The Neurosciences Institute

BrainMatters

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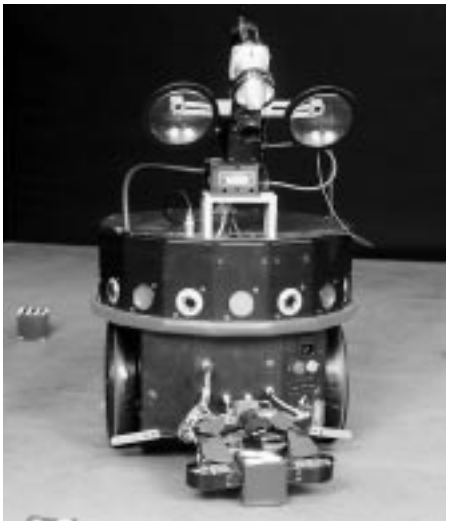
It is Not Science Fiction: NOMAD is for Real

In the W. M. Keck Foundation Laboratory for Machine Psychology, tucked away on the third floor of The Neurosciences Institute, an intriguing device rolls up to a small, black block with white dots and stops dead in its tracks.

With its video camera "eye," the device peers at the block and then picks it up with its mechanical gripper. After only a moment's pause, the device sets down the block, turns to its left, and picks up another block nearby, this one with a striped pattern.



NOMAD (Neurally Organized Mobile Adaptive Device) interacts with its environment and provides researchers with a unique window into the workings of the human mind.

To the untrained eye, this short, simple sequence of events is somewhat unimpressive, appearing to be nothing more than a robot going through its paces.

But what is occurring is actually something quite momentous. What this device called NOMAD does, in effect, is perceive. And it is able to do this because it is controlled by a *brain,* not built of flesh and blood, but rather one constructed by scientists at the Institute to simulate electronically the most complex and mysterious organ on earth.

The creation of NOMAD, which stands for Neurally Organized Mobile Adaptive Device, is based on years of pioneering research by Nobel laureate Gerald M. Edelman, M.D., Ph.D., director of The Neurosciences Institute, and his scientific colleagues.

For more than a decade, Institute scientists have used an approach called *synthetic neural modeling* to construct a series of computer simulations. This approach uses biologically reasonable simulations of individual components that are linked to form (or *synthesize)* the brains of simulated "beings." More recently, a simulated brain has been linked with a real-world body—NOMAD, a two-foot tall structure that exchanges signals with the brain. NOMAD moves around the real world exploring and learning. It is used at the Institute as a tool to learn more about the brain and behavior and has progressed to operate at a behavioral level comparable to that of certain simple animal species.

"NOMAD not only has the ability to react to its environment, it actually

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Profile: The Cullmans

Lewis Cullman's business genius helps finance strong philanthropic spirit

Lewis B. and Dorothy Cullman

If there is anything in life that Lewis Cullman is better at and enjoys more than business, it may be philanthropy.

The man who put At-A-Glance appointment books, calendars, and diaries on millions of desks across America is getting great pleasure in his later years from donating as much of his fortune as he can to his favorite charities.

The Neurosciences Institute, fortunately, is one of them. Cullman and his wife, Dorothy, not only believe in the work of The Neurosciences Institute, they want to make sure it continues many years into the future.

That is why the New York couple recently pledged $10 million in support of the Institute's $100 million fund-raising campaign (see sidebar story inside). Fulfillment of the Cullmans' pledge is contingent on

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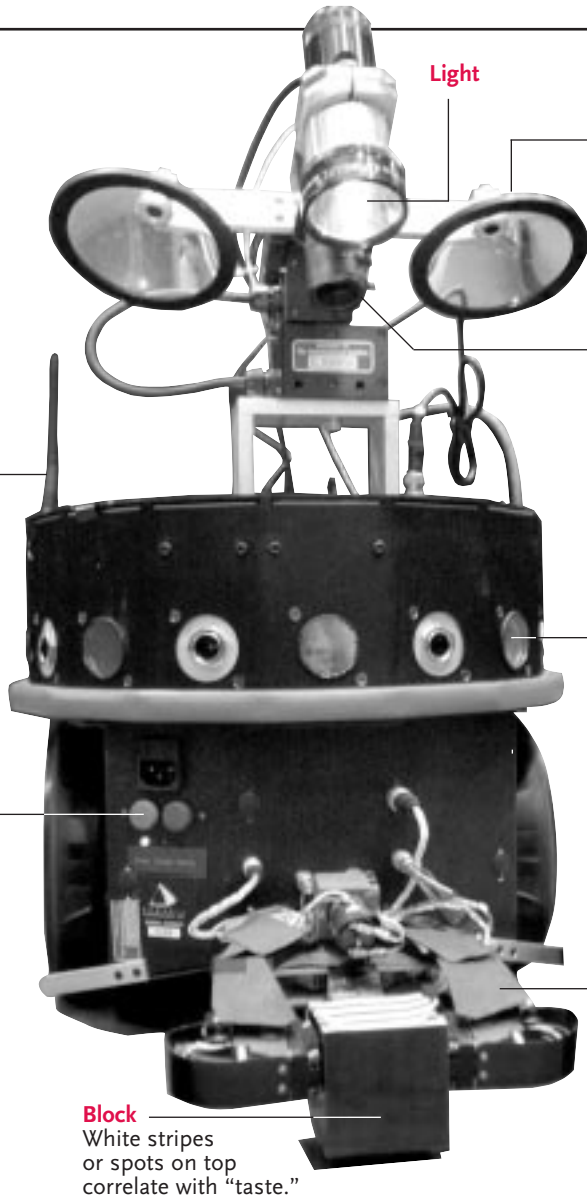
NOMAD IS FOR REAL *continued from cover*

