Thirty-Third Annual Briefing NEW HORIZONS IN SCIENCE

November 5 through 9, 1995
Washington Duke Inn
Durham, North Carolina

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

Program by:
Ben Patrusky, Executive Director, CASW

Sponsored by:
Duke University

With support from:
Burroughs Wellcome Fund

With additional support from:
Sigma Xi, The Scientific Research Society

Sunday, November 5
2:00 p.m. to 4:00 p.m.

TOUR OF DUKE PRIMATE CENTER
Buses depart Washington Duke Inn at 1:45 p.m.

6:30 p.m. to 9:00 p.m.

WELCOME RECEPTION
Washington Duke Inn

Monday, November 6
8:30 a.m. to 11:30 a.m.

RNA GENE THERAPY

Bruce A. Sullenger, Ph.D., Assistant Professor of Experimental Surgery and Genetics, Duke University Medical Center, Durham

There could soon be another way to go with gene therapy — other than introducing "wildtype" DNA into tissues to correct for aberrant genes. For certain inherited and acquired diseases — cystic fibrosis, sickle cell anemia and cancer, among them — a more appropriate treatment may well be "reconstructive molecular surgery" aimed at intercepting, editing and otherwise refurbishing mutant RNA messenger transcripts so as to yield normal couriers of genetic information that prompt production of fully functioning proteins. Human cell trials are just getting underway.

THE COMING 'GOLD' RUSH

Allen D. Roses, M.D., Jefferson-Pilot Professor of Neurobiology and Neurology, and Chief, Division of Neurology, Duke University Medical Center, Durham

With lessons learned from the recent detection and isolation of a naturally occurring, normal gene variant that increases susceptibility to Alzheimer's disease, scientists have now set about searching for gene forms (and ensembles) that increase the risk of other common, later-in-life maladies. The effort — dubbed the GOLD (Genetics of *L*ate-Onset *D*iseases) Project — holds promise of leading to new strategies for forestalling development of atherosclerosis, diabetes, glaucoma, multiple sclerosis, Parkinson's, asthma and other complex ills.

Monday, November 6
2:30 p.m. to 5:30 p.m.

IN SEARCH OF EXOPLANETS

Roger Angel, Ph.D., Regents Professor, Professor of Astronomy and Optical Sciences, and Director, Steward Observatory Mirror Laboratory, University of Arizona, Tuscon

It's an age-old mystery that continues to beg resolution: Are there other solar systems? To date, no planets have been detected around any normal star save the Sun, although new ground-based search techniques should turn up Jupiter-sized planets, if they exist, within the next few years. But what about smaller planets capable of supporting life? That, say researchers, will require placing advanced, post--Hubble, 50-meter-long telescopes in distant orbit — an enterprise that could shape up as the centerpiece of NASA's next major space venture. The ultimate goal: not only detection of Earth-like planets, but capture of radiated-heat spectra stamped with the markings of life.

THE NEW MICROWAVE SKY

Neil Turok, Ph.D., Professor of Physics, Princeton University, Princeton

How after the Big Bang did cosmic structure — stars, galaxies and galaxy clusters — come to be? The answer could emerge from efforts now afoot to generate a highly detailed map of the sky's microwave background. Two competing theories currently hold sway: inflation and symmetry-breaking, each predicted to bear its own distinctive, telltale microwave "signature." Recent discovery by the Cosmic Background Explorer (COBE) of fluctuations in microwave-sky temperatures represented an important, early step in the map-making process, but measurement resolution was too limited for requisite signature discrimination.

6:30 p.m.

CHANCELLOR'S RECEPTION

Hosted by Duke University Medical Center. Buses depart Washington Duke Inn at 6:15 p.m.

Tuesday, November 7
8:30 a.m. to 11:30 a.m.

RECEPTORS, G PROTEINS AND RAS: TAPPING THE CLINICAL POTENTIAL

Robert J. Lefkowitz, M.D., James B. Duke Professor of Medicine, and Investigator, Howard Hughes Medical Institute, Duke University Medical Center, Durham

Patrick J. Casey, Ph.D., Associate Professor of Molecular Cancer Biology and Biochemistry, Duke University Medical Center, Durham

Now, finally, after years of intense struggle to untangle the biochemical details of signal transduction — the process by which cells respond to outside stimuli — researchers are on the verge of huge clinical payoffs. Delineation of the G-protein signalling system (which mediates the effects of hormones, drugs and such sensory triggers as odorants and photons) has opened the way to new approaches to treating congestive heart failure and could well augur development of a male contraceptive. By the same token, knowledge of another ubiquitous player in the signal-relay game, the *ras* protein (a key regulator of cell division), is spurring development of novel cancer therapies.

