Enfin, nous avons procédé à une analyse biométrique des formes di- et tétraploïde, portant sur la taille des grains de pollen. Les formes à $n = 18$ ont une courbe à un sommet, tandis que les formes à $n = 36$, y compris un tétraploïde obtenu expérimentalement par la colchicine, à partir d'un matériel à $N = 18$ sont caractérisées par une courbe bimodale.

Institut de botanique, Université de Neuchâtel, le 5 février 1952.

R. SÖLLNER

Zusammenfassung

Die Chromosomenzahlen von mehr als 20 Arten und Unterarten der Gattung *Cerastium* wurden bestimmt. Für solche mit grösserer geographischer Verbreitung wurden Pflanzen aus mehreren Standorten untersucht. Unsere Kenntnisse über das Areal des diploiden und des tetraploiden *C. arvense* wurden erweitert. Vergleichende biometrische Kurven über Pollengrösse der beiden Rassen des *C. arvense* wurden aufgenommen.

2 Mev X-ray and Cathode-ray Irradiation of *Pseudomonas aeruginosa*

In the course of investigating the use of microorganisms as biological dose indicators, the bactericidal effects of 2 Mev X-rays and cathode-rays produced by Van de Graaff generators were studied[1].

Cultures of *Pseudomonas aeruginosa* (Standard strain from the American Type Culture Collection) were used in the experiments. The control and experimental preparation were grown on horse meat infusion agar and maintained under identical experimental conditions.

A mutant of the standard strain was produced during the study presumably as a result of the X-ray radiation[2]. It differed from the parent strain in that it grew more slowly and did not produce pyocyanine.

Agar plates were prepared for irradiation by the spray method of Hardung[3]. This procedure facilitated irradiation of the bacteria while on the surface of the agar plates, having therefore all the same distance from the target and no additional absorption through the agar.

To count the colonies after 24 hours incubation the petri dishes were simply placed on photographic printing paper (Type Kodabromide A2) and exposed to light. After the usual photographic procedures the colonies showed up very distinctly and could be counted with much more ease and safety as directly on the plates (Fig. 1). A preliminary study to determine whether irradiation of the agar alone would influence the bacterial growth was done. There was no bacteriocidal effect of 2 Mev cathode-ray irradiation below the 15,000 reps (physical roentgen equivalent) range[4]. At higher doses the agar changed it's color gradually and at about 2×10^7 reps became a dark brown liquid with low viscosity and a pH of 5 to 5·5. Experiments done with frozen agar (– 30°C) resulted in the same answer.

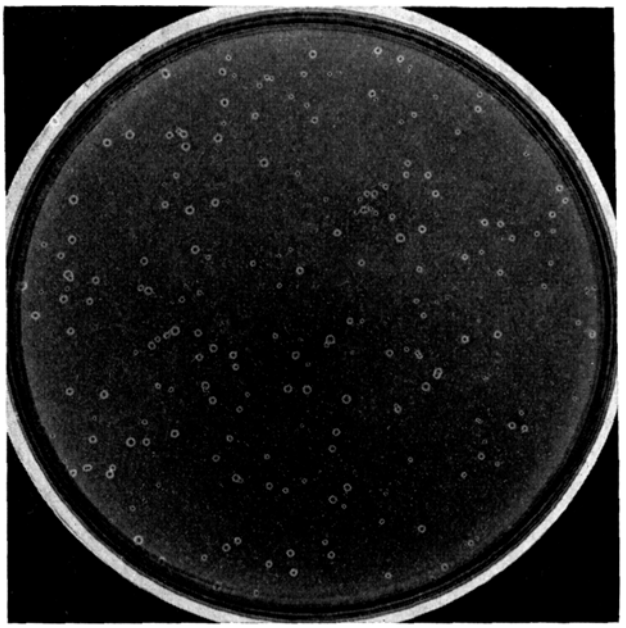

Fig. 1.—Sample of bacteria colonies in petri dish printed on photographic paper.

Figure 2 shows the results obtained by irradiating normal (curve I) and mutated bacteria (curve II) with X-rays (filtered by 0·3 cm gold and 0·2 cm brass, initial half value layer 0·7 cm lead) at a dose rate of 1,800 to 2,000 r per minute at 18 cm target sample distance. Curve I is derived from a mixture of normal and mutated bacteria, the latter produced during irradiation. The nature of this curve shows an exponential relationship between dose and survival rate.

