competing speaker. The difficulty of the comprehension tests is scaled to the user's ability, to prevent either boredom or frustration.

In addition, LACE provides training in cognitive skills that diminish with age, such as auditory memory and speed of processing. Finally, the program also helps users acquire new interactive communication strategies. The program was tested on 80 subjects and results showed that LACE training improved comprehension and increased user confidence in challenging listening situations. A portable version of the program for a hand-held device is being built to allow patients without access to a computer to experience these benefits.



Software Improves Productivity of Grant and Faculty Effort Managers

Vanderbilt University

Compliance with federal regulations governing sponsored research is a constant challenge for research-intensive organizations. In particular, faculty effort committed to federally-funded research projects is highly scrutinized by auditors. To improve efficiency in sponsored research and faculty effort administration, Mark A. Hughes, departmental administrator for Vanderbilt University Medical Center's department of microbiology and immunology, invented the "Project and Investigator Effort Reporting" database software, or PIER.

This grant management software was developed between 2002 and 2006 with funding from the Vanderbilt University School of Medicine. The program consists of a relational networked database platform for sharing critical research data elements among administrators, centers, departments, divisions or the entire research enterprise. The software can be customized to provide research administrators with the enhanced resources they need to manage research personnel, projects and awards.

Launched in July 2006, the program is being used at Vanderbilt and the University of Southern California. For more information, go to www.piersoftware.com.



Grading the Professor: Online Tools Give Instructors Feedback on Their Courses

University at Buffalo

University instructors depend on evaluation and feedback from their students to revise and improve their study materials and teaching methods. This information is also useful for academic planning and accreditation activities.

Researchers at the University at Buffalo's School of Dental Medicine launched *The Academic Software Collaboration (TASC)* in the 1990s to develop software that allows academic institutions to set up Internet-based course, faculty and other program assessment tools licensed as CoursEval™.

In 2001, TASC became Academic Management Systems, a University at Buffalo startup company within the University at Buffalo Technology Incubator. The company provides software solutions for universities, colleges and health professions schools. CoursEval™ is now widely recognized as the premier platform for online course and instructor assessment. A self-assessment and a peer-review mechanism also allows members of a group to evaluate themselves, as well as each other's performance.

AMS software product lines now include admissions management, course evaluation and electronic CV software. More than 250 institutions across the U.S., Canada, Europe and the Middle East use AMS products. Visit www.academicmanagement.com for more information.



Web-based Software Program Uses Math to Grade Students' Writing

University of Colorado, Boulder

After 10 years of research, Thomas K. Landauer, Ph.D., a psychology professor at University of Colorado in Boulder, Peter Foltz, Ph.D., a psychology professor at New Mexico State University, and Darrell Laham, Ph.D., a graduate student at University of Colorado, invented Intelligent Essay Assessor (IEA). IEA is Web-based and conducts sophisticated mathematical and statistical evaluations of the semantic content of writing to issue a grade that correlates closely with what teachers or test examiners would give.

IEA allows teachers to assign more writing assignments to students without additional grading time and gives students opportunities to practice and improve their writing abilities. IEA automatically assesses and critiques electronically submitted essays providing feedback to both the student and instructor.



The software relies on Latent Semantic Analysis to evaluate the quality of the semantic content of writing. Computer modules are used to conduct a mathematical analysis of the semantic space, evaluate the words in the text, compare sections of the essay and integrate the scores from each module to arrive at a final score. IEA can also identify areas of weakness, recommend instructional materials and identify sections in need of rewriting.

Initial funding came through a series of research grants from the National Science Foundation, the Defense Advanced Research Projects Agency, the U.S. Army and the U.S. Air Force. IEA was invented in 1997 and patented in 2002 by Knowledge Analysis Technologies, LLC, a company formed by Landauer, Foltz and Laham. The company was acquired by Pearson Education in 2004 at which time it became known as Pearson Knowledge Technologies. IEA has scored more than two million student essays.



Software



Software



Library Management Software Streamlines Day-to-Day Operations

Clemson University

Library operations are complex and include production processing setup, expediting resource requests, scheduling operator activities, supporting unattended operations and dealing with processing delays.

