Albert M. Clogston

1917–2013

BIOGRAPHICAL *Memoirs*

A Biographical Memoir by
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NATIONAL ACADEMY OF SCIENCES

ALBERT McCAVOR **CLOGSTON**

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Elected to the NAS, 1973

By P. W. Anderson and W. F. Brinkman

Albert McCavor Clogston was born in Boston, MA, to Alice Louise and Luman Geoffrey Clogston, and grew up north of the city in Melrose, MA. He attended the Massachusetts Institute of Technology, something he had long expected to do, as his father diligently took him to open houses there every year while he was in high school. Al was fascinated by the high-voltage electrostatic generators and the huge sparks. He was an excellent student at MIT, even asked to give a public lecture during his freshman year. Although he started in chemistry, he quickly switched to physics, which he had come to regard as his destiny. In Al's senior year he studied advanced quantum mechanics in a special seminar, along with Richard Feynman and others.

Al graduated in the spring of 1938 and was admitted both to Princeton and MIT for graduate school. Upon learning that Feynman was enrolling at Princeton, Al began his graduate studies at MIT, even though he would have liked to work with John Wheeler. Very rapidly Al started his research and wrote a paper in which he calculated the 3p and 3d excited states of the light elements, getting good agreement with the observed transition energies. He also wrote two papers with Herman Feshbach on small variations of boundary conditions in calculating sound waves.

At the beginning of World War II, Al joined MIT's Radiation Laboratory, where he did his thesis work. (The original copy of the thesis is now in his grandson's keeping.) The Rad Lab was already famous for being the center of R&D on radar, and the radar systems it created were to become very important in winning the war. The Rad Lab was also of great professional benefit to Al; he always said that he had matured there as a scientist and science manager.

Al did research on magnetrons (the central power-producing tubes of radar systems) at the Rad Lab and soon became head of the Magnetron Research and Development

Group. Al made several inventions aimed at improving the functioning of magnetrons—most notably an injection magnetron that reduced the noise from the hot cathode—and he authored the segment of the Rad Lab's official history dealing with the subject. Later, after moving to Bell Labs, he invented a better injection magnetron and made improvements on the coupling of the radiation from a magnetron into a waveguide, among several other inventions.

In the meantime, Al met Molly Wyland (in 1939). A student at Barnard College, she was the roommate and best friend of his cousin. Corresponding and visiting throughout 1939–1941, they were married in September 1941, soon after he received his Ph.D. from MIT. Al and Molly had two children during his time at the Rad Lab—Nancy in 1943 and Carole in 1945.

When Al arrived at Bell Labs in 1946, he joined John Pierce's team that was doing research in electron tubes and high-frequency transmission. During his time in the electronics area Al acquired several patents on electronic devices, but his major contribution there was the "Clogston cable," which had a laminated central conductor that much reduced microwave system losses. On the strength of this achievement Al was promoted to department head, and in 1953, in their search for managers knowledgeable in quantum physics, the Bell leadership appointed him department head in the burgeoning area of quantum solid-state physics.

On the home front, after a brief stay in Morris Plains, NJ, Al and Molly settled in Mendham, a pleasant village in the hills and a 10-mile drive from the Murray Hill Labs; it was in Mendham that they brought up their two girls. Al, characteristically public-spirited, was on the school board shortly after one of the authors (PWA) moved to Mendham in 1951. Later, the Clogstons lived in Madison, NJ, closer to Murray Hill.

Not long after Al's appointment in quantum solid-state physics he brought with him from his original Bell Labs department at least Larry Walker and possibly Harry Suhl; and by 1957 (reflecting the earliest department list during his tenure that we were able to find) he had added as new hires Joe Dillon, Seymour Geller, Stan Geschwind, Vince Jaccarino, Art Schawlow, and a couple of others. It is interesting that, as far as we know, neither Al nor any of these young physicists had a background in magnetism, yet they very quickly became one of the dominant groups in that field. Al's first publication after the move was a review article in the *Bell System Technical Journal* on ferromagnetic resonance relaxation in the ferrites. PWA had just returned from a Fulbright lectureship in Japan, where he had lectured on the theory of magnetism, and when he repeated that course for the benefit of the new Bell Labs departments developing solid-state devices, some of Al's young physicists attended.