MALARIA: NEW PERIL, NEW PROMISE

Dyann F. Wirth, Ph.D., Professor of Tropical Public Health, Harvard School of Public Health, Boston

Carole A. Long, Ph.D., Professor of Microbiology and Immunology, Medical College of Pennsylvania and Hahnemann University, Philadelphia

With parasitic resistance to anti-malarials growing unchecked, tropical health experts worry that the already fierce human toll (300 - 500 million new cases each year, resulting in 2.7 million deaths) will continue to rise. But there's encouraging news, too. For one, researchers have finally succeeded in efforts to insert foreign genes into the genome of the malarial parasite, a crucial first step in understanding drug resistance and prelude to the design of effective, new, disease-fighting agents. Second, a new, genetically engineered vaccine is currently undergoing primate trials, with human testing slated to begin soon.

Tuesday, November 7
2:00 p.m. to 5:00 p.m.

DENDRIMERS: NEW POLYMERS, NEW PROSPECTS

Donald A. Tomalia, Ph.D., Research Professor, and Director of Nanoscopic Chemistry and Architecture, Michigan Molecular Institute, Midland

It began 20 years ago with a chemist's dream: to fashion something entirely new, namely large, precisely defined, highly ordered, tree-like molecules. Wish became reality just a few years later. For some time afterwards, however, that synthetic feat and the branched polymers deriving from it, dubbed dendrimers (from the Greek *denon* for tree), went all but unnoticed, as evidenced by the paucity of scientific papers — fewer than a dozen — published between 1980 and 1990. Since then: an explosive increase in research and development activity, testimony to the far-reaching potential of these extraordinary supermolecules in a host of medical, environmental, electronic and chemical settings.

THE NANOMANIPULATOR

Russell M. Taylor II, Ph.D., Research Assistant Professor of Computer Science, University of North Carolina, Chapel Hill

Marry atomic force microscopy to virtual reality and what do you get? Not only stunning, big-as-life, 3-D representations of particles 10-billionths the size of ordinary objects, but also the ability to interact tactually with — and modify — nanoscale materials in real time. So new is this remarkable hybrid technology that researchers are hard put to guess at its full potential. For the nonce, however, they see it at work in such diverse enterprises as fabricating nanocircuits and in exploring the surface characteristics of viruses.

7:00 p.m.

RECEPTION AND ANNUAL CASW BANQUET

Washington Duke Inn

Presentation of the 1995 National Association of Science Writers' Science-in-Society Journalism Awards

Featured Speaker: Henry Petroski, Ph.D., Alexander S. Vesic Professor of Civil Engineering, and Chairman, Department of Civil and Environmental Engineering, Duke University, and author of *The Pencil; The Evolution of Useful Things*; and the newly published *Engineers of Dreams: Great Bridge Builders and the Spanning of America*.

Wednesday, November 8
8:45 a.m.

Buses depart hotel for Bryan Research Building for Neurobiology on the Duke campus.

9:00 a.m. to 12 Noon

'COMPLEXITY' APPLIED

Richard G. Palmer, Ph.D., Professor of Physics, Experimental Psychology and Computer Science, Duke University, Durham, and External Professor, Santa Fe Institute, Santa Fe

Fair to wonder, given the confusion, hype and hullabaloo surrounding the so-called science of complexity, whether anything useful can be expected to devolve from it. Latest consensus: the interplay and cross-fertilization among fields as diverse as physics, economics and immunology, in research alliances formed under the rubric of complexity (however defined), have begun to bear significant fruit. To wit: development of electronic "antibodies" to do battle with computer viruses; a fuller appreciation of how infection with HIV progresses to full-blown AIDS; and a better understanding of marketplace dynamics.

FREE ELECTRON LASERS: THE COMING ERA

John M. J. Madey, Ph.D., Professor of Physics, and Director, Duke Free Electron Laser Laboratory, Duke University, Durham

Karl D. Straub, M.D., Ph.D., Research Professor of Physics and Assistant Director for Research, Duke Free Electron Laser Laboratory, and Professor of Medicine, Duke University Medical Center, Durham.