learns from what it encounters and experiences," says Jeff Krichmar, Ph.D., one of the lead neuroscientists on the project. "In fact, it often makes mistakes, but teaches itself to avoid the errors the next time around."

For Krichmar, watching NOMAD's thinking and learning abilities expand has been the most thrilling experience in his scientific career.

"It's exciting because you can actually see NOMAD behaving, so much so that I sometimes feel like interacting with the device myself. There have been times NOMAD did something so amazing that I've wanted to say 'Good boy!' It's almost like training a child."

NOMAD's behavior is life-like because its brain is designed to work just like a real one. Using powerful computers, the Keck Lab team has equipped NOMAD's brain with the equivalent of 10,000 brain cells with more than one million connections. These are small numbers compared with the complexity of a human brain but



How NOMAD is Not a Robot or Artificially Intelligent

If NOMAD had feelings (and one day it may), the fastest way to insult this amazing device would be to call it a "robot." And do not confuse NOMAD's special talents with the claims made by proponents of artificial intelligence.

NOMAD is so different in principle from a robot, it is not fair to mention them in the same breath. And it works like a real brain because it is modeled after the same neural network circuitry real brains possess and not according to the computer wizardry of artificial intelligence.

Jim Snook, the project's chief engineer, says NOMAD differs from a robot in many ways, but among the most important is that it is virtually autonomous when interacting with the real world.

"A robot operates either from someone controlling it externally or through a series of instructions installed onboard. Either way, the robot is not independent. It can't "think" for itself. It's being told what to do, whether it's through someone punching a remote control or through pre-installed software. If it makes a mistake, it's a real problem and that mistake will likely cause a breakdown.

"NOMAD, by contrast, is acutely responsive to its environment. It reacts to what it touches, feels, and hears and then responds based on what it has learned in the past. And NOMAD makes mistakes, but these errors actually improve its performance because like a real brain, it learns through trial and error," Snook says.

Artificial intelligence also suffers in comparison with the complex nature of NOMAD's cognitive abilities, according to Jeff Krichmar, Ph.D., one of the lead neuroscientists on the project.

"Artificial intelligence tends to rely on the blazing speed of modern computers to quickly sort through hundreds of thousands, if not millions, of known situations loaded into its memory circuits," says Krichmar.

"The best example I can give is that artificially intelligent computers can now defeat the world's best chess player.

they are enough for NOMAD to try to make sense of its environment.

The block exercise is a good example. NOMAD's brain has been endowed with an ability to taste two "flavors," according to Jim Snook, the project's chief engineer.

"When NOMAD grabs a striped block with its metal gripper, it senses electrical conductivity that registers as good taste," Snook says. "Blocks with dots don't conduct and register as bad taste. As NOMAD's gripper holds the block, its brain associates the taste of the block with the pattern it sees with its video camera "eye."

What is special scientifically is that NOMAD actually learns from the experience.

"Once NOMAD has learned to correlate what a block looks like with its taste, it will no longer pick up the bad-tasting blocks. It will roll up to them, but after seeing they have spots, it will remember the unpleasant experience and move on. Of course, like us, from time to time it will make a mistake. But that will actually help in its future performance," Snook says.

Through creation of synthetic neural modeling devices such as NOMAD, scientists at The Neurosciences Institute believe they will ultimately understand how brain mechanisms from molecular on up produce the range of behaviors associated with higher brain functions, from perception and movement to memory and creative thought.

