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CHARLES JUDSON HERRICK

1868—1960

A Biographical Memoir by

GEORGE W. BARTELMEZ

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Judson Herrick

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October 6, 1868–January 29, 1960

BY GEORGE W. BARTELMEZ*

THE AMERICAN HERRICKS are descended from Heneri Herrick, who came to Massachusetts from the Midlands of England in 1628. In 1854 Nathan Herrick migrated with his family from Stowe, Vermont, to the West and four years later settled in the growing town of Minneapolis. His eldest son, Henry Nathan, had married Anna Strickler, a girl of Swiss descent who had been intrigued by the prospect of spending her life in the wide open spaces of the West. Charles Judson was the youngest of her four sons. Their father had become pastor of a frontier Baptist church, but the chief support of the family came from the small farm on which they lived and labored.

Charles began his formal education in a one-room schoolhouse, but he had already been introduced to Nature by his elder brother Clarence.[1] His interest in collecting and identifying plants continued through his college days. His schooling was originally directed toward the ministry, but after two years in the "classical" course at college he decided that he was not "called to be a minister of the Gospel." He prepared

* Manuscript transmitted to the Academy by Dr. Heinrich Klüver after the death of Dr. Bartelmez.

[1] See C. J. Herrick, "Clarence Luther Herrick, Pioneer Naturalist, Teacher, and Psychobiologist," *Trans. Amer. Philos. Soc.*, 45, part 1 (March 1955):85 pp.

himself for majoring in science and took his B.S. degree at the University of Cincinnati in 1891. In the following year he married Mary Elizabeth Talbot, daughter of the retired president of Denison University, and obtained what he called "a settee of sciences" at a small college in Kansas. When he found that the president of the college was offering a course in psychology he ventured to suggest that his own course on the nervous system be coordinated with it. "Young man," said the president, "the brain has no more to do with the operations of the mind than have the cabbages out there in my garden."

In the succeeding academic year he enrolled as a graduate student at Denison University under his brother Clarence, who had become Professor of Biology there. At the end of the year his brother was stricken with acute pulmonary tuberculosis and had to resign his professorship. C.J.H., at the age of twenty-five years, took over the bulk of the teaching and the administration of the department. In addition, he refused to suspend the publication of the *Journal of Comparative Neurology,* which his brother had founded two years previously, in 1891, "because its suspension would break my brother's heart and jeopardize his recovery." It was a purely personal enterprise and he became editor, business manager without secretary, proofreader, supervisor of engravings, and, on occasion, typesetter. These labors continued until 1907 except for the academic year of 1896. Many a robust man would have been overwhelmed, but C.J.H. was inspired and his research program was not interrupted. From 1902 to 1907 he served as secretary of Section F of the American Association for the Advancement of Science.

In 1896 he obtained leave of absence from Denison University and worked at Columbia University and Woods Hole for his Ph.D. degree. In 1898 he was appointed Professor of

Zoology at Denison, where he was quite content with his opportunities. When, in 1907, he was offered the professorship of Neurology at the University of Chicago he hesitated to accept, because of his health and the example of his brother's early death due primarily to overwork. The opportunity of abundant time and support for research, the incentive of inspiring colleagues like R. R. Bensley working on the relations of structure to function, the presence of graduate students, the freedom from tedious and annoying executive duties, and a salary almost twice what he had been making were all powerful inducements. His wife's question, "Would you sooner go to Chicago and burn out or stay here and rust out?" settled the matter. Mary was an ideal wife; without her help he could not have accomplished what he did. He continued to work at the University of Chicago for thirty years. During his stay there, the Indiana Dunes country became a refuge from the foul air of the city. In 1910 "Bubbly Creek" at the stockyards still periodically filled much of the city with its stench, supplemented by the steel mills at Gary.

In 1918 Herrick was elected to membership in the National Academy of Sciences.

