

# "Experiments on Embryonic Induction III. A Note on Inductions by Chick Primitive Streak Transplanted to the Rabbit Embryo" (1934), by Conrad Hal Waddington <sup>[1]</sup>

By: Navis, Adam R. Keywords: [Induction](#) <sup>[2]</sup> [Organizers](#) <sup>[3]</sup> [Mammals](#) <sup>[4]</sup>

Conrad Hal Waddington's "Experiments on Embryonic Induction III," published in 1934 in the *Journal of Experimental Biology*, describes the discovery that the [primitive streak](#) <sup>[7]</sup> induces the mammalian embryo. Waddington's hypothesis was that a transplanted [primitive streak](#) <sup>[7]</sup> could induce neural tissue in the [ectoderm](#) <sup>[8]</sup> of the [rabbit](#) <sup>[9]</sup> embryo. The [primitive streak](#) <sup>[7]</sup> defines the axis of an embryo and is capable of inducing the [differentiation](#) <sup>[10]</sup> of various tissues in a developing embryo during [gastrulation](#) <sup>[11]</sup>. In this experiment Waddington was, in fact, able to induce neural [differentiation](#) <sup>[10]</sup>. Waddington noted that the tissue is "competent" for a [chick](#) <sup>[12]</sup> [organizer](#) <sup>[13]</sup>, and by deduction a mammalian [organizer](#) <sup>[13]</sup> must exist. Competence refers to a cell's ability to respond to an inducing signal, which is temporally limited to certain [developmental stages](#) <sup>[14]</sup>. Waddington's initial work laid the foundation for many decades of research to follow, including further experiments by Waddington with the mammalian [organizer](#) <sup>[13]</sup>.

Waddington's inspiration for this as well as previous [induction](#) <sup>[15]</sup> experiments came from Hans Spemann's discovery of the amphibian [organizer](#) <sup>[13]</sup>. Prior to 1929 Waddington had pursued a ScD in geology; however, thanks to inspiration he derived from Spemann's discoveries and his friendship with geneticist [Gregory Bateson](#) <sup>[16]</sup>, Waddington switched fields to study [embryology](#) <sup>[17]</sup> at the [Strangeways Research Laboratory](#) <sup>[18]</sup>. His early work at Strangeways focused on the amphibian [organizer](#) <sup>[13]</sup>. In 1932, as part of this line of research, he confirmed the presence of organizing tissue in [chick](#) <sup>[12]</sup> and [duck](#) <sup>[19]</sup> embryos, which led the way for his experiments on the mammalian embryo.

The [rabbit](#) <sup>[9]</sup> embryo was not simple to culture *in vitro* <sup>[20]</sup>. Therefore, Waddington first needed to develop a more stable method to allow for transplantation experiments. Waddington expanded on his own earlier method of culturing [chick](#) <sup>[12]</sup> embryos on coagulated plasma from an adult [chicken](#) <sup>[21]</sup> and [chick](#) <sup>[12]</sup> embryo extract. They were successful in culturing the [rabbit](#) <sup>[9]</sup> embryo on this substrate up to the development of six somite pairs. Once this stable method of culturing the mammalian embryo was tested, Waddington was able to move on to transplanting [organizer](#) <sup>[13]</sup> tissue from the [chick](#) <sup>[12]</sup> to the [rabbit](#) <sup>[9]</sup>.

Waddington intended to induce [neural plate](#) <sup>[22]</sup> formation by [grafting](#) <sup>[23]</sup> a [chick](#) <sup>[12]</sup> [organizer](#) <sup>[13]</sup> into the [rabbit](#) <sup>[9]</sup> embryo. For this experiment, as he did in his earlier work, he utilized plasma coagulate and [chick](#) <sup>[12]</sup> extract as the [culture medium](#) <sup>[24]</sup>. Rat or [rabbit](#) <sup>[9]</sup> extract showed no improvement over [chick](#) <sup>[12]</sup> extract in development of the embryo. Since the [rabbit](#) <sup>[9]</sup> embryo was more difficult to manipulate, in this experiment the [chick](#) <sup>[12]</sup> [primitive streak](#) <sup>[7]</sup> was transplanted to a pocket between the [ectoderm](#) <sup>[8]</sup> and [endoderm](#) <sup>[25]</sup>. Waddington noted the difficulties encountered during the manipulation of the [rabbit](#) <sup>[9]</sup> embryo are due to its "transparency, toughness, and stickiness." In this experiment two embryos were shown to have developed neural tissue in the presence of the [chick](#) <sup>[12]</sup> [primitive streak](#) <sup>[7]</sup>.