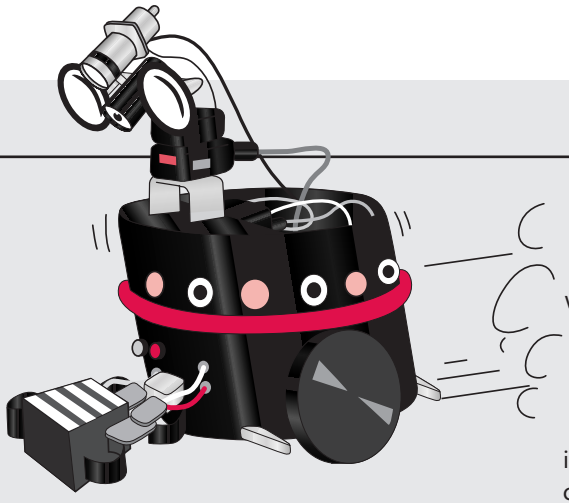
And NOMAD will continue to grow in sophistication and cognitive ability.

"Ears" were recently added to NOMAD so that the device can locate and categorize sound. In the near future, the team will add long-term memory so that it will remember objects, places, and events with the ability to put them into context.

Snook thinks the NOMAD project has reached a critical mass and that the next few stages of its development will be remarkable.

"We're entering uncharted territory, but I honestly believe there will come a day when a derivative of NOMAD will be conscious. Not in a human sense, but with imagination and cognitive responses that cannot be explained directly by the hardware or software.

Snook adds, "When we reach that point—and I feel it won't be that far into the future—we will have at our fingertips the most powerful tool ever created for understanding the human brain."



But it's not because the computer can consciously think the way a human does. It wins because, based on the history of chess games, it has the pre-programmed ability to analyze every possible combination of moves in seconds.

"NOMAD's behavior, however, is based not on number crunching but neuron crunching. It has a network of simulated cells that work together—as they do in a real brain—to create perception, recognition, and memory.

"Nothing in NOMAD's behavior is pre-programmed, so its behavior changes as it experiences its environment and samples stimuli in the environment," Krichmar adds. "No two brain reactions, even those believed to lead to similar behaviors, are ever the same. Like us, NOMAD shows individuality, even its similar behaviors."

SAVE THE DATE:

TUESDAY, NOVEMBER 21

Scientific American Frontiers

The PBS science series hosted by Alan Alda will broadcast "Changing Your Mind," featuring The Neurosciences Institute Director Gerald Edelman, Senior Fellow Giulio Tononi, and NOMAD in a special segment entitled "Monastery of the Mind." Dr. Edelman demonstrates the process by which mammals learn from experience. Outfitting Alda with special glasses and a flickering TV screen, Drs. Edelman and Tononi also show how human brains switch from one state to another. Check your local TV guide for the time it airs in your city.

The NOMAD Team is the Perfect Fit

Talk with Jeff Krichmar and Jim Snook for any length of time and it is hard to tell which one is happier in his respective job overseeing The Neurosciences Institute's NOMAD project.

Not only are both of these good-natured and intensely dedicated scientists thrilled with the chance to work on a challenging and important project, they see it as a quest they were almost destined to pursue. In fact, both recall seeing notices of the openings at the Institute and thinking they had found their dream jobs.

A glimpse at their backgrounds reveals that few other candidates could be more qualified for the complex task of building a brain than these two men in their 30s.

Krichmar, who designs the intricate computer programs that help simulate NOMAD's nervous system, earned his bachelor in computer science degree at the University of Massachusetts at Amherst, after which he joined Raytheon as a software engineer to work on its Patriot missile project. Subsequently, he secured a master's in computer science from George Washington University and landed a job with IBM helping build the next generation of software for the nation's air traffic control system.

It was when Krichmar pursued his Ph.D. at night at George Mason University that he started down a path that ultimately led him to the Institute's La Jolla campus.

Krichmar had earlier whetted his appetite with his final class toward his masters degree, an elective course on neurobiology, which he found fascinating.

When it came time to pursue his doctorate, Krichmar chose to combine his computer science expertise with his new interest by studying computational neurobiology, a portion of which entailed creation of computer models of the brain.

But Krichmar grew skeptical of the artificial intelligence community's claims of replicating brain processes, and he was not convinced that modeling brains only in the cyberspace of computers was effective. As a result, he was more than ready for a new challenge when the job opened up at The Neurosciences Institute.

"I had read some of the Institute's papers on the NOMAD project and then heard they were looking for someone to combine robotics with computational neuroscience," Krichmar says. "They were actually building a brain and putting it on a mechanical body. That was unique and I happened to believe it was the right strategy. So I felt it was a perfect fit for me."

