by Patrick Young

Prizes and Awards for Industry

Physicists have honored their own again this year for outstanding contributions to fields of importance to industry, that including optoelectronics, low-temperature measurement, and the discovery and exploration of nanotubes.

Industrial Physics

Charles H. Henry, the co-inventor of the quantum-well laser, received the 2001–2002 American Institute of Physics' Prize for Industrial Applications of Physics. Henry, a pioneer in optoelectronics at Bell Laboratories, was cited for his "fundamental contributions to the understanding of the optical properties of quantum wells and semiconductor lasers." Indeed, much of his research made today's optical-networking systems possible. A mastery of theory and experiment has marked Henry's innovative career. In the early 1970s, he calculated the energy levels of quantum wells, and, together with Bell Labs colleague Ray Dingle, he explored the optical transitions in quantum wells. This seminal work led in 1976 to the patent on the quantum-well laser, a now ubiquitous device in compact disc players and optical communication systems.

Charles H. Henry

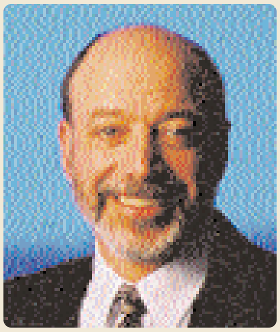
Henry then began investigating semiconductor laser materials and devices, work that established the alpha parameter as an important factor in these materials. The Schawlow–Townes (S–T) theory of laser linewidths states that linewidth is inversely proportional to the optical power. In 1960, Melvin Lax suggested that the S–T formula needed an additional term (the alpha parameter), although it was negligible for gas lasers. "But Chuck understood that it was important to semiconductor lasers," says Alice E. White, director of integrated photonics research at Bell Labs. "He showed that fluctuations in carrier density lead to phase fluctuations that cause the residency of the lasers to move around."

In the late 1980s, Henry began investigating silica waveguides fabricated on silicon wafers. "Chuck used his fundamental understanding of optics to design devices—such as external Bragg reflectors to stabilize lasers, polarization splitters, add–drop filters, and multiplexers and demultiplexers—that would be useful for optical systems," says White. Those pioneering efforts helped make possible dense-wavelength multiplexing, the backbone of fiber-optic communications systems (see page 18).

Although Henry officially retired in 1997, he continues to work with Bell Labs as a consultant.

Pake Prize

The American Physical Society (APS) commends a special kind of physicist with the annual George E. Pake Prize—one who has combined original scientific accomplishments with management leadership. The 2002 Pake Prize honors **Paul Horn**, an IBM senior vice president and its director of research. He was cited "for his innovative contributions to the understanding of 1/*f* noise, the elucidation of surface phases and phase transitions, and his signal achievements in managing IBM Corporation's global research team."



Paul Horn

Horn joined IBM in 1979 and quickly displayed a blend of innovative science and managerial skills. His most noted scientific work was in studies of 1/*f* noise, the phenomenon also known as "flicker" or "pink" noise. Horn was also among a small group of physicists who pioneered the use of synchrotron radiation at glancing angles to study the structure of surfaces. His other investigations include studies of inhomogeneous superconductivity, organic conductivity, magnetic critical phenomena, the structure of quasi-crystals, and high-temperature superconductivity.

Beginning in 1980, Horn held a series of increasingly demanding management positions, in addition to his research, which culminated in his becoming IBM's research director in 1996. Today, he oversees more than 3,000 employees at eight laboratories around the world, and he is credited with stabilizing IBM's research resources, improving morale, and restoring IBM science to its once towering status.

"Paul is sharply focused on integrating emerging technologies into the IBM product stream, and the immediate value our innovations bring in solving our customers' business problems," says Nicholas M. Donofrio, the company's senior vice president for technology and manufacturing. "Our technical teams around the world have embraced Paul's vision, and it is very exciting to see the results of the enthusiasm and leadership Paul had inspired in them."

Keithley Award

The APS's 2002 Joseph F. Keithley Award honors **Robert J. Soulen, Jr.**, of the U.S. Naval Research Laboratory (NRL) in Washington, DC, for major advances in low-temperature measurement. He was cited for developing low-temperature noise thermometry to measure temperatures between 1 mK and 1 K, and "for other significant contributions to thermometry measurement over a distinguished career."