After his mother's death in 1934 (she was 104 years old) the Herricks went to live with their daughter, "Doctor Ruth," in Grand Rapids, Michigan. He kept in touch with the neurologists at the University of Michigan where the most distinguished of his students, Professor Elizabeth C. Crosby,[2] arranged to preserve his large library. Its unique reprint collection includes many significant papers not available elsewhere in this country. He continued his exacting histological studies for thirteen years thereafter.

[2] See Elizabeth C. Crosby, "Charles Judson Herrick (October 6, 1866 [*sic*]–January 29, 1960)," *J. Comp. Neurol.*, 115 (1960):3–8.

RESEARCH

The leitmotiv of Herrick's scientific career was to contribute to the "psychobiology" envisioned by his brother Clarence in 1891. This was to be a coordinated attack on the "mind-body" problem by comparative anatomists, physiologists, psychologists, and psychiatrists in correlation with the advances in other fields of science. In 1956 he summarized the progress in this field in his *The Evolution of Human Nature.*

He began his research career while still an undergraduate at Cincinnati, working on the nervous system of locally available bony fishes. In the course of the next seventeen years he established his reputation as a comparative neurologist with a series of studies on this group. He made a detailed study of structure as related to function by selecting species highly adapted to particular modes of life in which the peripheral and central nervous systems had hypertrophied. Thus in the carps and their allies there is a large organ in the mouth adapted to separating the edible from the inedible material scooped up from the bottom of ponds and streams. The nerves which supply this palatal organ and also their centers in the brain are so prominent that they can be identified in normal animals. This "natural experiment" made it possible to recognize the previously unknown gustatory centers and their functional connections with other regions of the brain and spinal cord.

His studies on the feeding habits of catfish demonstrated another gustatory system present in the outer skin of trunk, fins, and head including the barbels. All are supplied by a large branch of a cranial nerve (the facial). It had been known that there were two kinds of sense organs in the skin of some groups of fishes: the lateral line organs supplied by several cranial nerves and the "terminal buds" supplied by the facial nerve. It was common knowledge that catfish are carnivorous

bottom feeders, particularly active at night or when the water is muddy. The resemblance of the microscopic structure of the terminal buds of the skin to human taste buds as well as those in the mouths of other vertebrates led Herrick to train a group of catfish to distinguish between meat or meat juice (which they could accurately localize and snap up) and a bit of cotton wool brought into contact with the tail fin under conditions in which vision was excluded. The fish were living happily in an aquarium and the trauma of surgical interference was avoided.

His doctoral thesis was the first complete functional analysis of every nerve of the head and adjacent spinal cord. It was stimulated by Henry Fairfield Osborn's (1889) discovery that the cranial nerves are made up of groups ("components") of fibers which differ in size and structure from those of other groups as well as in their endings in the brain. In the same year E. P. Allis showed in another fish that the fibers which supply the organs of the lateral line of head and trunk can be distinguished from other components and traced by gross dissection. In 1895 O. S. Strong followed the various components of certain cranial nerves of the frog tadpole to their peripheral and central endings, using all the staining methods known at the time. Herrick went to Columbia University in 1896 to work under Osborn and Strong, choosing the unspecialized minnow, Menidia, for his analysis. The technique of preparing a complete series of sections of the head of a bony fish for microscopic study had to be worked out before the analysis could begin. The importance of this complete analysis impressed Ira Van Gieson, then director of the Pathological Institute of New York State Hospitals, and he made it possible to prepare adequate illustrations and publish Herrick's 300-page monograph with its seven large lithographic plates. A sufficient number of copies of the plates were printed so

that they could be published in the *Journal of Comparative Neurology* as well as in the *Archives of Neurology and Psychopathology*. No such sumptuous work has appeared in the *Journal* since then. The monograph is now recognized as the cornerstone of the "American School of Neurology." It has provided evidence for a fundamental analysis of the brain stem applicable to all vertebrates, namely the presence of four longitudinal columns, dorsally two formed by a series of centers that receive impulses from the environment and adjoining centers for visceral stimuli, and ventrally a column of centers concerned with visceral reactions adjoining which are the cell groups that control the skeletal musculature.