Snook, NOMAD's chief engineer, is a San Diego native who majored in cognitive science at the University of California at San Diego. There were no jobs for cognitive scientists upon graduation, but luckily Snook had an innate talent for engineering and found a succession of jobs at San Diego area companies, such as General Atomics, Lytel Instruments and Linear Corp., building everything from precision control devices to wireless security systems.

But he never lost his interest in cognitive science. "That's why when I saw the Institute's ad for a position that essentially combined my major with my engineering skills, my jaw dropped," Snook recalls. "I said to myself, 'this is it!'"

Over the past few years, Krichmar and Snook, under the guidance of Gerald Edelman, M.D., Ph.D., the Institute's founder and director, have infused the NOMAD project with new energy and creativity. With their skills perfectly complementing each other, the two researchers have significantly increased the pace of NOMAD's development. Snook credits the nature of the project for much of their success.

"Most of the great leaps in the history of human beings have been the result of tools, whether it's fire, the wheel or the computer," he says. "Here, Jeff and I are at the center of the creation of a new tool unprecedented in its ability to help us understand the human brain. It's extremely motivating to know that NOMAD's immense potential rests squarely on our ability to do our jobs."

Krichmar agrees, but says the special environment at The Neurosciences Institute is also responsible for much of the progress of NOMAD.

"I can tell you this is one of the unique places in the world to conduct research," he says. "There are no commercial pressures. Dr. Edelman has given us free rein to try anything we can think of. As a result, our imagination and creativity are allowed to flow, and that makes us far more innovative and productive in determining how to take NOMAD to the next level of performance."

Jeff Krichmar

Jim Snook

A Message from the Founder and Director

A decade ago, The Neurosciences Institute undertook a remarkable project: to construct a device based on how the brain carries out perception, memory, and learning. We are now on the high road toward realizing that aim.

Before I say something about this device, which has gone through many generations of development, I want to give you the rationale behind its design. The brain is the most complicated material object in the known universe. If you attempted to count the number of connections, one per second, in the mantle of our brain (the cerebral cortex), you would just finish counting 32 million years later. But that is not the whole story. The way the brain is connected—its neuroanatomical pattern—is enormously intricate. Within this anatomy a remarkable set of dynamic events takes place in hundredths of a second and the number of levels controlling these events, from molecules to behavior, is quite large. All of these facts confront us with one of the largest challenges faced by modern science. How can we meet that challenge?

One might think that more experimental data will clarify the situation. Certainly data will be welcome, but, in addition, we need to develop a theory that will explain how everything fits together. Unlike physics, in which theory takes on a mathematical form, the study of the brain requires us to model its levels and dynamics in computers. Here we face an interesting dilemma. The existing evidence points to the conclusion that the brain is not a digital computer. Yet we must use computers to simulate its dynamics as it interacts with the body and the world. Most certainly, however, we cannot simulate the world that you and I confront every day in all its rich complexity. What can we do to resolve these issues?

The answer rests in a procedure we at The Neurosciences Institute call synthetic neural modeling. Instead of just mathematics, or even a theoretical description analyzing the situation, we build a device, with a simulated brain, which goes around in the real world carrying out behavior, pattern recognition, and learning. We use computers not as models, but as tools to follow what the brain of the device is doing at all of its levels as it explores its world and learns.

After years of development, we now have such a device, called NOMAD (with a brain we call Darwin 6 after the great scientist whose principles it incorporates). You will learn in this issue about some of its behavior.

What I wish to do in this brief message is to distinguish its behavior from that of a computer. A digital computer is a logic machine, one that has changed our lives. But not everything falls out according to logic. The brain, for example, carries out pattern recognition that precedes logic, and such recognition occurs in animals that have not developed logic. More than that, the brain allows learning to take place in situations of novelty that could not be specifically programmed by logical criteria.

NOMAD actually accomplishes such tasks. Studying its brain while it carries them out gives us an unprecedented ability to follow the "layers and loops" of brain dynamics in real time and in the real world. Understanding these loops is of inestimable value in our theoretical efforts to describe how the brain works. This is our main purpose in studying NOMAD's behavior.

But, like all scientific advances, the synthetic neural modeling program has a practical goal as well: to construct brain-based devices that will complement digital computers in areas where they cannot function. Imagine a brain-based device capable of learning in situations of novelty or complexity where pattern recognition can be combined with the operation of large computers. The result would, I believe, herald another revolution in the information age.

At this point, we simply cannot predict or even envision everything the study of NOMAD would accomplish. By comparison, though, I can give you a glimpse of its potential in the practical domain. Back in the 1950s, when I was at the University of Pennsylvania, I had a chance to see ENIAC, the world's first practical large scale computer. I must admit that, while appreciating the advance, I had no vision of the detailed applications that would emerge, nor even that I was witnessing the launch of the information age.

