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Authors

Wakerling, R.K.
Folden, M.F.

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RESEARCH PROGRESS MEETINGS

August 19 and August 26, 1948

by

R. K. Wakerling
and
Margaret Foss Folden

Special Review of Declassified Reports

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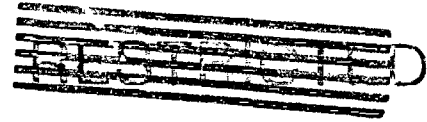
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RESEARCH PROGRESS MEETINGS

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Chromosomal Changes Induced by Radiation. N. Giles. Dr. Norman Giles, a visitor in the Laboratory, described some work being done on the genetic changes produced by ionizing radiation. The effects can be studied by observing the changes in the offsprings, or by observing the changes produced in the chromosomal cells of the organism itself. The second method is the one employed in the present studies.

For this work the plant *tradescantia* is used since its chromosomes are large and few. The genetic changes are observed in the developing pollen grains.

The type of aberration in the chromosomes has been found to be definitely related to the dosage, as is illustrated in Fig. 1 for x-rays.

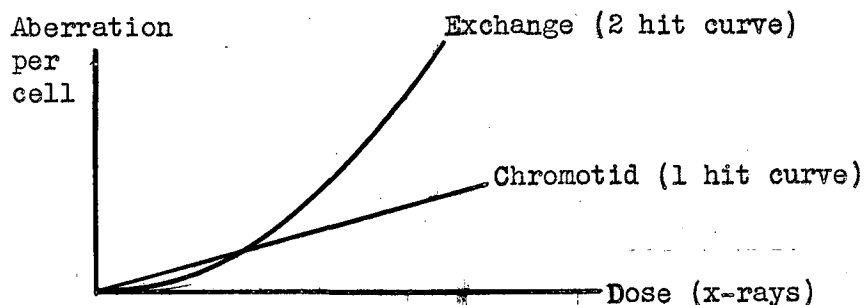


Fig. 1

Neutron irradiation gives the same sort of change but the yield is greater. This effect is interpreted as showing that the neutrons ionize more efficiently. The neutron, however, have been found to give rise to a one-hit rather than a two hit-curve for interchanges. See Fig. 2.

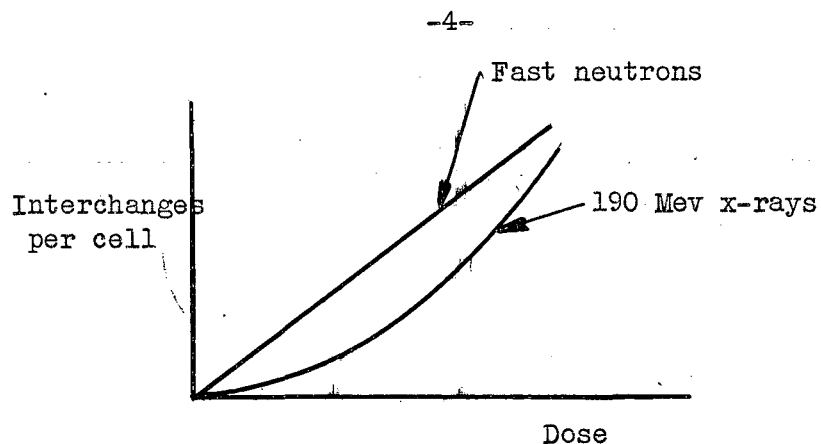


Fig. 2

The magnitude of the effect for neutrons varies definitely with the energy of the neutrons, being smallest for the most energetic neutrons, as illustrated in Fig. 3.



Fig. 3

Experiments are being carried out here with the deflected deuteron and alpha particle beams of the 184-inch cyclotron. The exact results at this date cannot be given, but it seems clear that the highly ionizing portions of the beams, near the end of the ranges of these particles, have a relatively larger effect than the low ionizing portions of the beams. It is hoped that quantitative

information can be obtained on the dependence of chromatid as well as chromosome changes on radiation dosage. The cross section for the process involved will be calculated for several regions of specific ionization.

British Physics. L. Alvarez. Dr. Alvarez described his brief visits at Oxford, Harwell, Cambridge, Birmingham, and Bristol during a stop over in England on way to the International Congress at Zurich where he spoke.

Half-life of Negative Heavy Mesons. J. Reginald Richardson. Mesons of mass about $300 m_e$ have been produced by the 380 Mev alpha particle beam of the 184-inch cyclotron. These mesons are susceptible to $\pi \rightarrow \mu$ decay. A preliminary investigation has been made of the loss of negative mesons from a beam of these particles, and since this beam is moving in a region at a pressure of 10^{-5} mm Hg, the assumption is made that this loss corresponds to the $\pi \rightarrow \mu$ decay process.