To streamline these operations, Clemson University's Multiple Virtual Storage Systems programming group invented Expert Library Manager (ExLM) in 1988. The research was funded by the Clemson University Research Foundation.

ExLM is licensed software that manages automated and virtual tape library resources. It uses customer-defined rules and policies to automate content management, placing tape resources where they are needed, when they are needed. From a single point of control, customers can manage complex storage environments with minimal operating costs. ExLM helps customers productively use their automated tape libraries by concentrating activity at the best times to minimize robotics and manual activity during peak production windows. Complete consolidated tape management reports are also provided.

ExLM has been upgraded regularly since its release and is still in high demand today. The software is used by approximately 1,000 customers around the world, including major banks, telephone companies, oil companies and government agencies.



Decision-Planning Technology Generates More Efficient, Higher Quality Meetings

University of Arizona

Some of the most important work that people do — brainstorming, strategic planning, problem solving, organizing and information gathering — occurs during group meetings. With that idea in mind, Jay Nunamaker, Ph.D., Regents Professor and Director of the Center for Management of Information (CMI) at the University of Arizona, founded the management information systems (MIS) department at the university in 1974, a U.S. top-five ranked MIS department for the past 17 years.

In 1985 at the University of Arizona, Nunamaker made a quantum leap by building the first operational decision support center under funding from the U.S. Army, the National Science Foundation, IBM and others. Nunamaker, one of the developers of "group support systems," engineered a computer-supported approach that gives people new ways to collaborate. Using networks, personal computers and software products, the decision-making planning software has led to improved productivity and more efficient meetings.

The innovative group support systems technology resulted in the development of GroupSystems software product in 1989. Licensed to Ventana Corp., a Tucson-based startup company founded by Nunamaker, the company has evolved to GroupSystems, a Colorado company that provides team-based information technology tools to hundreds of organizations that want to help people collaborate effectively.



Super Vision: MRI Scanners Replace the Need for Riskier Surgical Procedures

University of Nottingham

The technique was developed by a number of UK academics during the 1970s and 1980s. In 1976 Peter Mansfield at the University of Nottingham was the first to publish a successful MRI scan of a living human body part — a finger. Approximately 15,000 MRI scanners are now used in hospitals around the world, replacing the need for riskier surgical and X-ray procedures.

The machines are standard kit for doctors detecting neurological diseases such as stroke, cancer, multiple sclerosis and Alzheimer's disease. Sir Peter was awarded the 2003 Nobel Prize for Medicine (joint with Paul Lauterbur) for his work in developing the concept of MRI and for pioneering ultra-high speed imaging techniques.

During the 1980s John Mallard at the University of Aberdeen took MRI another step forward when he discovered a technique, known as spin-warp imaging, that could produce three-dimensional images unaffected by the movement of patients. MRI scans produce a map of the water content of the parts of the body using magnetic and radio waves. It is based on a phenomenon discovered by scientists in the 1930s, called nuclear magnetic resonance, in which magnetic fields and radio waves cause atoms to give off tiny radio signals. The MRI scanners convert the signals into visual images.



FSU SmartCard® Technology

Florida State University



Technology

At Florida State University (FSU) one card does it all! This city-size university, with a student population of 29,000, added functionality to their student ID cards and paved the way for the SmartCard® technology on university campuses across the country.

In 1985, FSU developed and combined a student ID card that also served as a library card; a secure access card to enter dorm rooms or to view confidential university academic and financial records; a bank card (debit and ATM); a phone card; and a cash equivalent card, holding up to \$100, for use in everyday small purchases. They recognized the technology's benefits for students and staff: convenience, ease of use, speed and driving new efficiencies in their operational systems.

In 1997, having identified and appreciated FSU's substantial expertise in the design and use of multifunctional cards, particularly those with both embedded computer chips and magnetic strips, CyberMark licensed the FSU technology. Bill Norwood and eight colleagues left FSU in 1997 to jumpstart CyberMark's expanding business.

Sixty people at CyberMark processed transactions on 700,000 issued cards. In May 1999, First USA, the world's largest credit card issuer, purchased shares in CyberMark and added a credit card option to the card. CyberMark continued marketing and issuing the cards to educational institutions (Villanova, Guilford College, University of Toronto, and Cleveland State University) and marketing to corporations for use at sporting events. Corporations are interested in it for many of the same reasons as universities — secure access to buildings or records, banking functions and cash equivalent for small purchases.