In such matters it is the first steps that count. We are in the early stages of synthetic neural modeling. Thanks to the efforts of Institute scientists and the development of our ideas by others in the community, we can look forward to basic advances and practical outcomes that will change our lives.

Gerald M. Edelman, M.D., Ph.D.
Founder and Director
The Neurosciences Institute

the Institute's receiving $15 million from its trustees and other private sources by June 30, 2005.

Cullman says their pledge—established as the Cullman Leadership Challenge—grew out of his opportunity to observe the Institute's efforts first hand in recent years as vice chairman of the Board of Trustees of the Institute's parent corporation, the Neurosciences Research Foundation, Inc.

"The Neurosciences Institute is one of the most exciting and important endeavors I've ever been associated with," says Cullman, 81, former owner of the At-A-Glance Group. "We truly believe in what the Institute is trying to achieve and we are highly impressed with Dr. Edelman's leadership, vision, and research contributions to the world of science."

The Cullman family has a long tradition of philanthropy, and the couple is frequently listed among the nation's leading contributors to not-for-profit organizations supporting arts and education.

Among the major beneficiaries of the Cullmans' generosity are The New York Public Library, American Museum of Natural History (New York), The Museum of Modern Art (New York), The Metropolitan Museum of Art (New York), Planned Parenthood of New York City, The Joseph Papp Public Theatre (New York), Human Rights Watch, The New York Botanical Garden, Lincoln Center (New York), The Enterprise Foundation, Chess-in-the-Schools (New York), and Thirteen WNET New York.

The Cullmans' ability to help their favorite charities stems from a remarkable business acumen possessed not only by Lewis Cullman but also by members of his family and forebears.

The Cullman family success dates back to the 1800s when his grandfather, a German immigrant, started in business as a tobacco merchant. In 1929, his father and grandfather were asked to head up a tobacco investment company called Tobacco & Allied Stocks. Later, his father's desire to own a tobacco operating company led him to purchase a major interest in a small New York firm called Benson & Hedges.

When Benson & Hedges was acquired by Philip Morris, Cullman's father, uncle, and his brother, Joseph, joined it. In 1957, Joseph Cullman 3rd was elected president and CEO of Philip Morris. By the time he retired in the 1970s, he had helped build the company into a huge conglomerate and was named chairman emeritus for life.

Lewis Cullman, however, did not follow his family into the tobacco business.

After graduating from Yale and studying engineering at NYU, Cullman entered the Navy to work as a meteorologist during World War II. After being discharged, he formed a private weather service that provided snow and ice warnings to 40 towns and cities in Massachusetts.

Cullman then left the weather business to go to Wall Street. Later he completed one of the first leveraged buyouts, then called a "bootstrap."

"I remember I put up $400, another guy put up $400 and a third guy put up $200, providing us $1,000 of equity," Cullman recalls. "With that investment we were able to borrow enough money to buy Orkin Exterminating Co. for $62 million. I think that's what's called leverage," Cullman says.

That transaction led to the Cullmans' 1966 purchase of Allied Graphic Arts, a catalog agency business whose principal account was S&H Green Stamps. By 1978, Allied was able to provide the necessary $3 million in equity to permit Cullman to acquire Keith Clark for $13 million.

Many people probably had not

Cullman Leadership Challenge Helps Raise $25 Million

Lewis Cullman has issued a challenge to trustees of The Neurosciences Institute and other donors to provide $25 million for the Institute over the next five years.

As part of the challenge, Cullman and his wife, Dorothy, have pledged $10 million in support of the Institute's $100 million fundraising campaign. Their pledge is contingent on the Institute's receiving $15 million from its trustees and other private sources by June 30, 2005.

Funds donated by the Cullmans will be used to support two endowed Senior Fellow positions on the Institute's scientific staff and to provide research support for the Institute's post-doctoral fellows, according to its director, Nobel laureate Gerald M. Edelman, M.D., Ph.D.

Edelman says the Cullman challenge will help the Institute to reach its full potential.

"Our work depends entirely on private donations to underwrite research and conference activities,"

heard of Keith Clark, a family-owned printing business started in New York City that had a side business making calendars. After Cullman made the acquisition, he built up the calendar, appointment book, and diary business by buying a number of other "mom-and-pop" calendar companies.

After the purchase of Keith Clark, it was renamed At-A-Glance, and over the next 20 years it became one of the premier calendar companies.

