STANFORD TECHNOLOGY BRAINSTORM

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A Device to Warm Your Body as Well as Your Mind

Random events sometimes bring together ideas and people, and prove to be serendipitous. This certainly appears true for the Postanesthetic Warming Device, a unique invention arising in part from space suits, ice hockey, the shivers and friendship. Sound like a Disney movie? Read on.

Dennis Grahn of the Biological Sciences department was aware of a postanesthesia problem. During surgery, the anesthesia impairs thermoregulatory processes so that the body core temperature of a patient decreases a couple of degrees, varying from person to person. After the surgery, the body's temperature warms about 1° Celsius per hour (depending on numerous factors) until it is at normal temperature. Therefore, the normal recovery time to regular body temperature is one to three hours.

But there are problems associated with this lower than normal temperature. First of all, the body experiences something known as postanesthetic tremors (basically the shivers). The shivers

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PHOTO: HASSAUN JONES-BEY

Jochen Kumm (center) re-enacts his glory days as a test subject of the Postanesthetic Warming Device, modeled on his right arm. With him are the inventor, Dennis Grahn (left); and anesthesiologist Dr. John Brocke-Utne, who aided them in their initial experiments and clinical trials. Licensee Aquarius Medical Corporation is in the process of developing a user friendly and portable version of the device.

The Litton Project: Far from Manhattan

A unique Research Project at Stanford known as the Litton Program showed its first significant royalty income from commercial product licenses in the 1995-1996 fiscal year. This program began almost 20 years ago in the lab of Professor Emeritus H. John Shaw of Applied Physics and Ginzton Lab and has produced fiber optic technology, components and devices that have been adopted in laboratories and companies worldwide.

The program began by chance in the late 1970's when John Fling, then General Manager of IC Engineering, was trying to solve a databus problem for fiber optics. His couplers weren't working right, and Fling was having trouble finding a solution. Fling happened to mention the problem to an acquaintance, John Shaw. Much to Fling's surprise, Shaw was working on a directional coupler in fiber optics that would answer his problem.

The company Fling managed, IC Engineering, of which Fling was co-founder, was by then owned by Arco through another company, Anaconda. Anaconda and Arco became very interested in the fiber optics research Shaw's lab was conducting, and, at the same time, Shaw was looking for more sponsorship for his lab.

The sponsorship Shaw received from the government was adequate, but there was "more research freedom and flexibility" from industry sponsors, said Shaw. And industry was truly interested in putting the results into commercial use, which motivated Shaw.

A research proposal was given to Anaconda in 1980, which was executed and carried out for a couple of years. However, based on a decision by Arco to limit its participation in certain high tech endeavors, coupled with the rather rapid expansion of scope and success of Shaw's efforts, it was determined that the program should be transferred to other auspices.

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Stanford University
Technology Transfer
Through Licensing
Office of Technology Licensing

STANFORD TECHNOLOGY BRAINSTORM

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OTL's services are available to any Stanford faculty, students, or staff who invent technologies which may benefit the public or be of commercial value.

To learn about a specific technology or to disclose one of your own, contact us at the above address.

A Device to Warm Your Body...

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can break down tissue, increase infection rates and decrease the time it takes for wounds to heal, all of which increase the time it takes to recover. The tremors can be minimized through the use of drugs, but these drugs will then extend the length of time the core temperature is below normal.

Secondly, the body is already in a fragile state. Anything that can help it back to normal conditions will speed up the recuperation of the patient.

"So our idea was for the patients to be at regular temperature as soon as possible," said Grahn. At UCSF, researchers experimented with forced air warming of the body parts. This had a limited effect due to vasoconstriction (narrowing of the blood vessels) which is also caused by the lower core temperature. How then could the body core be directly warmed in a non-invasive manner?

Grahn said the catalytic idea for his invention arose from a FASEB conference in Anaheim. One woman had a poster describing how NASA routinely uses negative pressure to create normal blood flow in the legs of their astronauts during space flight. An interesting concept for space, Grahn thought, but the full impact of what he had just seen didn't hit Grahn until he was on his flight back home.

He suddenly saw the solution to his problem: open the blood vessels via negative pressure and at the same time apply heat to the skin. The blood would then transport the heat back to the heart, up to the brain, and body temperature would soon return to normal.

"It seemed too simple," said Grahn. In fact, it was so simple that Grahn held off on being excited about the idea, but proceeded to start experiments with it.

Editor's Note

As you may have noticed, it's been a while since you received your last BRAINSTORM. Due to staff changes that are (hopefully!) settling down, we will be able to once again publish BRAINSTORM on a quarterly basis.