PWA recalls that members of a Clogston-led department during that era worked as more of a team than most of the other departments in the basic research area, with Al himself often being part of the collaborating group (though not necessarily in a dominant role, contrary to the sociology of most academic research groups at the time). It particularly impressed us that when the theory department was formed in 1956, Suhl and Walker chose not to join it but to remain part of Clogston's team. There were important developments in his department that were quite independent of Clogston—notably Schawlow's invention of the laser and Jaccarino and Shulman's collaboration on nuclear magnetic resonance in magnetic fluorides—but they were exceptional. Results of the more collaborative model were the work on mechanisms of relaxation in ferromagnetic resonance, the introduction of iron garnets as insulating magnets (Dillon), Suhl's research in nonlinearly driven processes in ferromagnetic resonance, and particularly the long series of efforts on magnetic impurities in metals and superconductors. The latter began from a classic letter in 1960, by Berndt Matthias, Suhl, and several other members of Clogston's team, that addressed the effect of various magnetic impurities on Tc, and the investigations continued for half a dozen years as an in-depth study of the magnetic impurity states in metals. In the course of this incursion into superconductivity, Al proposed the "Clogston Limit" on the critical fields of superconductors.

In 1963 he was promoted to assistant director of the Metallurgical Department, in response to a momentary crisis of some kind; and with the retirement of Sid Millman, Al was promoted in 1965 to director of the Physical Research Laboratory. This was a laboratory that drew its name from the beginnings of Bell Labs in the 1920s. With this promotion, Al's personal research publications ceased for 25 years, not surprisingly, because he was now responsible for managing a third of the fundamental research in the physical sciences at the Labs—involving the work of some 50 Ph.D. scientists.

The period from the mid-1960s to the late '70s, was a golden age of basic physics research in American industry, and Al was one the leaders of Bell Labs' great efforts during that time. As a manager he showed strong interest in the research of those who reported to him, and he frequently visited a researcher's office to discuss the state of the work.

Al and Molly, now in Madison, NJ, had frequent dinner parties to make us feel warmly welcomed to Bell Labs.

Condensed matter physics, particularly superconductivity, was the dominant activity at the Labs but there also were efforts in far-out subjects such as neutrino mass and gravitational waves. Al allowed the founding and growth of a small molecular biology department that would later lead to the invention of functional MRI technology. Moreover, he was hospitable to unconventional personnel arrangements, such as Matthias' running of no less than three laboratories—at La Jolla, Los Alamos, and Bell—and PWA's joint appointment with Cambridge University.

A large number of us in research were opposed to this program because we did not believe it would work, and we rather innocently signed a petition to that effect. Soon a full-page ad appeared in the *Washington Post* with the headline, "Look who is opposed to ABM, the people who built it."

One of the many interesting stories about Al's management during this period involved the viability of the proposed anti-ballistic missile (ABM) system that the U.S. Department of Defense was proposing. A large number of us in research were opposed to this program because we did not believe it would work, and we rather innocently signed a petition to that effect. Soon a full-page ad appeared in the *Washington Post* with the headline, "Look who is opposed to ABM, the people who built it." Indeed, at that time Bell Labs was a major defense contractor that had (at the Whippany site) the contract for the ABM. Given this embarrassment to the Labs, its top management thought we should be fired. But because most of the petition signers were in Al's department, and Al said he would resign if they fired us, this threat and his careful management of the situation saved our jobs. One of us (PWA) remembers with some regret a raucous dinner party at which Al endured in silence merciless twitting on this subject by Matthias, myself, and others.

AT&T (Bell Labs' parent) was the long-term contractor that managed Sandia National Laboratory (near Albuquerque, NM) under a contract with the Department of Energy and its predecessors. As part of that management, the company regularly sent out to Sandia one person to be its president and another to be the vice president of research, appointments that typically were for two to three years. Al was sent to Sandia in 1971 and spent two years there as vice president of research. People there remember him as a person keenly interested in the technology of nuclear weapons and the Lab's other research activities, and he was well known for his early-morning tutorials on these subjects. It was during this time that Al and Molly fell in love with the New Mexico

Late career portrait of Albert Clogston. (Photo by Bachrach.)

climate and lifestyle, and they decided to move there when he retired.

Following his tenure at Sandia, Al returned to Bell Labs and was appointed executive director of the Physics Research and Academic Affairs Division, which contained three labs: the Physical Research Lab, the Chemical Physics Lab, and the Solid-State Electronics Research Lab. He remained in this job until his retirement in 1982, and during his tenure he oversaw the work of a large number of outstanding young scientists—Bob Birgeneau, Bert Halperin, Maurice Rice, Tony Tyson, Steve Chu, Al Cho, Doug Osheroff, and David Tank, to name a few—who were then starting their careers at Bell Labs. Al encouraged new and collaborative activities, such as Birgeneau's neutron scattering at Brookhaven Lab and Peter Eisenberg's X-ray scattering at the National Synchrotron Facilities. At the same time, his Bell colleagues were doing much research on semiconductor laser technology—Cho in particular developed molecular beam epitaxy, which became widely used to fabricate many types of electronic devices. By the beginning of the 1980s, Al's division was doing field trials that would lead to the enormous growth of optical networks.

