ROBERT HERMAN

1914–1997

BY R. S. SCHECHTER

PROFESSOR ROBERT HERMAN (Bob to his legions of friends) passed away on February 13, 1997, at his home in Austin, Texas, after a battle with cancer. I lost a dear friend and the world lost a remarkable scientist and engineer, whose diverse interests ranged from cosmology to the practical problems of vehicular traffic flow and control. All of his life Bob struggled constantly toward creative achievement. That his endeavors were fruitful may be measured by the substantial recognition that has been accorded to him by the scientific and engineering community. I had met Bob several times at various conferences but really came to know him well after he joined the University of Texas faculty in 1979. It became our practice to share a brown bag lunch about twice each week. During these confabulations Bob would tell me about the wonderful people that he had worked with, and he would also share some touching and humorous moments in his life. I enjoyed these sessions immensely, grew to respect his intellect, and now miss him very much. Preparing this memorial was a difficult task for me for I felt a great need and desire to convey to the reader something of Bob's human qualities as well as his scientific and engineering achievements. I was not a participant in Bob's intellectual accomplishments. I was simply a confidant. I hope, therefore, by sharing some of our conversations to convey my wonderful memories of Bob, the profound sense of sadness that I felt on his death, and the importance of his many

accomplishments.

Robert Herman was born on August 29, 1914, and grew up in the Bronx area of New York City. Bob entered the City College of New York in 1930 majoring in physics. He told me that there was an excellent student body at the City College in those days, including many of the best students from the New York City high schools, who for economic reasons had little choice but to go to the free city colleges. With the high quality of the student body, you can imagine the intense discussions that regularly took place over coffee in the college cafeteria. These no doubt ranged from the most esoteric to the very pragmatic. Political issues were of course a serious topic. In my many heated discussions with Bob that encompassed debatable issues, my view would seldom prevail because his debating skills had been so well honed in the crucible of the City College cafeteria.

At the City College, Bob studied with (in Bob's words) “that wonderful pedagogue Mark Zemansky” who became world renown for his textbook on thermodynamics. Bob and Mark Zemansky developed a special relationship. When Bob learned that I.C. Maxwell (the great British scientist) had, upon reading the Gibbs papers on thermodynamics constructed in plaster a Gibbs surface [coordinates: U(energy)-V(volume)-S(entropy)] for water, he embarked on a similar project. Bob's Gibbs surface was displayed in his first publication a (1936) paper coauthored with Zemansky. Unlike Maxwell's, Bob's surface was color coded and quite artistic (additional comments on Bob's artistic leanings follow.)

Upon graduation, cum laude, with special honors in 1935 and spending one additional year at City College as a graduate teaching assistant, Bob entered Princeton University in the fall of 1936. His friend, Robert Hofstadter [Nobel Prize in 1961], had enrolled the previous year and immediately introduced Bob to his research supervisor, Edward Condon, a brilliant theoretical physicist. Bob began working on infrared molecular spectra and judging from the publication record, he and Hofstatder worked closely together. Bob told me that he and Hofstatder were able to estimate the lengths of the two bonds flanking the hydrogen atom in dimers of acetic acid. These findings were

published and to his pleasure cited as the definitive value by Linus Pauling in his classic book *The Nature of the Chemical Bond.* Based on his work on molecular spectroscopy, Bob received a Ph.D. in physics from Princeton in 1940. He spent the academic year 1940 to 1941 working on a Bush differential analyzer at the School of Electrical Engineering, University of Pennsylvania, and the next year teaching physics at the City College of New York.

He left City College in 1942 to join the staff at the Department of Terrestrial Magnetism, the Carnegie Institution of Washington, and the Applied Physics Laboratory of the Johns Hopkins University, all research centers for the war effort. He worked on the proximity fuse for naval antiaircraft fire. This device was effectively deployed during the war. Bob was especially proud of his experimental program that the development of the fuse required. In 1945 he received the Naval Ordnance Development Award in recognition of his contributions.

