Institute of Physics 1984 Awards

The Institute of Physics has presented its 1984 awards: Peter W. Higgs of the University of Edinburgh and Thomas W. B. Kibble of Imperial College were jointly awarded the Rutherford Medal and Prize; Ian A. Shanks of Unilever-Research was presented the Paterson Medal and Prize; Peter E. Trier of Philips Electronics, Ltd., received the Glazebrook Medal and Prize; David W. Bullett of the University of Bath won the Maxwell Medal and Prize; Jacob Klein of Cambridge University and the Weizmann Institute, Israel, was honored with the Charles Vernon Boys Prize; Peter G. LeComber of the University of Dundee was awarded the Duddell Medal and Prize; and Michael J. Seaton of the University College, London, was presented the Guthrie Medal and Prize.

Higgs and Kibble received the Rutherford Medal for their "contributions to theoretical elementary-particle physics and particularly for the concept of spontaneous symmetry breaking in gauge theories." The Higgs–Kibble mechanism, as it is now almost universally called, demonstrates how gauge theories can be used to describe both massless photons and spin-1 particles with mass. It forms the basis for the Glashow–Salam–Weinberg unified gauge theory of electromagnetic and weak interactions; striking evidence for the latter was provided by the discovery in 1983 of massive $W^{\pm}$ and Z^0 bosons at CERN. The theory also predicts the existence of spinless particles now known as Higgs particles.

Higgs received a MSc in 1951 and a PhD in theoretical physics in 1954 from King's College, University of London. He became a senior research fellow at the University of Edinburgh in 1955, holding an ICI research fellowship from 1956–58. He then lectured in mathematics at University College in London until 1960, when he returned to Edinburgh, becoming a full professor of mathematical physics in 1980. Kibble studied at the University of Edinburgh, where he received an MA in mathematics and natural philosophy in 1955, a BSc in physics in 1956 and a PhD in mathematical physics in 1958. After spending a year at the California Institute of Technology as a Commonwealth Fund Fellow, he accepted a NATO fellowship at Imperial College, where he became a professor of theoretical physics in 1970 and head of the physics department in 1983. Apart from their joint research, Kibble has done important work in gravity theory and the theory of coherent photon states; Higgs has worked on the Feynman path integral and on supersymmetry.

Shanks received the Paterson Medal for his "contributions to the applications of liquid crystals and his several inventions in the field of displays." The author of 34 patents, Shanks' inventions are internationally known. His first, which was based on the new concept of waveform identity addressing, led directly to the liquid-crystal storage oscilloscope and he has modified the technique to make possible analogue displays. His second invention, concerning large-area, switchable, liquid-crystal color filters, was based on novel two-frequency driving techniques, which allow the colors of the filters to be rapidly switched; he has applied these to field-sequential color displays that use a monochrome cathode-ray tube. This technique involved understanding fundamental hydrostatic instabilities of twisted nematic liquid-crystal cells. More recently, a study of depth perception in displays led him to develop a system that presents a three-dimensional picture obtained from a single tv camera.

Shanks received a degree in electrical engineering in 1970 from Glasgow University. After working for two years as project manager of a group of

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photographic processing laboratories, he went to Portsmouth Polytechnic to carry out research in the field of liquid-crystal displays for his PhD. In 1973 he joined the liquid-crystal group at the Royal Signals and Radar Establishment as a research fellow and was appointed Principal Scientific Officer in 1977, having obtained his PhD from the Council for National Academic Awards in 1976. In 1982 he joined Unilever Research in Bedford, where he leads a research program in the fields of medical diagnostics, quality assurance and process control, using field-effect transistors and optical fibers to measure chemical compositions.

The Glazebrook Medal was presented to Trier for "his activities in organizing and encouraging research and development in the electronics industry as director of the Mullard Research Laboratories and subsequently director of research and development in the UK Philips Group."

Trier graduated from Cambridge as a Mathematical Wrangler in 1941. He spent nine years in the Royal Naval Scientific Service, where his main field of research was the application of uhf and microwaves in direction finding, electronic warfare and naval communications. This work generated his lasting interest in statistical communication theory and in information theory.

In 1950, Trier joined the Mullard Research Laboratories, becoming director in 1953. Under his influence, the laboratories broadened out from working on development and applications for the company and the government, to embrace research on solid-state physics and devices, electron-beam devices, consumer and professional electronics, and military systems. Significant advances included the growth of single-crystal ferrites and the elucidation of anisotropy effects, the identification of transferred electron effects in compound semiconductors, the application of digital interferometers in radar and the development and application of solid state maser amplifiers. In 1969 Trier became a main board member of Philips UK, responsible for all Philips research and development and technical innovation in the UK. He held this post until his retirement in 1981, but still acts for Philips as a consultant and nonexecutive director.

The Maxwell Medal was given to David Bullett for "his outstanding contributions to the theory of bonding in solids." Bullett has revitalized the local approach—the linear combinations of atomic orbitals or tight-binding method—for calculations of electronic structures. His method provides a fully quantitative description of chemical bonding in terms of local atomic environment and its accuracy enables one to consider more complicated systems such as transition-metal chalcongenides. Another area of application is to the chemical properties of surfaces: the copper-surface calculations, for example, had been thought totally inaccessible to those atom-based methods, but are a great success. His most recent work, on boron, attacks a classical problem of formidable difficulty, and his refinements on the "linear combinations" methods makes it possible for the first time to throw light on many features of the various known structures.

Bullett obtained his PhD in 1975 while working in the condensed-matter group at the Cavendish Laboratory of Cambridge University. He was elected to a Science and Engineering Research Council Fellowship at the Cavendish Laboratory in 1977. Subsequently, he joined the University of Bath in 1979 and was appointed reader in the school of physics in 1983.