The alpha particle beam in the cyclotron is in a horizontal plane. A target of 1/16 inch graphite is provided, and then the mesons are selected by a semicircular spiral channel which rises 1/2 inch vertically in one semicircle (180 degrees). At this point six photographic plates are exposed. The horizontal projection of the channel has an inner diameter of 4.5 inches and an outer diameter of six inches and is oriented in such a way that it selects negative mesons whose initial horizontal component of velocity is in the same direction as the alpha particle beam at the target. A similar channel is provided for mesons spiraling downward at an equal angle, but it is unobstructed at the 180 degree position. These mesons then spiral downward, passing one inch below the center of the target and through another channel to the 540 degree position, having dropped 1.5 inches in 1-1/2 turns. At this point another set of six plates is exposed simultaneously with the first. The ratio of the number of mesons in these two sets of plates when corrected for geometry will give the loss of mesons in the time corresponding

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to one revolution in the magnetic field. This "cyclotron" time is independent of the speed of the meson. The desirable 360 degree focusing properties mean that in a uniform magnetic field the geometrical correction is simply a factor of three in the above case. Because the experiment was done in the fringing field of the cyclotron, room was left in the second part of the lower channel for the slight precession caused by this non-uniform field. The effect of the vertical focusing forces due to the fringing field was investigated theoretically and also experimentally by performing the experiment at different cyclotron radii. Most of the data were taken at a cyclotron target radius of 76 inches where the alpha particle energy is 350 Mev. At this radius the correction for vertical focusing is negligible compared to the statistical uncertainty in the experiment. In order to check the possible presence of any unknown asymmetry, the channels were interchanged, so that the 180 degree channel spiraled down and the 540 degree channel spiraled up. No difference could be detected and the two situations are represented with approximate equality in the final results. In each case a simultaneous background exposure was made at the 540 degree position in a channel which was an extension of the 180 degree channel. The plates placed here would record any mesons which originated in places other than the target. This background was negligibly small.

Some 250 plates were exposed during the course of the investigation. Although a check was made on the thickness of the emulsion in the individual plates, the number of plates used was so large that the resulting correction was very small. Fortunately the background of neutron recoils, etc., in the photographic plates was practically identical in the 180 degree and 540 degree positions, so that the search for mesons was made under identical conditions. The 18 plates of a run were all developed at once and received identical treatment.

Although all the mesons observed had a range consistent with a mass in the neighborhood of $300 m_e$ it was decided to count only those mesons which ended

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in stars. Sixteen star-producing mesons were observed in the plates at 540 degrees whereas the number expected on the basis of geometry would be 41. The latter number is based statistically on a count of 80 mesons. Assuming a mass of $300 m_e$ for the meson, the time for one revolution turns out to be 7.6×10^{-9} seconds. Therefore the number of mesons obtained, together with the assumption mentioned earlier indicates that the half life of the star-producing negative mesons for $\pi \rightarrow \mu$ decay is $(5.7 \pm 1.1) \times 10^{-9}$ seconds, where the error indicated is the statistical probable error.

Analysis by Paper Chromatography in Photosynthesis. A. Benson. Radio-active photosynthetic products in plants are being analyzed by paper chromatography. Since the separation of compounds by this method is a function of distribution between liquid phases and not adsorption, it is applicable to the separation of tracer amounts of metabolic intermediates. In this process a small aliquot of the solution to be analyzed is evaporated on a 1 cm. area near the corner of an 18" by 22" sheet of filter paper. One edge of the sheet is then immersed in a trough of water-saturated phenol. When the solvent has traversed the paper, the components of the original sample are distributed as spots in a line. After drying, an adjacent edge of the paper is immersed in a water-saturated solution of lutidine which is allowed to traverse the paper. Thus, the components are distributed in characteristic positions on the whole sheet of paper, dependent upon their relative distribution coefficients between wet paper and the organic phase. After drying, radioautographs of this sheet are made by exposing them to X-ray film for three hours to two weeks depending upon the amount of radioactivity involved. Ninhydrin color tests give the location of amino acids which serve as markers for the other radioactive components.

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With this technique, complex mixtures of compounds can be analyzed in a few days with little labor. With classical methods, the same results can be obtained only with months of labor, and in many cases the results are very uncertain. The importance of this technique in this type of research was emphasized.

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