During this period and well into the 1980s, Al was very active on the national scientific scene. He was elected to the National Academy of Sciences in 1973 and served on a variety of its committees. He was a member of the NAS Council and its Executive Committee from 1984 to 1987. He also served on several committees of the American Physical Society, including that body's Council and Executive Committee.

Al retired from Bell Labs in 1982 and moved to Tesuque, New Mexico, where he and Molly had built a new home. He soon became involved in materials research at the Los Alamos National Laboratory and in 1983 was appointed chairman of its Center for Materials Research for three years; he remained a member of the Center for 10 years. John Wheatley, a renowned low-temperature physicist who worked under Al at Los Alamos, called him the best boss he ever had because Al was truly interested in the research that John was doing!

After retiring for the second time, Al continued to do physics with Keith McDowell, working on a generalized Langevin theory as it applied to vibrational spectroscopy.

For health reasons, Al and Molly decided in 2000 to leave their much-loved New Mexico and live near their daughter in Raleigh, NC. He died there on January 14, 2013.

Al walking his dog in Tesuque.

SELECTED BIBLIOGRAPHY

1939 With L. Goldberg. Variational atomic wave functions. *Phys. Rev.* 56:696–699.

1941 With H. Feshbach. Perturbation of boundary conditions. *Phys. Rev.* 59(2):189–194.

1948 Principles of design. In *Radiation laboratory series*, edited by L. N. Ridenour. pp 401–459. New York: McGraw-Hill.

1951 Reduction of skin effect losses by the use of laminated conductors. *Bell System Tech. J.* 30(3):491–529.

1955 Relaxation phenomena in ferrites. *Bell System Tech. J.* 34(4)739–760.1956.

With H. Suhl, L. R. Walker, and P. W. Anderson. Ferromagnetic resonance line width in insulating materials. *J. Phys. Chem. Solids* 1(3)129-136.

1958 Susceptibility of the three-level maser. *J. Phys. Chem. Solids* 4(4):271–277.

Inhomogeneous broadening of magnetic resonance lines. *J. Appl. Phys.* (29)3:334–336.

1959 With A. L. Schawlow and D. L. Wood. Electronic spectra of exchange-coupled ion pairs in crystals. *Phys. Rev. Letters* 3(6):271–273.

Optical Faraday rotation in ferrimagnetic garnets. *J. Phys. Radium* 20(2–3):151–154.

1960 With B. T. Matthias, M. Peter, H. J. Williams, E. Corenzwit, and R. C. Sherwood. Magnetic moment of transition metal atoms in dilute solution and their effect on superconducting transition temperature. *Phys. Rev. Letters* 5(12):542–544.

1961 With V. Jaccarino. Susceptibilities and negative Knight shifts of intermetallic compounds. *Phys. Rev.* 121(5):1357–1362.

With B. T. Matthias, H. J. Williams, E. Corenzwit, and R. C. Sherwood. Ferromagnetism in solid solutions of scandium and indium. *Phys. Rev. Letters* 7(1):7–9.

1962 With B. T. Matthias, M. Peter, H. J. Williams, E. Corenzwit, and R. C. Sherwood. Local magnetic moment associated with an iron atom dissolved in various transition metal alloys. *Phys. Rev.* 125:541–552.

With P. A. Wolff, P. W. Anderson, B. T. Matthias, M. Peter, and H. J. Williams. Magnetization of localized states in metals. *J. Appl. Phys*. 33(2):1173–1177.

With A. C. Gossard, V. Jaccarinno, and Y. Yafet. Orbital paramagnetism and Knight shift of D-band superconductors. *Phys. Rev. Letters* 9(6):262–265.

Upper limit for the critical field in hard superconductors. *Phys. Rev. Letters* 9(6):266–267.

1964 With V. Jaccarino and Y. Yafet. Interpretation of Knight shifts and susceptibilities of transition metals: Platinum. *Phys. Rev.* 134:A650–A661.

Impurity states in transition metals. *Phys. Rev*. 136:A1417–1427.

1967 Range of a static spin perturbation in palladium. *Phys. Rev. Letters* 19(10):583–585.

1978 With N. B. Hannay and C. K. N. Patel. B. T. Matthias—Scientist and humanist. *J. Less Common Metals* 62(1):vii–ix.

1987 Applied research: Key to innovation. *Science* 235(4784):12–13.

1993 With H. K. McDowell and P. Tsai. Maximum entropy approach in molecular timescale generalized Langevin equation theory. *Chem. Phys. Letters* 210(1):274–278.