joints with quartz windows would have been prohibitively expensive. Cemented quartz windows proved unsatisfactory because they could not be heated during the evacuation of the tubes. I therefore asked the glass blower to try one of the ultra-violet transmitting glasses, making it about as thin as the wall of an incandescent lamp bulb. He succeeded without great difficulty in joining it to ordinary glass through which the lead-in wires, from two to eleven in number, were sealed. With a few exceptions, the tubes did not crack, and in all cases the transmission of the desired mercury line was satisfactory.

Another fact of great importance in work of this kind deserves mention. One of the first objections raised to the use of ultra-violet transmitting glass was that its transmission might decrease with age, thus making the apparatus useless. This objection obviously was based on the popular notion that solarization, which occurs when such a glass is exposed to sunlight or to short wave-length arc radiation, destroys the properties which distinguish it from ordinary glass. Had this been true the experiments could not have been performed, for quantitative measurements had to be made. A careful study of the matter was made, therefore, to determine the nature of the solarization. My laboratory found that the depreciation in transmission was not serious, that it took place within a short length of time and that the deterioration then ceased so that the glass retained its characteristic properties indefinitely thereafter.

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SPECIAL ARTICLES

THE EFFECT OF X-RAYS ON BACTERIA

THE effect of X-rays on certain insects and plants seems to be a popular study at the present time. There seems, however, to have been but little work done on the effect of these rays upon pure cultures of bacteria.[1, 2, 3] The present report is the result of a preliminary study of the effects of irradiation on pure cultures of *B. coli* and *Erythrobacillus prodigiosus*.

The *B. coli* used was isolated from fresh sewage. Its morphology and cultural characteristics were studied in order to prove that it was true to type. The stock culture of *Erythrobacillus prodigiosus* was secured through Dr. F. W. Tanner, of the bacteriology department. The stock culture was "pepped-up" by growing it on agar slants at 20° C. It was transferred daily to a new slant. In this way young and active organisms were available for study. In all cases the characteristic red pigmented colonies developed in twelve hours. The bacterial suspensions which were irradiated were prepared by adding two small loops of the organisms, as removed from a single colony on an agar slant, to 200 cc of sterile physiological salt solution. In each experiment 10 cc of this suspension was added to sterile test tubes of the following specifications:

Soft glass with lip

Length	152.0 mm.
Diameter (inside)	18.0 mm.
Diameter (outside)	21.0 mm.

The test tubes containing the suspension of the organism were placed in an inclined position in an all-wood test tube rack and placed in the lead box containing the X-ray tube. The position chosen for the test tubes was the one which was most convenient and one which did not place the tubes in the beam from the X-ray tube directly perpendicular to the target in order that the effect might be slower and more easily followed. Immediately before starting the X-ray treatment one of the test tubes containing the suspension of the organism was removed and dilutions plated out to determine the original count per cc. The irradiation was then started with a tungsten target tube using a potential of sixty-five kilovolts and a current of three to four milliamperes. At certain time intervals test tubes were removed and dilutions plated out to determine the total counts. The analytical results are summarized in Table I. The rate of sterilization may be noted when the bacterial count is plotted logarithmically against time of irradiation.

RESULTS AND CONCLUSIONS

(1) X-rays act like sterilizing agents upon cultures of *B. coli* and *Erythrobacillus prodigiosus*, in that the curves are characteristic sterilization or death-rate curves showing that the total counts decrease logarithmically with time.

(2) In this experiment *B. coli* did not show variation or mutation when it was treated with X-rays.

(3) With increasing irradiation *Erythrobacillus prodigiosus* showed a tendency toward lack of ability

[1] "Recherches sur l'Action Bactericide des Rayons X," J. J. Trillat, Annales de l'Institut Pasteur, 41, 583 (1927).

[2] "Influence of Temperature on Biologic Action of X-rays," A. Dognon, Arch. Phy. Therapy, X-rays, Radium 9, 55–9 (1928).

[3] Production of Monochromatic X-rays of Long Wave Length," "The Quantum Action on Microbes," F. Holweck, Compt. rend. 188, 197 (1929).

to produce its characteristic red pigment. By allowing the organism to grow on the plate for a period of five days the greater portion of the colonies produced their pigment. If a transfer of a white colony is made to an agar slant the characteristic pigment is produced in twelve hours. In only one case was it necessary to make a second transfer in order to bring about the development of the pigment. The above is another example of the variation tendency of *Erythrobacillus prodigiosus.*

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TABLE I
SUMMARY OF ANALYTICAL RESULTS

B. coli Data

Sample number	Time of irradiation in minutes	Total count per cc (24 hrs.–37° C.)	Remarks
1	0	70,000	
2	5	70,000	
3	15	17,000	Single colonies were picked from plate of sample number
4	30	9,000	6 and morphology and cultural characteristics were ex-
5	45	1,700	amined. All tests were characteristic of the original.
6	60	10	
7	90	0	

Erythrobacillus prodigiosus Data

Sample number	Time of irradiation in minutes	Observations of Glucose-Agar Plates			
		2nd day		3rd day	5th day
		Total count per cc 20° C.	Pigment	Pigment of colonies	Pigment of colonies
1	0	800,000	red	red	.....
2	5	600,000	red	red	.....
3	15	480,000	red	red	.....
4	30	400,000	red	red	.....
5	45	300,000	red	red	.....
6	60	45,000	80% white*	50% white	90% red
			20% red	50% red	10% white
7	90	400	100% white*	80% white	60% red, 40% white
8	120	0	.....	.....	.....

* All white colonies that were fished from the plates (12 in number) and streaked on agar slants produced luxuriant red pigmented growth at 20° C. in twenty-four hours with the exception of one colony fished from sample number 7 which failed to give red pigment until it was transferred to a second agar slant.

MULTIPLE GLACIATION IN THE SIERRA NEVADA[1]

DEFINITE and conclusive proof of two stages of glaciation was found in the Sierra Nevada of California in 1913 independently by Knopf, on the east flank of the range, and by the writer, in the Yosemite region. The evidence consists primarily of two series, or bodies, of moraines, an older characterized by subdued, partly eroded forms and containing weathered, disintegrating boulders, and a younger characterized by well-preserved, sharp crests and containing mostly fresh, unweathered boulders. In addition both observers found erosional evidences of a roughly quantitative sort demonstrating that the interval between the deposition of the older and younger moraines was of the order of an interglacial stage.

The detailed mapping of the moraines of the Yosemite Glacier and its tributaries, however, soon enabled the writer to distinguish further subdivisions of the glacial record. Each of the two great bodies of moraines he found to be composite in its nature, so that together they embody a four-fold record—of two earlier and two later glacial advances. But

[1] Published by permission of the director of the U. S. Geological Survey.