WENDELL JORDAN KRIEG

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On April 13, 1906 Frank Wendell Krieg, a physician, and Rosabelle Jordan Krieg, a woman of solid Virginia stock, became the proud parents of a son. This event took place in Lincoln, Nebraska. This son, named Wendell Jordan Krieg after both his father and mother, would make substantial contributions during his professional career to the field we now call neuroscience. Krieg, however, has always been proud of his profession as a "neuroanatomist" or a "neuroanatomical scientist".

Krieg attended public school in Lincoln, Nebraska and at the age of 18 (1924) he began a brief period as a teacher at the local high school. He attended the University of Nebraska and received the B.Sc. in "medicine" (although the meaning of this is unclear) in 1928. From his early years Krieg had a profound interest in anatomy, especially that of the brain. He was quite fascinated by the concept of the mind and with the mystery of how the brain might do its work. He expressed this growing interest by taking a position as an Instructor at the University of Nebraska at Lincoln for 1928-1929.

In 1929 Krieg began his graduate study at New York University (NYU) from which he received the M.S. (1931) and the Ph.D. (1935) degrees. The topic of his graduate work was a detailed study of the hypothalamus of the albino rat. During this general time frame he was first an Instructor of Anatomy in the College of Dentistry at NYU (1929-1932) and then he became an Instructor of Anatomy in the School of Medicine at NYU (1932-1937). He was promoted to the rank of Assistant Professor at NYU in 1937.

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In his early years Dr. Krieg took, as one of his middle names, the last name of a well-known German philosopher (Schopenhauer) whom he greatly respected. However, since this was not part of Dr. Krieg's given name it is not used here. Also, the initial S. does not appear in any official biographical sketch consulted by the Alpha Helix in the preparation of this brief biography of Dr. Krieg.

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Figure 1. Wendell J. Krieg in 1947 when he was Director of the Institute of Neurology at Northwestern. This photograph, courtesy of Northwestern University Archives.
(only two years after receiving the Ph.D. degree) and held this rank until he left the University in 1944 to go to Northwestern.

Krieg published a number of books, and these are listed below. However, it was the first edition of his large textbook "Functional Neuroanatomy" in 1942, his second book, that was a major factor leading to his long and successful affiliation with Northwestern University. In 1944 Krieg joined the Institute of Neurology of Northwestern University Medical School as an Associate Professor of Neurology. He was promoted to the rank of Professor of Neurology in 1946 and in the same year became Director of the Institute of Neurology, a position he held until 1948. Krieg was Professor of Anatomy at Northwestern from 1948 until his retirement in 1974. He has been Emeritus Professor of Anatomy at Northwestern since his retirement.

Wendel J. Krieg married Roberta Elaine Neill on June 28, 1952. Mrs. Krieg has been a devoted helpmate over these many years and Krieg in an expression of his appreciation has dedicated books to her. For example, the dedication page of Brain Mechanisms in Diachrome (1955) reads "To my wife Roberta, affectionately". They have one son (by a previous marriage), Rupert Krieg, who is a cartographer.

Krieg was a prolific writer during his career producing 15 books as author, editing another, and publishing numerous papers in peer-reviewed scientific journals. Eleven of his scientific papers appeared in the Journal of Comparative Neurology alone. These focused on the diencephalon (1932, 1944, 1946, 1948) and on connections of the cerebral cortex of the albino rat (1946a,b; 1947) and of the macaque monkey (1949a,b,c; 1954). His books, listed in chronological order, are:

- Polychrome Atlas of the Brain Stem, 1960
- Letters to My Son, 1960
- Connections of the Cerebral Cortex, 1963
- Synoptic Functional Neuroanatomy, 1973
- Architectonics of Human Cerebral Fiber Systems, 1973
- (Ed) Lord's Prayer in 250 Languages, 1973
- Interpretive Atlas of the Monkey's Brain, 1975
- Stereotaxy, 1975
- Heritage of Borders, 1977

Krieg was quite inventive in his approach to publishing his books, as well as his research papers, and clearly anticipated some of the contemporary approaches to presenting visual information. For example, his use of color diachrome sheets, at the suggestion of Mr. Arnold Ryan, to illustrate superficial and deeper structures of the brain in various colors. In Brain Mechanisms in Diachrome, small color and black and white booklets came with the book and were tucked in sleeves on the side of the front and back covers. Krieg was one of the very first to fully develop the idea of making teaching demonstrations available as movies (now video tape). Between 1971 and 1975 he produced a total of 20 movies under the main title "Anatomical Basis of Brain Function". These were used at a number of medical schools for many years.

