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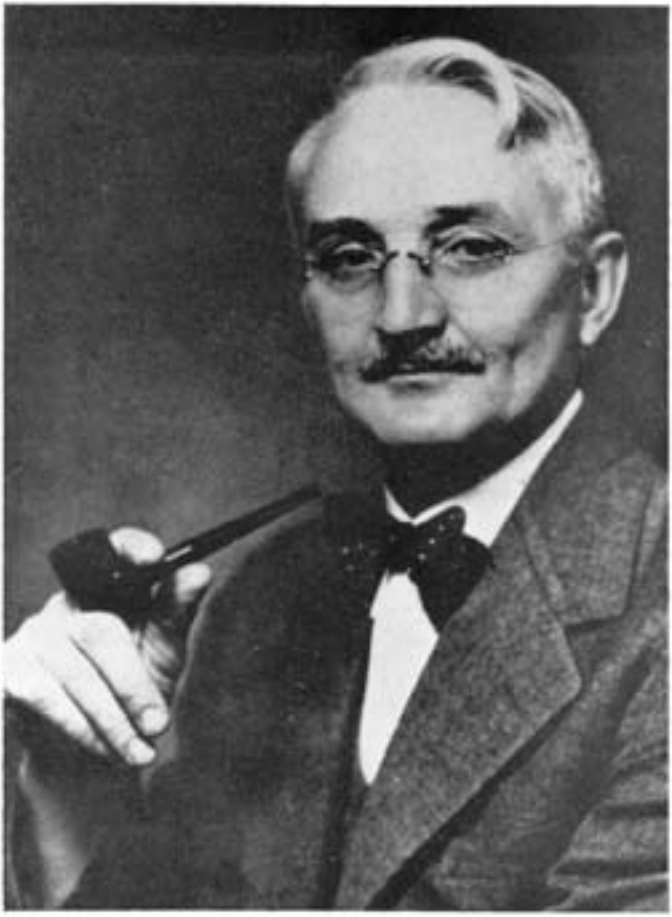
GEORGE WILLIAM BARTELMEZ

1885—1967

A Biographical Memoir by

DAVID BODIAN

Biographical Memoir



George W. Bartholomew

GEORGE WILLIAM BARTELMEZ

March 23, 1885–September 2, 1967

BY DAVID BODIAN

GEORGE WILLIAM BARTELMEZ became widely known as a brilliant and versatile microscopist, in the direct line of succession to those who created the sciences of cell and tissue biology. He made major contributions toward understanding the cellular mechanisms of menstruation, the structures involved in the transmission of nerve impulses from cell to cell, and the complex transformations of the embryo which lead to the development of the adult human nervous system. Few scientists and teachers have evoked greater personal affection, or greater respect for high standards of scientific scholarship.

Bartelmez was born and educated in New York City; he died in Missoula, Montana, at the age of eighty-two. A brief draft of a biographical sketch prepared for the National Academy of Sciences by Bartelmez in 1958 informs us that his father, Theodore Bartelmez—the son of a forester—came from the Schwarzwald of Baden and migrated to the United States in his teens. Theodore Bartelmez became manager of a lumber company and later married a Philadelphia girl, Caroline Osten. Writes Bartelmez of his mother, "Her father had come from Braunschweig as a boy of sixteen and reached the American shore in a breeches-buoy after the shipwreck of the schooner that brought him over. Her mother came from Rudesheim where her father had settled after serving under Napoleon."

Bartelmez continues: "My father had been the only member of the family who had more than an elementary school education but I was permitted to go to one of the newly established public high schools, a two-mile walk from home. My reading had been confined to my father's travel books and to the Sunday School library. School opened up an entirely new world that became increasingly more exciting with each new subject that was presented. During this period my grandfather became totally blind and I read to him for two hours after school—mostly German historical romances. Several summers were spent with old friends of the family, the Rev. and Mrs. F. W. Kirwan in Delaware County, New York.

