

delight and amazement some of those excursions when he was well into his nineties. On the walks, he would often act as a mentor, sharing experiences with me about running large laboratories in an effort to help me to successfully run the MIT Center for Materials Science and Engineering. His devotion to the outdoors and exercise contributed to his own high energy level, to his long and active research career that stretched well into his eighties, and to his long life.

On the personal side, von Hippel was devoted to his wife and life partner, to his four sons and daughter, and to his grandchildren. One family thread that struck me was the large concern his offspring have for making the world around them a better place.

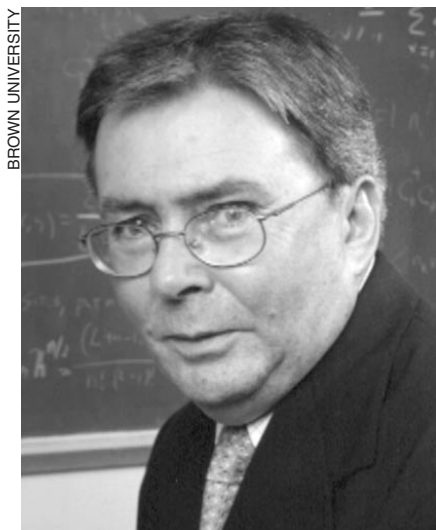
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Anthony Houghton

Anthony Houghton, a world-renowned theoretical condensed matter physicist, died of cancer on 28 July 2003 in Providence, Rhode Island.

Born on 4 October 1935 in Heanor, England, Tony received a BSc in mathematical physics from the University of Birmingham in 1956. His 1959 PhD thesis, "Non-Perturbative Approach to Impurity Resistance in Metals," was conducted at Birmingham under the supervision of Geoffrey Chester in the group of Rudolph Peierls. Tony carried out postdoctoral research at the Carnegie Institute of Technology (now Carnegie Mellon University) in Pittsburgh, Pennsylvania; the University of California, San Diego (UCSD); and at McMaster University in Hamilton, Ontario.



Anthony Houghton

In 1963, Tony joined Brown University in Providence as an assistant professor in the physics department and rapidly rose through the academic ranks. During his career at Brown, he made many lasting contributions to condensed matter physics as the single author and coauthor of more than 90 papers. His early work focused on aspects of the Bardeen-Cooper-Schrieffer theory of superconductivity, including ultrasonic attenuation. In a well-known collaboration in 1973 with Franz Wegner, then at the Institut für Festkörperforschung, KFA Jülich, Germany, Tony made an important contribution to renormalization group theory by developing a differential form of the recursion relations.

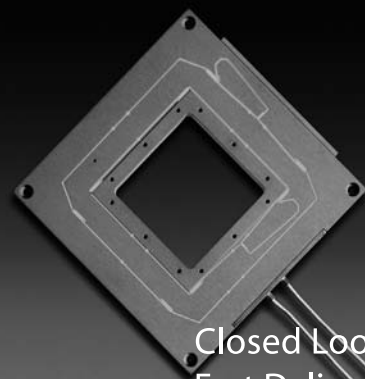
During the 1980s, Tony turned to the physics of strongly correlated electrons and carried out pioneering work on the use of the $1/N$ expansion to describe the Anderson impurity model. After the 1986 discovery of high-temperature superconductors, Tony worked with collaborators to develop a theoretical description of the melting of the vortex lattice; that description provided excellent agreement with experimental data.

Much of Tony's attention during the 1990s was devoted to the physics of fermion liquids. Alan Luther and Duncan Haldane showed that bosonization could be extended to dimensions greater than one, and Tony spent much of that decade exploring the ramifications of those ideas. During that period, he also was Brown's physics chair (1992–98).

Tony held visiting professorships at many European and American institutions, including Oxford University and UCSD. He held Science Research Council fellowships and, in 1977, won an Alexander von Humboldt Senior Scientist Award.

Tony was a superb teacher and mentor to his students and junior colleagues. He taught a wide range of classes, from introductory pre-med to many-body theory, and prepared and delivered his lectures with the utmost care and diligence. Throughout his life, Tony ventured into new physics with the energy and determination of a young person just starting in the field, and he did not take the easy way out. He worked through every complicated calculation himself and understood each detail of all of his collaborative efforts, whether with his students or other researchers. Colleagues would pass by his office and see him bent over his desk doing page after page of calculations to fill in the details of important papers in an

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emerging field; he was convinced that this was the only way to truly master a new subject.

Despite a diagnosis of cancer in early 1999, Tony maintained high spirits and often used his wry sense of humor to calm his concerned colleagues. He continued to work on strongly correlated systems during a period of remission. But in late 2002, the cancer reappeared and his condition deteriorated quickly. A blackboard covered with equations and derivations remained in his office after his death.

