and tyrosine, and the degree of saturation of the tissues with vitamin C. Whether the same metabolic error is present in full-term infants under similar dietary conditions or in older infants with manifest scurvy is at present being investigated. Studies are also under way to determine the specificity of vitamin C in remedying the defect. The spontaneous occurrence of hydroxyphenyl compounds in the urine of premature infants fed cow's milk deficient in vitamin C affords the opportunity of studying the intermediary metabolism of aromatic amino acids in the growing human organism.

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REACTION OF VARIOLA VACCINE VIRUS TO ROENTGEN RAYS[1]

ROENTGEN ray irradiation of variola vaccine virus particles causes a reduction in number of active particles. The rate of inactivation proceeds exponentially.

Vaccinia virus[2] for irradiation was extracted from infected rabbit testis preserved in glycerine, by grinding the testis in sand and diluting it 1:10 with Locke's solution. After centrifuging, 0.75 cc of the supernatant solution which carried the virus was exposed to x-rays from a copper target tube.[3] The mean effective wave-length of this radiation was found to be 1.5 Å. The reduction in the velocity of virus inactivation was determined by titration experiments in which 0.1 cc of the irradiated and the control virus suspensions were inoculated intradermally into normal rabbits. Estimates of the infectious particles, remaining after irradiation, were made from those tests in the dilution series which gave both positive and negative takes.[4]

The inactivation curves of three experiments, in which vaccinia virus was irradiated with increasing dosages of x-rays, are plotted in Fig. 1. The logarithms of the numbers of infectious particles are the ordinates of the graph. The abscissae represent the Roentgen units of irradiation incident to the surface of the virus solution. Each curve is evidently linear

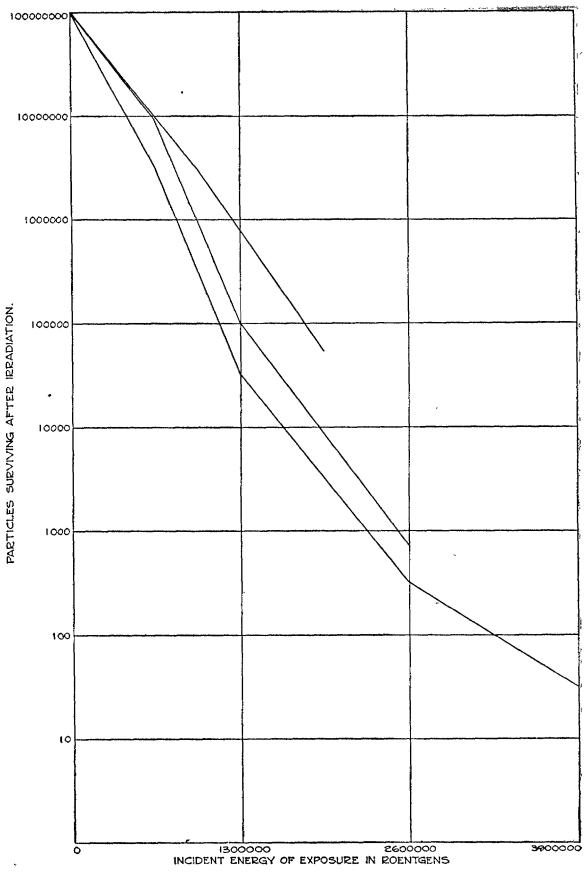

FIG. 1. Survival ratios of vaccinia virus treated with Roentgen rays of 1.5 Å.

in its trend; the inactivation of virus particles begins when irradiation commences. The small quantitative differences in the slope constants which do occur are partly accounted for by small variations in the Roentgen units in each experiment.

The linear nature of the raw data when plotted on the semi-logarithmic coordinates, and the absence of any initial lag during the inactivation of the virus is expected if we assume that one unit of radiant energy is sufficient to inactivate an infectious unit of the virus. The curve form would further postulate that the ultimate virus particles are held separate and distinct from each other in the water suspension when irradiation takes place—not in any conglomerate of particles—for if they were conglomerate the entities would require more than one unit of x-ray energy for inactivation and consequently lead to raw data having an initial lag period and a convex curvature instead of the straight lines observed.

The experimental observations are due to the inability of certain virus particles to reproduce after they have absorbed a unit of irradiation. The portion of the virus particle with which we are dealing is therefore only that which has to do with reproduction.

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[2] We are pleased to acknowledge our indebtedness to Dr. A. B. Sabin for the dried virus from which these experiments were started.

[3] L. E. Pinney, *Iowa State College Jour. Sci.*, 13: 269–273, 1939. We are indebted to Mr. Pinney for much other assistance.