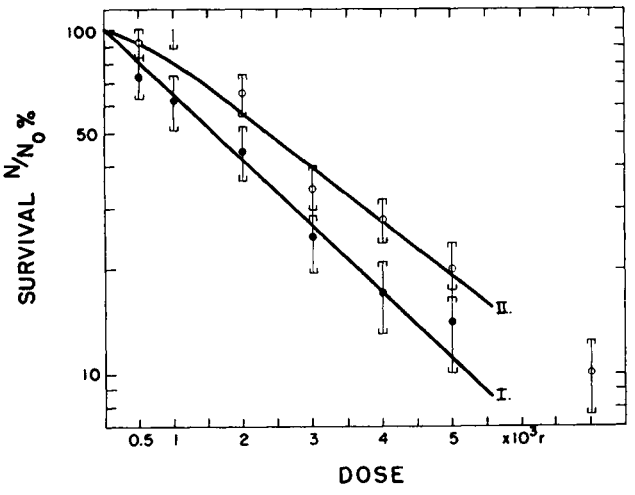

Fig. 2.—Survival curve of bacteria irradiated with 2 Mev X-rays. I. Normal strain. II. Mutants.

Curve II is obtained from irradiated pure cultures of mutated bacteria. The relative flat slope at the beginning of the curve becomes increasingly steeper at higher doses, indicating a higher killing rate, than at lower ones. This curve also demonstrates that the mutants require a

[1] H. BERG and W. PAUL, Z. Physik *126*, 422 (1949).—H. BLECK and W. PAUL, Naturwissenschaften *36*, 28 (1949).—W. DITTRICH and W. PAUL, Z. Naturforschung [B]*4*, 226 (1949); Strahlentherapie *80*, 17 (1949).—C. G. DUNN *et al.*, J. appl. Phys. *19*, 605 (1948).—H. FASS *et al.*, Naturwissenschaften *36*, 381 (1949).—J. G. TRUMP *et al.*, J. appl. Phys. *21*, 345 (1950).—J. G. TRUMP and R. J. VAN DE GRAAFF, J. appl. Phys. *19*, 599 (1948).

[2] D. E. LEA, *Action of radiation on living cells* (MacMillan Company, New York 1947).—J. GOWEN, Cold Spring Harb. Symp. *9*, 187 (1941); Third Int. Cancer Congr. 17 (1939).—D. E. LEA *et al.*, Proc. Roy. Soc. [B] *123*, 1 (1937).— N. W. TIMOFÉEFF-RESOVSKY and K. G. ZIMMER, Nachr. Ges. Wiss. Göttingen *1*, 189 (1935).

[3] V. HARDUNG, Helv. phys. acta *18*, 45 (1944).—V. HARDUNG and W. MOOS, Exper. *5*, 155 (1949).—W. MOOS, Nucleonics *8*, 50 (1951).

[4] H. B. HEWITT, Brit. J. Radiol. *23*, 416 (1950).

higher dose to obtain the same lethal effect than the normal bacteria.

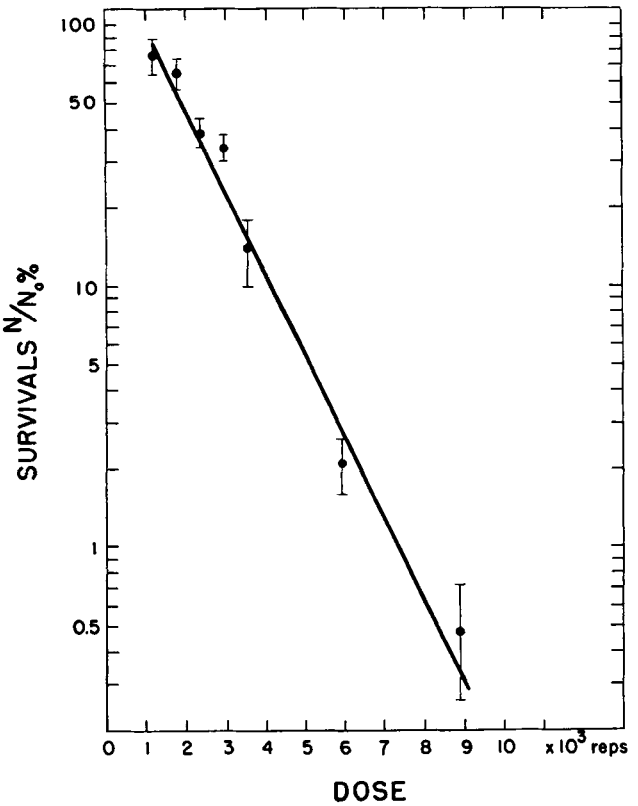

Fig. 3.—Survival curve of bacteria irradiated with 2 Mev cathode-rays.