After the war, Bob spent another decade at the Applied Physics Laboratory, at first continuing his research in spectroscopy. During this period he met Ralph Alper, who was also employed at the laboratory. Alper worked at night toward his doctorate in physics at George Washington University under the tutelage of George Gamow. Professor Gamow was among the earliest scientists who seriously accepted the concept of a very hot, dense early universe now known as the “the big bang.” His student, Alper, was working to relate the observed abundance of the chemical elements in the universe to the conditions of the early universe. At some point Alper must have interested Herman in his research and they initiated a collaboration that would continue throughout Bob's life. Bob's publication record indicates a substantial interaction between them. In 1948 they jointly published a paper predicting that there should be a low-temperature residual black body radiation pervading the universe. The existence of this relic radiation would provide evidence for a “big bang.” In 1967, some twenty years after their publication predicting the background black body radiation, R.W. Wilson and A.A. Penzias detected the residual radiation. For this discovery they received the Nobel Prize in 1978.

Bob Herman and Ralph Alper received a number of awards

in recognition their remarkable intellectual achievement. In 1980 they shared the John Price Wetherhill Gold Medal of the Franklin Institute. In 1981 Herman and Alper received the New York Academy of Sciences Award in Physical and Mathematical Sciences for their pioneering work in understanding the early phase of the Big Bang Universe. In 1993 they received the prestigious Henry Draper Medal of the National Academy of Sciences. The citation of the Draper Medal Committee stated that the award was given "for their insight and skill in developing a physical model of the evolution of the universe and in predicting the existence of a background microwave radiation years before this radiation was serendipitously discovered; through this work they were participants in one of the major intellectual achievements of the twentieth century."

Herman also received the Magellanic Premium of the American Philosophical Society, the oldest scientific award in the United States, in 1975, and the eighth quadrennial George Vanderlinden Prix of the Belgium Academy in 1975.

I must add at this point that based on his publication record, it is clear that Bob frequently collaborated with a number of scientists on a variety of research problems. I believe that this was the case because of Bob's deep insight into many aspects of physics and into the complexities of the human enterprise. Thus his assistance and collaboration were often sought by those scientists who came to know him. Bob's criticism and help were highly valued because they were was never pernicious and often pointed to new directions for research or to issues incompletely addressed. Bob's collaborators seemed to find renewed inspiration as a result of his enthusiastic and often passionate input. His ability to work harmoniously and productively with others on a variety of topics is, I think, one of the important hallmarks of Bob's career.

In 1956 Bob joined the General Motors Research Laboratory as head of the Basic Science Group, later renamed the Theoretical Physics Department. Bob's record of publications indicates that he initially continued to work on matters that might be properly termed physics, collaborating with R.W. Wallis and R.J. Rubin on papers dealing with spectroscopy, electron cap

ture, and solid state physics. However, in 1958 he published a paper with R.E. Chandler and E.W. Montroll entitled "Traffic Dynamics: Studies in Car Following." Thus his work within the physics department at the General Motors Research Laboratory expanded into a new dimension. He never did tell me just why this transformation took place, but one might imagine that in an environment where the problems facing General Motors are a quotidian issue, that it was a natural, not a mandated, evolution. Bob entered this new field of research, which is now called traffic science, with all of his usual passion and enthusiasm. In his lecture accepting the second Philip McCord Morse Award, Herman stated that he found traffic science intriguing because it is a study of "how human beings interact through a machine— the automobile." The fascination with this subject was to last the remainder of his life. His work launched the field of traffic science. Bob and his colleagues founded the Traffic Science Section of the Operations Research Society of America (ORSA). With Nobel Laureate Ilya Prigogine, Herman developed a kinetic theory of multilane traffic flow based on a Boltzmann-like model of interaction of cars with each other. In recent years, he together with others developed a "two fluid model of town traffic." This model promises to contribute to the development and design of intelligent transportation systems. In recognition of these seminal contributions, Bob was awarded the Geoges E. Kimball Medal in 1976 by ORSA. He was elected to the National Academy of Engineering in 1978 and awarded an honorary doctorate in engineering by the University of Karlsruhe in 1984 for his outstanding research in the mathematical foundations and development of the theory of traffic flow. In 1990 he received the first Lifetime Achievement Award of the Operations Research Society's Transportation Science Section for his research on vehicular traffic science.