Klein received the Charles Vernon Boys Prize for "his outstanding contributions to experimental macromolecular physics." His research activities have focused on two separate aspects of polymer physics: the effect of adsorbed polymers on short-range interactions between surfaces and the dynamics of entangled, nonlinear polymers. To study short-range interactions Klein used polymer-bearing surfaces made from molecularly smooth sheets of mica, with separations measured to within 0.2 nm using optical interferometry. This work has provided new information on the nature of intermolecular interactions between surfaces covered with swollen or bulk polymers. The technique for the studies of the diffusion of long-chain organic molecules through a polymer matrix, developed in conjunction with Brian Briscoe, involves labeling the diffusant, which can then be detected by infrared spectroscopy to determine the profile of penetration as a function of time. Klein's experiments have provided the first direct support for the reptation model for long-chain diffusion introduced by Pierre-Gilles de Gennes (PHYSICS TODAY, June 1983, page 33).

Klein's doctoral research at the Cavendish Laboratory was on the diffusion of long molecules in bulk polymers; he obtained his PhD in 1977. He then spent three years as a postdoctoral fellow in the Polymer department of the Weizmann Institute of Science in Israel. In 1980 he received the appointments he now holds as senior scientist at the Weizmann and as a university demonstrator at the Cavendish.

LeComber was awarded the Duddell Medal and Prize for "his outstanding work in the field of amorphous semiconductors." LeComber's early research concerned electron transport in CdS, ZnS and in the molecular solids and liquids formed from rare and other simple gases. The first measurements, in 1969–70, of electron drift mobility in amorphous silicon films led to his major research interest in the field of amorphous semiconductors and to an extensive study of these films, produced by the glow discharge decomposition of silane, with W. Spear. Their discovery, in 1972, of the remarkable low density of states of the material provided an explanation of its exceptional properties and led to their development of the amorphous silicon field effect transistor. It also enabled them to produce both n-type and p-type material and to make the first amorphous p–n junction, with the subsequent development of amorphous silicon photovoltaic cells. Since 1976, LeComber has contributed greatly to the development of these transistors and has explored their potential for addressable liquid-crystal displays, image sensor arrays and logic circuits.

LeComber obtained his PhD at the University of Leicester before going, in 1965, to Purdue University in Indiana as a research fellow. He returned to Leicester in 1967 as a Sciences Research Council research fellow for a year before moving to Dundee, where he obtained his DSc in 1981.

Seaton received the Guthrie Medal and Prize for "his many outstanding contributions to atomic and molecular physics, atmospheric physics and astrophysics." His work has included: fundamental research on the forbidden lines seen in auroral spectra and gaseous nebulae; the development of multichannel quantum-defect theory, which is now widely used throughout the world; the study of central stars of gaseous nebulae.

After serving in the Royal Air Force during World War II, Seaton became an undergraduate at University College in London, obtaining his physics degree in 1948. With the exception of brief visits elsewhere, he has remained at University College London since then. For his PhD in applied mathematics he worked, under the direction of David Bates, on calculating atomic reaction rates for applications to plasmas.

Seaton next turned to Hartree-Fock equations for continuous states. Around 1954, he realized that the quantum-defect theory provided a powerful tool for the interpretation and production of atomic data and, also during this period, he carried out the work that established the importance of proton collisions with atomic ions in laboratory and astrophysical plasmas. In 1957, he gave the first rigorous discussion of the partial-wave theory of long-range interactions between electrons and hydrogen atoms, and somewhat later he collaborated on the first algebraic formulation of the problem of the polarization of line radiation by electron impact, which now forms the basis for the interpretation of electron–proton coincidence experiments. Since 1963 he has been professor of physics at University College London; in 1967 he was elected a Fellow of the Royal Society.

Wolf Foundation Prize in Chemistry

Herbert S. Gutowsky, Harden M. McConnell and John S. Waugh have been awarded the Wolf Foundation Prize in Chemistry for 1983–84 for their work in magnetic resonance spectroscopy.

Gutowsky, of the University of Illinois at Urbana, is being honored for "his pioneering work in the development and application of nuclear magnetic resonance spectroscopy in chemistry." Gutowsky's work on the chemical shift effect and its relation to molecular structure has provided chemists with working tools to study molecular conformation and molecular interactions in solutions. His pioneering work on the spin–spin coupling effect developed this phenomenon into a "finger print" method for identifying and characterizing organic compounds. He was also the first to observe the effect of dynamic processes on the lineshape of high-resolution nmr spectra, and he subsequently exploited it for the studies of hindered rotation in molecules. Simultaneously with others, he discovered the effect of the scalar and dipolar interaction with unpaired electrons in solutions of paramagnetic ions. Gutowsky, who obtained his PhD from Harvard University, has been on the faculty of the University of Illinois since 1948, heading its chemistry department for the past 14 years.

McConnell, of Stanford University, is being honored for "his studies of the electronic structure of molecules through paramagnetic resonance spectroscopy and for the introduction and biological application of spin label techniques." McConnell recognized that the discovery of nuclear hyperfine interactions in aromatic free radicals represented a major breakthrough in the study of the electronic structure of unsaturated hydrocarbons: his studies showed conclusively that this interaction gave a measure of the densities of unpaired electron spins in the carbon atom. McConnell's investigations of the anisotropic nuclear hyperfine interaction laid a firm foundation for the analysis of the paramagnetic resonance spectra of organic free radicals in molecular crystals; his work also provided the first experimental demon-