involved only in extreme cases. The weight of the dog increases sharply up to 30% or 40% above the control level in spite of decreased appetite and loss of flesh. The edema usually begins when the plasma proteins have fallen to 3% or less and recedes with a rise above that level if daily bleeding is discontinued. The ascitic fluid or subcutaneous edema fluid usually has a protein content of less than 0.25% and often below 0.1%. Most of the animals have died of accidents connected with the method used. Even massive edema and ascites, however, are compatible with good general condition of the dog.

Further work is being carried on to control the various factors involved in the production of this edema.

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Ultraviolet Radiation; Stimulation and Inhibition in Lower Organisms.

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The statement is sometimes made that radiation depends for its effectiveness as a stimulating or an inhibiting agent upon wavelength rather than upon dosage. Quality rather than quantity is the factor which decides whether an effect is to be stimulative or inhibitory. However, a number of workers, among them Bovie, L. Loeb, and Packard, using ultraviolet, x-ray, and radium, respectively, found that it is possible to produce both types of effect with the same region of the spectrum. A survey of about 5 years' work with the lower animals shows this to be the case in at least 2 regions of the spectrum, ultraviolet, and the visible region (following the action of sensitizing dyes). While the experiments were originally not conducted to test this point, it soon became apparent that with the same spectral region, short exposures produced primarily stimulation, and longer exposures, depression. Later work included experiments in which the rate of a physiological process was modified in either of 2 directions following exposure for short and long periods to the unscreened radiation from a quartz mercury-vapor arc.

Such studies were made with yeast. Ordinary baking yeast was suspended in distilled water and exposed, in open dishes, to radiation from the quartz mercury-vapor arc at various distances from

the center of the arc. In these experiments, distilled water was used because it had previously been found that the action of ultraviolet radiation upon the constituents of the ordinary nutrient solution produces substances which are toxic to yeast. Earlier studies made by Woodrow, Bailey, and Fulmer reported only depression of sugar-fermenting power as a consequence of the action of ultraviolet radiation upon the nutrient solution itself.

In our experiments it was found that the sugar-fermenting power of yeast, as measured by rate and total amount of carbon dioxide production for a given period, could be stimulated or inhibited. The results may be summed up as follows:

1. 75% of all cases which produced stimulation were the results of exposures of less than 10 sec. in duration, at from 20 to 73 cm distance from the center of the arc.

2. 97% of the cases which produced depression at from 20 cm. to 56 cm. were due to exposure of 30 sec. or longer.

3. The effect of radiation, whether it be stimulative or inhibitory, is transitory, and the rate of carbon dioxide production returns toward normal after an interval of several hours or longer, depending on the degree of stimulation or inhibition originally produced. In some cases, the effect was permanently inhibitory, and no recovery occurred. Where the effect was temporary, a gradual return to normal was found to be followed by a slight advance beyond normal in the other direction. For example, slight inhibitions of rate of fermentation may gradually disappear, and an actual increase in rate may follow.

4. Preliminary studies indicate that the rate of cell division is affected by radiation, which probably largely accounts for the increase or decrease in the rate of carbon dioxide production of a given mass of yeast suspension, although the effect on metabolic activity and enzyme production of the single cell, as well as the effect of radiation on the rate of enzyme activity, cannot be excluded.

In our experiments to date, short exposures to radiation stimulate, and longer exposures depress. This was found to be true whether the studies were being made upon cell division, as in the case of Paramecium, on embryological development, or on physiological processes such as the activation of starfish eggs or the stimulation of frog gastrocnemei to contraction. Developmental modifications may proceed in either of 2 directions, *i. e.*, they may appear as differential inhibitions or differential stimulations, as in the case of *Arbacia punctulata*. The more slowly developing vertebrate embryos are difficult to stimulate differentially because the short per-

iod of radiation loses its effectiveness before it can register a modification of developmental processes. The longer exposures are, however, certain to produce differential inhibitions. By this is meant that the regions of highest metabolic activity, at the time of exposure to radiation show the greatest inhibition in later development. In the salt water minnow, *Fundulus heteroclitus,* we find modifications in the brain and head region, the eyes, and the circulatory system, particularly the heart, when exposures are made during early stages of development. Exposures made before the 2-cell stage are often the cause of production of 2-headed forms. When exposures are made later in development (when the tail region is developing) malformations of the tail are produced.

Similar studies were made upon the chick with comparable results. In these experiments, windows were sawed through the shell of the egg, and exposures were made of the developing blastoderm at various stages, and then the shell was again closed and sealed and the egg returned to the incubator to complete its development to the desired stage. Cross-sections of 72-hour embryos show that radiation causes differentiation of brain cells to be interfered with, while proliferation continues. The brain of such a chick is a large mass of irregular folds which cannot be interpreted as normal convolutions when compared with the control animals of the same stage of development.

Differential stimulation or inhibition in the development of *Arbacia,* the increase or decrease in the production of fertilizin by *Arbacia* eggs, and the corresponding increase or decrease in fertilizability of such eggs, the increase or decrease in the rate of division of Paramecium, the shortening or lengthening of the period of division in the same form, are examples of the effect of short and long exposures to radiation, respectively. In Paramecium it was possible so completely to inhibit division in a cell which was about to divide, that the process was never fully accomplished and the pair of cells was permanently united. Successive exposures at the time of division of the members of such a pair again inhibited division, and permanent chains of 3 and 4-celled animals resulted.

From the experiments with yeast, and the other experiments described above, it seems reasonable to conclude that the factor which determines whether the effect of radiation shall be stimulative or inhibitory, is a quantitative rather than a qualitative one. In other words, the amount of radiation in a given region of the spectrum, which is absorbed by the protoplasm in a given period of time, determines whether there is to be an increase or decrease in the speed of its physiological processes.