Today, Cullman is semi-retired but still oversees the business, which still retains AGA Creative, formerly Allied Graphic Arts. That remaining corporate responsibility still permits him to play tennis and ski competitively in the Masters program.

He also has found time to become one of the nation's foremost philanthropists.

"I donate a lot of money to charity for the simple reason that I'd rather give it away in my lifetime than leave it in my will," Cullman says. "Dorothy and I love being able to pick and choose the organizations we want to support in their important work. My interest focuses on science and hers, on art."

Cullman also enjoys encouraging others to give. He is confident that his challenge will help The Neurosciences Institute achieve its goal.

"I'm a great believer that people who are capable of giving money should use their wealth to support important causes," he says. "Sometimes all that is needed to loosen purse strings is more awareness and motivation.

"If my challenge succeeds in spreading the word about the need to support the great work at The Neurosciences Institute while encouraging the right people to increase their support, then we will have built the foundation of something that will ensure that this remarkable Institute remains strong and vibrant well into the 21st Century."

Make a Donation

"The brain may be the last frontier. Discoveries in brain research will follow the same pattern as other unexpected scientific discoveries. Having a group of bright scientists working together increases the odds of making an unexpected important breakthrough. The Neurosciences Institute comes as close as any institution I have ever observed that creates this atmosphere. There already have been unexpected important scientific discoveries."

Lewis B. Cullman

- *President and Chief Executive Officer*
  Cullman Ventures LLC, New York, New York
- *Vice Chairman of the Board, Neurosciences Research Foundation, Inc.*

for the Institute

Edelman says. "The Cullmans' support is absolutely fundamental to securing both our financial future and our scientific success. We are extremely grateful for the Cullmans' vision and generosity."

The Cullmans established the Cullman Leadership Challenge as the mechanism to administer their gift. In each of the next five years, The Neurosciences Institute must obtain a minimum of $3 million annually from its trustees and other private sources to qualify for $2 million each year from the Cullman Challenge.

Challenge gifts have been used successfully in education, cultural, and other not-for-profit organizations for many years, according to David Mitchell, Director, Institute Relations.

"Such challenge gifts are especially effective in attracting increased support for a particular cause," Mitchell says. "The Institute's donor base has traditionally consisted of a very limited number of foundations and individuals, largely because we are a relatively small organization whose reputation is confined primarily to scientific circles.

"It's important that we now connect with those individuals who might value our special focus on human brain functions yet who currently know little or nothing about the Institute. The Cullman Challenge should stimulate considerable interest in the Institute both locally and nationally," Mitchell adds.

Make a Donation

Here's What Others Are Saying About The Neurosciences Institute

"There is no place in the world like The Neurosciences Institute. It is, in effect, a scientific monastery, where extremely gifted and dedicated people from all over the world can do fundamental work, experimental or theoretical, undistracted by the demands of an academic or industrial setting.

Under the presiding genius of Gerald M. Edelman, The Neurosciences Institute is a place of pure, concentrated, original work of the highest level which runs the entire range of neurobiology, and holds out great promise for our understanding of the workings of the brain and mind — and indeed, the very nature of consciousness."

Oliver Sacks, M.D.

- *Clinical Professor of Neurology, Albert Einstein College of Medicine*
- *Adjunct Professor of Neurology and Psychiatry, Mt. Sinai – NYU Medical Center*
- *Author of* Awakenings *and* The Man Who Mistook His Wife for a Hat

"What is going on in America today is that, in the biomedical sciences, there is an increasing bureaucratization of science, research laboratories are getting larger and larger, and the funding comes increasingly from federal research grants. In my judgment, this is not the kind of funding that is necessary for fundamental breakthroughs in science, that is, for people to engage in high-risk research.

In fundamental and basic research, the great discoveries tend to take place in those organizational settings that are quite small. Therefore, what we need at this moment in America are small research institutes that have a high degree of flexibility and that internalize a great deal of scientific diversity. These small institutes should provide opportunities for young people to work within a nurturing environment where they do not have to constantly apply for research grants that discourage high-risk research and instead reward incremental, low-risk research."

J. Rogers Hollingsworth, Ph.D.

- *Professor of Sociology, History, and Industrial Relations University of Wisconsin – Madison*

Excerpt from his June 3, 2000 address to the NRF Board of Trustees:
"The Style and Mode of Research Organizations: Innovation in Science"

"What is most remarkable about The Neurosciences Institute is that it has had the courage to address questions distinctly ahead of their time and not commonly raised elsewhere. I worried, at first, whether they were not too ambitious in wanting to tackle some of the tough problems that science was not ready to answer, such as the mechanistic basis for sleep and consciousness. But they proved me wrong: by using rigorous experimental approaches and procedures, they showed that it could be done as seen by their outstanding recent publications. Their studies might well establish the foundation for a global theory of brain function."

