Forty-First Annual Briefing NEW HORIZONS IN SCIENCE

October 26 through 29, 2003
Radisson Summit Hill Hotel
Knoxville, Tennessee

CASW *Council for the Advancement of Science Writing, Inc.*

Program by:
Ben Patrusky, Executive Director, CASW

Sponsored by:
UT-Battelle/Oak Ridge National Laboratory
The University of Tennessee

With support from:
Burroughs Wellcome Fund
Tennessee Department of Economic and Community Development
Tennessee Valley Authority

With additional support from:
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Saturday, October 25
1:00 p.m. to 5:30 p.m.

NASW Workshop *(Tennessee Salon B&C)*

Sunday, October 26
9:00 a.m. to Noon

UNTANGLING AMYLOID

Ronald Wetzel, Ph.D., Professor, Graduate School of Medicine, University of Tennessee Medical Center, Knoxville, TN

Alan Solomon, M.D., American Cancer Society Clinical Research Professor, Professor of Medicine and Head, Human Immunology and Cancer Program, Graduate School of Medicine, University of Tennessee Medical Center, Knoxville, TN

Given the nation's ever-increasing elderly population, one group of diseases — disorders attributable to abnormal deposition of proteins in tissues and organs — looms as perhaps the major medical health threat of the coming decades. At the root of many of these ills is amyloid, the term for a misfolded, gum-up-the-works form of any one of a number of proteins. At present some 30 such diseases have been identified, most notably Alzheimer's, Parkinson's and Huntington's, with more sure to surface with improved diagnostic procedures. What's lacking are effective therapies. Main reason: the absence of high-resolution, 3-D portraits of amyloid molecules, as prelude to the discovery of inviting drug targets. But researchers have recently made significant headway in that direction, including a finding that holds out the possibility of developing agents capable of combating a host of these maladies. One such is about to be put into clinical trials — initially against the most common, systemic, invariably fatal amyloid-caused disease.

BEYOND PROTEOMICS: DEFINING THE 'MACHINES OF LIFE'

Michelle V. Buchanan, Ph.D., Director, Chemical Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN

Seldom do proteins in living cells act alone. Rather, they combine to form multi-protein complexes; it is these aggregates that bear responsibility for the vast repertoire of tasks — growth, metabolism, replication, repair, intra- and intercellular signaling — required to nurture and sustain life. Researchers have very limited knowledge of these ensembles, largely because proteins are generally isolated and studied on an individual basis. But a large, multidisciplinary effort is beginning to change all that. In the pilot phase, the team is working with two bacterial species to evaluate newly minted technologies for "pulling down" distinct, intact complexes (thought to number in the thousands in these model microorganisms) and for determining the contents and dynamics of each of these "machines of life" and how they interact with each other under varying environmental conditions. One goal among many: using this newly gained protein-complex wisdom to develop tailor-made therapies against complex — i.e., multigenic — diseases.

Sunday, October 26
2:00 p.m. to 5:00 p.m.

SEXUAL TREACHERY
David M. Buss, Ph.D., Professor, Department of Psychology, University of Texas, Austin, TX

If sexual conflict permeates human social relationships, blame natural selection. But there may be more to the tale than simply a coevolutionary deception/deception-detection arms race between the sexes. For there's tantalizing empirical evidence to suggest that mating strategies may have developed as a consequence not only of reciprocal, two-party (dyadic) antagonistic coevolution but also of a triadic, or multiparty, Darwinian dance. Multiparty conflict rears its head throughout the temporal arc of mating — from pre-mating courtship, through couple formation, and in the aftermath of a breakup. Triadic-mating coevolution has been documented in non-human species. Example: proteins produced in the semen of males simultaneously combat competitor's sperm while diminishing sexual arousal in the mating partner, but may also be toxic to the female. He sees psychological and strategic analogs of these manipulative seminal proteins in human mating — e.g., mate poaching and stalking.