I have recently taken over the writing and editorial duties associated with the publication and would appreciate your comments and suggestions. Please contact me through e-mail at kirsten@otlmail.stanford.edu, or by writing to our address noted in the box just to the left. Thanks for your patience, and we hope you continue to find BRAINSTORM a source of knowledge and amusement. -Kirsten Leute

For their first experiment, Grahn, Jochen Kumm, a research scientist in the same department, and Dr. John Brock-Utne, professor of anesthesia, used Kumm as their guinea pig. Submerging Kumm in a 13° C bath, Kumm's core temperature soon began to fall.

While still in the bath, Grahn placed the first prototype of his warming device on Kumm's arm. Kumm's core temperature stabilized so quickly, Grahn wasn't sure the sensing meters were working. But after repeated experiments, Grahn knew he had hit the mark, and then some.

"I was originally thinking the device would cut 20 minutes off of rewarming," said Grahn. Instead of taking 20 minutes off, the device reduced the entire time for the body to return to normal core temperature to about 20 minutes.

It is important to realize that the time will vary with each patient, said Grahn. But from the results so far, most patients are expected to be at their normal temperatures within a half an hour.

"In fact, our results would indicate that patients will return to normal temperature in 15 minutes or less, " said Kumm. Dr. Brock-Utne, impressed by the initial trials and the device's possibilities, helped orchestrate getting approval for further tests on human subjects.

While waiting for this approval, Grahn met Michael Egan, a partner in a venture capital firm and fellow ice hockey Dad (the two met at the hockey practice of their sons, Matt Grahn and Timmy Egan). After finding out they had similar interests in arthroscopic devices and fluid management systems, Grahn and Egan arranged to have coffee.

Their mutual respect and admiration grew into a strong and trusting friendship. Grahn brought up his postanesthetic warming device, and Egan immediately became interested.

"[The device] probably wouldn't have gone anywhere if Mike and I hadn't sat down and started talking about it," said Grahn. Egan was a bit more modest, saying he just gave advice to apply for a patent and keep moving on with the trials and development. But the end result was the two of them "pumping each other up," Egan said. Enough so that Egan and one of his companies, Aquarius Medical Corporation, decided to take an option license to the device and focus their development efforts on creating a user-friendly version.

Meanwhile at the Stanford University Medical Center, the device moved to clinical trials. Conducted by Kumm and supported by Brock-Utne, the trials were also notably aided by the intrigued PostAnesthetic Care Unit (PACU) nurs-

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A Sampling of Licenses Granted by OTL in the Last Quarter

Docket(s)	Title(s)	Uses	Licensee(s)	License Type
S74-043	"Cohen-Boyer Recombinant Technology"	DNA Cloning – Production of proteins Total number of DNA licensees: 358	Aurora Biosciences; Aeiveos Sciences Group; Molecular Devices Corp.; ProScript; Virologic; NeoRx Corp.	Non-exclusive
S76-074	"Monolithic Semiconductor Switch Device"	IGBT's	Toshiba, Corp. Hitachi, Ltd.	Non-exclusive
S81-035	"MINOS (Software)"	Optimization	MDC Process	Non-exclusive
S94-099	"...Drosophila Gene Patched"	Drug Target	Ontogeny	Exclusive
S95-028	"CMV Latent Gene Expression"	Gene therapy	SmithKline-Beecham	Non-exclusive
S95-082	"Scanning Probe...Cantilever"	Microscopy	Digital Instruments	Non-exclusive
S95-085	Sondius® trademark, patents	Sound synthesis	Staccato, Inc.	Non-exclusive/ Exclusive
S95-101	"Scanning Optical Microscope"	Microscopy	Confocal Technologies	Field Exclusive
S96-017	"Epilepsy EPM1"	Therapeutic	Mercator Genetics	Exclusive
S96-067	"Internet/Phone Speech Recog."	Internet	NeTalk	Exclusive

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The Litton Project: Far from Manhattan

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Alton Brann and T. J. Hutichings of Litton Guidance & Control Division were aware of the Arco program, and when they realized that it could be made available to Litton, they immediately made arrangements with both Arco and Stanford to assume sponsorship of the program. John Fling was retained as a Litton consultant.

This alliance was very fortunate for both Litton and Shaw's program, in that Litton brought to the effort its extensive background in laser gyros and its associated optical technology, whereas Shaw was a source of cutting edge optical fiber technology.

Myron A. Kleinbard, Executive Director of Commercial Products & Technology Licensing at Litton, commented that "the Litton Research Program created a very special relationship between Stanford University and Litton. The joint research efforts have resulted in the development of fiber optic products that have been successfully brought to the marketplace."

"Our work here has had a direct effect on Litton products," agreed Shaw. The Stanford/Litton Research Partnership has resulted in the introduction of fiber optic gyroscopes (FOGs) into inertial navigation, for which Litton enjoys a major position in the world. Litton has also recently developed fiber optic technology for telecommunications and CATV with optical fiber amplifiers (OFAs) that it produces under the exclusive license from Stanford.

