strength ($\mu = 0.096$) and had no effect at the higher ones ($\mu = 0.15$ and 0.25) provided its contribution to the total ionic strength at various *p*H's is taken into account. The results were the same when histidine or acetate buffer was used in place of phosphate buffer. Crystallization of paramyosin thus appears to be most influenced by the *p*H of the solution.

The mechanical properties of "catch" muscles could be thus controlled by altering the *p*H of the medium. The control is simple and can be achieved under conditions which alter little the properties of actomyosin, since at low ionic strength the maximum tension and isotonic shortening of a glycerol-extracted psoas muscle fibril remains approximately constant between *p*H 6 and 7. If there is a connection between crystallization of paramyosin and the "catch" mechanism one would expect that the mechanical properties of glycerinated preparations of such muscles will show a *p*H dependence different from that of other muscles.

The isotonic shortening of glycerinated byssus fibers is greatly dependent on *p*H (Fig. 2). In solutions with a total ionic strength of 0.07, 0.15, 0.25, shortening is maximum above *p*H 6.7. Acidification causes a gradual inhibition. At *p*H 6.0 and ionic strength 0.07 the inhibition amounts to about 80 percent, while at higher ionic strengths inhibition occurs in more acid solutions. A comparison of the solubility curves of paramyosin and the data on isotonic shortening indicates that in conditions where paramyosin is crystallized shortening is inhibited. The correlation between cyrstallization and inhibition of shortening is reflected in the dependence on both *p*H and ionic strength. Fibers which failed to contract at low *p*H contracted readily when the *p*H of the solution was raised. Glycerol-extracted preparations of other catch systems, such as *Mytilus* adductor, *Venus* adductor—both tinted and white portions—*Ostrea* white adductor and *Pectin* white adductor, show essentially similar dependence of shortening on *p*H and ionic strength.

The inhibition of shortening was not caused by a reversible inactivation of the actomyosin system. The isometric tension did not show a considerable *p*H dependence and was nearly maximal under conditions where shortening was inhibited by about 80 percent. Thus one fiber developed 0.28 kg/cm² at *p*H 6.0 and another from the same bundle 0.32 kg/cm² at *p*H 7.2 at ionic strength of 0.07. Another fiber of the same bundle developed 0.42 kg/cm² tension at *p*H 6.0 and 0.25 ionic strength. There was, however, a difference in the rate of tension development at various *p*H's, the rate being greater at higher *p*H. Preliminary experiments on the *p*H-dependence of adenosine triphosphatase activity of breis prepared from glycerinated byssus muscles of *Mytilus* indicate that a peak occurs at *p*H 6.3 to 6.5 with little decline between *p*H 6.0 and *p*H 7.0. Although the optimal conditions for tension development in these preparations have not been worked out, the above results indicate little *p*H dependence of tension development, certainly not enough to produce up to 80 percent inhibition of shortening.

These experiments may be simply explained by assuming that actomyosin and paramyosin are at least functionally separated in catch muscles. The behavior of the actomyosin system does not differ much from the actomyosin system of other muscles. The different behavior of "catch muscles" could be explained by the presence of the paramyosin system, the crystallization of which "freezes" the muscle at any length or in any state, inhibiting shortening and increasing the resistance to stretch. It has been found recently that the 145-A periodicity, observed in electron micrographs, is predominantly associated with muscles in the catch state, suggesting that crystallization occurs in these muscles (*9*). In this way the tension developed by the actomyosin system may be preserved by the paramyosin system for an indefinite time without any further active process and without the need for a continuous expenditure of energy. In vivo, the two sytems may be activated independently and, even though it is not necessarily a *p*H variation which activates the catch system, it is of importance that essential features of the "catch mechanism" can be shown by glycerol-extracted preparations.

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* This work was done during the tenure of a postdoctoral fellowship supported in part by a grant from the National Science Foundation and the Graduate College of the University of Illinois.
† This work was done during the tenure of an established investigatorship of the American Heart Association, and supported by research grants from the National Heart Institute, U.S. Public Health Service (No. H-2042R), the American Heart Association, and the Muscular Dystrophy Associations.