Soulen's list of advances in low-temperature thermometry includes measurement techniques, devices, sensors, and products. "In cryogenic circles, Bob has undoubtedly been the leader in the development of thermometers over the last quarter of a century," says physicist John Clarke of the University of California, Berkeley. In addition to his scientific research, Soulen has served in management positions, twice served as a U.S. representative to the international

Consultative Committee for Thermometry, and worked extensively with the low-temperature research community.

The Keithley award winner began his research career in 1966 at what is now the National Institute of Standards and Technology (NIST), and he joined the NRL in 1987. Two of his principal contributions came in the fields of noise thermometry and fixed-point thermometry. He perfected a noise thermometer, based on a resistive superconducting quantum-interference device, to measure thermodynamic temperature below 1 K and down into the millikelvin region. “Soulen’s triumph has been, over the ensuing years, to investigate and ultimately pin down all the systematic errors so that we can now use the device to measure absolute thermodynamic temperature from 1 K down to 1 mK,” says Ralph P. Hudson, Soulen’s former mentor at NIST.

In fixed-point thermometry, Soulen’s major innovation was the use of superconductor transition temperatures to pinpoint temperature over the ranges of 0.5 to 20 K and 15 to 200 mK. He also developed a circuit that is almost universally used to measure these superconductivity transitions.

McGroddy Prize

Sumio Iijima of NEC Corp. (Tsukuba, Japan) and **Donald S. Bethune** of the IBM Almaden Research Center (San Jose, CA) shared the APS’s 2002 James C. McGroddy Prize, which recognizes outstanding achievement in the science and application of new materials. They were cited for their independent discovery and development of single-wall carbon nanotubes, a form of pure carbon that can behave like a metal or semiconductor, transmits heat better than diamond, and ranks among the strongest materials known.

In 1991, while studying the geodesic C_{60} molecules called “buckyballs” with an arc-discharge between two carbon rods, Iijima discovered multiwall nanotubes in the residue on the carbon rods. C_{60}, one of a family of molecules called fullerenes, had so intrigued researchers that no one

INDEX OF ADVERTISERS

Page #:	Company	URL	Reader Service Card No.
38	A-VAC Industries	www.avac.com	27
36	American Chemical Society	www.pubs.acs.org	25
41	Ametek	www.ortec-online.com	
29	Amptek, Inc.	www.amptek.com	19
Cover 3	CLEO/QELS	www.cleoconference.org	28
Cover 2	Comsol, Inc.	www.comsol.com	1
29	Constellation Technology	www.contech.com	20
7	Cryogenic Control Systems, Inc.	www.cryocon.com	6
Cover 4	Digital Instruments	www.di.com	29
35	Goodfellow Corp.	www.goodfellow.com	24
27	Hellma Cells	www.hellmausa.com	18
11	Huettinger Electronic, Inc.	www.huettinger.com	8
13	J.A. Woollam	www.jawoollam.com	10
27	Janis Research Co. Inc.	www.janis.com	17
6,12,29	Lakeshore Cryotronics Inc.	www.lakeshore.com	4, 9, 21
2	Lambda Physik USA Inc.	www.lambdaphysik.com	3
7	Neocera	www.neocera.com	5
21	Oxford Instruments	www.oxford-instruments.com	12
13	Pfeiffer Vacuum	www.pfeiffervacuum.com/prisma80.html	11
23,24,25	Polytec, PI	www.polytecpi.com	13, 14, 15
33	Quesant Instruments Corp.	www.quesant.com	23
9	Stanford Research Systems Inc.	www.thinkSRS.com	7
30	Televac	www.televac.com	22
1	ThermoLaser Science, Inc.	www.laserscience.com	2
27	VAT, Inc.	www.vatvalve.com	16
38	Velmex, Inc.	www.velmex.org	26

Advertisers listed in bold-face type have banner ads on THE INDUSTRIAL PHYSICIST Web site (www.tipmagazine.com).

