

THE INFLUENCE OF DISTILLED WATER ON THE HEALING OF SKIN WOUNDS IN THE FROG.*

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PLATES LXXIII AND LXXIV.

It has been established by Jacques Loeb for certain marine animals that growth is accelerated by a slight diminution and retarded by a slight increase in the osmotic tension of the surrounding fluid medium. In this article it is my purpose to describe briefly the effects of variations of the dilution of the culture media and of the blood and lymph upon the healing of cutaneous wounds *in vitro* and *in vivo*.

THE EFFECTS OF DISTILLED WATER IN VITRO.

The epithelial proliferation of the skin of the adult frog is markedly increased by diluting the plasma with distilled water. Small fragments of skin have been cultivated in plasma containing one fifth, one fourth, two fifths, one half, three fifths, three fourths, and four fifths distilled water, and it has been noted that the increase of proliferation is already apparent in the one fifth dilution, and reaches its maximum in the one half dilution. When the dilution is carried further, the rate of proliferation progressively diminishes, until with plasma containing three fourths and four fifths distilled water, it ceases entirely (chart 1). Hence it follows that the growth of the cutaneous epithelium of the adult frog is influenced by the degree of dilution of the medium, as are certain other tissues.¹

The influence of a diluted medium on the healing of cutaneous wounds *in vitro* of the skin of the frog was next determined. A method analogous to the one already described was employed.²

* Received for publication, March 20, 1911.

¹ Carrel and Burrows, *Jour. Exper. Med.*, 1911, xiii, 562.

² Ruth, *Jour. Exper. Med.*, 1911, xiii, 422.

Wounds of equal size were made in the skin of the back with a small steel tube with a cutting edge, after which small fragments of skin containing the wounds were resected and implanted in normal and diluted plasma. The growth of the epithelium from the edges of the wounds toward the center could be followed under the microscope and drawn with the camera lucida. An accurate comparison of the rate of growth in normal and diluted plasma was easily secured. The earliest indication of repair by epithelial proliferation was observed in the plasma diluted one half with distilled water. In one experiment the epithelium was observed to begin to wander from the edges of the wound after five hours in this diluted plasma, while in normal plasma the wandering was observed only after fourteen hours. Moreover, the cicatrization was completed earlier in the plasma containing one half distilled water and was retarded when less than one half was used. The appended camera lucida drawings (figure 1) exhibit the progress of the cicatrization and show unmistakably the accelerating effect resulting from the dilution of the plasma.

THE EFFECTS OF DISTILLED WATER IN VIVO.

In order to secure dilutions of the blood and lymph within the body of the frog, distilled water was injected into the peritoneal cavity. Then wounds of equal size were made in the skin with the cutting tube, and the rate of cicatrization was observed. The wounds were identical in the normal control and in the frogs injected with distilled water in quantities of two, three, five, seven, and ten cubic centimeters respectively. Still another series of frogs was injected, each with one cubic centimeter of sodium chlorid solution of the following strengths: 0.015, 0.02, 0.03, 0.06, 0.07, and 0.10 gram per cubic centimeter. The wounds and surrounding fragments of skin were extirpated after eighteen, twenty, and twenty-two hours, and subjected to microscopical examination.

The results were striking. The appearance of the wounds was almost identical with those undergoing cicatrization in cultures, and the newly proliferated epithelium was readily seen and drawn. The healing of the wounds of the frogs injected with hypertonic salt solution was retarded, or had not even begun, while in the control animals it was complete.



FIG. 1.

