IN MEMORIAM

August "Gus" Maki
Professor of Chemistry, Emeritus
UC Davis
1930-2008

August (Gus) Maki was born in Brooklyn, NY, in 1930. His Finnish parents returned briefly to Finland with young Gus when he was a toddler (from this time he probably retained his strong liking of collecting mushrooms, including the frightening but delicious parasol mushrooms, that he disclosed to us during his visits to Berlin in the 70's), but Gus mostly grew up in New York. He attended Brooklyn Technical High School, and after graduating in 1948, Gus enrolled at Columbia University, where he received his A. B. degree in chemistry in 1952. He then began work on his chemistry Ph.D. at the University of California, Berkeley. The U.S. government had different plans for Gus at this time however, which resulted in a two-year stint in the U. S. Army, spent mostly stationed in Europe. During this time he learned more important things to do than to shoulder arms, for example to develop a fondness of French cuisine including a good red Bordeaux.

Upon returning to Berkeley in 1955, Gus decided to join the research group of a new assistant professor, Bruce McGarvey, using the relatively new technique of EPR (Electron Paramagnetic Resonance) spectroscopy to probe the details of metal ligand bonding in transition metal complexes. Gus was attracted to McGarvey's group by the promise of using EPR to directly probe the electronic structure of such molecules via the hyperfine and quadrupolar couplings. Their primary publication on this work (A.H. Maki, B.R. McGarvey, The Journal of Chemical Physics 29 (1958) 31), focusing on the EPR properties of copper (II) bis-acetylacetonate, is a classic in the field of EPR spectroscopy of transition metal complexes. In 1982, this paper was selected as a "citation classic," and in the associated article Gus explained that the paper had generated a great deal of interest because it was only at this time that chemists were really moving into using EPR, in part because commercial EPR spectrometers were becoming available, and their paper provided a chemist- accessible link between EPR parameters and molecular orbital theory and bond covalency.

Gus received his Ph.D. from Berkeley in 1957, and then moved to Harvard University, first as an instructor of chemistry (1957-1960) and then as an assistant professor (1960-1964). Gus continued to apply EPR spectroscopy to chemical systems during these years. In an EPR newsletter remembrance (see EPR newsletter 2004, vol.14, no.3, p 13), Gus recalled that at that time the Harvard Physics Department was extremely powerful in magnetism and magnetic resonance research (with Purcell, Pound, Ramsey, Bloembergen and van Vleck), while the Chemistry Department had Assistant Professor August Maki. Gus started at Harvard before "startup funds" were the norm, but fortunately this was the immediate post- Sputnik era, so he was able to obtain NSF funding to assemble a homemade EPR spectrometer. "The Times They Are a- Changin'": When RDB was struggling to put together his first UC- Davis NIH proposal, 25 dense pages and all, Gus was proud to show him this first NSF proposal, which was in essence a letter to the NSF director explaining that he is a new assistant professor at Harvard, and he would like to explore applying EPR to chemical systems, so he needs money to build a spectrometer.

One of the chemical directions Gus pursued at Harvard was to generate solution radicals electrochemically inside the EPR cavity, work done in collaboration with his colleague David Geske. This opened a rich area of research, with new highly resolved radical spectra to measure and interpret, and a large number of Gus's Harvard EPR papers resulted from this technical advance. These experiments gave electrochemists direct new insights into radical formation and characterization, and this became a very active EPR research area for a number of groups following Gus's pioneering efforts.

Gus also continued to study paramagnetic inorganic coordination complexes. Most famously, he teamed with Dick Holm and Alan Davison to use EPR to study the d7 Ni (III) ion in a bis- dithiolate coordinated complex. Gus's EPR spectra showed this to be a low- spin complex with significant spin density in a Ni d(pi) orbital, but also with significant delocalization into the ligand pi- system. This was a very different electronic structure picture than one promoted by Professor Harry Gray, who favored a purely ligand- radical description for this complex. A number of articles were published by both groups, and in his EPR newsletter reminiscence, Gus describes the experience of being caught up between the "Gray forces and the Holm forces."

Also it was at Harvard that Gus began his studies on photoexcited triplet states, later to be one of his major scientific targets via the ODMR method. Gus was inspired by Hutchinson and Mangum's work on the naphthtalene triplet, and he and his student Jim Vincent quickly extended this work, using conventional EPR, to a number of other organic triplets photogenerated in durene host crystals.