ADVERTISING SALES OFFICES

United States
Merrie Lynch
CEL Associates
781-848-9306
781-848-2063 Fax
merrie@quik.com
States covered: CT, MA, ME, NH, RI, VT

John Waller
Brian Welsh
Waller Company, Inc.
215-822-7600
215-822-0450 Fax
johnwaller@attglobal.net
brianwelsh@attglobal.net
States covered: DC, DE, MD, NJ, NY, PA, VA, WV

UK, Ireland, France, Belgium, Netherlands, Scandinavia
John Gold
John F. Gold & Associates
+44-208-641-7717 Tel/Fax
johngoldspace@compuserve.com

Sabo Associates West
Mike Sabo
310-375-2197
310-375-2037 Fax
msabo@earthlink.net
John Sabo
310-379-8455
310-798-1394 Fax
jsabo@jsaboassoc.com
States covered: AK, AZ, CA, CO, HI, ID, MT, NV NM, OR, TX, UT WA, WY

Steve Goodman
American Institute of Physics
516-576-2449
516-576-2481 Fax
sgoodman@aip.org
States covered: FL, NC, GA, SC

Germany, Austria, Switzerland
Adela Ploner
Mediaagentur Adela Ploner
+49-8131-366-9920
+49-8131-366-9929 Fax
info@ploner.de

Mike Shevlin
Didier and Broderick
847-498-4520
847-498-5911 Fax
shevlin@didierbroderick.com
States covered: AL, AR, IL, IN, IA, KS, KY, LA, MI, MN, MS, MO, NE, ND, OH, OK, SD, TN, WI

Australia & New Zealand
Keith Sandell
Sandell Strike Skinner
Whipp Pty. Ltd.
+61-2-9922-2977
+61-2-9922-1100 Fax
keith@sssw.com.au

Japan
Hirokazu Morita
Japan Advertising Communications, Inc.
+81-3-3261-4591
+81-3-3261-6126 Fax
hmorita@media-jac.co.jp

Product Guide Advertisers pages 39–40


Sumio Iijima


Donald S. Bethune

had carefully explored the deposits formed on the electrodes used to create buckyballs. When Iijima examined the residue with a high-resolution transmission electron microscope, he found tiny tubes that consisted of two or more concentric tubules only nanometers in diameter.

"That finding established the connection between multiwall nanotubes and the fullerenes," says Mildred S. Dresselhaus, professor of physics at the Massachusetts Institute of Technology. Iijima—who is also a professor at Meijo University (Nagoya, Japan)—continued his research. Two years later, he and Bethune published separate papers reporting the discovery of single-wall nanotubes, which had been predicted but which were thought to be impossible to fabricate in the laboratory. Unlike the multiwall tubes, single-wall nanotubes are nearly perfect molecular structures, which makes them ideal for components in nanoscale electronic devices.

"This experimental discovery of single-wall carbon nanotubes led to an extremely productive period for both theoretical and experimental developments in this important field," says Dresselhaus. "Currently, the carbon nanotubes field is moving rapidly, with a publication rate of about 1,000 papers per year relevant to both novel science and promising applications."

Europhysics Prize

Sumio Iijima also shared the 2001 Agilent Technologies Europhysics Prize with three other physicists for his discovery of multi- and single-wall carbon nanotubes and pioneering studies by all four researchers of the new materials' fundamental properties. Co-winners were **Thomas W. Ebbesen**, currently at the NEC Research Institute (Princeton, NJ); **Cees Dekker** of Delft University in The Netherlands; and **Paul L. McEuen**, now at Cornell University.

"These researchers have made essential contributions to open a new field in condensed-matter physics at the interface of nanoscience, nanotechnology, and molecular electronics," the European Physical Society announced in awarding the prize.

Ebbesen and his team developed ways to produce large quantities of purified nanotubes, which further expanded research. His group also demonstrated that nanotubes have exceptionally large elastic moduli and are remarkably strong fibers. This strength is combined with an ability to buckle in a reversible manner, a mechanical property with many promising applications.

Dekker and McEuen's groups pursued the electrical properties of nanotubes. In 1997, both teams reported that the tiny tubes behave as coherent quantum wires, which opened a new research direction. Nanotubes are one-dimensional conductors, which can be envisioned as rolled-up, seamless graphite sheets with a hexagonal lattice. Their electrical properties depend on their detailed atomic structure. Several groups had predicted that nanotubes should be either metallic or semiconductors, depending on the tube diameter or the wrapping angle. Cees and his colleagues first showed this in 1998. In the same year, they demonstrated the first single-molecule transistor based on an individual carbon nanotube that could operate at room temperature. The next year, they revealed an intramolecular junction. McEuen and his team showed in 2000 that inter-nanotube junctions can act as molecular diodes. Ω

The Forum department is initiated by the American Physical Society's Forum on Industrial and Applied Physics. For more information about the Forum, please visit the FIAP Web site (http://www.aps.org/ FIAP/index.html) or contact the chair, Laura Smoliar (Laura.Smoliar@gte.net).