It's perhaps the last word in photon manufacture — new-to-the-scene free electron lasers capable of producing exceptionally powerful, tailor-made, precisely tuned beams at wavelengths ranging from infrared to ultraviolet, X-rays and even gamma rays. Now, because of this new generation of power sources, there's much new that beckons, including: a new technique that would allow scientists to alter individual molecules atom by atom so as to create new kinds of reactions and compounds; production of unusually clear, highly magnified microscopic images of living cells; the capacity to detect and analyze individual pollutant molecules; a promising mechanism for removing space debris from Earth orbit.

Wednesday, November 8

12:30 p.m.

Box Lunch

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

TOURS OF DUKE UNIVERSITY SCIENCE AND MEDICAL LABORATORIES

6:30 p.m.

'BARBECUE AND BLUEGRASS'
Festivities hosted by Duke University at the North Carolina Museum of Life and Science. Buses depart hotel at 6:15 p.m.

Thursday, November 9
8:30 a.m. to 11:30 a.m.

LOCOMOTION: TOWARD A UNIFIED THEORY

Robert J. Full, Ph.D., Professor of Integrative Biology, University of California, Berkeley

For all the remarkable variation in leg form and function manifested by insects, arthropods and vertebrates — i.e. leg number, shape, length and position — recent studies have revealed surprising, across-the-board similarities in whole-animal biolocomotion dynamics, suggesting the existence of common, basic, unifying principles. Now, with the help of computer modeling and simulation, these principles are beginning to find their way into the design of novel robots, including a crustacean-like droid capable of walking underwater and through roiling surf.

EVOLUTION OF SEX . . . AND SPECIES

Ursula W. Goodenough, Ph.D., Professor of Biology, Washington University, St. Louis

In the neodarwinian telling, new species arise as a consequence of geographical separation, then natural selection and genetic "drift" and finally, as an offshoot of that divergence, reproductive isolation. But a growing body of evidence suggests another scenario, pointing instead to sexual divergence as engine rather than byproduct of the speciation process. The data says genes governing sex mutate at far faster rates than other parts of the genome. If so, the sex genes could offer the means to generate diversity, and new species, without otherwise compromising well-adapted genomes. That, in turn, would go a long way toward explaining, once and for all, what it is that sex is "good for."

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

P.O. Box 404, Greenlawn, NY 11740 • 516/757-5664

About the Speakers/ CASW New Horizons 1995

ROGER ANGEL received his B.A. from Oxford University in 1963, his M. Sc. from CalTech in 1966 and returned to Oxford to earn his doctorate in 1967. Before moving to Arizona in 1974, he served as associate professor of physics at Columbia University. He is currently Regents Professor and professor of astronomy and optical science at the University of Arizona and director of the Steward Observatory Mirror Laboratory. Angel is a fellow of the British Royal Society, a member of the American Academy of Arts and Sciences and has served on numerous national committees, including the board inquiring into the optical aberration of the Hubble Telescope. He is the author of more than 230 papers on X-ray sources, active galactic nuclei, interstellar dust, observational techniques, and the search for planets of other stars. (520/621-6541)

PATRICK J. CASEY, born and raised on a small farm in North Dakota, did his undergraduate work at Augustana College in Sioux Falls, where he received his B.S. in 1978. After spending three years as an analytic chemist at General Mills in Minneapolis, he went on to earn his Ph.D. (biochemistry) from Brandeis University in 1986. His interest in cell-cell communication led him to pursue postdoctoral work on GTP-binding regulatory proteins at Southwestern Medical Center in Dallas under Alfred Gilman, who helped to spearhead G-protein research. In 1991, Casey joined what soon became the department of molecular cancer biology at Duke University Medical Center. In 1992, he was named to a five-year term as Established Investigator of the American Heart Association. (919/613-8612)

ROBERT J. FULL, a native of Buffalo, NY, completed his undergraduate studies in 1979 at the State University of New York at Buffalo, where he went on to earn his M.A. (1982) and Ph.D. (1984). He held a research postdoctoral teaching position at the University of Chicago from 1984 to 1986, during which time he also did extensive research at Harvard University. In 1986, he joined the faculty of the University of California at Berkeley as an assistant professor of zoology. He was promoted to associate professor of integrative biology in 1991, and full professor in 1995. Author of more than 80 papers, Full has an active research program in comparative physiology and biomechanics that has shown how examining a diversity of animals leads to the discovery of general principles of animal locomotion. (510/642-9896)