At Harvard, Gus realized that Feher's new ENDOR technique could provide superior resolution and simplified analysis, not only for solid- state samples, but also for free radicals in liquid solution. The implementation of this idea occurred when Gus had a sabbatical semester in 1963, during which he was invited to spend a visiting professorship at Varian Associates in Palo Alto. This allowed him to work with Jim Hyde in modifying a cylindrical Varian cavity for high- power ENDOR, and they then applied this to the study of the proton ENDOR of Coppinger's radical in liquid n- heptane. Their first short communication (J.S. Hyde, A.H. Maki, The Journal of Chemical Physics 40 (1964) 3117) became another citation classic signaling the beginning of a new research era, ENDOR- in- solution. Hyde refined the instrumentation after Gus returned to teach at Harvard, and this became Varian's commercial ENDOR accessory to their EPR instrument line.

Despite his enormous successes in applying EPR to chemical systems, it was understood that the Harvard assistant professorships in those days were terminal appointments. In 1964, Gus moved out west to the University of California, Riverside, starting as an Associate Professor, followed by a promotion to Full Professor in 1968. Gus wanted to continue work on radical ENDOR, so he set up an ENDOR spectrometer at Riverside, not relying, however, on Varian Associates but rather on a collection of surplus instruments. Robert Allendoerfer assisted him as a postdoc in this endeavor and, ultimately, they succeeded in obtaining well- resolved ENDOR spectra of radicals in solution. They developed a phenomenological theory to describe the dependence of the ENDOR enhancement factor on key parameters of the radical molecule and solvent environment, which determine the delicate balance of the electron and nuclear relaxation rates necessary to obtain continuous wave ENDOR signals.

To learn from the experience Gus Maki had accumulated already on ENDOR in solution at UC Riverside and to benefit from it for his own, still new high- power ENDOR efforts, K.M. spent a postdoctoral year 1969/70 in his laboratory. There he met Maki's postdocs Brian Moores and Hans van Willigen. Together they shared the fun and frustration to rebuild the dismantled ENDOR spectrometer which had been cannibalized after Robert Allendoerfer had left the Maki lab. Eventually, they found a solution to the stray pick- up problems originating in the high- power radio frequency (rf) circuitry by properly grounding the dubious surplus devices and by impedance matching the ENDOR coil through incorporating a California wine bottle (empty) wrapped with a few turns of heavy copper wire (see A. H. Maki in EPR newsletter 2004, vol.14, no.3, p 13). This resort to empty (and full) wine bottles enabled them to get through their day and night struggles with the beast of a machine and to perform an ENDOR study on the lifting of orbital degeneracy in high- symmetry large organic molecules by weak deuteration- induced perturbations. Gus was relieved when, after so many months of trials and tribulations with only noise recordings, finally beautiful ENDOR signals were creeping out of the noise floor. Then he shared the California wine celebration of the resurrection of the ENDOR machine with us, as did the other postdoctoral fellows in the Maki lab, Luis Alcacer and Chris Winscom. They were involved in Gus's other magnetic resonance activities, Chris Winscom for example in optically detected magnetic resonance (ODMR) at zero magnetic field.

In 1967, Gus's successor in EPR at Harvard, Al Kwiram, used field- swept ODMR to study phosphorescent triplet states. The following year Jan Schmidt and Joan van der Waals from Leiden University reported triplet ODMR spectra at zero field using a microwave frequency scan supported by a slow- wave helix. Gus was impressed by this development, and this led to a discussion at an Asilomar Spectroscopy meeting with Mostafa El- Sayed of UCLA and Charles Harris of UCB. The group agreed to pool equipment resources and expertise in order to add ODMR capabilities to a phosphorescence spectrometer in El Sayed's lab. Dino Tinti, Gus's future UC Davis colleague, was a postdoc in El- Sayed's lab at the time, and together this group of four used the instrument to measure the zero- field ODMR of individual vibronic bands of the 2,3- dichloroquinoxaline triplet. It was around July 1969, when Harris, Tinti, El- Sayed and Maki (Chemical Physics Letters 4 (1969) 409) submitted their manuscript describing the novel optically detected ENDOR experiment in zero field on photoexcited 2,3- dichloroquinoxaline. Interestingly, independent work on the same subject was performed at the same time by the Leiden group (I.Y. Chan, J. Schmidt, J.H. van der Waals, Chemical Physics Letters 4 (1969) 269), and the results are in essential agreement with each other.