Edmond H. Fischer, Ph.D.

- *Professor Emeritus of Biochemistry, University of Washington*
- *Nobel Laureate in Physiology or Medicine, 1992*
- *Associate, Neurosciences Research Program*
- *Member, Scientific Advisory Committee, The Neurosciences Institute*

"From any perspective, The Neurosciences Institute is a highly innovative, perhaps unprecedented, strategic departure in brain research. While seeking to advance selected areas of molecular and cellular neuroscience and selected aspects of robotics and unconstrained learning machines, the heart of the effort is to advance the ability to propose and test the basis for the most profound of the unsolved problems, namely the basis for conscious thought. Surely there can be no greater challenge than to understand this mental function, and NSI's team has the leadership and talent to do so."

Floyd E. Bloom, M.D.

- *Chairman and Professor, Department of Neuropharmacology, The Scripps Research Institute*
- *Immediate Past Editor-in-Chief,* Science
- *Chairman, Scientific Advisory Committee, The Neurosciences Institute*

Giving Opportunities at The Neurosciences Institute

The Neurosciences Institute is conducting a capital campaign to procure $100,000,000 in gifts and pledges by June 30, 2005. The campaign is being undertaken to fulfill the Institute's vision of leadership in interdisciplinary brain research. The campaign is seeking both expendable and endowment commitments from interested individuals, foundations, businesses, and other private associations.

The following are donor recognition opportunities that acknowledge major private contributions in support of the capital campaign:

- To name **The Neurosciences Institute**: **$50,000,000**
- To name the **Auditorium**: **$10,000,000**
- To name the **Laboratory Building**: **$5,000,000**
- To name the **Theory and Meeting Center**: **$5,000,000**
- To name and permanently endow a **Senior Fellow**: **$2,000,000**
- To fund a named **Senior Fellow** for one year: **$100,000**
- To name and permanently endow an **Associate Fellow**: **$1,000,000**
- To fund a named **Associate Fellow** for one year: **$50,000**
- To name and permanently endow a **Post-doctoral Fellow**: **$700,000**
- To fund a named **Post-doctoral Fellow** for one year: **$35,000**
- To name and permanently endow a **Visiting Scientist**: **$1,000,000**
- To fund a named **Visiting Scientist** for one year: **$50,000**
- To name and permanently endow the **Institute's Library**: **$3,000,000**
- To name and permanently endow the **"Food for Thought" Fellows Symposium** (Luncheon Series): **$2,000,000**
- To fund the **Food for Thought Fellows Symposium** for one year: **$100,000**

For information on these or other giving opportunities, please contact David Mitchell at (858) 626-2020 (phone), (858) 626-2013 (fax), mitchell@nsi.edu (e-mail), or visit our website at www.nsi.edu.

PERFORMING ARTS AT THE NEUROSCIENCES INSTITUTE EVENTS CALENDAR • JANUARY - APRIL 2001

La Jolla Symphony & Chorus Series
January 20 & 21, 2001
Bach & Stravinsky

Mainly Mozart Spotlight Series
January 27, 2001
Clarinet trio, the Boston Chamber Music Society featuring cellist Ronald Thomas

Mainly Mozart Spotlight Series
February 16, 2001
Flute trio featuring Timothy Day, Principal flute, Mainly Mozart Festival

La Jolla Chamber Music Society
March 3, 2001
Vassillis Varvaresos, piano prodigy

Mainly Mozart Spotlight Series
March 23, 2001
Piano trio, The Eroica Trio

Mainly Mozart Spotlight Series
April 6, 2001
The Diaz String Trio, featuring Andres Cardenes, concertmaster of the Pittsburgh Symphony

TICKETS/INFORMATION

Performing Arts Chamber Music Series	(858) 626-2055
The Athenaeum	(858) 454-5872
La Jolla Chamber Music Society	(858) 459-3728
La Jolla Symphony & Chorus	(858) 534-4637
Mainly Mozart	(619) 239-0100
Playwrights Project	(619) 239-8222
San Diego Ballet	(619) 294-7378
San Diego Opera	(619) 232-7636

New Board Members

The Neurosciences Institute welcomes the following new trustees:

Paul J. Dostart is the founding partner of La Jolla-based Dostart Clapp & Coveney, LLP, a law firm serving the taxation, compensation, corporate, and strategic planning needs of not-for-profit and regional businesses involved in education, science, and healthcare. Dostart is active with the business and tax law sections of the State Bar of California and the American Bar Association, and he is a Life Fellow of the American Bar Foundation and a Fellow of the American College of Tax Counsel. Dostart works with the Nonprofit Support Center of San Diego and is on the planned giving committees of Francis W. Parker School and La Jolla Country Day School. He also is the co-inventor of the Baseball Brain, a paper slide rule-like device for teaching baseball strategies to young people.