'HOT-SPOT' VOLCANISM: PLUMES V. CRACK THEORY
James H. Natland, Ph.D., Professor of Marine Geology and Geophysics, Rosentiel School of Marine and Atmospheric Science, University of Miami, Miami, FL

The hypothesis that has long held sway in explaining the origins of the Hawaiian Islands and other volcanic chains has come under severe challenge. Promulgated by geophysicist W. Jason Morgan in the early 1970's, it introduced the notion of hot plumes — narrow jets of molten rock rising from deep within the Earth. Migration of tectonic plates across these stationary, eons-old hot spots gives rise, over geologic time, to linear strings of volcanoes. But there's now a fair body of evidence to suggest an alternative proposal, dubbed the crack theory, which calls into question the very idea of plumes (including the hot spot that allegedly accounts for the hot springs and geysers of Yellowstone National Park). Crack theorists disavow both deep and hot. As they see it, these so-called hot spots are more the product of crustal tectonic processes — i.e., the propagation of fractures across plates — occurring at shallow depths rather than of any upwelling from the Earth's mantle. A major debate — one that's likely to get hotter in the coming months and years — is now in full swing.

6:30 p.m. to 8:30 p.m.

WELCOME RECEPTION
The University of Tennessee President's Residence. Buses depart the Radisson at 6:15 p.m.; return at 8:45 p.m.

9:00 p.m.

Hospitality Suite *(Cumberland Room)*

Monday, October 27
8:00 a.m.

Buses depart for Oak Ridge National Laboratory.

9:00 a.m. to 11:15 a.m.

BIONANOSENSING: NEW FRONTIERS

A look at some promising advances in the detection of environmental and biological nanometer-sized particles (molecules one ten-thousandth the width of a human hair).

ENGINEERING SIGNAL INTELLIGENCE INTO CELLS

Michael L. Simpson, Ph.D., Professor of Materials Science and Engineering, University of Tennessee, Knoxville, and Distinguished R&D Staff, Oak Ridge National Laboratory, Oak Ridge, TN

Efforts are underway to convert genetically engineered microorganisms, bacteria and yeast, nested in carbon nanotube-laced silicon chips, into executive decision-makers with the power to regulate their surroundings and in the process perform such beneficial functions as waste treatment, disease diagnosis and perhaps cell-based computation.

THE CANTILEVERED MEMS CHIP

Thomas G. Thundat, Ph.D., Distinguished Staff Scientist, Life Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN

Custom-crafted to fix chosen chemical targets, ultra-tiny, chiseled-in-silicon cantilevers — miniscule "diving boards" that bend in response to capture of nanoparticles — open the way to a slew of applications. To wit: forensic searches; detection of chemical and biological agents of terror; as retinal prostheses; as implants to assess the effectiveness of hip and knee replacement.

NANOFLUIDICS AND THE ARTIFICIAL CELL

J. Michael Ramsey, Ph.D., Corporate Research Fellow, Chemical Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN

New developments in the ability to manipulate fluids transiting through channels of the smallest possible dimensions lay the groundwork for, among other things, the creation of receptor-flecked artificial cells capable of: spotting hazardous environmental agents; screening compounds for their potential as drugs; sequencing of DNA at rates many orders of magnitude faster than currently possible.

WEARABLE ROBOTICS

Francois G. Pin, Ph.D., Corporate Fellow and Group Leader, Robotics and Engineering Machines Group, Engineering Science and Technology Division, Oak Ridge National Laboratory, Oak Ridge, TN

The images — of a woefully fatigued U. S. solider, savaged by the blistering Iraqi desert sun, struggling to get to his feet from a kneel-rest position under the weight of his 125-pound backpack — make a lasting impression. Now, picture this: same solider, same conditions, only this time he's up in a trice, all but indifferent to the fact that he is bearing such a heavy load. What made the difference? The exoskeleton, a wearable machine that's able to sense the intent of limb movement and to amplify strength. Although not quite yet here, the day of the "Superman Suit" is rapidly approaching, a consequence of recent advances in a slew of enabling technologies, ranging from compact power sources and power-dense actuators to advanced body-sensing methodologies and computational capabilities. For now, the developmental focus is on easing the infantryman's plight so as to significantly increase endurance and mobility. Eventually, exoskeletons will be put to work benefiting others, including the elderly and handicapped; patients needing physical rehabilitation; and assembly line, construction and rescue workers.

Monday, October 27
11:30 a.m. to 12:45 p.m.