[4] K. Iwaszkiewicz and J. Neyman, *Acta Biol. Exp.*, 6: 101–142, 1931.

The inactivation effects on vaccinia are similar to those observed for a widely separated group of viruses affecting plants. When exposed to radiant energy of either the x-ray[5] or ultra-violet[6] these viruses are also inactivated, the survival ratios following simple exponential curves of constant slope.

Curves of the linear type have been observed for several more highly organized forms of life when they are inactivated by Roentgen rays. The bacteria *Escherichia coli, Salmonella aertrycke* and *Staphylococcus aureus*[7] are all inactivated in this manner by various wave-lengths. *Drosophila melanogaster* sperm[8] are killed in like manner. These Drosophila results are of particular interest because of their analytical possibilities. Irradiation of Drosophila sperm by x-rays of wave-length from 2.29 Å–0.01 Å of radium caused (1) death in certain of the sperm, (2) rearrangements in the chromatin (either within the gene or linin thread) which expressed themselves as lethal effects in succeeding generations, crossing-over effects and phenotypic differences of the non-lethal type of gene mutations. Each of these effects of the radiant energy is described by exponential curves. Since the gene which makes these changes seems best interpreted as a single unit, and since the gene in some cases after radiation is modified rather than destroyed, it follows that the energy absorbed within it must be absorbed by different parts of the molecular structure, each dealing with different phases of the gene's several functions. Diverse expression of radiation effects are thus to be expected on irradiating viruses and may be expressed by loss of reproductive capacity (inactivation) and by mutation. Mutation effects and methods of converting the Roentgen dosages incident to the surface of the virus solution to those actually received by the virus will be discussed in the completed work.

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ELECTROPHORETIC STUDY OF PITUITARY LACTOGENIC HORMONE[1]

AN electrophoretic study of White's crystalline lactogenic hormone has been reported by Shipley *et al.*[2] Using the Hellige apparatus developed by Tiselius,[3]

FIG. 1.

we have investigated the electrophoretic behavior and iso-electric point of our own lactogenic preparations. The lactogenic hormone (L 269) was prepared in

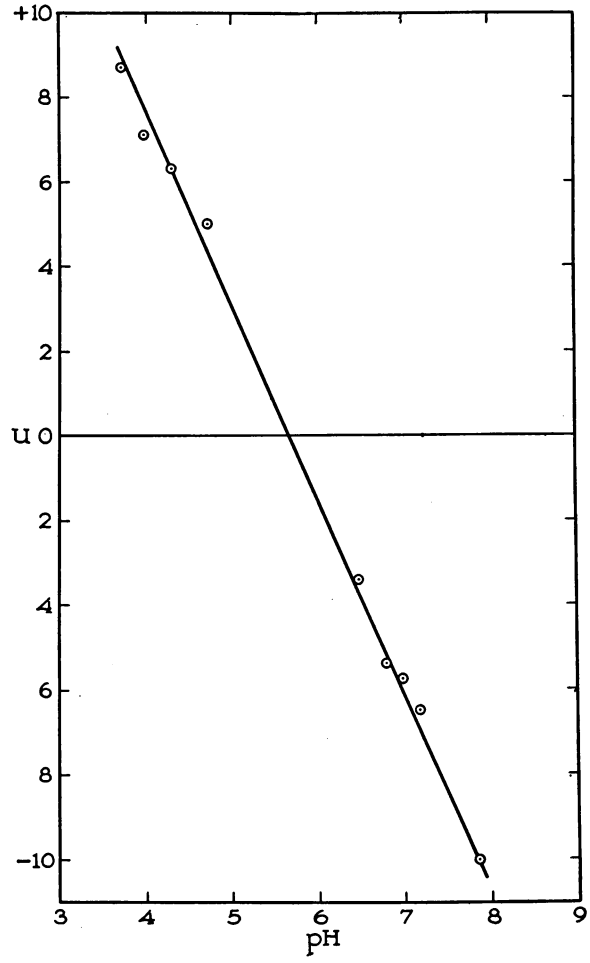

FIG. 2.

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[7] R. W. G. Wyckoff, *Jour. Exp. Med.*, 52: 769–780, 1930; R. W. G. Wyckoff and T. M. Rivers, 51: 921–932, 1930; R. W. G. Wyckoff, 52: 435–446, 1930.
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[1] Aided by grants from the National Research Council, the Rockefeller Foundation and the Board of Research of the University of California.
[2] R. A. Shipley, K. G. Stern and A. White, *Jour. Exp. Med.*, 69: 785, 1939.
[3] A. Tiselius, *Trans. Faraday Soc.*, 33: 524, 1937.