URSULA W. GOODENOUGH, professor of biology at Washington University in St. Louis, was educated at Radcliffe, Barnard and Columbia, and received her Ph.D. (biology) at Harvard in 1969. She continued on as a postdoctoral research fellow and then as assistant and associate professor of biology, before moving to St. Louis in 1978 to assume her present position. Author of a widely adopted textbook, *Genetics*, she currently serves as president of the American Society of Cell Biology. She is also president of the Institute on Religion in the Age of Science. Goodenough's research centers on the molecular genetics and cell biology of sexual differentiation in a single-celled green algae, *Chlamydomonas*, work supported by the National Science Foundation, National Institutes of Health and U.S. Department of Agriculture. (314/935-6836)

ROBERT J. LEFKOWITZ, a native of New York City, received his B.A. (1962) and M.D. (1966) from Columbia University and his clinical and research training at Columbia's Presbyterian Medical Center, NIH and Massachusetts General Hospital. In 1973, he accepted an invitation to join the Duke University Medical Center faculty. In 1982, he was named James B. Duke Professor of Medicine and, in 1985, was also promoted to a full professorship in the department of biochemistry. Since 1976, Lefkowitz has also served as investigator in the Howard Hughes Medical Institute at Duke. He is the recipient of numerous honors, including the Bristol Meyers Squibb Award for Distinguished Achievement in Cardiovascular Research, and is a member of the National Academy of Science and the American Academy of Arts and Sciences. (919/684-2974)

CAROLE A. LONG was born in Baltimore, MD. She earned an A.B. in 1965 from Cornell University and her doctorate (microbiology and immunology) in 1970 from the University of Pennsylvania. She stayed on for another three years as an NIH postdoctoral research fellow and then joined Wyeth Laboratories as a senior research scientist. Long was appointed an assistant professor of immunology and microbiology at Hahnemann Medical College (now University) in 1977, associate professor in 1982 and full professor in 1989. Beginning in 1994, she served a year-long tenure as president of the American Society for Tropical Medicine and Hygiene. Author of 35 papers and more than 10 major book chapters and reviews, Long holds membership on the editorial board of the journal *Experimental Parasitology*. (215/762-8706)

JOHN M. J. MADEY obtained his B.S. (1964) and M.S. (1965) from CalTech and his Ph.D. (1971) from Stanford University. He joined Duke as professor of physics in 1989 and serves as director of the Duke Free Electron Laser Laboratory. Madey, while still a graduate student, conceived of the free electron laser, for which he received a U.S. patent in 1975. He led the team that demonstrated the first FEL at Stanford in 1976 and, joining with the French, the first visible FEL at Orsay in 1982. The compact infrared FEL technology which he pioneered in 1985 was commercialized in 1990. Madey is the recipient of the 1985 Prize for Achievement in Accelerator Physics and Technology, the 1988 International FEL Prize, the Franklin Institute's Stuart Ballantine Medal in 1989, and the North Carolina Award for Science in 1992. (919/660-2643)

RICHARD G. PALMER earned his B.A. (1970) and Ph.D. (1973, condensed matter theory) from Cambridge University, England, and then moved to the U.S. to join the Princeton University physics faculty. He has been at Duke University since 1977, where he currently holds rank as professor of physics, computer science and experimental psychology. He also serves as external professor and member of the science board of the Santa Fe Institute. Palmer was awarded an Alfred P. Sloan Fellowship in 1979 and a Guggenheim Fellowship in 1986. He is the author of some 70 research papers. Palmer's recent and current research interests include the physics of glasses, the theory of artificial neural networks, agent-based modeling of economic systems, and the theoretical basis of genetic algorithms. (919/660-2559)

(over)

ALLEN D. ROSES was educated at the University of Pennsylvania (B.S., 1963; M.D., 1967). After completing his residency at Columbia University in 1970, he joined Duke University Medical Center's Division of Neurology, which he has headed since 1977. In 1979, he was named a full professor in medicine and appointed director of the Duke Muscular Dystrophy Association Clinic. In 1985, he assumed additional responsibilities, as director of Duke's Joseph and Kathleen Bryan Alzheimer's Disease Research Center and as professor of neurobiology and neurology. In 1990, he was named Jefferson-Pilot Corporation Distinguished Professor. With more than 300 papers to his credit, Roses is the recipient of a host of honors, including the 1994 Metropolitan Life Award for Excellence in Medical Research. (919/684-6274)

