

## A nose for the embryo: the work of Pieter Nieuwkoop

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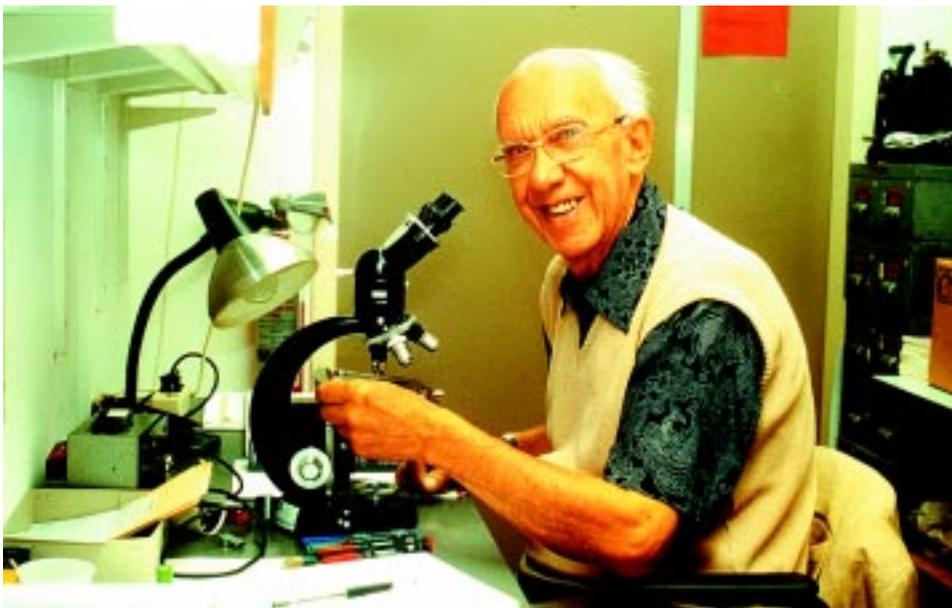
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Pieter Nieuwkoop was a giant of twentieth century embryology with a unique feel for the embryo. For example, it is notable that by simply observing histological sections he realized that *Xenopus* gastrulation started long before any external dorsal lip ever appears. He described these movements of the internal anterior endoderm in the highly recommended description of *Xenopus* gastrulation and neurulation by Nieuwkoop and Florschütz (1950). The images shown in that paper are but a small part of the immense knowledge lovingly described, but regrettably not illustrated, in the *Normal Table of Xenopus* by Nieuwkoop and Faber, 1967.

At a time in which transplantation of the gastrula organizer dominated experimental embryology, Nieuwkoop realized that patterning had to start much earlier, first in endoderm, then mesoderm and finally in ectoderm. Breaking loose from the then prevailing concept of continuous morphogenetic fields he brought us a paradigm in which endoderm induces mesoderm.

Perhaps his most ingenious work was the use of implants of folds of ectodermal tissue to demonstrate that neural induction results from an activation step followed by transformation (or posteriorization). He

realized that a complete series of brain parts was formed; folds placed in anterior regions formed only forebrain, but posteriorly implanted folds formed fore-, mid-, hind-brain and spinal cord. His conclusions depended entirely on the histological identification of structures such as nose, pineal, tectum and cranial nerve ganglia.



**Pieter Nieuwkoop at work.** Photo by John Bluemink, August 1996.

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To this day this work remains a joy to read (Nieuwkoop *et al.*, 1952).

In the hope of inducing younger scientists to read his classic papers, let me end with a recent quote from his 1995 paper with K. Koster (Nieuwkoop and Koster, 1995): "In this study the authors did not use molecular markers, because the first author, having more than 50 years of experience in normal and atypical histology, is perfectly sure of the correct identification of all the definitive larval structures. The reliance on molecular markers has actually given rise to misinterpretations in several recent articles, since the majority of molecular markers are expressed at rather early stages of development at which identification of structures is still uncertain."

Many of the histological sections resulting from this truly wonderful life in embryology (1917-1996) are available in the Hubrecht Laboratory Collection.

## References

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