"My desire to become a physician had been confirmed by the courses in Biology and I was enrolled in the medical preparatory course. At its end there were no funds for medical school tuition and Mr. Kirwan decided that I ought to go to college. He came to the city and talked with the teachers at the high school. They recommended my taking a fourth year to prepare for college and applying for the scholarship offered to the school by the University College of N.Y.U. It had recently been moved into the country (212th St.) but could be reached by streetcar and was within walking distance of home. At that time the college had about 300 students."

Bartelmez graduated with the B.S. degree from New York University in 1906, and continued his work there for a year as Assistant in Zoology with C. L. Bristol. He writes:

"After entering the laboratory of C. L. Bristol most of my time was devoted to biology but it was possible to enroll in any course that did not conflict with a required course so I was able in this and later years to take additional courses in English and German literature, in chemistry and in geology. Bristol had inherited the teaching methods of Louis Agassiz through C. O. Whitman, which involved a maximum of en-

couragement and minimum of supervision so that we learned to work independently. After the sophomore year Bristol invited me to help collect fish for the New York Aquarium in Bermuda and I became acquainted with the teeming life of the coral reefs and the ways of the fisher folk. A little experience with research on the toad, common in Bermuda, led me to abandon all plans for medical school."

While working in the research laboratory established by Professor Bristol, on White's Island in Bermuda, Bartelmez met both his wife-to-be and E. V. Cowdry, who remained a close friend throughout his life.

Bartelmez continues: "After another year with Bristol as a laboratory assistant he [Bristol] arranged with Whitman for me to be given a fellowship at the University of Chicago. It paid $320 per year of which $129 went for tuition. The opportunity of collecting a load of fish for the Aquarium netted $100 so that I had enough to pay expenses during the first year."

Bartelmez was appointed a Fellow in Zoology at the University of Chicago in 1907. At Chicago, Whitman, head of the department, prompted Bartelmez' doctoral work on the bilaterality of the pigeon's egg, for which he received his Ph.D. in embryology in 1910, the year of Whitman's death. The study, which was later extended to other bird species, demonstrated an interesting point overlooked by embryologists during the lengthy history of the study of the bird's egg: that the long axis of the embryo was related to the long axis of the egg in a regular manner. Despite a degree of variation of the angle between the two axes, the right side of the embryo, with few exceptions, faced the pointed end of the egg. Bartelmez made the significant inference that the basic bilateral symmetry of the embryo was determined in the ovum before ovulation.

Bartelmez writes of this germinal period in his scientific and personal life:

"On my arrival in Chicago Whitman took me into his home for a week, had a rig sent over so that his son could drive me about the neighboring parks and talked about universities and research. His advice was to concentrate on research, waste no time taking courses and avoid university committees and politics as well as social engagements. As to a research problem he said, 'Take the development of the pigeon's egg immediately after ovulation: there are many problems to be solved during that period.' He did not realize how abysmal my ignorance was in many fields of biology, especially in embryology, so I registered in Lillie's 'Physiology of Development' which was most stimulating and suggested the thesis problem on the organization of the bird's egg. J. T. Patterson was then finishing his study of gastrulation in the pigeon under Whitman and was most helpful in orienting me in the field, for Whitman rarely came to the laboratory, as his large pigeon colony was kept in and about his home. When, after a year, my need for material became acute, he had 2 tiers of large cages for my birds built in the greenhouse at his own cost. After the first year he arranged for me to go to Woods Hole to study living eggs. I arrived there on a hot day early in June and was plodding up the hill with two bags and microscope when a tall impressive young man overtook me, took the bags and escorted me to my rooming house. This was the beginning of the friendship with Herbert Evans that will continue as long as I live. Three other friendships began at this time that have enriched my life: H. D. Arnold was a fellow in Physics; he became the second staff member of the Bell Laboratories and played a major role in its discoveries; J. W. E. Glattfeld was beginning his work on sugars with Nef and H. L. Wieman was pioneering in physiological cytology.

