

as yet been used. It is therefore not known whether or not other nerve fibers in the new environment have exerted any influence upon the taste organs.

No direct evidence was obtained of the formation of new organs by budding such as already found in grafted tongues of larvae.¹ The tongue epithelium of the adult is too thick and the taste organs are too deeply imbedded to allow a satisfactory study of the living graft under the high powers of the microscope. However, during and after the proliferative stage of the epithelium mitotic figures were found in some organs. The size of the graft did not increase with the advance of age. As a matter of fact there was some decrease. Nevertheless, the older grafts showed many more organs than those at the time of operation or shortly after. This may indicate that taste organs increase in numbers in adult tongues by a budding process such as is found in larvae.

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Grafted Eyes of Adult *Triturus Viridescens* with Special Reference to Repeated Return of Vision.

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The present experiments are part of a series of investigations which have already been reported^{1, 2, 3, 4} on grafted larval and adult amphibian eyes. Over 600 grafts of functional eyes have been studied in various types of operations. All eyes while living have been observed daily and the findings have been correlated with closely staged histological preparations.

This report is based on the observations of 140 reimplanted and transplanted eyes in the adult *Triturus viridescens*. In all cases the eye has been placed in the orbit, *i. e.*, in its normal environment. In some cases the eyes have been regrafted as many as 2 and 3 times involving reimplantation and transplantation in different orders of sequence.

Following operation some reduction in the size of the eye takes

¹ Stone, L. S., and Ussher, N.T., PROC. SOC. EXP. BIOL. AND MED., 1927, **25**, 213.

² Beers, D. N., PROC. SOC. EXP. BIOL. AND MED., 1929, **26**, 477.

³ Stone, L. S., *J. Exp. Zool.*, 1930, **55**, 193.

⁴ Stone, L. S., and Cole, C. H., PROC. SOC. EXP. BIOL. AND MED., 1931, **29**, 176.

place as in the case of larval eyes. The latter recover their original size after the return of circulation and soon become equal to that of the normal control. In adult eyes the reduction in size is maximally attained at a time (20-25 days) when the degeneration of the retina has reached its height. In most cases there is no complete recovery in the size of the eye although in other respects it may appear normal except for slight histological changes.

Observed return of circulation in the superficial vessels of the iris usually occurred within the first week after operation, the earliest being on the fifth day. However, temporary opacities of the cornea in some cases prevents the observation of the earliest movement of blood cells within the vessels.

Slight or even considerable opacity of the cornea took place in about half of the cases. Except in a few sloughed eyes this condition was transient and usually disappeared in a few days. Histological examination showed edema and thickening of the cornea. The changes were largely in the *substantia propria* which by hypertrophy brought about a permanently thicker cornea.

The lens undergoes degeneration very rapidly but before this is completed a new lens regenerates from the pupillary margin of the iris. This is as early as the nineteenth day after operation. The new lens appears structurally normal in less than 4 weeks after operation but for at least 4 or 5 months the lens never attains the size of that of the normal.

There is no measurable pupillary response to light and darkness in the adult eyes of this species such as there is in *Amblystoma*. However, following operation there is an early rapid reduction in the size of the pupil in all cases. The maximum reduction is attained during the period of degeneration seen in the retina. During the regeneration stages, beginning about the third to fourth week, the pupil begins to widen but never in 4 or 5 months attains the diameter equal to the original. The pupil may even in some cases fluxuate in size before it reaches a point of stability.

A marked degeneration of the retina takes place by the second day after operation and progresses until, by about the end of the third week, it is destroyed with the exception of the ciliary margin. From this margin regeneration extends as a single layer of cells, and, by rapid proliferation various layers of a new retina begin to appear as early as the thirty-fifth day after operation.

The degeneration of the optic nerve follows about as rapidly as the retina. Its complete regeneration coincides with the differentiation of the new retina. A complete connection with the brain is

made before the end of the second month and by the third month return of vision is clearly demonstrated.

A selection of 35 eyes was made for the tests of visual function and in every case proof of return of vision was obtained between the second and third month after operation. The technique has been reported in the literature cited. One case will give an idea of the results after grafting the eye 3 times (reimplant, reimplant, transplant, respectively). The first return of vision was on the eighty-seventh day; the second return of vision was on the seventy-ninth day; the third return of vision was on the sixty-first day. How many times this perfect eye could have been grafted so successfully is problematical.

Repeated grafts showed that the eye went through the same changes each time as in the first operation. There was only one striking change and that was a gradual permanent reduction of the ganglion cell layer, about 40% reduction. We hope to use this method in testing how far the reduction of ganglion cells can be obtained and still prove the presence of visual function.

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Production and Metamorphosis of Chimeras in Anurans and Urodeles.

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The perfect union of the anterior and posterior halves of the embryos of 2 species of anurans¹ and the metamorphosis² of such a combination into a perfect adult was shown to be possible by Harrison 30 years ago. Up to the present day the opportunities which this operation makes possible have never been realized. The intention of the present report is to demonstrate that such combinations can be produced in large enough numbers to enable the experimental embryologist and geneticist to carry out a variety of new studies.

The frog embryos employed were *Rana palustris* and *Rana sylvatica*. Those of the salamander used were *Amblystoma tigrinum* and *Amblystoma punctatum*. The stages at which the operation was done were in the early tail-bud period of development.

¹ Harrison, R. G., *Arch. f. mikr. Anat. u. Ent.*, 1904, **63**, 35.

² Harrison, R. G., *Anat. Rec.*, 1908, **2**, 385.