

Gerhard Giebisch and the Gift of Mentorship

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Figure 1. | Gerhard Giebisch.

Gerhard Giebisch, one of the giants of renal physiology, died on April 6th, 2020, at 93 years of age (Figure 1). He was widely known and admired for his many groundbreaking scientific accomplishments and was beloved for his wonderful personal qualities as an academic leader, educator, advisor, friend, and mentor. Indeed, Gerhard's life exceptionally well illustrates the enduring gift of mentorship, from the mentors who critically affected his life to his own role as a legendary mentor to dozens of trainees. As the present tribute will provide only a brief summary of his biography, it is strongly recommended to access Gerhard's own written (1,2) and video (<https://www.youtube.com/watch?v=0PiuL51OA1Q>) accounts of his life to learn more about this truly remarkable man.

Gerhard was born in 1927 in Vienna, Austria, where he was raised and attended elementary and high school. His first mentors were his parents, neither of whom had a background in science or medicine. His father was a high school teacher of German and French literature who had a special interest in history, and his mother had a love of literature and music. Gerhard developed lifelong interests in history, literature, and the arts, especially music, which he attributed to his parents. His family struggled financially during the economic depression in Austria after World War I, and his high school years were during World War II, with frequent interruption by bombing raids. Nevertheless, he persisted with his studies, including learning English as his second language. Gerhard credited the unconditional love and support of his parents for allowing him to flourish academically amid the economic and wartime hardships of this period.

Motivated by his respect for two uncles who were physicians, Gerhard was one of about 1800 entering medical students at the University of Vienna in 1946, from which he graduated with the MD degree in 1951. Gerhard's original career goal was to be an internist. Despite the very impersonal nature of medical education at that time and place, he encountered two memorable teachers whose influence changed the course of his eventual career. The superb lectures of Franz von Brücke, the Chair of Pharmacology, impressed Gerhard with the importance of physiology as the foundation of medicine. A faculty member in internal medicine, Erwin Deutsch, also emphasized basic science as the basis of medicine and advised Gerhard to pursue 2 years of research training in basic science before beginning clinical training. Gerhard followed this advice by performing research in the pharmacology department.

Gerhard's career was also greatly influenced by his interaction from afar with Homer Smith. While still a student in Vienna, Gerhard's specific interest in renal physiology was inspired by reading Homer Smith's Porter Lectures. Fascinated by Smith's pioneering work using clearance methods to study renal physiology and pathophysiology, Gerhard wrote to Homer Smith to request a free copy of Smith's comprehensive book *The Kidney*. Amazingly, Smith graciously responded to this unknown Austrian medical student (but future Homer Smith Award recipient) by sending the book to him.

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A book by Otto Spühler on modern methods to study renal function also greatly impressed Gerhard, which led him to arrange for a 3-month stay in Spühler's unit in Zurich. Gerhard credited his time with Spühler as pivotal to his final decision to devote his life to renal physiology. It was also at this time that he realized that he would eventually need to go to the United States for training if he wanted to learn the newest methods in renal physiology. Gerhard returned to Vienna to finish his medical studies and was appointed an instructor in pharmacology in 1951. His first original research paper published in 1952 was on the effects of mercurial diuretics (3).

The opportunity to visit the United States came about due to developments in Gerhard's personal life. To improve his English, Gerhard had been exchanging letters for 5 years with a young American woman, Ilse Riebeth, the daughter of close family friends who had emigrated from Austria to Milwaukee. She was an outstanding pianist, and they shared a love for music. The Riebeth family helped arrange for Gerhard to obtain a rotating internship at the Milwaukee Hospital during the 1952–1953 academic year. He and Ilse were married in 1952 and thereafter, enjoyed a wonderful life together until her passing in 2008.