Today, HDO Card Systems is the privately held successor to CyberMark and is a leading provider of college "smart cards" and ID related services and products, servicing more than 100,000 students nationwide.





Veterinary Science

95 Specially Formulated Feeds Keep Reindeer and Muskox Herds Healthy

University of Alaska

Alaska's large-animal herds are an increasingly important part of its overall economy. Because the nutritional value of pasture grasses varies with the seasons, reindeer and muskox are susceptible to nutritional deficiencies that can lead to compromised immune systems and intestinal problems.

To counter this problem, researchers at the University of Alaska Fairbanks developed cost-effective, well-balanced feed rations for these unusual animals. In the late 1990s nutritional physiologist Perry Barboza and Dr. John Blake, D.V.M., attending veterinarian at University of Alaska Fairbanks, developed and tested three specialized feed products: 1) M Ration, a pelleted feed supplement for muskox, 2) C Ration, a complete diet for muskox calves, and 3) D Ration, a complete feed for reindeer and caribou.

The research was conducted at the Large Animal Research Station at the University of Alaska Fairbanks and funded by Alaska Science and Technology Foundation.



Professor John Blake feeding a muskox food supplements that he and his team developed at the University of Alaska.

The new feeds have improved the health of the university's captive reindeer and muskox herds and reduced the risk of life-threatening intestinal disease in muskox calves. The feeding standards developed from this research strengthen established husbandry techniques for reindeer and muskox, and facilitate the production of qiviut, a super-fine underwool that is prized for its beauty, texture and warmth. The sale of raw qiviut fiber, processed yarn, and finished clothing from captive muskox provides sustainable income for rural Alaskans.

96 New Food Product Relieves the Serious Problem of "Tying Up" in Horses

University of Minnesota

"Tying up" is an age-old condition in horses that causes them to develop severe muscle cramping and muscle tissue damage during exercise. Some horses are particularly predisposed to "tying up" and develop pain, stiffness, severe cramping and sometimes complete immobility with very little exertion.

Researchers at the University of Minnesota have discovered inborn errors in muscle metabolism that predispose horses to developing tying up. Common horse feed ingredients such as cereal grains and molasses that are high in starch can contribute to the onset of tying up in these horses.

In 1999 Dr. Stephanie Valberg, D.V.M., Ph.D., at the College of Veterinary Medicine at the University of Minnesota, doctorate student Jennifer MacLeay, and Joe Pagan, Ph.D., from Kentucky Equine Research, a private nutrition company, obtained funding through the Southern California Equine Foundation to develop RE-LEVE, a new horse feed for horses that are prone to tying up.

RE-LEVE is the first feed developed for horses that uses alternative energy sources such as soy hulls, rice bran, and soy oil, which not only provide easily digestible, high-energy fat and fiber, but are also low in starch. The product is fortified with all the vitamins and minerals horses need for peak performance. The concept of feeding fat to horses has revolutionized the equine feed industry.

Research has shown that when horses predisposed to tying up were fed RE-LEVE, they demonstrated less post-exercise muscle damage than horses fed on conventional grains or sweet feed. RE-LEVE allows horses with muscle disorders to continue to exercise and compete without developing painful cramping or muscle damage.





Cholera Vaccine Keeps Turkeys Healthy

Brigham Young University

If you enjoyed that gobbler you and your family ate at Thanksgiving, or simply like the occasional turkey-on-rye sandwich, you may be indebted to a Brigham Young University (BYU) emeritus professor of microbiology named Marcus Jensen.

Jensen, who retired from BYU in 1994, developed a vaccine that prevents turkeys from getting coryza, a whooping cough-like disease. He also created vaccines to fight avian cholera and staph infections. Because of Jensen's work, coryza has been eliminated from many flocks.

Jensen started his research on poultry diseases in the late 1970s to help Utah turkey farmers who were experiencing severe financial losses because of high mortality rates among their flocks.

Jensen was able to develop the M-9 coryza vaccine extraordinarily fast in 1979. Instead of working on the vaccine over a period of years, he and colleagues developed it in about six months. They started in January and by July were reporting successful field tests. Since then, billions of turkeys have been inoculated with Jensen's M-9 vaccine and grown fat on their way to market.