The results obtained with cathode ray irradiation (88 reps/10^{-8} amp per s at 44 cm window-sample distance, 0·037 cm Al scatterer) of normal bacteria are given in Figure 3. Irradiation of the bacteria in the dose range between 0 and 500 reps did not give reproducible results and therefore left some doubts whether the killing effect in these experiments has been exponential as it might be suspected by the stright form of the rest of the curve.

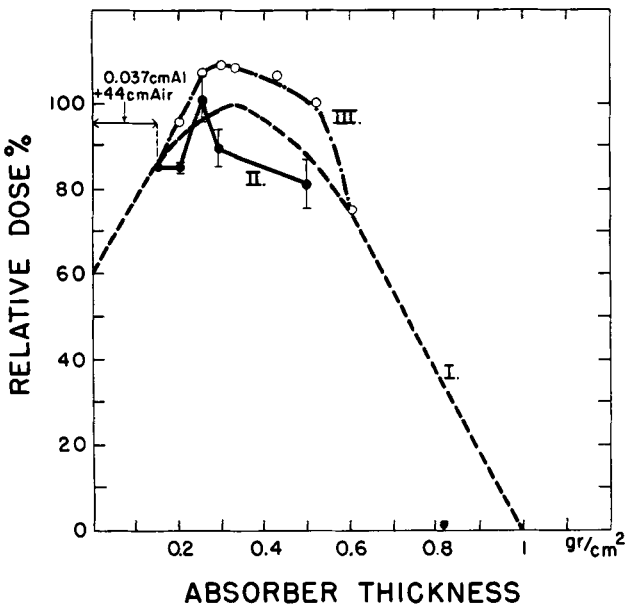

Fig. 4.—Absorption curves of 2 Mev cathode-rays measured with: I. Ionization chamber, II. Bacteria, III. Photographical method.

Application of bacteria as a biological dose indicator was also investigated in form of absorption measurements of cathode rays. This was performed by placing different absorbing layers of aluminium foils on top of the petri dishes. Figure 4, curve II was the result of these experiments and is compared with the results of physical measurements, curve I[1]. The amount of X-rays produced by the scatterer and absorbing Al foils was neglegible. The dose causing the smallest amount of survivals (N/No) in the absorption measurements was arbitrarely adopted as 100% relative dose value. For every number of survivals obtained at different absorption depths the proper dose value could be evaluated from Figure 3, and transformed in reference to the 100% value. The curve indicates a definite dose maximum at the depth of 0·251 g/cm² and follows approximately the physically measured absorption curve, which has a peak at about 0·3 to 0·33 g/cm². With essentially the same conditions, an additional check with photographic films (Kodak, Technical X-ray film, Type A) was performed, curve III. In these experiments the relative dose was calculated in the same manner as with the bacteria taking the highest film density obtained in the absorption measurements as the 100% reference point and using a film calibration for the conversion of density in relative dose. The location of the greatest relative dose and the form of the curve can be considered the same as curve I. The somewhat increased value of relative dose may be due to overlapping exposure caused by scattered radiation.

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Department of Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. U.S.A., November 20, 1951.

Zusammenfassung

Der Effekt von 2-Mev-Röntgen- und -Kathodenstrahlen auf Bakterien wurde untersucht. Die eventuelle Verwendung von Mikroorganismen für Dosismessungen wurde in Betracht gezogen. Die physikalisch bestimmte Absorptionskurve der 2-Mev-Kathodenstrahlen konnte trotz der mit biologischen Objekten zu erwartenden Ungenauigkeit relativ gut dupliziert werden. Als Strahlenquelle diente ein druckisolierter Van-de-Graaff-Generator.

[1] J. G. TRUMP *et al.*, J. appl. Phys. *21*, 345 (1950).

[2] At present research fellow at the National Cancer Institute, Bethesda, Maryland.

Discrimination entre l'inactivation de la virulence et du développement bactériens par le rayonnement ultra-violet de 2537 Å

(Etude sur *Bacillus cereus alesti* Tou. et V.).

Si les recherches sur la photosensibilité des microorganismes sont nombreuses, les études comparatives de cette action sur les différentes propriétés physiologiques des microbes sont encore peu connues.

Ainsi, la discrimination entre la virulence et la faculté de développement d'un germe, en rapport avec sa photosensibilité, restait à entreprendre sur un nombre important d'éléments permettant une interprétation statistique satisfaisante.