

ate education at Catawba College. He did graduate work at Vanderbilt University and the University of North Carolina at Chapel Hill, and was granted a PhD in physics by the latter in 1943.

During World War II Beck did research on the enrichment of uranium isotopes in the Manhattan District's SAM laboratories of Columbia University. After the war, the staff and facilities were moved to the Oak Ridge Gaseous Diffusion Plant, and he joined Dixon Callihan and Elizabeth Johnson in criticality studies for the safe handling and storage of fissionable material, which involved placing variable masses of U^{235} or Pu^{239} on a variety of lattices with variable spacings.

At this stage of the development of nuclear energy, it was widely assumed that all nuclear reactors had to be government owned and operated in facilities of the Atomic Energy Commission. Beck questioned the necessity of this policy and succeeded in persuading AEC to license the construction on a university campus of a research reactor owned and operated by the university. In 1949 he went to North Carolina State University as professor and head of the department of physics. There he directed the construction and operation of the first university research reactor, which was used to train undergraduate and graduate students in the new field of nuclear energy. Participants came from many locations for what became a pioneering and international study program.

While at North Carolina State, Beck was instrumental in organizing the American Nuclear Society and was a founding member and director of the organization. In 1953 he was elected to the board of directors of the Oak Ridge Institute of Nuclear Studies (now Oak Ridge Associated Universities), and was vice president from 1954 to 1956.

In 1956 the Atomic Energy Commission separated the regulatory from the promotional functions for nuclear energy, and Beck was appointed chief of the reactor hazards evaluation branch of the new division of licensing and regulation. Later, as deputy director of regulation Beck contributed significantly to establishing safety standards in the nuclear industry. When the Nuclear Regulatory Commission was established as an independent agency, Beck transferred from AEC to NRC and distinguished himself particularly in its international program.

From 1960 to 1969, Beck served as a member of Maryland's Montgomery County board of education, serving as its president in 1967. He was instrumental in founding the Maryland State Board of Community Colleges and

served as its chairman from 1968 to 1979.

Both of us were colleagues of Beck at Columbia during the war. As members of the dwindling community of those who had the thrill of participating in the Manhattan Project, we mourn his death and shall miss his companionship in the future.

WILLIAM G. POLLARD

Oak Ridge Associated Universities

DONALD B. TRAUGER

Oak Ridge National Laboratory

Henry Levinstein

Henry Levinstein, professor of physics at Syracuse University, died on 21 June 1986 at the age of 66.

Levinstein was born in Themar, Germany, and came to the United States in 1938. He did his undergraduate and graduate work at the University of Michigan, eventually receiving his PhD in 1947 under the sponsorship of H. Richard Crane. That same year he joined the physics department at Syracuse University.

His research was in solid state physics. At first his principal interest was in understanding and developing intrinsic photoconductive infrared-sensitive detectors, including PbSe, PbTe, InSb and GaAs. For some years, his research group was the only source of detectors whose sensitivity extended to the 5-micron region. These detectors were made available to workers in astronomy, environmental science, medicine and the military.

Subsequently he concentrated his efforts upon extrinsic infrared detectors, primarily the various doped-germanium types. Levinstein and his students greatly elucidated the physics of these materials, and many of his students continued to work in this field at various universities and industrial laboratories throughout the country.

Levinstein served as chairman of the New York State section of The American Physical Society. He was chairman of the Third International Photoconductivity Conference in 1969 and he edited its conference reports. He was also a longtime chairman of the detector group of IRIS and was president of the Syracuse chapter of Phi Beta Kappa. He served as an adviser to Texas Instruments and General Telephone and was a member of the technical advisory board of Aerojet General, and for many summers he taught a course on photoconductivity at the University of California at Santa Barbara.

One of his continued interests was "gadgets," and he developed it into a course on the physics of toys, which attracted hundreds of undergraduates

each time it was given. He became a noted speaker on the subject and gave numerous, entertaining after-dinner talks at APS meetings in the United States and Canada.

Levinstein was very popular with his undergraduate students, many of whom considered him a friend as well as a teacher and kept contact with him long after graduation because of his warm and gentle nature. His fellow faculty thought highly of him as a person and as a scientist.

NATHAN GINSBERG

H. W. BERRY

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Joyce Alvin Bearden

Joyce Alvin Bearden, professor emeritus at The Johns Hopkins University and a major figure for over half a century in x-ray research, died on 28 July after a period of ill health. He was 82.

Bearden was born in Greenville, South Carolina, in 1903 and graduated from Furman University in 1923. He received a PhD from the University of Chicago in 1926 and remained there as an instructor for three years. In 1929 he joined the Johns Hopkins faculty, advancing to a professorship in 1939. During World War II, Bearden worked with the National Defense Research Committee on the variable time proximity fuze, an association that not only took him to Europe as a Colonel in the US Army but also led to his founding, with D. Luke Hopkins, Merle Tuve and Lawrence Hafstad, The Johns Hopkins Applied Physics Laboratory. After the war he assumed the directorship of the radiation laboratory at Johns Hopkins, a position he held until 1955. From 1947 through 1949 he also served as chairman of the physics department.

Bearden's 50-year scientific career began in the early years of quantum mechanics and terminated only near his death. Best known is his work dealing with fundamental constants and accurate x-ray wavelengths. But one finds as well several efforts at conceptual clarifications, such as his first paper (published jointly with Arthur H. Compton) on the effect of a surrounding box on the spectrum of scattered x rays; in this category is also to be found a paper with John A. Wheeler on x-ray line strengths. Nevertheless, it is the body of his work concerned with exact measurement that is most widely appreciated and for which he will be long remembered. Within this domain there were two periods of intense productivity which, though separated by thirty years, pro-

duced work whose substance gives true meaning to the notion of the exact sciences.