"The writing of my thesis did not begin until shortly before Whitman's untimely death so that I had only one confer-

ence on it with him. He spent 2 hours dissecting and improving the first paragraph of my introduction. That was the only help I had with the preparation of the paper."

After receiving his Ph.D. degree, Bartelmez decided that the methods of genetics had little appeal and accepted an assistantship with R. R. Bensley, which gave him the opportunity to develop a human embryological collection in the Anatomy Department of the University of Chicago, where he remained from 1910 until his retirement as Professor Emeritus in 1950. In 1912, shortly after being promoted to an instructorship at $1500, Bartelmez married Erminnie Eliza Hollis, whom he had met in Bermuda while working there with Bristol. Their marriage was a happy one, but tragically brief. In 1917, while pregnant with their third child, his wife was struck by a car, and subsequently gave birth to a premature infant. Eighteen months later she died of meningitis, probably as a result of the accident. The effect on Bartelmez was devastating, but was softened by the joining of the Bartelmez household with that of their close friends, the Glattfelds. With the help and devotion of the Glattfelds the three young Bartelmez children were brought to maturity. In commenting on the early years of his loss, Bartelmez writes: "In order to keep from brooding I worked day and night in the laboratory and the Glattfelds brought up the children." This typically generous statement does not alter the fact that Bartelmez remained a devoted father, remembered by his children for wonderful times together. One of them relates: "He took us to hunt mushrooms, on camping and biking expeditions in the mountains; he made bows and arrows and taught us archery and read aloud superbly. During later summers in Michigan he taught us to sail, which all three of us have enjoyed as adults. Two memorable summers were spent at the Scripps

Institute at La Jolla, where he taught us about sea life and helped us learn to swim in the ocean."

In 1936 Bartelmez married Mrs. Leila Beeman Arnold, the widow of his friend H. D. Arnold, and together they shared the happiness of their respective children and grandchildren. Upon his retirement in 1950, they moved to Baltimore where as a consultant in the Department of Embryology of the Carnegie Institution, under George W. Corner, Bartelmez pursued his embryological studies for seven years. In 1957 he and his wife moved to Missoula to be near Mrs. Bartelmez' children. He explained in 1958: "When I reached retiring age I was most anxious to leave the department of anatomy and Corner's offer to give me a place in the Carnegie Laboratory was a godsend. It made possible the completion of various pieces of work under ideal conditions with the stimulus of Corner and the other colleagues and the splendid technical help of Didusch, Heard and Grill. The association with the laboratory has not been terminated, fortunately for me. We now have our headquarters in Missoula where we can live in comfort in all seasons of the year and where the Department of Zoology has provided laboratory space."

Bartelmez' first major line of research, which led to important publications from 1912 to 1964, was embryological. His interest in early human embryology continued, but he made excursions into two other fields, neurohistology and reproductive biology. In each of these, as well as in the study of the development of the human central nervous system, he became an acknowledged master, and quickly identified and assailed a key problem. In neurohistology this was the precise structure of the cellular components involved in synaptic, or nerve cell to nerve cell, transmission. In reproductive biology it was the nature of the changes of the uterine mucous membrane which were responsible for menstrual bleeding. In brain develop-

ment it was the determination of distinctive features of normal human embryogenesis and their relation to cerebral defects. These seemingly unrelated fields came together in Bartelmez' intense interest in the morphological basis of tissue processes at the limits of resolution of light microscopy.

By his own account, Bartelmez' curiosity about the nervous system was awakened by a neurology course with C. J. Herrick, whose behavioral approach to the analysis of nervous structure and connections was in sharp contrast to the dry accounts of neural structure he had known before. He soon came in closer contact with Herrick when, at the invitation of the pioneering cell biologist R. R. Bensley, he joined the Department of Anatomy as an assistant. At Herrick's suggestion, Bartelmez embarked upon a study of the auditory-vestibular system of fishes. He was sidetracked, however, into concentrating upon the giant Mauthner nerve cells which form a part of this system.

