

As was to be expected, no lag occurred in the sterilized milk inoculated from the actively growing young cultures. In the case of the freshly drawn raw milks, on the other hand, a slight but definite inhibitory effect upon the growth of the organism was found. In most cases a lag period of about one half hour was thus induced in the young inoculum, after which rapid growth followed.

### 10 (2533)

#### A further note on regeneration of the cut spinal cord in fish.

By J. FRANK PEARCY and THEODORE KOPPÁNYI

(Introduced by A. J. Carlson).

[From the Hull Physiological Laboratory of the University of Chicago, Chicago, Ill.]

In 1922 Koppányi and Weiss<sup>1</sup> reported in a preliminary note regeneration of the spinal cord in the fish (*Carassius vulgaris*, a small specimen 4-5 inches), and in the larvae of the salamander (*Salamandra maculosa*). Their method was complete section of the vertebra and cord in the high thoracic region. In one experiment three vertebrae were removed with their corresponding spinal cord. Regeneration occurred in both cases. Regeneration was evidenced by functional return in paralyzed regions and morphologically by histological examination. After the section, the animals were quiescent caudad to the section. Three weeks later the salamander larvae showed motility of the posterior portion. The motility slowly recovered until four or five weeks after the section when there was apparently complete functional recovery; their locomotion was coordinate and regular. During this period some of the salamanders metamorphosed. This confirms Loeb's statement that transection of the spinal cord in Axolotl does not prevent metamorphosis. Regeneration was less rapid in the fish, requiring six to eight weeks. There was apparent functional recovery, for swimming was coordinate, but the animals always lay upon the side and seldom swam in the normal position. Histologically, in conjunction with Kolmer, we traced the fibers across the section. These fibers were somewhat fewer in number than in the normal cord. They were mostly gathered in bundles although there was considerable interlacing.

<sup>1</sup>Koppányi, Th., and Weiss, P., *Akad. Anz.*, 1922, xii, 2.

In the salamander with the three vertebrae removed, the vertebrae and cord regenerated completely.

Our first experiments in the present series were done on the adult newts, *Diemyctylus viridescens* and *Diemyctylus torosus*. These animals were unsuitable for the experiments because the cord is so far dorsal that the body musculature is unable to hold the cut ends of the spinal cord in opposition when the vertebral column is transected. We used, therefore, the goldfish (*Carassius auratus*). These were large specimens from 8 to 14 inches in length. A small transverse section was made through the skin and the muscles spread apart and the entire vertebral column cut in two with scissors. There was no bony continuity remaining between the regions above and below the section. A probe was passed fully from side to side in the section. The spinal cord must have been sectioned. The skin was sutured with silk. Wound healing was slow and was incomplete in about six weeks time. During the sixth week occasional swimming movements of the fish behind the spinal transection were observed. These became more frequent in occurrence and more effective for locomotion so that after about two and a half months it had reached its maximum recovery. The animals lay constantly upon the side except when their swimming movements turned them into their normal position. They seemed to have very little power of orientation and when stimulated often showed circus movements. The swimming was rhythmic and coordinate. It could not be considered to be a Freusberg-like phenomena for the coordination between the parts anterior and posterior to the transection was definite and constant.

Thus functional recovery can be said to have taken place. Such a recovery may have resulted from a regeneration of axis cylinders from the nerve cells whose axones were cut. This would constitute a real morphological regeneration. There is another possibility, however. On the basis of Pütter's statements that cold blooded vertebrates have an indefinite period of growth, Carlson has suggested that undeveloped nerve cells in the cord above the section which have retained their embryonic potentialities, under the stimulus of the section grow peripherally, replacing the axones cut; thus there would be physiological recovery from morphological new growth instead of from morphological regeneration. The large number of nerve fibres crossing the

section, as recorded by Koppányi and Weiss, and the age of the animals favors the former explanation (morphological regeneration). Further work on the problem is contemplated.

We acknowledge with pleasure our thanks to Dr. Carlson for his encouragement and support, and to Mr. Parker and Mr. Young of the Lincoln Park Zoölogical Gardens, who kindly supplied us with the fish used in these experiments.

### 11 (2534)

#### The relative susceptibility to x-rays of the eggs and sperm of *Arbacia*.

By JAMES W. MAVOR and DAVID M. DE FOREST.

[From the Biological Laboratory, Union College, Schenectady, N. Y., and the Marine Biological Laboratory, Wood's Hole, Mass]

The eggs and sperm of the sea urchin, *Arbacia punctulata*, were exposed simultaneously to the same x-rayed treatment and subsequently the x-rayed eggs were fertilized by untreated sperm, and untreated eggs were fertilized by x-rayed sperm. Untreated eggs and sperm from the same sea urchins were used in the control cultures. Two sets of experiments have been completed, one during the summer of 1923 and the other during the summer of 1924. In 1924 the conditions of the x-ray treatment were so arranged that the temperature of the water in which the eggs or sperm were kept during treatment did not vary from that of the room in which all the cultures were kept by more than 1° C. The temperature of the room during the different experiments varied from 19° to 22° C. The x-ray treatment was given with a standard Coolidge tube, tungsten target, at 50,000 volts and 3 milliamperes, the distance from the target to the eggs and sperm being 25 cm. In 1923 a portable radiator type tube with tungsten target was used and run at 50,000 volts and 2.5 milliamperes. The distance from the target to the germ cells was 11 cm. and the glass cups were surrounded by a lead box covered on the top where the x-rays entered by a thin sheet of aluminum 3 mills in thickness.