Induction of the lens by the optic vesicle and the casual relationship between the optic cup and the lens has been one of the most extensively investigated problems of experimental embryology. It has become a classical example of secondary organic action. Lens inducing capacity of the vesicle has been tested by transplanting it to a new environment, by grafting over it ectoderm of varying ages from different regions either from the same or from different species, and by implanting it to an ectodermal explant and culturing in vitro. Similarly, the ability and degree of self-differentiation of the presumptive lens anlage have been tested by grafting it on a part outside the operative range of influence of the optic vesicle, or by implanting it into ectodermal explants, or by culturing it as an explant in vitro.

Results so far obtained are not uniform in all the different species of Anurans and Urodèles. Speemann (1901) was the first to demonstrate a failure of lens formation in Rana fusca after the removal of the optic cup. Results of King (1905) with R. palustris was opposite to Speemann’s. Later on, Speemann supported King’s finding in R. esculenta. In recent years Balinsky (1951) and Jacobson (1955) have shown that in Xenopus laevis and Triturus torosus respectively free lenses develop even without the optic cup.

From the reviews of Mangold (1931) and Needham (1942) and from the recent works by various workers it seems clear that some of the species demonstrate the influence of the head region even in the absence of the optic cup, while others demonstrate the primary importance of the optic vesicle in the formation of the lens.

Present series of experiments were undertaken on Xenopus laevis to determine (a) lens inducing capacity of the optic vesicle and competence of the ectoderm from various stages of development to lens formation; (b) inducing capacity of the optic vesicle when cultured as an explant in ectodermal jackets; (c) ability of self-differentiation of the lens anlage when removed from the influence of the optic vesicle; and (d) part played by the head region in the formation of the lens.
Materials and methods

Investigations were carried out in Xenopus laevis where self-differentiation of the lens occurs without the optic vesicle BALINSKY (1951). Operations were made on stage 24 NIEVWOOP and FABER (1956). These stages, according to SPEMANN (1938) are the most suitable ones to study the influence of the optic vesicle. One of the eyes was used for the operation, and the unoperated one was treated as the control.

Operations were conducted under sterile conditions. Full strength Holtfreter with 1 cc Sulphadiazene/litre was used for the operations. Operated embryos were transferred on healing to 10th Holtfreter with 0.5 cc Sulphadiazene/litre and reared for another 72 hrs. Operations were made with fine tungsten needles on petri dishes floored with 2% agar. Small grooves were made on the agar base to keep the embryos in position during the operations. Small glass bridges were used to hold the graft in contact with the optic vesicle. Embryos were fixed in SMITH, sectioned at 10 μ and stained with celestine blue and eosin.

Temperature of the medium which has been shown by TEN CATE (1953) to be the main factor causing differences in the results of SPEMANN (1912) and WOERDEMAAN (1939) on R. esculenta, was controlled and all the experiments were conducted at the room temperature, between 18 and 22° C.

A. Grafting of ectoderm.

After the lens ectoderm has been removed from the host, it was replaced by one or the other of the following ways:

a) presumptive ectoderm of an early gastrula which was a contemporary of the host;

b) presumptive ectoderm from an early gastrula;

c) belly ectoderm from embryos of the same age as the host.

In all these experiments care was taken to cover the whole of the optic vesicle with the grafts.

B. Wrapping up of the optic vesicle into ectodermal jackets.

Optic vesicles were carefully removed and wrapped up with early gastrula ectoderm either from Xenopus or from Axolotl and cultured in Holtfreter for over 48 hrs.

C. Presumptive lens ectoderm cultured with the host.

A U-shaped cut was made around the optic vesicle to remove the lens ectoderm. The lens ectoderm thus cut on the three sides was gently lifted and folded back at the sides of the optic vesicle where it remained attached as an accessory structure to the head region. Ectoderm from the neighbouring region soon covered the exposed vesicle.

Results

Series A. Lenses were induced from early and late gastrula ectoderm. Induced lenses from an early gastrula (Fig. 1) resembled very much the control (Fig. 2) in their differentiation except for their shape and size.

Lenses developed from late gastrula (Fig. 3) were not so much differentiated as the former and were more or less irregular in shape.

Ectodermal explants cultured over night before the grafting were thicker than the two previous cases, but were competent to some extent and the induced lenses (Fig. 4) were not much differentiated.

Small and ill-differentiated lenses were induced from the belly ectoderm (Fig. 5) showing thereby the loss of competence with the ageing.