

appeared the same marked increase in hemoglobin, erythrocytes, and cell volume as was previously observed, whereas none of the other 24 animals showed any increase above normal values. The total and differential leucocyte counts in this and in the previous experiments showed similarity between the different groups of animals. Further work of a preliminary nature with CoSO_4 , used in place of the CoCl_2 , has shown that it is also effective in producing a polycythemia. Thus, it is definitely established that Co acting with Cu as a supplement to a milk-Fe diet is the causal agent in producing the polycythemia observed in our rats.

In a study of the toxicity of metals, Waltner and Waltner² have reported a polycythemia in the rat after feeding metallic cobalt and after the injection of Co salts in significantly larger doses than those given in our experiments.

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Grafting of Larval and Adult Eyes in *Amblystoma Punctatum*.

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Replanted and transplanted eyes of *Amblystoma punctatum* were studied daily for many months in 193 larval grafts on larval hosts around 21 mm. in length and in 102 adult grafts on adult hosts varying in age from 1 to 2 years and in length from 6 to 18 cm. Since no striking differences exist based merely on replantation and transplantation, a comparison is given based on the age of the graft. Return of circulation after operation was obtained in 40% of old adults, where sloughing or partial resorption was high, against 80% of young adults. Its earliest appearance was on the first day in young adults and on the third day in old adults. The earliest in larvae was 18 hours. Although in adults it had occurred earlier in the younger specimens than in older ones it was present in half of the cases in 10 days. By the fourth day it was observed in one-half of the larvae. About one-third of adult grafts and most of the larval eyes showed no corneal or lenticular opacity. In a few cases of adult and larval grafts the opacity was transient but in any case of excessive trauma sloughing of the bulb was subsequent to a

² Waltner, K., and Waltner, K., *Klin. Wochenschr.*, 1929, **8**, 313.

corneal change. In the black pigmented iris of adult grafts changes were dependent upon early return of circulation. When they took place a subcorneal hemorrhage involving a segment of the iris appeared during the first 2 weeks. If limited in area regeneration was complete within a month in which a new capillary network was formed. If extensive, but not involving sloughing, it was accompanied by a delay in retinal regeneration. In the yellow pigmented larval eye a slight temporary dulling of the luster of the iris sometimes occurred during the first 2 or 3 weeks. It was frequently accompanied by a subcorneal hemorrhage.

A slight postoperative reduction in the size of adult and larval grafts is usually found during degenerative changes in the retina. In the growing larval eye it is more marked until circulation returns¹ and by the twentieth day a size equal to that of the normal control is usually obtained. In adult grafts the size reduction is usually permanently established by about a month as in *Triturus*² or slightly longer depending upon the age of the host and the amount of degeneration. In adult grafts miosis was noted in some cases immediately after operation—a condition which persisted only about a week. In larval grafts immediately after operation miosis was observed in some and mydriasis in others, but the condition lasted only a few days. In many the pupil did not change. The pupillary reflex persisted uninterruptedly until death at 57 days in one young adult transplant. Usually the pupillary reflex was interrupted during the first week. This was followed by a recovery within 2 to 4 weeks. A few young adults showed an immediate postoperative absence of pupillary response lasting over several weeks before recovery. In larval grafts the pupillary reflex always occurred at metamorphosis and continued uninterruptedly.^{1, 3}

In larval grafts the retinal change is confined to a permanent loss of varying amounts of inner ganglion cells during a short period when the graft is temporarily decreased in size and a crowding of the retinal cell takes place. In adult grafts vast degeneration of all layers of the retina took place during the first 25 days extending to the ciliary margin. By about the thirty-seventh day in young adults all layers of the retina were represented by a rapid regeneration largely from the ciliary margin and partly from islands of undegenerated retinal cells. Complete restoration in old adults was

¹ Stone, L. S., *J. Exp. Zool.*, 1930, **55**, 193.

² Stone, L. S., and Ussher, N. T., *PROC. SOC. EXP. BIOL. AND MED.*, 1927, **25**, 213.

³ Beers, D. N., *PROC. SOC. EXP. BIOL. AND MED.*, 1929, **26**, 477.

retarded from 1 to 3 weeks. In adults the degeneration of the optic nerve accompanies that of the retina and is accomplished during the first month. During the second month the growth of the new optic nerve from the bulb accompanies resolution of the retina. The nerve frequently approaches normal in size and passes to the optic chiasma usually along a tortuous course. In only 2 cases did the optic nerve fail to leave the bulb by the end of the second month. In these cases the nerve travelled a short distance between the retina and the choroid. In larvae a complete degeneration of the optic nerve took place during the first week although retinal change was slight compared to adult grafts. By the end of the third week it was completely regenerated in all but 4 cases (3 were rotated about 180° , one was normally oriented). The optic nerve was usually tortuous and less than normal in size.

Regeneration in a young adult transplanted eye was so rapid that return of vision was proven as early as the thirty-eighth day. Usually this was not determined in adults until after the second month. In larvae the earliest tests for vision which gave positive results were made on the forty-eighth day (a transplant). This host was still in a larval stage. Vision was proven in all types of grafts and in many specimens by methods already published in detail.¹ In them the microscopic studies showed complete optic nerves. Ocular movements were present and when the hosts were in the adult stage corneal and pupillary reflexes were demonstrated.

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Experiments on the Development of the Hind Limb of *Amblystoma*.

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Experiments with the hind limb of *Amblystoma punctatum* were undertaken to compare its developmental behavior with that of the fore limb, as described by Harrison.¹

In normal development the hind limb does not appear as a definite bud until approximately $2\frac{1}{2}$ weeks later than the fore limb, so that it lies latent in the host for a much longer period after transplantation than does the fore limb bud. Furthermore, the 2 halves of the

¹ *J. Exp. Zool.*, 1921, **32**, 4.