The first period began with his raising the level of precision and accuracy of ruled-grating x-ray measurement to that of crystal diffraction spectroscopy, which was by 1930 highly developed in both Europe and the United States. That his results implied an error in the electronic charge as determined by Millikan's oil-drop experiment was an inevitable conclusion, but one not easily maintained in the face of the authoritative and long-standing prior result. Although critically scrutinized by many, Bearden's measurements held and recourse was made to a collection of "explanations" involving mechanisms by which x-ray diffraction should behave differently from diffraction at longer wavelengths. Bearden sought to investigate these mechanisms in a series of elementary but difficult and quite beautiful experiments, including the first accurate prism deflection spectroscopy in the x-ray region. The end is well known: Bearden was correct and the oil-drop result for e was wrong owing to a subtle error in method of determining the viscosity of air, which was required in data reduction for the oil-drop experiment. With the final resolution of this problem came a brief golden age for x-ray determinations of fundamental constants. This period is well delineated in "A survey of atomic constants," which Bearden wrote with John S. Thomsen and which appeared ultimately as a 1957 supplement to *Il Nuovo Cimento*.

The second flowering of his scientific output came in the 1960s, when retrospective study and new measurements by Bearden and his collaborators suggested that there was a previously unsuspected inconsistency between the shorter wavelength region of the x-ray scale and its longer wavelength domain. In response to this discrepancy Bearden carried out a critical reexamination of all high precision x-ray measurements with a view toward establishing a new and internally consistent scale for x-ray wavelengths. This new scale was to be based on a new, easily distinguished unit for which the conversion factor would be closer to unity than was the case for the ratio of the Siegbahn x-unit to the milli-Angstrom. Bearden and his collaborators used William H. Bragg's ansatz to compute the dimension of a silicon crystalline unit cell from its density and mean molar mass together with the least-squares estimate of Avogadro's constant. Their efforts to improve the internal consistency of the x-ray wavelength scale were more successful than was their attempt to make

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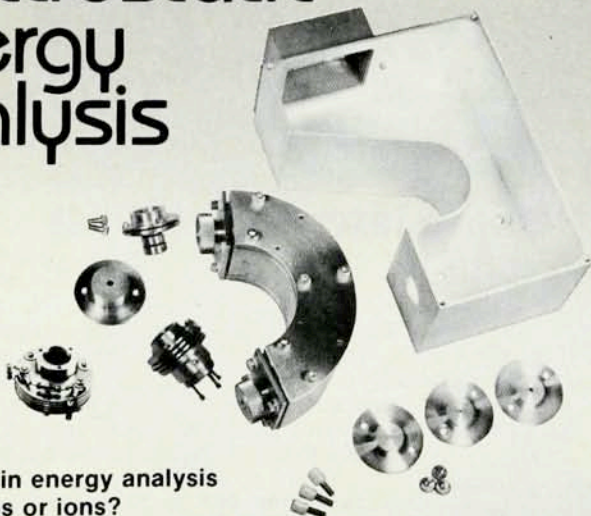
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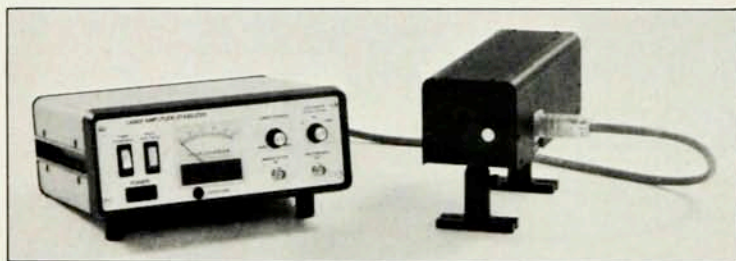


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the new unit $\text{\AA}^*$ be equal in length to the angstrom—a difficult task which required the determination of the numerical conversion factor between the two scales as then established via the krypton definition of the meter. The problems were twofold: they had access only to a geochemical average mean molar mass for Si (as deduced from isotopic abundance measurements); and the 1964 adjustment of the fundamental constants gave a value for Avogadro's constant biased by a wrong choice between values of the fine-structure constant implied by fine-structure and hyperfine-structure measurements, an issue only resolved by subsequent work using the Josephson effect. With all its limitations and indeed its own (though considerably smaller) internal inconsistency, Bearden's wavelength table stands even today as the most accurate and comprehensive work available for general recourse. The summation of this work appeared as two articles in the 1967 *Reviews of Modern Physics*: "X-ray wavelengths" and "Re-evaluation of x-ray atomic energy levels" (written with Alexander F. Burr).

As a teacher, Bearden took pains with the preparatory work on his general physics lectures, especially the experimental demonstrations. His graduate students, though encouraged to work outside the domain of precision measurement, were inevitably led to an appreciation of the rare beauty and austere pleasure of this exacting discipline. They also came to know a preacher of small sermons, a storyteller of charm and gentle humor and a faithful, objective chronicler of professional disagreements. As with the other preaching vocation (with which he was, incidentally, closely associated) there was one true goal and no other. It is hard to give this goal a name, but it would not be wrong to consider it to be scientific rectitude. That rectitude should begin with getting the physics straight, then getting an important measurement to operate correctly and well, and should conclude with rooting out by diligent inspection all hidden sources of possible bias.

After his formal retirement at age 70, Bearden continued to work in his laboratory, often still remaining late at night. At the time of his death he was working on an improved wavelength atlas. He was a hopeful realist whose life encompassed both his work and his church.

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