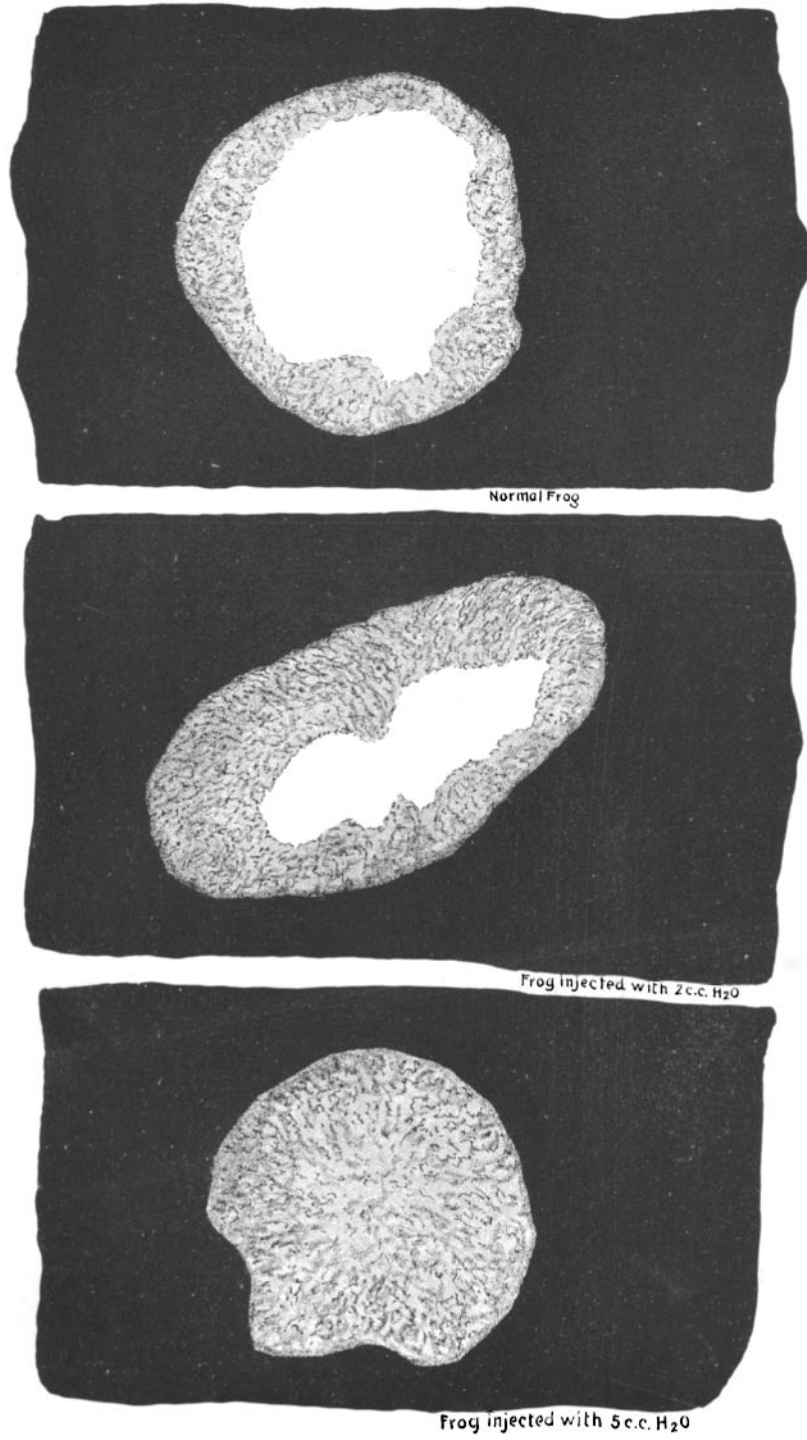


FIG. 2.

The frogs that received injections of distilled water showed great acceleration of epithelial proliferation, which was maximal in the animals having received from five to ten cubic centimeters of water (figure 2).

These experiments serve to demonstrate the important point that the healing of epidermal wounds of the frog takes place in a practically identical manner in cultures *in vitro* and in the body of the animal. They show further that the rate of growth of new epi-

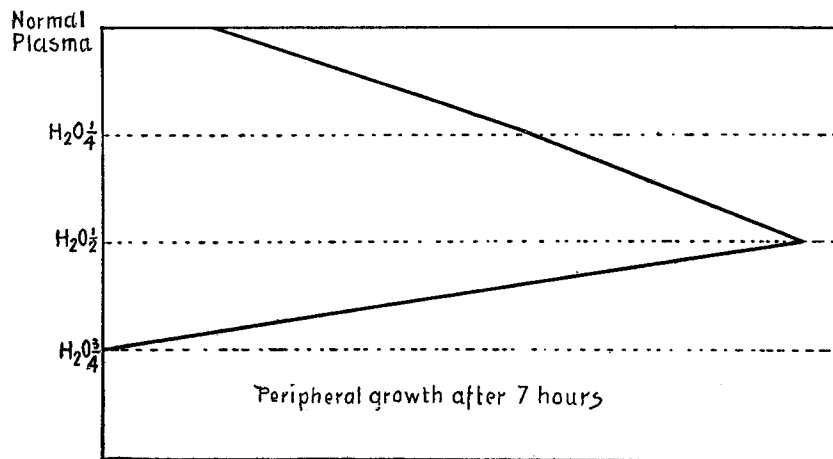


CHART I. Variations of the peripheral growth of fragments of frog's skin in different plasmas.

thelium which constitutes the process of cicatrization is accelerated by a diluted medium, both *in vitro* and *in vivo*. Thus, by increasing or diminishing the degree of dilution of the medium, or by injecting distilled water or hypertonic solutions into the animal, the rate of growth can, and will up to a certain point, be accelerated or retarded.

EXPLANATION OF PLATES.

PLATE LXXIII.

FIG. 1. Camera lucida drawings showing the differences of epithelial growth in wounds in cutaneous fragments cultivated for eighteen hours in normal and diluted plasmas.

PLATE LXXIV.

FIG. 2. Camera lucida drawings showing the differences, after eighteen hours, of epithelial growth in wounds made in the skin of a normal frog and in two frogs injected with distilled water.