During his internship year, Gerhard wrote to 12 prospective mentors for renal physiology training in the United States and heard back from four. The first to offer an interview was Robert Pitts, a trainee of Homer Smith and one of the foremost renal physiologists of the day. Pitts immediately accepted Gerhard as a postdoctoral fellow after interviewing him. So after completing his internship, Gerhard moved to the Department of Physiology at Cornell University Medical College in New York to train with Pitts from 1953 to 1956. A photograph of Gerhard reviewing data with Robert Pitts is shown in Figure 2A. Gerhard then fulfilled a promise to Franz von Brücke to return to Austria, where he became an assistant professor of pharmacology at the University of Vienna in 1956. However, when Pitts offered a faculty position, Gerhard returned to the Department of Physiology at Cornell because he thought it would be a stronger environment for renal physiology research and faculty development. Appointed as an assistant professor at Cornell in 1957, Gerhard was promoted rapidly through the ranks to associate professor in 1960 and to professor in 1965. In 1968, he was recruited to Yale as a professor and Chair of Physiology. Gerhard was designated Sterling Professor, Yale's highest honor, in 1970. He served as Chair of Physiology at Yale from 1968 to 1973 and then continued on the full-time faculty at Yale through 2004, when he became Sterling Professor Emeritus. Although nominally retired, Gerhard continued to be an active member of the faculty as a teacher and research collaborator into his late 80s.

For over 60 years, Gerhard dedicated his research career to investigating mechanisms of renal electrolyte and acid-base transport and their regulation. As a fellow, Gerhard realized that to examine mechanisms of tubular electrolyte transport directly, he would need to learn how to study single tubules using micropuncture techniques. This was a bold and potentially risky decision that required Gerhard to go beyond the clearance methods available in the Pitts laboratory. However, his mentor Robert Pitts supported Gerhard to spend 6 months learning micropuncture methods from Phyllis Bott in Philadelphia, who had learned the

technique from A.N. Richards. Gerhard first applied these methods to studies of chloride transport and acidification in amphibian proximal tubules, which were relatively large compared with mammalian nephron segments.

Although Gerhard would go on to make major contributions to the understanding of sodium, chloride, and acid-base transport, his most important work was on the mechanisms and regulation of potassium homeostasis. Indeed, an informal comment made in a state of semiconsciousness revealed which was his favorite electrolyte. As the anesthesia wore off after major surgery several years ago, Gerhard's first words were, "How is my potassium?" It was equally plausible that he was inquiring about his serum potassium level or the welfare of a dear old friend.

As a junior faculty member at Cornell, Gerhard became intrigued by the renal handling of potassium, which had been proposed to take place by sequential filtration, reabsorption, and secretion on the basis of the results of clearance and stop-flow experiments. However, to study mechanisms of potassium transport by micropuncture along the mammalian nephron, there was the additional challenge of measuring the amounts of sodium and potassium in tiny nanoliter samples of tubular fluid. With the help of a neuroscientist, Paul Müller, Gerhard then built an ultramicro flame photometer that was capable of analyzing tubule fluid samples. Subsequently, instruments on the basis of their design were used to analyze tubule fluid samples collected by micropuncture in laboratories around the world. The rapid adoption and adaptation of new techniques would be a recurring feature of Gerhard's research career. Gerhard now transitioned to become a mentor himself. His first postdoctoral fellow, Gerhard Malnic, used these micropuncture and microanalytical methods to map the sites of reabsorption and secretion of potassium along the mammalian nephron (4), work that has been recognized as a landmark in renal physiology (5,6).

Over the subsequent decades, Gerhard and his collaborators were leaders in applying a wide variety of methods to advance the understanding of electrolyte physiology from the descriptive level of net tubular transport to elucidation of the activities and regulation of pumps, transporters, and channels at the cellular and molecular level. Examples included use of electrophysiological methods to determine driving forces for potassium transport across individual cell membranes of tubule cells, development of a cell model to account for transepithelial potassium secretion in the distal nephron, description of the effects of diuretics on tubular potassium transport and excretion, identification of the regulatory and pathophysiologic factors that alter potassium secretion in the distal nephron, use of patch-clamp methods to characterize the properties of native and cloned channels responsible for potassium secretion, and elucidation of molecular mechanisms underlying regulation of potassium channels. Although using progressively more reductionist approaches, Gerhard's overarching aim was always to gain an integrated understanding of potassium homeostasis at the level of the whole organism.