Mauthner cells have been of special interest to neurobiologists since the nineteenth century. These astonishing nerve cells occur as a symmetrical pair in the hindbrains of teleost fishes and of amphibian larvae, in which they represent a two-celled integrating "center" for the vigorous "startle" or escape response to strong auditory stimuli. The huge size of these cells relative to their neighbors, their unusual shape, and their connections with other nerve cells attracted Bartelmez —among others —for three reasons. First, the Mauthner cell, as the second neuron of a three-neuron reflex, is unique in revealing with conventional methods the variety and sources of many of its neural inputs. Bartelmez was able to identify at least twelve different types of nerve fibers converging upon the Mauthner cell. Second, a single large neuron takes the place of the usual neuron cluster, thus ensuring perfect synchrony of response of all muscles involved in an essential reflex. Third, the exceptionally large synaptic endings of sensory neurons upon the

Mauthner cell offered an unparalleled opportunity to examine the precise anatomical relations at the site of transmission of signals relayed from the sensory neurons to the Mauthner cell. The site of transmission, or synapse, had recently become the primary target of neurophysiological research, and reports that the giant synapses on the Mauthner cell showed continuity of protoplasm from sensory neuron to the cell challenged the generally held neuron doctrine, which proclaimed the discreteness and functional independence of nerve cells, and their separateness at places of synaptic association.

Bartelmez recognized that the exceptionally large sensory nerve-fiber endings related to this neuron could be used ideally to test the reliability of cytological methods used by investigators who disagreed on the validity of the neuron doctrine. He was aware that the eminent histologists on both sides of the continuing controversy had reached a technical impasse owing both to the small size of the synaptic structures usually studied and to the limitations of the cytological methods employed. It seems clear that Bartelmez' preparations of the large Mauthner cell synapses—first described in 1915—represented the ultimate in refinement of light-microscopic methods used to investigate this problem. In this study, and in a later one with his associate Normand Hoerr in 1933, Bartelmez demonstrated convincingly that the two protoplasms at the Mauthner cell giant synapses were separated by a sharply defined membrane. Although only a single interface line could be defined with the best available light-microscopic equipment, Bartelmez correctly anticipated J. D. Robertson's electron-microscopic findings thirty years later by inferring that two limiting plasma membranes of the two components of the synapse were so intimately apposed that only one "membrane" could be resolved. He also concluded from the morphological analysis of all of its components that the Mauthner cell system must involve an

auditory reflex, in which speed and precision are very important, and not equilibratory reflexes. Many years later, electrophysiological studies of E. Furshpan and his colleagues confirmed and elaborated upon this prescient interpretation. The writer's own continuing work on the structure of the synapse was originally inspired by Bartelmez' work and was in some respects a direct continuation of it.

Although the electron microscope appears to have supplanted the light microscope by virtue of its hundredfold greater resolving power, Bartelmez' insistence on adequate preservation and on other important technical details has remained important precisely because the higher resolution of electron microscopy has revealed even more grotesquely the deficiencies of poor tissue preservation. At the close of his scientific career, when electron microscopy had fully established the generality of occurrence of appositional synaptic membranes, Bartelmez reasserted his lifelong faith in the need to judge data from preserved material by criteria based on the nature of living tissue. This point of view reflected the considerable influence of R. R. Bensley. Nor could he forget the tissue culture observation of Warren Lewis of half a century earlier, which defined an important characteristic of the limitation of the light microscope. In a letter to George W. Corner, who was completing Lewis' memoir, Bartelmez wrote: "[Lewis'] observations on connective tissue cells made it clear the processes of living cells come into contact with one another so that with the best optical equipment no boundary could be seen between them; yet they separated along the same area of contact. This was a most important finding for the interpretation of the histologic pictures at synaptic junctions in the nervous system."