At the University of Chicago Herrick had abundant leisure time and financial support for research, readily available material, and technical help. He began at once an intensive study of the brains of salamanders. This group of amphibians has survived through the ages since the Devonian period with relatively few skeletal changes. The brains of living urodeles have little more than the basic equipment present in all vertebrate brains for total reactions of the body as a whole. They can be assumed to be similar to the brains of the earliest vertebrates that acquired the ability to breathe air and crawl over dry land with four legs. They are not distorted by any highly developed systems such as are present in many fishes nor are they masked by the hypertrophy of centers and conduction systems such as evolved in reptiles and mammals. The urodele brain is primitive but by no means simply organized. It was more than forty years before Herrick decided that he had found all the details that his methods could reveal. In 1948 he published his monograph on *The Brain of the Tiger Salamander.*

Part I of this work is a profound discussion of the mode of functioning of the brain of vertebrates as interpreted by their

overt behavior. His close friend, G. E. Coghill, had in the interim worked out the genesis of behavior and its mechanisms in the salamanders. Herrick carried on the analysis to the adult stage and on through the series to the most elaborately organized neural mechanism known, the human cerebral cortex. This analysis involved his studies on the groups in the line of descent, that is, reptiles and primitive mammals, as well as a review of the extensive literature inspired by the "American School."

In Part II of the monograph he presents the details of his microscopic analyses on more than 500 amphibian brains. He recognized some 57 cell groups and more than 120 fiber bundles, in many of which he could determine the beginning and endings. Few conduction systems have been described so completely in any vertebrate brain. It could only be done after an exhaustive study of complete series of sections of over 250 brains prepared by the Golgi method. Such preparations are unique in that they differ widely in the regions stained in different brains and in various parts of the same brain. Thus one area or one element of an area may be revealed in great detail leaving the surrounding region clear. Dense thickets of interwoven cell processes and endings of fibers may be present, the "neuropil" of the pioneer histologists, which are valuable landmarks and presumably important centers of integration. In other brains the centers of integration can be analyzed because only a few of the nerve cells and all of their branches are stained, while in still others only a few fibers with their endings have been picked out from the surrounding bundles of fibers. Sometimes in these small brains a few fibers of a conduction system can be followed through the whole brain and not only their beginnings and endings but also their connections en route can be demonstrated. Such preparations can be interpreted only by an investigator who

is familiar with every detail revealed by other histologic methods and is able to prepare drawings of the essential features. Like S. Ramón y Cajal, Herrick drew all of his detailed illustrations. Of the 113 figures of this work, 110 are from his pen and half of them were made from Golgi preparations.

His unraveling of the structure and connections of the interpeduncular nucleus was a notable achievement. This center has long been known, for it is present in every vertebrate brain, but his was the first adequate analysis. The center is characterized by certain synaptic fields, "glomeruli," highly vascularized, unusually dense areas of neuropil, with connections from many regions of the brain. In some glomeruli only the cells with their processes were stained, in others one or another of the fiber tracts from other regions with their endings appeared. In some, the cells lining the cavity of the brain showed elaborately branched processes extending into the neuropil. He suggested that these "ependymal" cells may contribute a secretion to the synaptic neuropil. This would be adding a new and unexpected factor to a synapse. There are many such suggestions for further investigation.

The *Tiger Salamander* is the most complete account of the structure of any vertebrate brain that has ever been made; its functional interpretations will serve as the basis for future work. After it had been completed he decided to give up the long hours of labor at the microscope. He devoted himself to cultivating his associations with his surviving philosophically-minded friends, to reading, meditating, and writing *The Evolution of Human Nature.*