THE SPALLATION NEUTRON SOURCE

Thomas E. Mason, Ph.D., Associate Laboratory Director, Spallation Neutron Source, Oak Ridge National Laboratory, Oak Ridge, TN

Geoffrey L. Greene, Ph.D., Professor of Physics, University of Tennessee, Knoxville, and Research Scientist, Oak Ridge National Laboratory, Oak Ridge, TN

When the Spallation Neutron Source — the nation's largest science project — comes on-line in 2006, atop an 80-acre site on the Oak Ridge National Laboratory campus, the $1.4 billion, accelerator-based facility will generate pulsed neutron beams with up to 10 times more intensity than any other source in the world. As such, the SNS, with its 24 leading-edge neutron-scattering instruments, will enable researchers to add immeasurably to their understanding of the fundamental properties of materials — knowledge to be used in developing more powerful magnets, high-temperature superconductors, more effective medications and lighter, stronger structural elements. It is also expected to help nuclear scientists answer some basic, as yet unresolved questions about the neutron itself. When completed, the SNS will annually serve an estimated 2,000 chemists, physicists, biologists, geologists and engineers from the U.S. and abroad.

1:30 p.m. to 4:00 p.m.

ORNL EXPLORATIONS

As a follow-up to the session on the Spallation Neutron Source, a guided tour of the spectacular ridge-top construction site. Also on the schedule: a visit to the ORNL Center for Computational Sciences, featuring the latest in scientific computing and visualization technologies; and to the Aquatic Ecology Laboratory where environmental scientists are seeking to devise sonic measures to help young salmon safely circumvent dams and other obstacles in their migration to the sea.

Buses to the Radisson depart ORNL at 4:00 p.m.

6:30 p.m. to 9:45 p.m.

CASW ANNUAL RECEPTION AND DINNER

Knoxville Convention Center, within easy walking distance of the Radisson. Buses to the center depart at 6:15 p.m.

Presentation of the Victor Cohn Prize for Excellence in Medical Science Reporting.

Featured speaker: Performance Artist Bill Landry as "Einstein."

10:00 p.m. to 11:30 p.m.

Hospitality Suite

Tuesday, October 28
8:30 a.m. to 11:30 a.m.

THWARTING BIOLOGICAL INVASIONS

Daniel Simberloff, Ph.D., Nancy Gore Hunger Professor of Environmental Studies, University of Tennessee, Knoxville, TN

Invasive species — plants or animals that flourish in a given region following deliberate or accidental introduction from elsewhere — pose the second greatest threat to biodiversity (after habitat destruction), at a cost to the U. S. economy of $137 billion annually. These pests also constitute a potentially major health scourge. Witness recent outbreaks of monkeypox and West Nile virus. Often, too, introduced species interact with one another to exacerbate one another's destructive impact. Result: "invasional meltdown," a radical transformation of the original habitat, triggered by the widespread elimination of native dwellers. More bad news: Invasions are on the increase because of stepped-up international trade and travel. Exceptions notwithstanding, efforts to curb the pace of these incursions via brute-force mechanical, chemical or biological interventions have largely failed. What's needed, both to forestall these infiltrations and to deal with established invaders, is an entirely new strategy — ecosystem management, predicated on carefully nuanced, well-defined, research-based manipulations of natural processes.

INNATE IMMUNITY: THE NEW ERA

Richard J. Ulevitch, Ph.D., Professor and Chairman, Department of Immunology, The Scripps Research Institute, La Jolla, CA

To combat invasion by infectious agents, the body calls two arms of the immunological apparatus into sequential play. First into the fray is the innate immune system, which having rapidly sized-up the intruder as foe not friend — non-self rather than self — marshals the initial counterattack and then sounds the alarm that prompts the other arm, the acquired system, with its arsenal of antibody-generating B-cells and cell-killing T-lymphocytes, to join the battle. The first line of defense it may be, but when it comes to research interest and scrutiny, it has long played second fiddle to, and is therefore nowhere near as well understood as, the acquired system. But those years of relative neglect are over, with much progress being made of late in teasing out details of innate protection. And now, with the launch of several new multidisciplinary initiatives, researchers expect to go a long way in further delineating the thousands of genetic changes, proteins generated and biochemical pathways triggered when the innate system and pathogens meet and, in the process, discover new ways to treat autoimmune and other disorders.

Tuesday, October 28
1:00 p.m. to 4:00 p.m.

COSMIC DARKNESS: NEW WINDOWS
Novel ways of looking for the 96% of the universe that's still missing.