During the Chicago period Bartelmez' research influenced and was influenced by not only R. R. Bensley and C. J. Her-

rick, but also, through intimate association, Percival Bailey, who was Bartelmez' first graduate student, Ralph W. Gerard, Stephen Polyak, Jeanette Obenchain, Heinrich Klüver, Paul Weiss, Karl Lashley, and others of the outstanding neurological group at the University. These senior investigators—along with his younger colleagues, who included A. A. Pearson, David B. Clark, and the writer—often sought his counsel on problems of the development and structure of the nervous system.

Bartelmez' enduring interest in early human embryology began with the embryological collection of the Anatomy Department at the University of Chicago. It was accentuated when he obtained a well-preserved early human embryo of the somite period in 1917. This windfall caused him to drop a two-year project on the effects of feeding endocrine glands to amphibian larvae. He took the embryo to the laboratory of Franklin Paine Mall at the Johns Hopkins University, where he established research associations with several leading figures in American embryology. Bartelmez writes: "Evans was there working on embryos of the same period and we made plans to combine our forces, and include the early somite stages in a monograph. In addition I became acquainted with Mall, Warren Lewis, Streeter and Corner. Before this work was finished I had spent a spring quarter and several successive Septembers in the Carnegie laboratory, and had seen Corner working with his monkey colony, in his pioneer studies on the menstrual cycle."

Bartelmez' studies of the development of the human brain, initiated in association with H. M. Evans, were directed toward clarifying the earliest stages of differentiation in the forward end of the nervous system, including both the otic and optic primordia and the cranial neural crest. He soon recognized the importance of finding reliable landmarks to estab-

lish an accurate sequence of events, and of adequately controlling the preservation of highly fragile young embryos. By working back from late somite stages to presomite stages, he established the importance of early-appearing and permanent landmarks such as the otic segment of the hindbrain, the cranial flexure, the optic primordium, the trigeminal neural crest, and the first somite. These classical studies, published in 1922-1926, corrected gross errors of interpretation in previous accounts of these crucial stages. Later, in the thirties, well-preserved somite human embryos obtained by the gynecologist J. I. Brewer and others, as well as rat embryonic material prepared in 1925 at Berkeley with the help of Herbert Evans, made possible a series of important studies on the cranial neural crest. These studies, begun at the University of Chicago with Mary Blount, were extended and published after his return to the Carnegie laboratory when he retired. They were instrumental in clarifying the origin and role of neural crest derived from the primary optic vesicles.

Bartelmez' early friendship with H. M. Evans, whom he had met at Woods Hole in 1908, and his subsequent association with Evans in Baltimore, probably played an important role in his initial studies of human embryonic development. In a similar manner, Bartelmez' association with George W. Corner in the unique embryological facilities of the Carnegie laboratory (where Corner was later director) stimulated Bartelmez' extensive investigations of the uterus and the uterine cycle. These researches were carried out mainly at the University of Chicago, but collaboration with Corner and with Carl G. Hartman at the Carnegie laboratory was continuously influential. Bartelmez writes of the early Chicago work on the uterus: "In the interim I had met Cary Culbertson (a Chicago gynecologist) and arranged to collect human uteri from his abundant clinical material. With the help of J. L. O'Leary

and Caroline Bensley a large series of endometria was prepared for cytologic study. The need for fully controlled material in this field became increasingly more apparent and when the Rockefeller Foundation gave the University a grant for research in biology, Bensley allotted funds for a monkey colony which provided material for the work of Markee, Daron, Rossman and myself."

Thus, in the twenties, Bartelmez made a major commitment to the understanding of the events of the menstrual cycle, which led to significant contributions and publications until 1957. But even by 1937 he had become an acknowledged authority on cyclic changes in the uterus, after publishing a masterful and exhaustive review on the theories of menstruation. Subsequent collaboration with George W. Corner and Carl G. Hartman established a sound basis for defining cyclic changes in the endometrium and for relating them to stages in the development and regression of the corpus luteum. An important study of the form and function of the unusual uterine blood vessels of primates, published in 1957, concluded his experimental work on the monkey uterus.

