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Effect of Sublethal Doses of Monochromatic Ultraviolet Radiation on Bacteria in Liquid Suspensions.

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In the course of a quantitative investigation[1] of the lethal effect of monochromatic ultraviolet radiation below 3,000 A on stirred saline suspensions of bacteria *(Escherichia coli)* by a method similar to one described in a previous publication,[2] we observed the following phenomena:

If the bacteria are plated out in nutrient agar on Petri dishes subsequent to radiation, the colonies formed by the bacteria which survived the irradiation appear later than the colonies formed by the bacteria from the control suspension treated in the identical manner but protected from the ultraviolet radiation.

A careful study of the growth of the irradiated and control suspensions in a relatively poor medium (3 gm. NaCl, 0.2 gm. KCl, 0.2 gm. $CaCl_2$, 0.04 gm. Difco beef broth powder, 1,000 cc. distilled water, ca 10,000 bacteria/cc.) was made by determining the number of viable, colony-forming, organisms at proper intervals and several interesting observations were made:

1. The retarded growth (lag) phase of the irradiated bacteria was extended considerably over the control. This extension apparently depends on the energy applied to the suspension. When the bacteria had completed their growth, the suspension with the control and that with the irradiated bacteria contained the same number of organisms.

2. A careful determination of the lag phase revealed that where the control culture changed little in number of bacteria during this phase, the culture which had survived irradiation increased in number quite rapidly in the earlier part of the lag phase and then slowed down more or less for a certain time before it came into the log phase, thus producing a modified extension of the lag phase. The growth curve of the control rising in the beginning of the lag phase

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1 Hollaender and Claus, forthcoming publication.

2 Duggar, B. M., and Hollaender, Alexander, *J. Bact.*, 1934, **27**, 219, 241.

actually crossed the curve of the exposed culture and in the end an extension of the lag phase was induced by the radiation. The total number of viable bacteria of the exposed culture had increased during the lag phase. These increases were so pronounced that in the time during which the control culture showed a change in number of not more than 10 to 15%, the exposed culture had increased up to, or more than, 100%.

Tests have shown that the increased growth in the lag phase of the exposed culture was not produced by the decomposition products of the dead bacteria or by the excretion of any substance by the irradiated organisms. Stimulation is suggested, but the possibility of recovery of the irradiated bacteria is not entirely excluded.

The observed phenomena do not refer to the effects of very small amounts of energy, but only to energy values which kill some of the bacteria and allow the rest of the organisms to survive.

A detailed description of the experiments will be published later. The authors wish to thank Prof. B. M. Duggar for the help and advice he has given them in the course of this investigation.

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Effect of Infrared on Tissue Temperature Gradient as Influenced by Pigment.

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Determinations of the temperature gradients[1] from the surface of the skin to a depth of 16 mm. in 7 subjects with skin pigment types ranging from blond to negro, before, during and after exposure to varying quantities and wave bands of infrared radiation, indicate that the rise in temperature on the surface is proportional to the quantity of radiant energy and independent of wave length, between 0.75μ and longer than 5.0μ, and the amount of natural skin pigment.[2] The wave lengths of infrared used were broad bands 0.75μ to 3.0μ, 1.4μ to 5.0μ, 1.4μ to longer than 5.0μ, 3.0μ to longer than

1 Temperature gradients determined by a method similar to that of Bazett, H. C., and McGlone, B., *Am. J. Physiol.*, 1927, **82**, 415.

2 Our present knowledge of the function of skin pigment is reviewed by Laurens, H., 1933, The Physiological Effects of Radiant Energy. Chemical Catalog Co., New York, p. 122.