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Hideo Kubo

Hideo Kubo, a leading researcher and clinical practitioner in radiation therapy physics, died suddenly on 3 October 2003 in San Francisco of complications following heart transplant surgery. He was a man who thrived on all aspects of his profession, and despite the cardiomyopathy that drained his stamina, he maintained a rigorous pace at work up until the day before his surgery.

Dale, as he was commonly known, was born on 3 April 1943 in Yokosuka, a Japanese fishing town at the mouth of Tokyo Bay. He received his bachelor's degree from the Tokyo Institute of Technology in 1966. He then traveled to North America to complete his master's degree at McMaster University in Hamilton, Ontario (1968) and his doctorate in atomic and nuclear physics at the University of Rochester in New York (1973). After returning to Japan for three years to teach at the Kitasato Medical School in Sagami-hara, Dale moved back to the US permanently and completed his medical physics postdoctoral training at the Memorial Sloan-Kettering Cancer Center in New York.

Following that training, he joined the department of radiation medicine at Massachusetts General Hospital in Boston, where he began working in radiation dosimetry, an interest that he pursued throughout his career. He became a recognized expert in several areas of dosimetry, including calorimetry-absorbed dose standards for high-energy electron and photon beams and air-kerma standards for photon brachytherapy. One of Dale's early influential papers demonstrated experimentally that then current exposure standards for iodine-125 seeds were contaminated by low-energy characteristic x-rays. That finding,

along with theoretical calculations by one of us (Williamson), paved the way for the new wide-angle free-air chamber (WAFAC) standard implemented at NIST in 1999. Due in large part to Dale's work, 50 000 prostate patients treated annually with brachytherapy benefit from elimination of a 10% uncertainty in dose specification.

In the mid- to late 1980s, during his tenure first at Albany Medical College in Albany, New York, and then at the University of Rochester, Dale developed a Wheatstone bridge-based calorimeter for absolute dosimetry. That device used pulsed excitation instead of the conventional DC excitation to increase sensitivity and limit the self-heating to an acceptable level. In recognition of his contributions to the field, Dale was selected as a member of two American Association of Physicists in Medicine task groups on dosimetry and, from 1995 to 1998, chaired the AAPM ad hoc committee that oversaw the clinical transition to



Hideo Kubo

the new WAFAC standard of air-kerma strength for ^{125}I brachytherapy.

In 1991, Dale became the first chief of physics and professor of radiation oncology at the brand-new department of radiation oncology at the University of California, Davis; he held that position until his death. He was a driving force behind the development of the department, and his contributions helped the UC Davis Cancer Center win "clinical cancer center" designation by the National Institutes of Health.

While at UCD, Dale established himself as a leader in the emergent technology of breathing-synchronized radiotherapy, which seeks to reduce the irradiation of excessive volumes of normal lung or geometric miss of the

tumor resulting from respiration-induced organ and tumor motion (as large as 2 centimeters) during external-beam radiotherapy. By analyzing tissue motion on pretreatment cine fluoroscopic images synchronized to the patient's breathing cycle, Dale was able to determine the breathing cycle phase in which the organ motion is minimized. Through monitoring of the patient's breathing cycle during treatment, he succeeded in gating the linear accelerator output to produce radiation only during the designated breathing cycle. Although the concept of gating had been developed in Japan for ion-beam radiotherapy in the late 1980s, Dale, in 1996, was the first to implement gating for photon-beam radiotherapy and the first ever to do so in the West. Ultimately, this work led to a commercial gating system that is now used around the world to improve lung cancer radiotherapy. The method can also be applied to a CT scanner to produce a set of gated CT images.

Dale's interests went beyond his research to supporting and training young physicists as well as medical students, residents, and fellows. He was instrumental in establishing UCD's radiation oncology physician residency program, which received accreditation in 2004, and, before his death, had been working on establishing a matching medical physics residency. He worked hard to foster ties with the Japanese medical physics community; he formed collaborations with Japanese colleagues and visited Japan often to share his expertise. He created a visiting scholar program at UCD for members of the Japanese Society of Radiological Technology, but unfortunately died shortly before the first visitor was scheduled to arrive.

An active and respected clinical physicist, Dale was deeply involved in both AAPM and the American Society for Therapeutic Radiology and Oncology. He served on AAPM's radiation therapy committee and, from 1988 to 1991 was on the society's board of directors.

Although Dale spent much of his time and energy on medical physics, he had a variety of other interests. Foremost, he was devoted to his family. He also was an avid traveler, a nature enthusiast, a patron of music, and an insatiable learner. He is missed by all whose lives he touched.

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