

oxygen liberated in ten minutes was determined. Ten such determinations were made with an average of 118 c.c. of oxygen for the determinations. The smallest amount obtained in these determinations was 112 c.c. of oxygen, the largest amount 126 c.c. Similarly, 30 milligrammes of a moth were introduced into 30 c.c. of hydrogen peroxide and the amount of oxygen liberated determined. The amount of oxygen liberated by the moth was 8 c.c. of oxygen per 30 milligrammes of material. Determinations were also made using honey-bees, bumble-bees and butterflies. The amount of oxygen liberated in none of these determinations exceeded 25 c.c. of oxygen per 30 milligrammes of material. Thirty milligrammes of the luminous part of fire-flies were cut off and ground up. This part liberated 145 c.c. of oxygen from 30 c.c. of hydrogen peroxide, whereas the same amount of the ground-up non-luminous part of the fire-flies liberated 115 c.c. of oxygen from hydrogen peroxide.

*Conclusions.*—From the foregoing experiments it may be concluded that the oxidative processes of luminous insects, such as the fire-fly, are much more intense than of non-luminous insects, such as the moth, butterfly, etc.; that the oxidative processes in the luminous part of the fire-fly are probably more intense than in the non-luminous part.

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### THE MODE OF ACTION OF ULTRAVIOLET RADIATION IN PRODUCING STERILIZATION.

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It has been recognized for several years that when living cells, such as bacteria, are exposed to ultraviolet radiation they are killed in a few minutes. Since the life of a cell is dependent upon its intracellular enzymes, and since the ultraviolet radiation destroys enzymes, a theory has been advanced that ultraviolet radiation kills living cells by destroying the enzymes of the cell.

The object of this investigation was to determine if the intracellular enzymes in bacteria are destroyed when the bacteria are killed by exposure to ultraviolet radiation. The bacteria used were pure cultures of *B. prodigiosus*, *B. fluorescens*, *B. liquefaciens*, *B. pyocyaneus*, *B. proteus vulgaris*, and *B. subtilis*. These

bacteria were chosen because they possess the property of liquefying gelatine, this property in turn being dependent upon the intracellular proteolytic enzymes. Twenty-five cubic centimetres of liquid containing great numbers of *B. prodigiosus* were exposed in an open vessel to the radiation from a quartz-mercury vapor burner operating at 140 volts, 3.3 ampères, at a distance of 10 cm., until the bacteria were dead. By means of a centrifugalizing machine the dead bacteria were thrown down and washed in physiological saline. The mass of dead bacteria was ground up in a mortar with sand and 30. per cent. alcohol. In this way the intracellular enzymes were extracted from the dead bacteria. All of the bacteria named above were treated after this manner. Ten cubic centimetres of the alcoholic extract of the different kinds of dead bacteria were introduced into separate test-tubes containing gelatine. Ten cubic centimetres of liquid containing the different kinds of living bacteria were also introduced into tubes containing gelatine. These tubes were permitted to stand at room temperature for 96 hours. At the end of this time the extent to which the gelatine had been liquefied in the different tubes was measured. The extract of dead *B. prodigiosus* had liquefied 7 mm. of gelatine; *B. fluorescens*, 6 mm.; *B. liquefaciens*, 10 mm.; *B. pyocyaneus*, 4 mm.; *B. proteus vulgaris*, 5 mm., and *B. subtilis*, 4 mm. The gelatine in the tube containing living *B. prodigiosus* was liquefied 8 mm.; that containing living *B. fluorescens*, 6 mm.; *B. liquefaciens*, 12 mm.; *B. pyocyaneus*, 5 mm.; *B. proteus vulgaris*, 6 mm., and *B. subtilis*, 4 mm. If the amount of gelatine liquefied by the living bacteria be compared with that liquefied by the extract of the corresponding dead bacteria, it will be found that there is very little difference in the extent of liquefaction. This is taken to mean that, while the ultraviolet rays had killed the bacteria, it had affected very little their intracellular enzymes. These experiments would seem to render untenable the theory that ultraviolet rays kill living cells by destroying their intracellular enzymes.

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