26 February 1959

Contamination of the Air by Radioactivity from the 1958 Nuclear Tests in the Pacific

Abstract. By the use of bomb-produced tungsten-185 tracer, debris from the 1958 nuclear tests (Hardtack) held at the U.S. Pacific Proving Ground have been identified as they appeared in the ground-level air along the 80th meridian. A large amount of radioactivity from these tests appeared in South America, particularly at the high-altitude collecting stations.

The Hardtack series of nuclear tests in the Eniwetok-Bikini area afforded a unique opportunity to identify radioactive debris in the atmosphere which were associated with a known series of tests, since a number of nuclear devices exploded during that series contained tungsten which became activated by the intense neutron flux. This radiotungsten activity, then, served as a specific radioactive tracer for debris from this one series of tests.

Ground-level air-filter samples from 18 collecting stations located principally along the 80th meridian from Coral Harbour, Northwest Territories, Canada, to Punta Arenas, Chile, were analyzed by radiochemical techniques for β-emitting W^{185} and for a number of high-yield fission products, among them Sr^{90}.

Figure 1 shows the concentration of W^{185} activity in disintegrations per minute per 100 cubic meters of air (corrected to sea-level pressure) for the period of May–July 1958. Background samples collected at all stations during April 1958 showed that at that time there was no background activity of W^{185} in the atmosphere. The rapid spread of this activity is particularly noteworthy. By the end of May it was detected at 10 stations along the 80th meridian from Columbia, South Carolina (34°N), to Antofagasta, Chile (23°S). By the end of June, it was detected from Moosonee, Ontario (51°N) to Punta Arenas (53°S). In July, it appeared at Coral Harbour, (64°N), our northernmost station. The highest W^{185} concentrations appeared initially at the high-altitude sites of Chacaltaya, Bolivia (5220 m), Huancayo, Peru (3353 m), Quito, Ecuador (2818 m), and Bogota,

Colombia (2640 m). The only significant change in the activity pattern during this period was the increase in W^{185} concentration in the mid-latitudes of the Northern Hemisphere.

Both the high W^{185} activity and the high gross β-activity found in South America during the period May–July document the fact that one or more transfers of air from the Eniwetok-Bikini area into the Southern Hemisphere occurred. This is the first time that any appreciable quantity of radioactive matter from a known source in the Northern Hemisphere has been identified south of the equator.

In Fig. 2, plots of W^{185} relative to the gross fission-product β-activity (assumed to have an average β-energy of 1 Mev) are shown. It may be noted that even though debris from Hardtack appeared at a number of sites in the Northern Hemisphere, at only a few places did it contribute significantly to the total radioactivity present. The tungsten-containing debris was relatively more important during May and June at sites where the fission-product background was low, as at Miraflores, Panama Canal Zone, and Bogota, Colombia, above the equator and at most sites in the Southern Hemisphere.

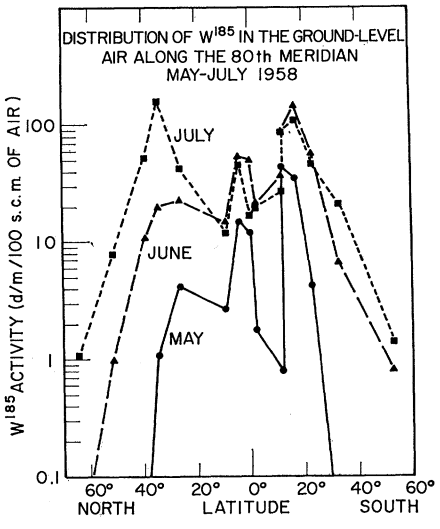

Fig. 1. Distribution of W^{185} in the ground-level air along the 80th meridian, May–July 1958.

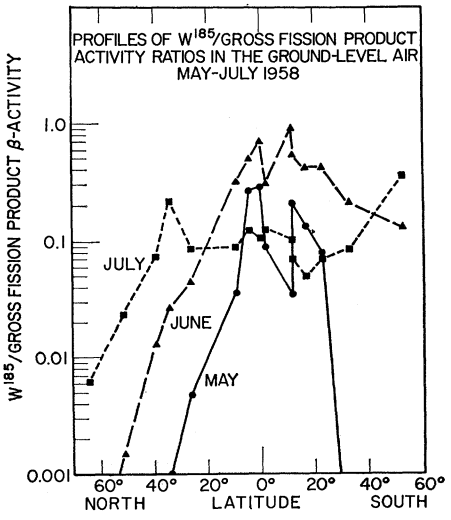

Fig. 2. Profiles of W^{185}/gross fission-product activity ratios in the ground-level air, May–July 1958.