Krieg also had a vision of the potential applicability of his neuroanatomical research that extended well beyond the technology of his time. In 1949 he was the originator of the idea of electrophrenoprosthesis. He saw this as a method to deliver direct patterned stimulation to the cortex in an effort to deal with blindness, motor problems, or deafness. Krieg also envisioned, in 1949, a "television scanner" that could transmit images from the environment to the visual cortex of the brain. A similar device could also carry auditory signals to the appropriate areas of the brain. While the basic theories existed, Krieg noted that a "...lot of work..." remains, and he did not know when practical tests could be done. Clinicians of the period cautioned "...no one who is blind or deaf should become unduly excited at the prospect that he might regain his lost powers any time soon". Although viewed as impossible.
at the time, this concept clearly foretold the development of a wide range of neuropsychiatric devices that have been used over the past 15-25 years. This includes visual cortex stimulation and cochlear implants; ideas that were in their essential features predicted by Krieg.

In addition to publishing his work in scientific journals and through extant publishing houses (such as C. C. Thomas and Blakiston), Krieg established Brain Books in 1955. This allowed him the unusual opportunity to publish some of his own books unencumbered by the constraints frequently imposed by a large house. Brain Books frequently had pleasing artistic embellishments at the beginnings and ends of chapters that were not seen in other textbooks of the period. This situation also released Krieg from the editorial constraints an author usually faces in dealing with a publisher. As a result Krieg had the freedom to engage in a more freewheeling editorial style that was uniquely his own. The reviewer of one of Krieg's books noted that "the writing is racy, lucid, and forthright".

Krieg's contributions cannot be fully discussed without a comment on the unique and detailed artwork that adorned his papers and especially his books. Wendell Krieg was enormously talented in putting down on paper his vision of the three-dimensional structure of the brain. While he did this type of drawing in books describing his experiments on animals, especially monkeys, it probably reached its highest level of expression in his illustrations of the human brain. Yakovlev, in his review of the 3rd edition of Krieg's Functional Neuroanatomy, referred to the author as "...a consummate craftsman in graphic arts, he carries the Vesalian tradition into this automated, linotyped century...". These drawings, which Krieg did literally in the hundreds, are extremely accurate, done in a 3-D mode to show relationships and structural continuity, and in many cases are tremendously detailed. Although some of these drawings are difficult to read because of the significant detail, once studied and figured out they are unusually informative. On most of these 3-D drawings Krieg carefully embedded labels (including Brodmann's areas in the case of the cortex) within the artwork itself. Consequently, the reader can study the artwork, appreciate the 3-D relationships, and see the names of structures all at the same time. In the history of neuroanatomical texts, none before and none since have included the large number of detailed 3-D drawings seen in Krieg's Functional Neuroanatomy, and no text has had so much of the artwork done singlehandedly by the author. To fully appreciate the investment of time and energy it must be remembered that each individual mark represents one stroke of a pen. Also, it should be noted that each piece of artwork had to be carefully planned so that everything came together in the end to create an informative image. Examples of some of these illustrations are reproduced at the end of this biographical sketch.

During his career Krieg was a member of 12 professional organizations. These are; American Association of Anatomists (1936-pres), Corporate Member of the Marine Biological Laboratory at Woods Hole, Cajal Club (past president) (1947-pres), Chicago Literary Society (past vice president), Chicago Neurological Society, Neuroelectric Society, American Neurological Association, American Academy of Neurology, International Stereological Society, Harvey Society, Society for Experimental Biology and Medicine, and the American Association for the Advancement of Science.

Dr. Krieg, although in frail health at the present time (he will be 90 years of age on April 13, 1996), remained active for a number of years after his retirement. He continued to attend meetings of the American Association of Anatomists and the meetings of his beloved Cajal Club. As summarized elsewhere in these Proceedings (see pp. 27, 36) Krieg was one of the founding members of the Cajal Club in 1947 and through his generosity (in 1985-1986) the Cajal Club initiated what are now known as the Krieg Cortical Kudos. The members of the Cajal Club are encouraged to express their greetings, even if belated, to Dr. Krieg in his 90th year. Dr. and Mrs. Krieg reside at 1236 Hinman Avenue, Evanston, Illinois 60202.
Figure 2. Examples of artwork produced by Dr. Krieg for his books. Note his name (left) and initials (right) at the bottom of each piece. These drawings of the human forebrain illustrate the internal relations of nuclei, cortex, subcortical white matter, and fibers (left) in 3-D and the corresponding appearance, in mirror image, of the same section as it appears in a myelin stain (right). The detail is outstanding, however the 3-D rendering is especially striking.
Figure 3. Three-dimensional drawings of the human brainstem produced by Dr. Krieg. A view of the pons is on the left and midbrain on the right. The 3-D relationships are clearly shown and lend a new level of understanding to the material. When rendered in color the visual impact is greatly enhanced. Both renderings are as if looking into each section from the rostral aspect.
Figure 4. Drawing, by Dr. Krieg (note his name at the lower right) of cranial nerve motor nuclei and fibers in the human brainstem. The view is from lateral and slightly caudal. As in the drawings in Figures 2 and 3, note the texture and relationships created by Krieg.