HERRICK AND THE JOURNAL OF COMPARATIVE NEUROLOGY

In 1891 Clarence Herrick founded a periodical, the *Journal of Comparative Neurology,* that was prepared to publish,

as he said, "anything from any source, bearing on a broad comparative study of the brain and mind." He had no outside support, no collaborators, no subscribers, and only the hope of contributors. When he was totally incapacitated three years later, he resigned his professorship at Denison University and recommended that the publication of the *Journal* be suspended. Brother Charles J. undertook to assume his academic duties and also to save the *Journal.* He succeeded in both projects and the *Journal* is now one of the outstanding biological periodicals in America. Except for small subsidies from Denison and Cincinnati universities at the time and some help from friends, notably H. H. Donaldson and O. S. Strong, the deficits from the publication of the *Journal* were paid out of his own meagre salary (Volumes 6 to 14). His sense of responsibility for the *Journal* is illustrated by his action when in 1905 his laboratory went up in flames. His "fireproof" safe contained the manuscript of the doctoral dissertation of Ariëns Kappers of Amsterdam, who had personally provided the plates for his illustrations. When the door of the safe was pried open, the manuscript appeared to be a large black cinder. After learning that no copy of it had been made, Herrick began a dissection of the cinder and found that only the end of every line was completely black. The manuscript had been handwritten in an iron-tannin ink and he found that it could be deciphered with difficulty under oblique illumination. The footnotes were totally destroyed and so he filled them in "by the judicious use of scientific imagination." It took the summer's vacation to prepare a typescript which was sent to the author and returned with but few changes! In later years he repeatedly felt obliged to rewrite manuscripts that had been written in dictionary English by foreign contributors and students who came to work in his laboratory.

In 1904 the largely morphological character of the papers

submitted to the *Journal* led Herrick to join forces with R. M. Yerkes, who brought in contributions on animal behavior. The Founder lived long enough in that year to commend enthusiastically this addition to his plan for the development of a psychobiology and to see the first number of the *Journal of Comparative Neurology and Psychology*. The association of Herrick and Yerkes continued to the great satisfaction of the editors until 1910, when the *Journal of Animal Behavior* was founded in order to provide additional space for the rapid increase of work in this field.

In 1908 Herrick deeded the *Journal of Comparative Neurology and Psychology* to the Wistar Institute as a gift and the Institute undertook to print and publish it in the same format as the *American Journal of Anatomy,* the *Anatomical Record,* and the *Journal of Morphology*. In 1914 the American Association of Anatomists voted to increase the dues of its members so as to be able to subsidize the publication program of the Wistar Institute. The members of the Association became subscribers to the four journals, which saved the lives of all of them and contributed to their prestige. This arrangement was continued until 1923, when the sequelae of the Great War had begun to subside. Then the Wistar Institute gave the members the privilege of subscribing to its journals at 25 percent less than the published rate.

Herrick continued as Managing Editor of the *Journal of Comparative Neurology* until 1927, when he induced G. E. Coghill to take his place while he remained chairman of the Editorial Board. In 1948 he assumed an "emeritus" status but the Board continued to consult him on major issues and on occasion he did not hesitate to veto its decisions.

TEACHING

At Denison University, from 1893 until 1898 when he was appointed Professor of Zoology, Herrick was the entire De-

partment of Biology although continuing with his research program at the same time.

During his first two quarters at Chicago in 1907 he delivered a brilliant series of lectures on comparative neurology to a group of students attracted to the University by his coming. To those of us whose knowledge of the nervous system was confined to its gross anatomy, the course was a revelation and an inspiration.

In the following spring quarter he introduced a new method of approach to the presentation of neuroanatomy to medical students. P. S. Roofe (his biographer) has published a series of letters[3] between Herrick and Adolf Meyer in 1909. They compared and criticized their respective programs for such a course. Both presented the subject by interpreting structure in terms of function; Herrick from the comparative aspect, Meyer from the clinical. This led to improvements in both courses.

After the publication of his *Introduction to Neurology* in 1915, many teachers of neuroanatomy were alerted to the value of presenting function with structure, and after the appearance in 1920 of S. W. Ranson's *The Anatomy of the Nervous System,* which adopted Herrick's analysis of the brain, a whole flock of textbooks for medical students was published based on the functional approach to the subject.