In the period referred to above, a quantum jump was accomplished in knowledge of the cyclic changes in the uterine mucosa, the relation of these changes to the endocrine function of the corpus luteum, and their further dependence on a highly specialized vascular supply. This jump began with the pioneering experimental studies of G. W. Corner on the menstrual cycle in rhesus monkeys, and continued with major contributions by Carl G. Hartman, Edgar Allen, and George Bartelmez. Bartelmez soon became convinced of Hartman's contention that menstruation was independent of ovulation or of pre-gravid changes of the uterine mucosa, and occurred as a normal cyclical event in which bleeding was the only constant feature. He was able to confirm Hartman's work in the

rhesus monkey by demonstrating with evidence from human material that menstruation may occur in the absence of a large ovarian follicle or a corpus luteum. By establishing the limits of reliability of his superb microscopic preparations, and thus separating fact from artifact, he was able to work out the sequence of regressive changes due to impaired circulation in the outer part of the endometrial lining of the uterus. The work of Bartelmez and his students, especially J. E. Markee, G. H. Daron, and I. Rossman, further established the peculiar characteristics of the spiral arteries of the uterine mucosa, their special sensitivity to general chemical or hormonal stimuli, and their variable time of rupture in different parts of the endometrium. He suggested that hemorrhage from these vessels might be induced and arrested by means of the rhythmic vascular constriction and relaxation (blushing and blanching) described by Markee in explants of endometrium in the anterior eye chamber of the monkey. Later, Bartelmez marshaled substantial evidence in favor of the view that constrictions of the spiral arteries, and consequent vascular stasis and ischemia, lead to injury and sloughing of the superficial layer of the endometrium, and to menstrual bleeding. The illustrations of elegant histological preparations in Bartelmez' paper of 1956 offer convincing evidence of the reality of the constrictions in the spiral arteries. His 1957 papers on the menstrual cycle summarize a wealth of histological and cytological observations on glandular activity, vascularization, and connective tissue components of the endometrium—observations which made possible an authoritative synthesis of events of the uterine cycle and their adaptive significance. Bartelmez' influence on gynecological practice and research was also notable, especially in the Chicago area—where he was elected an Honorary Fellow of the Chicago Gynecological Society.

Bartelmez' scientific publications are so well written that one might not suspect that their composing was generally a torment for him. He struggled for precision of thought and statement, and for a careful appraisal of previous writings, with the same insistence on technical perfection that he displayed in the laboratory. It was therefore not uncommon for a year or more to be taken in readying a manuscript for publication. It may be remarked that two older colleagues at Chicago who most influenced Bartelmez—Herrick and Bensley—were both masters of scientific writing and may have sharpened in Bartelmez those attitudes of work and thought which were already manifest in his earliest publications. At any rate, Bartelmez' writings combined the virtues of Herrick's meticulous recording of observations and interpretations with Bensley's uninhibited jousting with dogma.

Bartelmez was by nature a gentle and considerate person, but his irritation was apt to show when he was forced to deal with published data based on poorly preserved material. In discussing his strong reaction to workers who ignored the role of postmortem changes in creating artifacts and misinterpretations, he remarked that "such people need to be attacked violently or they will pay no attention whatever."

Bartelmez was so impressed with the work that was still to be done with conventional light-microscopic methods that he was somewhat reluctant to acknowledge fully the power and scope of new biochemical and electron microscopic approaches —the more so because so many of the exponents of electron microscopy showed an astonishing ignorance of the essential facts of microscopic organization and of tissue function. As a result, where he was rigorous and self-critical to a fault in dealing with microscopic problems, he was apt to be somewhat cavalier in dismissing the potentialities of new approaches, such as those in the field of histochemistry. His imagination

was captured by the cloistered life advocated by Whitman and by the vision of the scholar. Anything that might interfere prompted an irritation in Bartelmez, often humorously expressed, which could only charm the listener. In practice, his barbs about nonbelievers—the unscholarly medical student or practicing physician—were often more an expression of concern than of intolerance. His widely known patience with students and his helpfulness with physicians who consulted him led to a wider appreciation of the values of the scientific approach. This, of course, was his goal; he loved to transmit learning as well as to acquire it.