Through the agreement, Litton has an option to take an exclusive license on any of the inventions that come out of Shaw's lab, to which a very large number of graduate student Ph.D. candidates, research associates and visiting scholars from around the world have lent their talents over the years. If Litton elects to take the exclusive license, Litton pays patent expenses along with an earned royalty of net sales of any products made with the invention(s).

In accordance with the terms of the agreement, Litton then has the right to sublicense the inventions. Kleinbard's licensing team at Litton is currently focusing on licensing major telecommunications equipment suppliers and users in the United States, Japan, Canada, Europe, Taiwan and South Korea.

"It's been very productive," remarked Hans Wiesendanger, the Senior Associate at OTL who handles the Litton project. Over 160 U.S. patents have been applied for by Stanford as a result of the program.

As Shaw noted, "Most of these devices have become really important...some right away, while others had to wait for their field to catch up with them."

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PHOTO COURTESY OF MYRON KLEINBARD

Myron Kleinbard (l) of Litton presents Katharine Ku (center), Director of OTL, and Hans Wiesendanger, the Associate handling the Litton inventions at OTL, a check for the first significant royalty income from commercial products since the beginning of the Litton program almost two decades ago in the laboratory of Prof. John Shaw.

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Underlying all of the business and technology aspects is sushi. Yes, sushi. It seems that Wiesendanger and Kleinbard have a common love of Japanese cuisine. So while they were enjoying a meal pleasing to the palette, the atmosphere allowed them to communicate well with one another. Excellent communication between all of the players, Litton, Shaw's laboratory, and OTL, was indicated by each as being one of the major reasons the program has been so successful.

Good communication with industry gives universities insight as to what inventions would potentially be the most productive and useful to our society, along with letting each other know about opportunities and to exploit them when the time is right, not when it's too late.

"The key," said Shaw, "is technology transfer." Basically, let people know about inventions so they can utilize the advances and produce commercial products.

The Litton program has brought and continues to bring great benefits to both Litton and Stanford. "Stanford would certainly like to have more 15 year contracts," said Wiesendanger. The nearly 20 year relationship is impressive, especially considering the changes that have occurred in the industry over those years.

Despite government cutbacks and University policy changes, the program continues to be productive and an important element to Litton and Stanford. As the research at Stanford proceeds under Litton's support, Gordon Kino, W.M. Keck Professor of Electrical Engineering and a Ginzton Lab member, has become co-primary investigator of the program and is assuming the major responsibility for it.

"It's been very worthwhile for everybody," said Wiesendanger. The University conducted good science and is now receiving income, Litton received great amounts of valuable, state-of-the-art technology, and the public will benefit from the progress that is brought to them.

And Kleinbard and Wiesendanger enjoyed a bit of sushi.

OTL Fiscal Year 1995-96

Total Income: $43.75 Million (M)
Invention Disclosures: 212
U.S. Patent Applications Filed: 110
U.S. Patents Issued: 54
Cohen-Boyer DNA Patents:
- **Total Income: $31.49 M**
- **New Licenses: 44**

All Other Technologies:
- **Total Income: $12.26 M**
- **New Licenses: 92**

Companies in which Stanford took equity: 3
Distribution:
- **OTL Budget: $1.8 M**
- **Other Institutions: $14.9 M**
- **SU Departments: $7.4 M**
- **SU Schools: $7.3 M**
- **Inventors: $6.5 M**
- **Research Incentive Fund: $3.2 M**

A Device to Warm Your Body...

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ing staff and anesthesiologists, Grahn said.

The end result was that the clinical trials went very well, and the staff became enthusiastic about the device not only helping their patients, but also making their jobs easier and cutting down the amount of time each patient needed to spend in PACU.

In addition to the device performing spectacularly in PACU, there appear to be more and more applications for its use, said Grahn. Core temperature of a person may literally be controlled, which can be useful in surgery as well as out.

Applications for hypothermia and in-surgery temperature control are already being proposed for testing or are in progress. Grahn himself just returned from a trip to Norway to try out the device for accidental hypothermia on army personnel during NATO winter Arctic field exercises.

The positive clinical trials and the fervor of Aquarius in their development led to an exclusive license between Aquarius and Stanford for the device this past month. Working closely with Grahn, Aquarius is continuing development of his invention. They presently have a working prototype with new innovations, including making the device completely self-contained and portable. A patent on the device has been allowed and will issue soon.

Egan, who is also the Director of Aquarius, remarked that Grahn's invention is "probably going to be one of the best returns for Stanford" out of the numerous agreements OTL has done.

"Everyone wins," said Egan. And it looks like the biggest winners are the patients in PACU.

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