Above and beyond his monumental research contributions, Gerhard perhaps had even greater effect on nephrology through his role as an extraordinary mentor. Shown in Figure 2B is a partial list of his trainees. Dozens of these trainees achieved success as professors and department

A



B

Trainees of Gerhard Giebisch

J. Aceves	E. Gonzales	D. Landwehr	M. Sohtell
S. Agulian	J. Graf	J. Leipziger	K. Spring
J. Bahlmann	A. Grandchamp	R. London	B. Stanton
M. Bailey	R. Green	A. Lopes	N. Strieder
F. Beck	W. Guggino	M. Lu	J. Sullivan
J. Beck	S. Gullans	G. MacGregor	L. Sullivan
B. Biagi	J. Horisberger	C. McNicholas	K. Tsuchiya
E. Boulpaep	M. Hropot	J. Merot	R. Unwin
G. Capasso	M. Hunter	G. Malnic	C. Wagner
A. Cassola	P. Jaeger	Y. Matsumura	T. Wang
D. Cemerikic	B. Karlmark	S. Muto	W. Wang
Y. Chan	K. Kawahara	H. Oberleithner	P. Welling
B. Cohen	R. Khuri	A. Omerovic	S. White
M. de Mello-Aires	R. Klose	M. O' Regan	G. Whittembury
J. Diezi	F. Knauf	Y. Ridderstrale	M. Wiederholt
C. Duarte	B. Koeppen	S. Sansom	C. Wilcox
M. Field	M. Kubokawa	L. Schild	F. Wright
J. Geibel	T. Kubota	J. Schnermann	A. Zweifach
S. Glabman		A. Schwab	

Figure 2. | From mentee to mentor. (A) Gerhard Giebisch with his most important mentor, Robert Pitts. (B) Partial list of the trainees mentored by Gerhard Giebisch.

chairs both in the United States and in many countries around the world. Gerhard very much cared about his trainees as people, and they in turn developed strong affection for him as an older brother, father, or grandfather depending on their age. Reflecting their long-term scientific and personal bonds, many of his trainees continued to collaborate with Gerhard for many years, in some cases decades, after they had completed training and established their own independent research careers. In addition to his enormous influence in fostering the careers of his students and fellows, Gerhard was revered for providing encouragement and advice to young investigators who had never been his direct trainees but whose talent and potential he recognized and supported. Many of these individuals also became his close friends.

Similar to his commitment to future generations through his service as a research mentor, Gerhard was very strongly committed to service and excellence as an educator. In this activity, he was no doubt inspired by his own professors at the University of Vienna discussed earlier who had so influenced the course of his career. In addition, his mentor Robert Pitts had set an example of exceptional commitment to medical student teaching at Cornell. Indeed, Gerhard was

not only actively involved in teaching physiology to medical students at Yale, he also frequently gave lectures in physiology courses in other medical schools, including his alma mater the University of Vienna. Moreover, Gerhard regularly taught in postgraduate courses on renal physiology organized by his former trainees around the world, an activity he maintained almost to the age of 90. Another major educational contribution was his work with Donald Seldin, an alumnus of the Yale School of Medicine who had been a trainee of John Peters, to coedit the most comprehensive textbook in the area of renal physiology, namely *The Kidney: Physiology and Pathophysiology*. Seldin became one of Gerhard's closest friends.

Gerhard also made major contributions to nephrology as an outstanding and selfless academic citizen and leader both at Yale and in national and international organizations. His roles in creating environments conducive to research and training can be viewed as an extension of his role as a mentor. There had been little if any kidney research in the Department of Physiology at Yale prior to his recruitment as chair. However, Gerhard realized that existing strength in the biophysics of membrane transport in the Department of Physiology as well as strength in renal pathophysiology in

the Department of Medicine since the era of John Peters would together provide an outstanding research environment for his own work and for establishing a larger research and training program at Yale. In his roles as chair and then, as director of a large program project grant, Gerhard brought this vision to fruition, as he was the driving force behind the growth of the Department of Physiology at Yale into one of the world's leading centers for kidney physiology research and training. Indeed, although he only served a single 5-year term as chair, he was able to continue to steer the direction of the department over the subsequent years by virtue of the enormous respect he enjoyed for his judgment and commitment to the common good. Reflecting Gerhard's vision and influence, the department has had a series of outstanding kidney physiologists as chair over the past 40 years, including Emile Boulpaep, Walter Boron, Steven Hebert, and Michael Caplan.