In 1916, at the request of the Department of Psychology, Herrick offered a course on "Elementary Neurology" for graduate students. There were no prerequisites, all the rules and regulations of the pedagogues were disregarded, attendance was voluntary both for laboratory and for conferences, the content of the latter being usually determined by questions raised by the students. There were only two requirements for credit: a term paper that critically discussed a subject chosen by the student and a statement of such contents of the course

[3] See P. S. Roofe, "Neurology Comes of Age," *J. Kansas Med. Soc.,* 66 (1963): 124–29.

as were most pertinent to the student's interest and program. For twenty years the course was filled to capacity by students not only from the Department of Psychology but from other scientific departments and from the divinity school and the faculty of philosophy as well. Herrick regarded the course as the most satisfactory and stimulating work of his teaching career.

Another achievement at the University of Chicago was the organization of the "Neurology Club." This was purely a feast of reason needing no gastronomic allure. It was the first approach toward the development of a psychobiology. Members of most biological departments and eventually clinical neurologists, psychiatrists, and other clinicians of Billings Hospital found it instructive and stimulating. Some of the men generally participating in the meetings of this interdisciplinary group were Percival Bailey, Paul C. Bucy, Stephen Polyak, David Bodian, A. Earl Walker, Karl S. Lashley, Heinrich Klüver, Anton J. Carlson, Arno B. Luckhardt, Ralph S. Lillie, Ralph W. Gerard, Nathaniel Kleitman, Edmund Jacobson, Peter C. Kronfeld, Carl R. Moore, Paul Weiss, and B. H. Willier.

Many experienced investigators as well as graduate students were attracted to his laboratory at the University of Chicago. They came from Norway, Holland, Germany, Yugoslavia, Australia, New Zealand, Japan, and China.

In 1917 he collaborated in planning a course for neurosurgeons who had volunteered for service in World War I; and then he volunteered also. He was commissioned a major in the Sanitary Corps of the Army and put to work performing autopsies on the animals used in the physiological laboratory. Before long he was transferred to the Army Medical Museum and ordered to become a pathologist. A group of draftees, all candidates for the Ph.D. in biology, were placed under his command. They set up a histological laboratory and eventually

prepared a vast amount of microscopic material as well as a large collection of normal and injured brains. Not long after his discharge in 1919 all of this material had disappeared from the Museum, leaving no trace.

THE FINAL SUMMARY

The breadth and depth of Herrick's thinking are revealed in *The Evolution of Human Nature,* which was published four years before his death. In the introduction he wrote, "I did not devote sixty years to intensive study of the comparative anatomy of the nervous system merely to collect dead facts or to add to the store of 'accumulative knowledge.'[4] I wanted to find out what these animals do with the organs they have and what they do it for, with the expectation that this knowledge would help us to unravel the intricate texture of the human nervous system and show us how to use it more efficiently." He presents a variety of scientific evidences for the understanding of mind, defining psychobiology as "the study of the experience of living bodies, its method of operation, the apparatus employed and its significance as vital process, all from the standpoint of the individual having the experience." It calls for the cooperative efforts of specialists. "The first task is to discover by objective inquiry the properties of the living mechanisms that execute all animal behavior and the laws of their operation. The second group of studies must be concerned with the investigation of all kinds of mental processes by scientifically controlled introspection. . . . Introspective psychology gives us scientific knowledge of the spiritual life and the psychological factors of behavior."

"The laws of the physiological factors and those of the psychological factors are not directly comparable, for no com-

[4] He might have added, "helpful as this addition has been to the understanding of the subject."

mon units of measurement for them have as yet been found. The third task of psychobiology, then, is to define as exactly as possible the relations between the physiological processes and the colligated mental processes. This is the province of physiological psychology. When these relationships are adequately known we shall be able to formulate the principles of the mechanics of mental processes. . . . We have reason to believe that this goal is not unattainable."

His survey of the evolution of behavior in living creatures provides objective evidence of the basis for the attack on the problem. It can be summarized as follows:

In all animals that have a nervous system it controls the adaptation of the species to its environment. When its behavior is adequate the species survives. The evolutionary history of adaptive behavior parallels that of bodily structure; the more complex the behavior, the more elaborate is the structure of the nervous system.