Bartelmez' family background conferred on him the riches of both the scientific and the literary German classics. He was especially fond of Goethe's works, and above all loved to quote from *Faust*. In a laboratory conversation in the thirties about the unfolding of new complexities of the mechanism of blood clotting, he gleefully recalled a line from *Faust,* "Blut ist ein ganz besondrer Saft!" Or, much later at the Department of Embryology of the Carnegie Institution, when the following question was referred to him: "How many cells are there in a newborn baby?," he replied, "Weisst du wie viel Sternlein stehen an dem blauen Himmelszelt?" Bartelmez also loved Chaucer and Shakespeare and quoted them with relish.

Bartelmez embellished his scientific publications with important details from the early period of microscopic studies of tissues, often neglected by others. It is interesting that, of the pioneers whose writings he had studied in detail, the one who touched him the most was Purkinje, who himself had made major contributions to the fields of histology, embryology, and neurology, and whose findings foreshadowed the cell theory and the neuron doctrine. His interest in Purkinje led him to translate from Latin Purkinje's neglected but classical work, "Contributions to the History of the Bird's Egg Previous to

Incubation" (1830). Bartelmez' brief Foreword places Purkinje's embryological discoveries in perspective within Purkinje's life and times. Characteristically, he offered this carefully annotated translation as a tribute to one of his oldest and most esteemed scientific friends, H. M. Evans, on the occasion of his sixtieth birthday.

Bartelmez as a teacher was influenced by his department's primary concern with research and graduate training. Under R. R. Bensley, the department was an autonomous one within the University, and medical students—though numerically superior—were not distinguished from other students who came to the department for formal course work. For many years Bartelmez was responsible for and devoted to the neuroanatomy course, which he had inherited from C. J. Herrick. Like Herrick and others in the department, he was not at his best in lecturing to medical students, but developed an excellent laboratory course. He was often seen in the laboratory, urging students to examine the microscopic material provided in preference to textbook illustrations. He delighted in demonstrating special microscopic preparations to illustrate important points, and was quietly outraged when some students gave only perfunctory attention to elegant microscopic demonstrations. His emphasis on the analysis of primary materials, and on technical excellence, evoked greater response from graduate students and younger colleagues. Bartelmez demonstrated his own skill on one occasion by capping a discussion of the conditions necessary to prepare serial paraffin sections one micron thick with an awesome performance of the feat. Those medical students who pursued careers in clinical neurology were apt to recall gratefully his insistence on direct personal observations in the laboratory, long after their immediate reaction to his sometimes absent-minded lectures had faded.

Temperamentally Bartelmez was a highly sociable per-

son, who overcame both the loneliness which followed the death of his first wife and that engendered by long hours in the laboratory. He was always at the disposal of students and colleagues who needed technical assistance or advice on how to interpret difficult points of microscopic structure. At the microscope, Bartelmez treated beginners or experts as companions in the search for knowledge, and his students remembered gratefully that they came to maturity as scientists because they were treated as professional equals once they had proved the seriousness of their purpose. The writer's friendship with Bartelmez began as a student with sessions at the microscope together, and remained close throughout Bartelmez' life. His influence upon my entire scientific career was immeasurable, and included the transmission of the spiritual as well as the methodological values of science.

For many years a few of Bartelmez' students and colleagues gathered for luncheon in his office, where current events and scientific problems vied with a curiously satisfying (though somewhat unvarying) daily menu of buttered 100 percent whole wheat toast, marmalade, Jonathan apples, and green tea. The tea was often donated by Chinese students and friends. Bartelmez especially cherished prize samples unobtainable outside China and mailed by former students. On festive occasions, often signaled by a visit from a colleague, he prepared oyster stew from a favorite recipe—probably acquired in Baltimore—and served it in cups. While working in the Hunterian Building of the Johns Hopkins School of Medicine, after retirement from the Carnegie Department of Embryology, Bartelmez enlivened the departmental luncheons in the library with his sense of humor and his still youthful enthusiasm. By this time his staples had shifted from toast and apples to crackers and imported Roquefort cheese. No derivative blue cheeses would do.