Beyond Yale, Gerhard served in a number of important roles to foster the success of national and international organizations. In particular, he was the sixth President of the American Society of Nephrology. Additional positions included service as President of the Society of General Physiologists; member of the Executive Committee of the International Society of Nephrology; member of the Council of the National Institute of Diabetes and Digestive and Kidney Diseases; and countless editor and editorial positions, grant review committee memberships, and committee positions in academic societies. As the founding director of the Forefronts in Nephrology Symposia of the International Society of Nephrology, Gerhard traveled the globe as a statesman of nephrology, bringing information about the latest advances in kidney research to investigators and trainees in many different countries.

Gerhard's groundbreaking contributions to renal physiology and his exemplary academic citizenship and service as a mentor were recognized by many honors and awards. Particularly noteworthy is that he was the recipient of two of the major awards of the American Society of Nephrology: the Homer W. Smith Award in 1971 for his contributions in research and the John P. Peters Award in 2006 for his contributions in education and leadership in addition to research. Additional honors and awards included the Johannes Müller Medal of the German Physiologic Society in 1980; election to the Austrian Academy of Sciences in 1981; election to the American Academy of Arts and Sciences in 1983; election to the National Academy of Sciences in 1984; election to the Deutsche Akademie der Naturforscher Leopoldina in 1988; the Franz Volhard Medal of the German Nephrological Society in 1988; the Ernst Jung Preis für Medizin in 1990; the A.N. Richards Award of the International Society of Nephrology in 1993; the Robert W. Berliner Award of the American Physiological Society in 1994; the Donald W. Seldin Award of the National Kidney Foundation in 2004; and honorary doctorates from Uppsala University, the University of Bern, the University of Lausanne, the University of Vienna, and the University of Connecticut.

Gerhard's enormous success and effect as a mentor and role model were due to his wonderful personal qualities. He was revered for his humility, integrity, courtesy, kindness, decency, and generosity. He had sincere concern for others as individuals and as members of the larger academic community. He was a true intellectual with intense curiosity

about diverse domains of knowledge, and he read broadly about philosophy, history, and economics as well as different fields of science. Having observed the devastating effects of dogmatic and extreme political and economic movements during his lifetime (e.g., nationalism, fascism, communism), he instinctively rejected dogma and extremism whether in politics, economics, or kidney physiology. His intellectual predisposition was to expect, accept, and seek to understand the complexity that underlies phenomena in the natural world. This was illustrated by his comment many years ago concerning a dispute about whether chloride transport is mostly paracellular or transcellular. He commented that "someone from Vienna would surely know it is a little of this and a little of that." Moreover, his sincere humility was on the basis of his intellectual predisposition to recognize and accept the uncertainty that underlies knowledge. Gerhard liked to say that as we acquire knowledge, new questions arise so "we remain confused but confused on a higher level." He quoted Montaigne (1), "Le beaucoup savoir apporte l'occasion de plus douter" (to know much is often the cause of doubting more). He pointed out that, despite our best efforts, we still remain in a state of "learned ignorance," referencing Nicholas of Cusa (2).

A major unifying theme through Gerhard's life was his search for and appreciation of beauty in multiple different forms that he enjoyed sharing with others. Of course, he pursued and appreciated the beauty to be found in the intricacies of renal physiology. However, he also greatly appreciated the beauty to be found in art, literature, music, and especially, opera. He enjoyed the beauty of design and engineering of his old used Porsche that he drove along the back roads of Connecticut. He committed time every year to enjoy the beauty of the Alps through mountain climbing trips with his very close friend Heini Murer. And finally, Gerhard enjoyed the love and support of his beautiful family, to whom he was a devoted husband, father, and grandfather.

Gerhard is survived by his daughter Christina Giebisch and her husband Peter Mohrer, by his son Robert Giebisch and his wife Ninrong Giebisch, and by his four grandchildren, Daniella and Marisa Mohrer and Allison and Daniel Giebisch. Gerhard is also survived by all of us in his worldwide academic family, who will miss him greatly. However, we will find comfort in the knowledge that his legacy will endure through the lives and contributions of all those he so profoundly influenced and inspired by his brilliant scientific work and by the extraordinary gift of his mentorship.

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Author Contributions

P. Aronson wrote the original draft and reviewed and edited the manuscript.

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