At Lima, Peru, during June, the W^{185} activity was nearly as high as the gross fission-product activity. If a 1:1 ratio represents the relative values of these components of Hardtack debris during June, undiluted by fission products from other sources, the contribution of this debris to the activity in the air at other sites may be calculated. The fraction of the total activity due to the fresh debris at sites in the Northern Hemisphere decreases rather uniformly from 70 percent at the equator (Quito), to 30 percent at Miraflores, to 5 percent at Miami, Florida, and 1 to 2 percent at Washington, D.C. It is impractical to attempt a similar analysis for July because of the changes in this W^{185}/fission-product activity ratio through radioactivity decay and because of the influx of fresher debris having different amounts of tungsten activity. The different composition of the newer debris is evident in a comparison of the July data presented in Figs. 1 and 2. While at the sites between 10°N and 40°S latitude there was little change in the absolute quantity of W^{185} in the air, its activity relative to that of the gross fission products decreased markedly, indicating the presence of considerable radioactive material having a lower radiotungsten content. This was most evident at the sites which had previously had the highest W^{185} activity.

Results from the triad of stations at Subic Bay, Philippine Islands, and Pearl Harbor and Mauna Loa, Hawaii, are particularly interesting. Subic Bay, lying to the west of the test site, received a large amount of new debris in May, as is shown by increases both in the total β-count and in the W^{185} activity, but these decreased markedly during June. Pearl Harbor and Mauna Loa collected no tungsten-containing Hardtack debris during May. During June some of this material arrived at Pearl Harbor, but nearly 10 times as much appeared at the high altitude station of Mauna Loa (3394 m). This altitude difference was even more marked in July. Since no significant changes in Sr^{90} concentration occurred during this period, a rather stable background of old debris at these sites is indicated.

From the data presented here it is evident that fission products or other materials introduced into the atmosphere at a particular latitude do not necessarily remain in any restricted zone near that latitude but spread rapidly throughout the hemisphere. If such materials are introduced simultaneously on both sides of the equator, as happened in this case, rapid spread throughout both hemispheres occurs. The rapid spread of radioactive debris throughout the atmosphere of the Northern Hemisphere has been noted previously for a number of series of nuclear detonations in both Nevada and the U.S.S.R.

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30 April 1959

Phenotypic Effects of Heterozygous, X-ray-Induced Mutations in Drosophila

Abstract. Heterozygous mutations produced by 3000 r delay pupation in about 9 percent of larvae of *Drosophila melanogaster* under nutritional stress and kill approximately 6 percent. The effects are less, though appreciable, when there is excess nutrient; no effects are detectable after oögonia are irradiated. Irradiated sperm and oöcytes cause detriment, partly via different types of mutations, in approximately equal amounts.

In large cross-fertilizing populations, germinal mutations are usually present in heterozygous condition. Because of this it is desirable to determine, in the first generation receiving mutated genes induced by a large radiation dose, the nature and amount of the heterozygous effect, its dependence upon environmental factors, and its basis in chromosomal rearrangements and point mutations.

The specific aims of the present work (*1*) with *Drosophila melanogaster* were to study in F_1 larvae, some of which had been subjected to nutritional stress and some not, some of the heterozygous effects of eucentric rearrangements and point mutations induced by administration of 3000 r of x-rays (*2*) to sperm or to oöcytes and oögonia. The phenotypic effects studied were delay in pupation and failure to pupate.

Virgin yellow (*y*) females were mated to gray (y^+) males from an apparently unrelated strain. Males, when irradiated, were discarded after one day of mating. Females were permitted to oviposit on protein-deficient (sugar, agar, water) medium for ½ to 1 day; then they were removed, and the eggs were allowed to develop for 1 day into larvae. In this cross the sex of newly hatched F_1 larvae is easily distinguished, males having yellow mouth parts and females gray. In cases where larvae were to be