Vaccine Combats Porcine Pandemic

University of Minnesota

Porcine Reproductive and Respiratory Syndrome (PRRS) is a viral disease that began attacking swine farms in North America and Europe in the late 1980s. The disease causes stillbirths, miscarriages and piglet mortality rates as high as 70 percent during outbreaks. PRRS can be devastating to swine herds, and costs United States farmers more than \$560 million annually, making the virus the most financially burdensome porcine disease in the country.

In 1991, Jim Collins, D.V.M., Ph.D., of the University of Minnesota's Veterinary Diagnostic Laboratory, was the first to isolate the strain of the virus in the United States. He then collaborated with a commercial partner, Boehringer Ingelheim Vetmedica, Inc. to develop a vaccine, based on a modified live version of the virus. Through a global exclusive license to Boehringer Ingelheim Vetmedica, Inc. of the University's Intellectual Property, Collin's vaccine became the largest-selling veterinary vaccine in the world, resulting in annual global sales as high as \$30 million and annual royalties as high as \$1.3 million for the university.

In addition, HanSoo Joo, D.V.M., Ph.D., professor of veterinary population medicine at Minnesota, developed Selectigen™ MJPRRS™ Technology, a process that harvests and concentrates viral antigens from PRRS-infected tissue, maximizing the effective content in PRRS vaccines. The technology was licensed exclusively in 2005 to Minnesota-based company MJ Biologics.

The Veterinary Diagnostic Laboratory also became the first lab to provide same-day, high-volume testing for PRRS, enabling boar stud producers to identify and control the disease quickly and efficiently. The vaccines and testing, when combined with other proven herd-management strategies, are helping to prevent the spread of PRRS, allowing for healthier swine and economical food products.



Veterinary Science



Other



Improving Lives: Understanding What It Means to Be Poor

University of Birmingham
London School of Economics and Political Science
University of Oxford
University of Essex

Social scientists in UK universities have produced a series of seminal studies that have improved our understanding of the nature and impact of poverty. The findings have transformed the way that government and charities provide help for the less well-off.

The link between deprivation and ill health has been known for many years, prompting the Victorians to introduce clean water systems and sanitation. But thanks to the work of Thomas McKeown at the University of Birmingham in the 1970s we are now much more aware of all the influences of social conditions on health.

McKeown looked at the number of deaths in England and Wales caused by different diseases from the 19th century until the early 1970s. His statistics revealed a huge impact of factors such as nutrition, water supply, sanitation, food hygiene, smoking, diet and exercise on the health of less well-off communities. The study has led the government to take far more seriously these factors in its efforts to improve the health of people.

During the 1970s Richard Morris Titmuss at the London School of Economics and Political Science meanwhile found that poverty, not family circumstances, were behind the behavioural problems and learning difficulties in children from one-parent families.

In the late 1970s and early 1980s Peter Townsend at the University of Essex, revealed the full reality of social inequalities among different communities. Townsend identified the key groups living in poverty, including: the unemployed, low paid workers, disabled people and the long-term sick, large families, one-parent families, families with children with disabilities, older workers and the elderly. He also showed that the deprived do not only have poorer housing and diets than the better off, but also face more limited lives at work and within the family.

In the 1990s Michael Noble at the University of Oxford produced new official statistics that can more accurately identify those living in disadvantaged communities. The National Index of Multiple Deprivation covers several 'domains' of deprivation: income, employment, health, education, housing and access to services. The Index is used to allocate more than £2 billion of Government spending every year in the UK.

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“Pop-Up” Indicator Alerts Homeowners When Termites Are Near

Louisiana State University Agricultural Center

Termites continue to be a huge problem for homeowners. Every year more than 600,000 homes are damaged by termites causing over \$1.5 billion in damage.

Professor Gregg Henderson and graduate student Jay Paxson, researchers at the Louisiana State University Agricultural Center, invented an early-warning device called the “Pop-up Termite Indicator” in 1999–2000. Research was funded by Louisiana State University Agricultural Center.

The invention allows for the detection of termites by placing a termite feedstock in the ground. When termites eat through the feedstock an indicator flag pops up, indicating the presence of termites and also the need to treat the premises to eradicate the termite problem.