THE ON-GOING QUEST FOR DARK MATTER: AN UPDATE
Daniel S. Akerib, Ph.D., Associate Professor of Physics, Case Western Reserve University, Cleveland, OH

Astronomers have known for over 70 years that there was simply not enough ordinary matter, the baryonic starstuff that you and I are made of, to account for the speed of objects in galactic clusters. The luminous (light-emitting) matter observed, were that all that these systems contained, would have been far from sufficient to keep the galaxies from flying apart. Enter dark matter, which cosmologists now believe represents about 26 percent of the cosmos' missing mass and energy. But what is it? Many mundane possibilities have been ruled out. Among the remaining candidates are WIMPs, weakly interacting massive particles, which could have been produced soon after the big bang and may still be around in abundance today. But WIMPs, if they do exist, have yet to be detected, even after 20 years of intensive searching. Now, however, with several new, exquisitely sensitive technologies on-line, or in the pipeline, chances of spotting these elusive particles have dramatically increased.

DARK ENERGY: UNRAVELING THE PREPOSTEROUS
Sean M. Carroll, Ph.D., Assistant Professor of Physics, Enrico Fermi Institute and the Center for Cosmological Physics, University of Chicago, Chicago, IL

In this new era of "precision cosmology," researchers have good reason to think that the universe is 14 billion years old and made up of only about 30 percent matter (a mere 4 percent of it of the luminous variety). The predominant component, the remaining 70 per cent, is dark energy, a mysterious essence that was recently discovered by observations indicating that the expansion rate of the universe has been accelerating rather than slowing down. As to its nature, these proposals: a cosmological constant (vacuum energy that permeates empty space); a new dynamical field; a sign of extra dimensions; or a breakdown of Einstein's general theory of relativity. A number of experiments have been proposed for distinguishing among them, including: satellites to discover distant supernovae and measure fine features in the cosmic microwave background; radio telescopes to survey the distribution of galactic clusters; new optical telescopes to chart the evolution of the structure of the universe.

5:00 p.m. to 8:30 p.m.

EAST TENNESSEE PICK 'N GRIN GALA
A frolicsome evening at the Museum of Appalachia, one of the region's prime cultural centers, hosted by UT-Battelle, featuring entertainment by the Cluster Pluckers. Buses leave the Radisson at 4:15 p.m.

9:30 p.m. to 11:30 p.m.

Hospitality Suite

Wednesday, October 29
8:30 a.m. to 11:30 a.m.

COPING WITH BIOLOGICAL COMPLEXITY

Boris Shraiman, Ph.D., Professor of Physics and Astronomy, Rutgers, The State University of New Jersey, Piscataway, NJ

There's a small but growing group of theoretical physicists who believe they can be of service in opening up new channels of biological and biomedical inquiry, now that these pursuits have become ever more complex and increasingly quantitative and data-intense. But more than just offering the mathematical tools of their trade, they also seek to introduce to the life sciences an approach that's widely used to explore physical phenomena. Phenomenological modeling, as it's called, seeks to provide a stripped-down quantitative description of the process under study, one that incorporates only the most essential features and ignores many of the finer, more microscopic aspects of said process. However approximate, these models generate non-trivial predictions that can be put to experimental test. The phenomenological approach, say the physicists, is the key to attacking some of biology's most vexing problems — e.g., regulation of gene expression and egg-to-embryo development. If so, it will require close collaboration between theorists on the one hand and experimental scientists on the other. That would represent a significant break with life-science tradition, where, unlike division-of-labor physics, the bench scientist serves as his own theorist.

INTERPRETING ALL THAT REMAINS: NEW DATA, NEW INSIGHTS

Richard L. Jantz, Ph.D., Professor of Anthropology and Director, Forensic Anthropology Center, University of Tennessee, Knoxville, TN

Arpad A. Vass, Ph.D., Research Scientist, Life Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN

Hallowed as they may be to journalism (at least its old-school practitioners), the five w's are absolutely indispensable to crime-scene investigations. More often than not, the toughest question to resolve is when — when did the victim die. Current technologies can pinpoint the time of death to within two days for soft-tissue decay and two weeks for skeletonized remains up to about five years. But newly discovered biomarkers, stemming from investigations at The Body Farm, the one-of-a-kind, University of Tennessee forensic facility, could narrow the estimated range to less than 12 hours. The researchers are also parsing the chemical composition of decay odor as a first step towards developing hand-held devices capable of determining not only the post-mortem interval but also for locating clandestine graves. The skeletonized remains derived from The Body Farm, meanwhile, have been yielding information that is adding immeasurably to the database used by forensic experts worldwide to match the age, sex and ethnicity of skeletal finds. The newest edition of the Web-accessible resource is about to be released.

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