Bartelmez' lithe and springy stride was a familiar sight on the University of Chicago campus. He had been on his college gymnastic team, and continued throughout life to enjoy athletics, whether in the form of long walks, handstands, or handball. In the thirties he often repaired with his students to the handball courts "under the stands" in Stagg Field, a site to become known for the first successful nuclear chain reaction in December 1942. Handball partners learned that Bartelmez did not consider subzero weather an obstacle to the daily 5 P.M. game, even though it meant a bone-chilling run across Stagg Field from the dressing rooms in shorts and sweatshirt. Ice-skating on the Midway at the University of Chicago was another favorite sport.

Walking excursions in the Indiana sand dunes with C. J. Herrick, C. M. Child, and other biologist friends were also the occasion for vigorous and stimulating exercise, physical and mental. In his exploration through the countryside, Bartelmez cultivated his interest in mushrooms, of which he had collected and identified many species. In the summer, for many years, a farm in Chittenden, Vermont, gave further scope to his love for the outdoors, as well as relief from the dreaded hot weather in Chicago and Baltimore. In addition to facilities for visiting children and grandchildren, he had provided a small laboratory for his own use in research and writing. Later, after retirement to Missoula, he escaped the hot summer weather by taking hiking trips to high places in the Rockies.

Bartelmez was not a religious man in the ordinary sense of the word, but his lasting faith in the potentialities of human intelligence and in the power of genius was well expressed in an essay on "Man from the Point of View of His Development and Structure," published in 1926:

". . . those individuals who do more than merely acquire information, who are capable of true education, are lifted

thereby above the level of inherited reflex to the heights of intellectual control. Their number can assuredly be increased as time goes on, and mankind will profit accordingly. The greatest progress, however, will probably come through the labors of the sporadic genius, the pathfinder and torchbearer who must be recognized promptly, liberated from the bondage of class and caste and disease, and left free to develop his capacities and attain his ideals. Our greatest hope lies in him." And again: "In what direction may we look for progress? There is no evidence that the upper level of intellectual attainment has risen during historic time or that the race is likely to produce a higher percentage of geniuses in the future. Our most obvious need is in the improvement of the social relations among men." This early credo fails to include what was perhaps most characteristic of Bartelmez as a man—the reverence for life expressed both in work and in the warmth of his relations with others.

During the last few years of his life Bartelmez suffered from poor health, including arthritis, partial deafness, and a terminal illness, which, with recurrent illnesses of his wife, prompted him to despair of further work after 1962. He improved so markedly with therapy that in the next five years he was able to carry on a lively correspondence with his friends, especially A. Dekaban, with whom he collaborated in studies published jointly in 1962 and 1964. Between 1965 and his last letter to Dekaban on July 6, 1967, details of their work on the development of visual and motor centers of the cerebral cortex in human embryos were the central theme of his energetic letters. His correspondence with G. W. Corner about a proposed joint paper on the coiled arteries of the uterus, and on personal matters, continued until August 15, 1967.

Bartelmez was awarded an honorary Doctor of Science degree from the University of Montana in 1966, where he had

served as guest investigator in the Department of Zoology from 1957. He was elected to membership in the National Academy of Sciences in 1949. Between 1948 and 1950 he served as president of the American Association of Anatomists.

Bartelmez' devotion to science and learning, his gallant view of life, his youthful enthusiasm for new discoveries, and his lively interest in the activities of his own family and those of his associates remained keen to the end.

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KEY TO ABBREVIATIONS

Am. J. Anat. = American Journal of Anatomy
Am. J. Obstet. Gynecol. = American Journal of Obstetrics and Gynecology
Anat. Record = Anatomical Record
Carnegie Inst. Wash. Contrib. Embryol. = Carnegie Institution of Washington Contributions to Embryology
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