Jeffrey Dunigan is a financial consultant with the La Jolla office of Salomon Smith Barney, Inc. He is actively involved with several cultural organizations in San Diego, and serves as a commissioner of the San Diego Commission for Arts and Culture, which disburses funds from the City of San Diego to various local arts organizations. Dunigan provides charitable estate planning assistance as a volunteer to numerous not-for-profit organizations including The Bishop's School, the Salk Institute, and Scripps Foundation. He is a member of the San Diego Estate Planning Council.

Lawrence E. Kline, D.O., is an internist in the Division of Chest Medicine and Critical Care of the Scripps Clinic Medical Group in La Jolla. He is an adjunct associate professor with The Scripps Research Institute in the department of Molecular and Experimental Medicine, and is an Associate Clinical Professor in the UCSD School of Medicine. Kline is board certified in internal medicine and sleep medicine, and he is keenly interested in the field of sleep disorders.

Christopher S. McKellar is chairman and chief executive officer of California Traditions, a San Diego-based commercial and residential real estate development company. He is a director of Scripps Financial Corporation and chairs the board of directors of Medical Biology Institute. McKellar has been or is now a member of the boards of the San Diego Opera Association, Museum of Contemporary Art, UCSD Board of Overseers, Scripps Clinic and Research Foundation, San Diego Literacy Council, and San Diego Mayor's Housing Committee.

Toni Nickell is a community volunteer who has devoted much of her time to raising money for scientific and other causes in San Diego. A former executive with CBS, Nickell is an active member and immediate past president of the San Diego chapter of Achievement Rewards for College Scientists (ARCS), a board member of the Helen Woodward Animal Center, and co-chair of the Scripps Presidents Council, a fund raising arm of Scripps Foundation for Medicine and Science.

Charles Robins is chairman emeritus of the Robins Group in La Jolla, a privately owned investment banking firm that has acquired eleven domestic manufacturing companies. Now retired from a successful business career in Baltimore and Cleveland, Robins dedicates his time to charitable activities in San Diego. He is a former director of the San Diego Opera and now provides advice on its long-range financial planning. He serves as a trustee of the UCSD Foundation, co-chaired the capital campaign that funded the Birch Aquarium of Scripps Institution of Oceanography, and raises money for UCSD's Graduate School of International Relations and Pacific Studies. He is a member of the executive committee of the St. Vincent de Paul Village, the executive director of the World Trade Center of San Diego, and a former trustee of Scripps Foundation for Medicine and Science.

Kenneth A. Selzer, M.D., of Del Mar is an entrepreneur who founded INC Research, a venture capital-funded firm devoted to clinical research on new central nervous system and pain drugs and devices. Prior to establishing INC Research, he founded and remains executive editor of *Neuropractices* magazine. Selzer also established Integrated Healthcare Services, Inc., one of the pioneers in the development of ambulatory primary care centers. He is board certified in both neurology and pain management and holds a clinical appointment at the UCSD School of Medicine.

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Next Issue:

What Makes The Neurosciences Institute Unique?

"The Neurosciences Institute occupies a niche in the research community which is rapidly vanishing: a place where scientists of proven, creative ability are free to explore innovative approaches to the toughest and deepest scientific problems. It achieves this by being diverse enough to bring together novel viewpoints, small enough to foster an atmosphere of common purpose, and well integrated enough to make it all work."

Ralph J. Greenspan, Ph.D.

• *Senior Fellow in Experimental Neurobiology, The Neurosciences Institute*

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We welcome your comments concerning our newsletter. For additional information, contact:

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Every resident of San Diego County who makes a first-time gift of $100 or more to The Neurosciences Institute will trigger an additional gift of the same amount to the Institute from The Legler Benbough Foundation and the Thomas C. Ackerman Foundation. To receive these matching funds, the Institute invites San Diegans to make a gift of $100, $500, $1,000 or more. Our foundation benefactors will match all gifts from first-time donors, with a limit of $1,000 per donor.

Use the return envelope provided to make your gift. And gifts of appreciated stock or other property also qualify for a match!

If you have any questions, please contact David Mitchell at (858) 626-2020 (phone), (858) 626-2013 (fax), mitchell@nsi.edu (e-mail), or visit our website at www.nsi.edu.

Photography: Bob Ross Photography, Bill Timmerman

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