Harrison, Ross Granville

(13 January 1870–30 September 1959)

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Harrison, Ross Granville (13 January 1870–30 September 1959), biologist, was born in Germantown, Pennsylvania, the son of Samuel Harrison, a mechanical engineer, and Catherine Barrington Diggs. Harrison's family moved from Germantown to Baltimore during his childhood, and he prepared at local schools to enter the Johns Hopkins University in 1886. Declaring his interest in medicine at that time, he completed his A.B. at age nineteen and continued on to graduate school in biology at Johns Hopkins, finishing his Ph.D. there in 1894. Along the way he established close lifelong friendships with fellow students such as Edwin Grant Conklin and Thomas Hunt Morgan as well as developed a lifelong love for hiking trips and began the research interest in experimental embryology that occupied his entire career. Harrison pursued his medical interests through biology—for, as he said, medicine was essentially applied biology—and through his studies for an M.D. in Germany.

This was an exciting time in biology at Johns Hopkins, where students studied morphology with William Keith Brooks and physiology with Henry Newell Martin. Those interested in morphological problems such as anatomy or embryology also spent summers in fieldwork, either through the Chesapeake Zoological Laboratory in Jamaica, Bermuda, or in North Carolina, or at the United States Fish Commission in Woods Hole, Massachusetts. Harrison spent 1890 in Woods Hole and 1892 with Brooks's group in Jamaica. Although he did not pursue his study of marine organisms, Harrison clearly found the experiences at these research stations valuable and was pleased to serve on the board of trustees at the Marine Biological Laboratory in Woods Hole from 1908 to 1940.

In 1892–1893 Harrison went to Europe, as many scientists did throughout the nineteenth century. He settled in Bonn, where he continued with Moritz Nussbaum the study of teleost fin development that he had begun at Hopkins and where, in 1899, he received his M.D. Immediately after completing his Ph.D., Harrison spent the year 1894–1895 as lecturer in morphology at Bryn Mawr College, replacing Morgan while Morgan visited Europe to study frog development. Harrison returned to Bonn for 1895–1896 and married Ida Lange in Altona, Germany, in 1896. That year he returned to Hopkins as an instructor (1896–1897), then associate (1897–1899), and then associate professor of anatomy (1899–1907) in the medical school. He and his wife also began their family of five children during the Hopkins period. During this period, Harrison also began his study of the nervous system, focusing on how nerves develop in the peripheral nervous system to make functional connections.

Though he was comfortable at Hopkins, Harrison moved in 1907 to Yale, where he became Bronson Professor of Comparative Anatomy and in 1912 chair of the zoology department. Previously the sciences had resided in the Sheffield Scientific School rather than at Yale College, but Harrison's appointment was at the university level with membership in the college, Sheffield, and the graduate school and eventually the medical school. He was promised a new university laboratory building, but the Osborn Memorial

Laboratory was not finally occupied until 1913. With his move to Yale, Harrison began his administrative career at the same time that his research career also reached a peak. Though he was tempted by an offer to return to Hopkins in 1914 to replace Franklin Paine Mall as head of the anatomy department, Harrison remained at Yale for the rest of his career. He served there as chairman of zoology (1912–1938), director of the Osborn Zoological Laboratory (1918–1938), Sterling Professor of Biology (1927–1938), and professor emeritus after 1938.

As Harrison moved to Yale, he also published the results of his nerve development studies. Three different explanations had been offered for how nerve fibers develop to make their functional connections: Either preexisting protoplasmic bridges guide the fibers, the protoplasmic bridge or plasmoderm outgrowth theory; or the cells that form the nerve sheath arise first and serve as a chain to guide the nerve fiber, the cell-chain theory; or the fiber develops by protoplasmic outgrowth, the outgrowth theory. Harrison believed that if he could get the fibers to grow into foreign material without any bridges or sheath cells, he would have supported the outgrowth theory. As an experimental embryologist, he turned to laboratory experiments to provide the appropriate conditions and produced a successful tissue culture. Using frog lymph, he got frog nerve fibers to grow out into the surrounding medium under controlled experimental conditions. While his publications of 1907–1910 detailed this work and its role as evidence for the outgrowth theory, the work also showed for the first time that tissues can be cultured outside the living body—a discovery with obvious and immediate medical implications. He chose not to develop the practical applications himself but encouraged others to do so and to develop improved culture techniques.