Bob retired from General Motors in 1979 and accepted a position as a professor of civil engineering teaching in the transportation group of that department and as a professor in the Physics Department associated with the Statistical Mechanics Research Center. After some time it became obvious that his teaching and research were centered mainly within the Civil

Engineering Department and he was appointed as the L.P. Gilven Professor of Civil Engineering. He then devoted his full attention to the transportation group, where he supervised or cosupervised graduate research and lectured. Bob was an outstanding teacher. The students that studied with him speak of him with great affection. His door was always open to students or faculty in need of assistance. One might imagine that a productive and creativity researcher such as Bob Herman would have little room in his life for humor or family. This was certainly not the case. One of the reasons that I found our periodic luncheon sessions to be so enjoyable was Bob's great sense of humor. He recognized that creative activities are often catalyzed by moments of relaxed humor. He composed limericks and odes and often amused himself by drawing cartoons. He maintained a file of these that he shared with only a few close friends. I remember one in particular that depicted him responding to a request posed by one of his good friends and colleague (a distinguished physics professor) who asked Bob to suggest a name for his recently born ninth child—a son. Bob's cartoon showed Bob (I suppose) suggesting to the professor that an appropriate name would be "neuf." I am not certain that the professor knew *neuf* is the French word for *nine,* nor do I know if he was offended by Bob's cartoon. I never asked.

I remember once telling Bob that a professor I had visited in France was coming to lecture in Austin and that when I had lectured at his university, he had taken me to the student cafeteria for lunch. Bob suggested that I reciprocate by taking him to Dirty's (a favorite place for many faculty and students near the campus) for lunch. We had great fun trying to find an appropriate French translation of the name of the restaurant so that I could inform my visitor in French where we were going to dine.

Once, after I had returned from a trip to New York where my wife and I had attended an exhibition at the Metropolitan Museum of Modern Art (MOMA), I described the exhibition that had intrigued us. Bob told me that he had often visited that museum as a young boy and had been interested in art. He had, he told me, entered one of his sculptures in soap in a MOMA-sponsored contest. I must have said something that made Bob

think that I was skeptical, for the next time I spent an evening with Bob and Helen at their home, he retrieved a shoe box containing among other items a face carved in soap. This face appeared to be that of an American Indian with high cheekbones and a broad nose. The face expressed great sadness. I was most impressed by Bob's work, but even more impressive to me was that he had retained this object of art he had created as a teenager more than seventy years earlier. I found that to be quite remarkable. After having shown me the face and observed my favorable reaction, Bob then began to show me his more recent artistic creations—small abstract sculptures carved in exotic wood. Bob began showing others these small sculptures. The response was very positive, perhaps, I suspect, somewhat to Bob's surprise. An exhibition of his carvings was presented at the National Academy of Engineering in Washington, D.C., in 1994, at the College of Engineering at the University of Texas at Austin in 1995, and at the Leu Art Gallery of Bellmont University in Nashville, Tennessee, in 1996.

Bob was a cultured and modest man who had a wide range of interests that he continued to expand throughout his lifetime. At sometime during his tenure at the General Motors Research Center, he decided to learn to play the cello and began taking lessons. What fascinated him was the bow. He was concerned about the relationship of its curvature and materials of construction to the sound produced. He collected a large number of books on the physics of music and spent a few of his summers in London working in the shop of a master craftsman making cello bows. He showed me his collection of handmade bows, about twenty in all. I cannot comment on the overall quality of these bows, as Bob never did play his cello in the presence of others. In fact several of his friends tell the following story. After much pressure by the members of his department at General Motors he finally agreed to give a cello recital one evening. He purchased a rather inexpensive cello and began to play. With each sour note emitted, he would strike the cello until, after a few minutes, it was totally destroyed and the recital terminated. Punishing the instrument for producing sour notes is reminiscent of a Victor Borge skit in an old movie that I saw many years ago.

Apparently Bob's recital was a success because his colleagues never pressed him for a repeat performance. His ability as a cellist remains a deep secret. Only his instructor knows.

Robert Herman was a multifaceted man deeply devoted to his family, to his friends, to his science, and to the betterment of the human condition. He was a model of integrity and modesty for all of us who were fortunate enough to get to know him. He is survived by his wife of fifty-eight years, Helen, and three daughters. Jane B. Herman and Lois E. Herman live in Farmington Hills, Michigan. Dr. Roberta Herman lives in Austin with her husband, Ron Humphrey, and their two sons, Brandon and Parker.