This experiment thus demonstrated the presence of tissue competent for [induction](#) <sup>[15]</sup> by a [chick](#) <sup>[12]</sup> [organizer](#) <sup>[13]</sup> in the mammalian embryo. Although the mammalian [organizer](#) <sup>[13]</sup> itself was not directly identified in this experiment, its presence was deduced by the action of the grafted [primitive streak](#) <sup>[7]</sup> from the [chick](#) <sup>[12]</sup>. Waddington surmised that the action of the mammalian [organizer](#) <sup>[13]</sup> was very similar to organizers discovered in [birds](#) <sup>[26]</sup> and amphibia, and that the lack of species specificity showed that the inducing agents were highly conserved across species.

## Sources

- Slack, Jonathan M. W. "Conrad Hal Waddington: The Last Renaissance Biologist?" *Nature Reviews Genetics* 3 (2002): 889–895.
- Stern, C. D. "Conrad H. Waddington's Contributions to Avian and Mammalian Development, 1930–1940." *The International Journal of Developmental Biology* <sup>[27]</sup> 44 (2002): 15–22. <http://www.ijdb.ehu.es/web/paper/10761841/conrad-h-waddington-contributions-to-avian-and-mammalian-development-1930-1940> <sup>[28]</sup> (Accessed November 10, 2014).
- Waddington, Conrad H. "Experiments on Embryonic Induction III. A Note on Inductions by Chick Primitive Streak Transplanted to the Rabbit Embryo." *Journal of Experimental Biology* 11 (1934): 224–7. <http://jeb.biologists.org/content/11/3/224.full.pdf+html> <sup>[29]</sup> (Accessed November 10, 2014).
- Waddington, Conrad H. "Experiments on the Development of Chick and Duck Embryos, Cultivated *in vitro* <sup>[20]</sup>." *Philosophical Transactions of the Royal Society of London. Series B, Containing Papers of a Biological Character* 221 (1932): 179–230. <http://rspb.royalsocietypublishing.org/content/221/474-482/179.full.pdf+html> <sup>[30]</sup> (Accessed November 10, 2014).
- Waddington, Conrad H., and A. J. Waterman. "The Development *in vitro* <sup>[20]</sup> of Young Rabbit Embryos." *Journal of Anatomy* 67 (1933): 355–70. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1249296/pdf/janat00548-0003.pdf> <sup>[31]</sup> (Accessed November 10, 2014).

Conrad Hal Waddington's "Experiments on Embryonic Induction III," published in 1934 in the *Journal of Experimental Biology*, describes the discovery that the primitive streak induces the mammalian embryo. Waddington's hypothesis was that a transplanted primitive streak could induce neural tissue in the ectoderm of the rabbit embryo. The primitive streak defines the axis of an embryo and is capable of inducing the differentiation of various tissues in a developing embryo during gastrulation. In this experiment Waddington was, in fact, able to induce neural differentiation. Waddington noted that the tissue is "competent"; for a chick organizer, and by deduction a mammalian organizer must exist. Competence refers to a cell's ability to respond to an inducing signal, which is temporally limited to certain developmental stages. Waddington's initial work laid the foundation for many decades of research to follow, including further experiments by Waddington with the mammalian organizer.

## Subject

[Waddington, C. H. \(Conrad Hal\), 1905-1975](#) <sup>[32]</sup> [Embryos](#) <sup>[33]</sup> [Cell differentiation](#) <sup>[34]</sup> [Embryology](#) <sup>[35]</sup> [Chickens--Embryos](#) <sup>[36]</sup> [Organizers, Embryonic](#) <sup>[37]</sup>

## Topic

[Experiments](#) <sup>[38]</sup>

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