All vertebrates have a forebrain primitively dominated by smell, a midbrain associated largely with vision and hearing, a hindbrain, the primary center for the cranial nerves, and a spinal cord for the nerves of the trunk and limbs. The polarized neural mechanism for analyzing incoming impulses and for integrating responses is the same in all vertebrates. Primitive species have little more than this fundamental neural equipment.

As sense modalities become more refined and behavior is adapted to a wider range of environmental conditions, certain parts of the brain become relatively larger, more intricate in structure and connections. The cerebral hemispheres of the forebrain especially are larger when more sense modalities are carried into them.

From the outset of mammalian evolution in the tertiary period the brain case was relatively larger than in any reptile.

Among living mammals there is a progressive increase in the size of the cerebral hemispheres as we pass from the simpler to the more highly organized groups. The outer layers of cells of the hemispheres ("cortex") are as distinctive mammalian characters as are the mammary glands.

In all primates, including man, the pattern of arrangement of centers in the cortex is the same. Those primates that became more manlike (anthropoid apes) have developed behaviors more like the conscious cerebral activities of man.

The series of fossil "hominids" that arose after the liberation of the hands from locomotion show a relatively rapid increase in the capacity of the brain case. The brain became progressively larger presumably in association with the use of tools and the development of speech. There is no evidence of so rapid an increase in any anthropoid strain.

The average brain of Homo sapiens weighs twice as much as that of any great ape; its association centers, which are independent of direct connections with afferent and efferent impulses, are relatively much larger.

The activities of the human mind are not merely greater quantitatively than those of any other animal; the acquisition of language through social inheritance has stimulated the development of cerebral activities that are qualitatively different from those of any animal.

This is but one of the series of topics presented in the book. The book itself is a scrupulously documented and annotated compendium of a long and active life. There are discussions of the fundamental differences between the analytic (discriminatory) and integrative (perceptive) functions of the cerebral cortex. "All thinking is now and here: but in this present act of thinking, memories of things past in time and remote in space and predictions of the future are tied into the mental process, so that in thought the perceptual

data of time and space lose some of their specific qualities and limitations. When symbolized in the mental processes they may emerge, lose their sharply defined boundaries, and reappear in a radically different setup of relationships. . . . Some of our abstract ideas may be totally devoid of any temporal or spatial quality." He stresses subjective experience and its control of behavior, and the inadequacy of a purely objective psychology. He considers "psi" phenomena and discusses values: "science has a code of moral values that are inherent in the organic structure of science and essential for its existence." "Science is a way of life in quest of truth for life's sake." He attacks dogmas in science as in other fields. There are chapters on sociology from the biological point of view. The totalitarian societies are compared with insect colonies where the individual is sacrificed for the benefit of the colony. "The ideal society is based on the voluntary cooperation of intelligent and altruistic individuals."

BIBLIOGRAPHY

KEY TO ABBREVIATIONS

Anat. Anz. = Anatomischer Anzeiger
Anat. Record = Anatomical Record
Ann. Rep. Ohio State Acad. Sci. = Annual Report of the Ohio State Academy of Science
Denison Univ. Bull., J. Sci. Lab. = Denison University Bulletin, Journal of the Scientific Laboratories
J. Comp. Neurol. = Journal of Comparative Neurology
J. Nerv. Ment. Dis. = Journal of Nervous and Mental Disease
J. Philos. = Journal of Philosophy
J. Philos., Psychol., Sci. Methods = Journal of Philosophy, Psychology and Scientific Methods
Proc. Nat. Acad. Sci. = Proceedings of the National Academy of Sciences
Psychol. Rev. = Psychological Review
Sci. Monthly = Scientific Monthly
U.S. Fish Comm. Bull. = United States Fish Commission Bulletin

The following list does not include newspaper articles or reviews, except a few regarded as of permanent scientific interest. Some autoabstracts are selected from a large number, particularly those of papers not otherwise published.

1891

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