Although in 1917 a majority of the Nobel Prize committee supported the choice of Harrison for this work, as Harrison's chief biographer, J. S. Nicholas, has explained, no award was made because of the war. Harrison was again considered in 1933, but the age of his work and its "rather limited value" kept it from receiving a prize—a conclusion which Nicholas found ridiculous, since "Never has a *method* of as *limited value* (v. supra) been used so much" (1961, p. 148). In fact, the importance of tissue culture and its application for medicine and biological research was considered one of Harrison's major accomplishments and contributed to his receiving a number of other prizes and honorary degrees, including the John Scott Medal and Premium of the City of Philadelphia in 1925 and the John J. Carty Medal of the National Academy of Sciences in 1947.

Throughout his career Harrison explored various problems of embryonic development, including issues of symmetry and polarity, asking how the three body axes (anteroposterior, mediolateral, and dorsoventral) are established. While his contemporaries worried about the nature and cause of "organization" in the embryo, Harrison asked about the nature and causes of symmetry. By transplanting pieces of tissue, such as the limb bud, which normally gives rise to a limb with a certain pigmentation, onto a host body with different pigmentation, he examined the relative contributions of central and peripheral tissue. This technique, called heteroplastic grafting, revealed, for example, that the limb grows at its own rate rather than that of the host. Other parts, such as parts of the eye, respond to directions from the host, while others depend on interactions between host and grafted material.

With the salamander, Harrison showed in 1921 that a disk of mesoderm produces the limb. When he grafted this disk onto the "wrong" side of the body, it developed a reversed limb, so a left disk produced a left limb on the body's right side. If he inverted the disk, however, it developed a "proper" right limb.

Similar experiments with other parts through the 1920s led Harrison to conclude that the anteroposterior axis is determined very early while the body remains unfixed and more nearly what Hans Driesch had called a "harmonious equipotential system" until later. He tried to discover what it is that effects the determination of axes, and he thought there must be some structural, particulate basis. But experiments with X-ray crystallography did not produce any results, and the underlying cause remained unknown.

In addition to his own substantial research contributions (presented in more than eighty professional papers and invited lectures at the Harvey Society, Harvard, the Royal Society of London, St. John's College, Cambridge, and Yale), Harrison played important leadership roles. He served as managing editor of the *Journal of Experimental Zoology* from 1904 to 1946 and on boards for other major journals, including the *Proceedings of the National Academy of Sciences* from 1915 to 1916 and from 1921 to 1946. He served on various supervisory boards and held presidencies of numerous professional societies, including the American Society of Anatomists, 1912–1914; chair of section F for the American Association for the Advancement of Science, 1936; American Society of Naturalists, 1913; American Society of Zoologists, 1924; Anatomische Gesellschaft, 1934–1935; Beaumont Medical Club, 1933; Society for the Study of Development and Growth, 1946–1947; and the Sixth Pacific Science Congress, 1939. Perhaps his most important administrative role involved his chairmanship of the National Research Council during World War II from 1938 to 1946, where he worked to rationalize the distribution of penicillin and other medical procurement issues. (The place of death has not been ascertained, but it is assumed that Harrison died in New Haven.)

In all capacities, Harrison retained a sense of control and reason that Jane Oppenheimer has characterized as "his dispassionate temperament and his calm judiciousness." Even though he was very reserved and even shy, Harrison's students held him in awe as the rather intimidating but inspiring "chief." Former students and colleagues reported that he never managed to keep up with his paperwork or clean his desk, but he always had time for a visitor or to show appreciation for excellent work by others. As Nicholas enthused about Harrison, "It is seldom that one man can attain such true greatness. Every major effort was constructive and conspicuously successful. His contribution to biological thought is equivalent to that of Einstein [Albert Einstein] or Planck in other branches of science" (1960, p. 412).

Bibliography

Harrison's papers, cataloged and described by his long-time assistant, Sally Wilens, are in Manuscripts and Archives, Yale University. J. S. Nicholas, "Ross Granville Harrison, 1870–1959," National Academy of Sciences, *Biographical Memoirs* (1961): 132–62, is a major biography and contains a complete bibliography of Harrison's publications. Jane Oppenheimer in *Dictionary of Scientific Biography* and "Ross Harrison's Contributions to Experimental Embryology," *Bulletin of the History of Medicine* (1967) 40: 525–43, provide the best assessments of his research. See also Nicholas's entry in the *Yale Journal of Biology and Medicine* 32 (1960): 407–12.

See also

Conklin, Edwin Grant (1863-1952), biologist

Morgan, Thomas Hunt (1866-1945), biologist

Brooks, William Keith (1848-1908), zoologist

Martin, Henry Newell (1848-1896), physiologist

Mall, Franklin Paine (1862-1917), embryologist and anatomist

Nicholas, John Spangler (1895-1963), embryologist

Einstein, Albert (1879-1955), theoretical physicist