This simple and cost-effective method allows homeowners to monitor their property for the presence of termites. Most pest control companies use a ground treatment to prevent termites from gaining access to the structure. However if the chemical treatment fails, a homeowner never knows until the termites have already done the damage. The “Pop-Up Termite Indicator” allows homeowners to monitor for termite presence as part of their overall termite prevention strategy.



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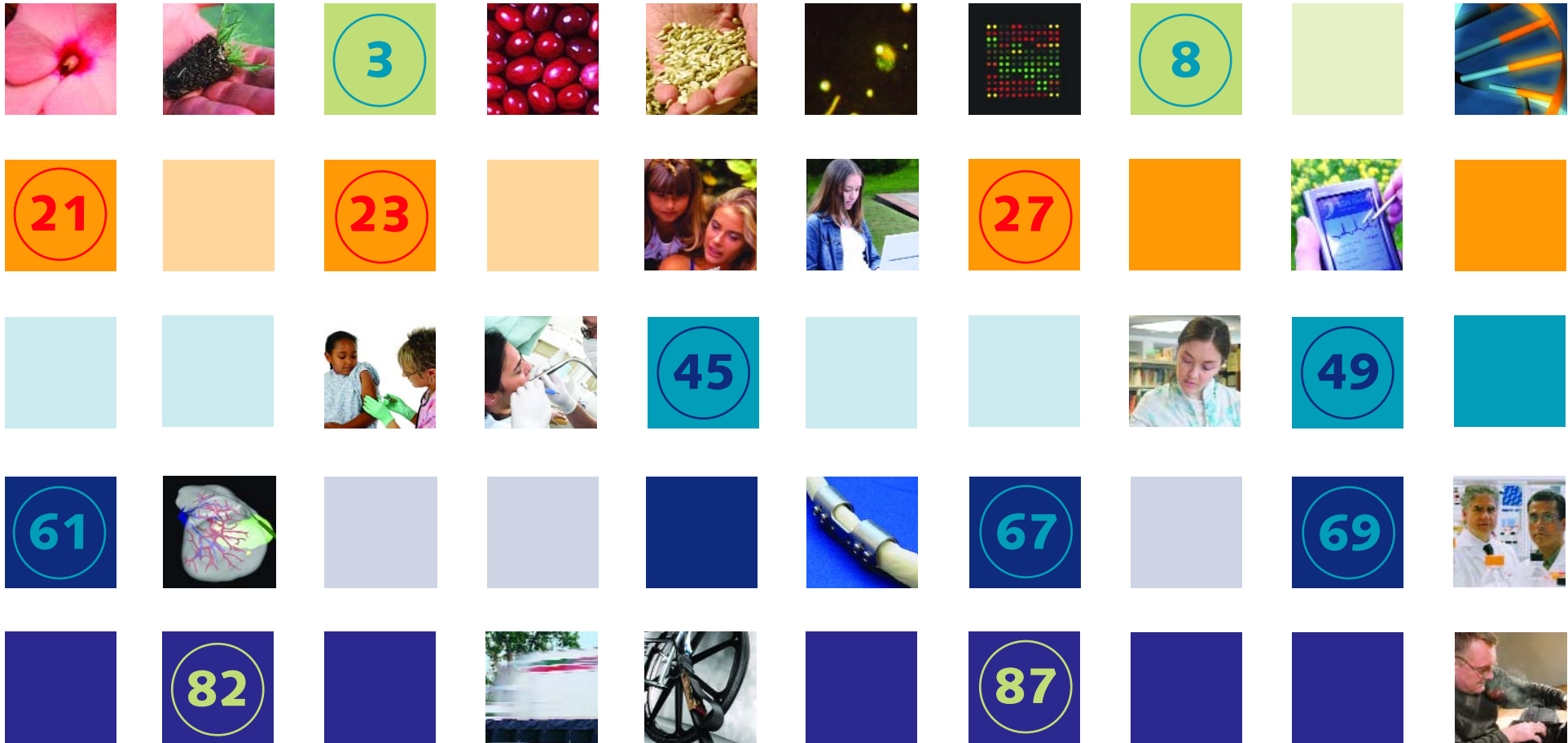
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