KARL DAVID STRAUB was born in Louisville, KY, in 1937, and educated at Duke University, where he earned his B.S., M.D. and Ph.D. (biochemistry). Following a two-year stint as Lt. Commander in the U.S. Navy Medical Corps, he worked for 20 years at the VA Hospital in Little Rock, AK, as research biophysicist, staff physician and associate chief of staff of research, while at the same time serving as professor of medicine and biochemistry at the University of Arkansas. He is currently assistant director for research at the Duke Free Electron Laser Laboratory, research professor of physics, professor of medicine at the Duke University Medical Center, and staff physician at the VA Medical Center in Durham. His research centers on vibrational energy transfer in proteins and small molecular systems. (919/660-2674)

BRUCE A. SULLENGER, a native of Dayton, Ohio, did his undergraduate work at Indiana University (B.S., 1986) then moved to New York City, where he entered the doctoral program at the Cornell University Graduate School of Medical Sciences. There, in the laboratory of Dr. Eli Gilboa (now at Duke), he developed a novel approach to gene therapy against AIDS. After completing his Ph.D. in 1990, he immersed himself in the world of RNA biochemistry as a postdoctoral research fellow in the laboratory of Nobelist Thomas Cech at the University of Colorado, Boulder. In 1994, he accepted appointment as assistant professor in the departments of experimental surgery and genetics at the Duke University Medical Center, where he is pursuing efforts to develop RNA-based therapies against a range of genetic and acquired diseases. (919/684-6375)

RUSSELL M. TAYLOR II was educated at the University of North Carolina at Chapel Hill (B.S., 1989; M.S., 1991; Ph.D., 1994). Upon completing his doctorate, he was invited to join UNC's computer science faculty as research assistant professor. Taylor's interest in scientific visualization initially involved studies aimed at graphically displaying drug-protein interactions and subsequently led to efforts to develop the capacity to visualize results of computational fluid dynamics. Currently, as director of the Nanomanipulator Project, he is working on the visualization of scanning probe microscope data and leading an investigation of new force-feedback and visualization techniques to determine how to put the nation's graphic supercomputers and the information superhighway to the best scientific use. (919/962-1701)

DONALD A. TOMALIA received his B.A. (1961) from the University of Michigan, his M.S. (1962) from Bucknell University, and his Ph.D. (1968, physical-organic chemistry) from Michigan State University. From 1964 to 1990, he was a member of the Dow Chemical Company scientific staff. In 1990, he joined the Michigan Molecular Institute as research professor. A year later he was named director of nanoscopic chemistry and architecture. Tomalia, who holds 85 U.S. patents and has published more than 70 papers and chapters, also serves as scientific advisor and director of Dendritech, Inc. He is the recipient of numerous honors in recognition of his synthetic polymer research achievements, including the Industrial Research — 100 Award (1978, 1986, 1991) and the Sigma Xi Award (1987). (517/832-5601)

NEIL TUROK was born in 1958 in South Africa, where his parents were active in political opposition. After three years in East Africa, he spent his childhood in London, England, and a year as a volunteer teacher in Lesotho, before taking an undergraduate degree at Cambridge University. His doctoral research was conducted at Imperial College, London. After postdoctoral training at the University of California, Santa Barbara, he was named an associate scientist at Fermilab and then moved to Princeton, where he is now professor of physics. In 1992, he was awarded the James Clerk Maxwell Medal by the U.K. Institute of Physics. His research has focused on the physics of the early universe and structure formation, phase transition in condensed matter systems, and mathematical aspects of soliton and string theory. (609/258-4743)

DYANN F. WIRTH earned her B.A. (1972) at the University of Wisconsin and her Ph.D. (1978, cell biology and biochemistry) from the Massachusetts Institute of Technology. In 1981, following three years of postdoctoral training at Harvard, she was invited to join its department of tropical public health as an assistant professor. She was named associate professor in 1986 and full professor in 1990. Her research centers on development of new DNA-based diagnostic techniques to allow for earlier intervention in the treatment of disease and new drugs aimed at overcoming multi-drug resistance in parasites. Wirth has twice been the recipient of the Burroughs Wellcome Award in Molecular Parasitology and currently chairs the WHO/UNDP/World Bank Tropical Disease Research Steering Committee on Drugs for Malaria. (617/432-1563)