Osborne Overton Heard (1890-1983) [1]

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Osborne O. Heard was a noted Carnegie embryological model maker for the Department of Embryology at The Carnegie Institute of Washington (CIW), Baltimore, Maryland. Heard was born in Frederick, Maryland, on 21 November 1890. His father died while Heard and his three brothers were quite young. Heard attended night school at the Maryland Institute of Art and Design where he studied sculpting and patternmaking. While working as a patternmaker for the Detrick and Harvey Machine Company, Heard made models of tools using a variety of materials such as wood, plastic, and plaster of Paris. These models were then handed over to a mold maker to form a casting. Heard's work came to the attention of Franklin Paine Mall [5], the first director of the CIW's Embryology Department. Mall persuaded Heard to leave the machine company and to continue his craft at the Carnegie Institute. Hired in 1913, Heard remained an employee of the department for forty-two years, making hundreds of wax and plaster embryo models and contributing to several improvements in reconstruction technology.

Heard was initially hired on a trial basis but quickly became a permanent Carnegie employee when Mall saw the precision and detail Heard brought to the modeling laboratory (this was unlike the experience of the well-known German embryo wax modeler Adolf Ziegler [6], who worked out of his own modeling studio and was paid on commission). With little training in embryology [7] Heard basically taught himself the arrangement of organs and systems by sectioning and fixing embryos, mounting them on slides, and peering through microscopes. Another problem for Heard to overcome was that most of the embryo literature at the time was written in German. Not to be deterred, he began studying German at the Baltimore City College Night School. His interests in botany and hiking also started at this time; he became a long-standing member of the Baltimore Botanical Society and a charter member of the Mountain Club of Maryland.

Mall was the Carnegie Institute's leading embryologist and had learned Gustav Born's stacked plate sectioning techniques while working in Europe. Having realized how important embryo models would be to his research, Mall had the equipment for making stacked plate embryo models already in place when Heard arrived. With Mall's guidance, Heard soon began modeling the large number of human embryo specimens amassed by Mall and, later by George L. Streeter, the second director of the Department of Embryology.

With the stacked plate method, embryo sections were enlarged and traced on thin wax discs. The discs were then oriented in the right positions and stacked on top of each other, without fusing, so that they could be easily unstacked later. Once the three-dimensional model was completed, it was then glued, filed smooth, and painted. Though Heard became an expert in using this technique, there was a drawback: wax models are sensitive to heat. As early as 1914 Heard decided to save the left-over pieces of wax that normally would be discarded after the embryo shapes were cut out of them. By stacking the discarded pieces of plates Heard created hollow wax molds into which he poured plaster of Paris. The outer shell of wax was melted away by placing the entire mold in boiling water, leaving a heat-resistant plaster mold behind. The plaster mold was then polished and painted with watercolor paint. Heard's experience with making template models and creating casting molds was essential for the success of this technique.

Heard was an important contributor to the Embryo Department's development of the Carnegie Stages [8]. In 1917 Streeter became director of the Department of Embryology and directed embryologists and staff to work on a universal chronology (staging) of the human embryo. Instead of focusing on the age of an embryo, the maturity of the embryos would be identified by the presence and morphology [9] of multiple physical structures. This required that normal human embryos and specific organs be studied longitudinally from fertilization [10] to approximately sixty days of development (the final stage represents an approximately eight-week-old embryo, the time by which most organs and tissues are formed). Eventually, twenty-three Carnegie Stages [8] were identified, becoming the worldwide standard to which all embryo specimens continue to be compared. The stages were carefully described in Carnegie monographs, reports that included both photographs and wax models of embryos, many prepared by Heard. Heard's work is all the more remarkable when one realizes that the scientific artist was legally blind in his right eye.

After World War II, Heard's focus shifted from making models of embryos to photographing them. He made many improvements in microphotography and microtomes, always trying to resolve the ever-present problem of specimen distortion. While microtomes are essential for making thin slices of embryos, even the sharpest of microtome [11] knives are notorious for distorting the true morphology [9] of the embryo. This is mainly due to compression of the embryo by the knife. In 1946 Heard published "Microtomy with a Reciprocating Circular Knife and a Mechanism for Sharpening the Knife" in which he outlined his technique of using a reciprocating circular knife that he had designed and engineered into a microtome [11]. This method proved successful for making single embryo sections with little distortion. Heard compared the mechanics of sectioning with a reciprocating circular knife to that of a nonreciprocating straight knife by describing how one cuts bread. If a straight knife is pressed down through a loaf of bread, a slice may be obtained but its original shape will be deformed. If the same amount of force is used to push down and pull horizontally on the knife, the shape of the bread slice is far less altered. Such were the effects on the tiniest of embryo sections in Heard's laboratory. Heard also wrote about the techniques of microtome [11] knife sharpening (he built his own sharpeners) and how to lessen the effects of paraffin contamination on microtome [11] knife blades.

Photography of embryos became important both for the developed photos and for the transparent negatives projected onto a drawing board for drawing enlarged images of embryos. In order to photograph individual sections, a technician first stained and then embedded the embryo in paraffin. The embryo was then sectioned by a technician who was in charge of the microtome [11] while a second person was responsible for the camera and its shutter speed. One early problem was trying to decide the proper orientation of the embryo once the film was processed. To help solve this problem Heard designed a photographic apparatus to fit over the microtome [11]. Within the camera Heard had designed an aperture plate with v-shaped notches in the corners to serve as orientation guides. The special aperture plate was intended to be photographed in each picture taken of the embryo sections. With the v-shaped notches embedded into each embryo photograph there was never any question of an embryo's plane of view.

By the 1950s, the study ofembryology [7] had shifted to the laboratories of geneticists and molecular biologists. With this change, the demand for Heard's artistic reconstructions diminished. By the time he left in 1956 the Carnegie Institute was home to over 800 embryo models that Heard had constructed and ten scientific publications that he had written or coauthored. Heard's attention to detail along with his ability to shape glass, wax, plaster of Paris, metal, and wood made him a superior scientific artist and an essential pillar in CIW's Department of Embryology. Upon retiring Heard moved to Idaho where he died in August 1983. Many of his embryo models remain stored or on display at the National Museum of Health and Medicine[12] in Washington, DC.

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- The Embryo Project at Arizona State University, 1711 South Rural Road, Tempe Arizona 85287, United States

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