Based on this success, Gus constructed an ODMR instrument at Riverside, and he became so interested in the power of ODMR that he largely focused on this technique for the rest of his career. But the way to building up zero- field ODMR and even extending it to electron- nuclear double- resonance capability was a long and weary one. It needed the tenacity of Chris Winscom to eventually lead it to success. Like ENDOR- in-solution, zero- field ODMR had a rather sparse phase around 1969, as far as new results were concerned, and Gus turned out to be not too patient with his postdocs. He gave us all a hard time in the demanding discussions with him. And robust, but scientifically sound responses to his criticisms were needed in this very provocative period to convince him that we were indeed on the right way to solve the instrumental problems. But when both ODMR and ENDOR- in- solution were rolling, Gus kept company with us in some long nights in an effort to cheer us up to get first signals before the coolants ran out. Rather frequently, such nights ended in Frank's bar in downtown Riverside for a game of pool, a beer and a bowl of chili. And even the animating dancing activities next to us could not stop our heated discussions about science, society, and the Vietnam war.

Shortly later, Gus realized that, in addition to examining small organic molecules, zero- field ODMR would have the sensitivity and resolution to be useful for examining photo- induced triplets in non- crystalline biological molecules such as DNA constituents. At Riverside, he and his group, among them Joseph Zuclich, demonstrated the promise of this technique both with protein and nucleic acid samples. This was the research area where a string of German postdocs got consecutively involved in the early 70's: Dieter Schweitzer, Jost von Schuetz (still in Riverside) and Peter Dinse (already in Davis). They did not only contribute to push the new biological ODMR projects into the publication phase, but they also turned out to be expert craftsmen for the various phases of completion of Gus's mountain cabin.

In 1974, in one of the State of California's cyclic economic downturns, the UC powers decided that they needed to downsize the UC Riverside campus. Interestingly enough, other campuses were offered the option of recruiting key Riverside faculty, an interesting distillation process indeed. UC Davis was fortunate enough to move Gus Maki up to Davis, where he was to remain for the rest of his career. At Davis, Gus largely focused on the further technological development of the ODMR technique and its concomitant application to the study of increasing complex and interesting biomolecules. He was able to establish an NIH funded program studying protein – nucleic acid interactions via photo- induced triplet state ODMR, including the effects of antibiotics in affecting such interactions. During his time at UC Davis, Gus was always a key member of the faculty, and a driving force for a strong physical chemistry division and high standards across the board. He trained several generations of students, both undergraduate and graduate, with these high standards. Gus was part of a very strong UC Davis magnetic resonance group, along with Gerd LaMar, Dino Tinti, and Nancy True, and his presence here was crucial later for bringing Matt Augustine and David Britt to the department. Gus was a great mentor to his new junior magnetic resonance colleagues. We could always count on him for great advice in magnetic resonance, physical chemistry, or practical things from equipment construction to grant writing. Plus he always was happy to convey a refreshingly cynical view of the campus administration! And his former postdocs will certainly share Chris Winscom's remembrance that "Gus was good fun if you could handle a more robust line of conversation, and he enjoyed engaging in quite challenging and provocative scientific discussions around magnetic resonance. He was open to the more imaginative proposals if they offered something new to be found out. We learned a lot from him."

Gus formally retired in 1994, but maintained an active NIH- funded ODMR focused laboratory for a number of years after his retirement. He and his wife Judy also spent a good deal of time during these retirement years

up at their beloved Mt. Shasta cabin and time with their family, including new grandchildren, was a source of great joy.

Gus Maki earned a number of honors during his career. As a graduate student, he was the Allied Chemical and Dye Fellow (1956-57). As mentioned earlier, in 1963-1964 he was a Visiting Professor at Varian Associates. He was a Guggenheim Fellow in the 1970-1971 period, which allowed him to spend a year at the Physics Institute of the University of Stuttgart. He was a Visiting Professor at the Free University of Berlin in the Spring of 1981, and at the Department of Biology at Johns Hopkins University in Spring, 1985. He was selected as the Chevron Lecturer in the Department of Chemistry at the University of Nevada, Reno, in 1983. In 2000, he was elected as a fellow to the International EPR Society.

Gus Maki passed away on October 22, 2008. He had fought hard against several cancers over past few years, and ultimately succumbed to a pulmonary embolism. He is survived by his wife Judy Maki in Davis, his children Paul Maki and Linda Maki in Menlo Park, CA, Jeff Maki and Ian Maki in Seattle, WA, and stepchildren Michael Schulman in Sacramento, CA and Apryl Murray in Las Vegas, NV, along with six, soon to be seven, grandchildren.

Gus was always a real gentleman, and one of the nicest and most stimulating fellows one would ever meet. He will be greatly missed by his family and friends and by the magnetic resonance community as a whole. In his memory, the Chemistry Department has established a Gus Maki Memorial Fund to support physical chemistry graduate students. Contributions to this fund can be mailed to Chairman, Department of Chemistry, UC Davis, One Shields Avenue, Davis, CA 95616. (Checks should be made payable to the “UC Regents” with a note on the memo line that the contribution is for the Gus Maki Fund.)

R. David Britt
Klaus Möbius