signs of tearing of an artery or signs of increased intracranial pressure from any cause. Infections are avoided by the liberal use of 70-percent alcohol on skin and on all of the aforementioned parts. Recently reductions in the hammering force required and in "angulation error" (Fig. 2) have been effected by reducing the diameter of the sleeve guide from No. 20 hypodermic needle tubing to No. 22 and by improving the fit of the director's channel on the sleeve's outside surface. The outside diameter of the roving electrodes and cannulae is reduced by use of No. 27 tubing in place of No. 24, decreasing their stiffness and, possibly, increasing the danger of arterial puncture.

Recently, sleeves made of No. 15 hypodermic needle tubing were manually hammered into the skulls of two restrained porpoises under only local anesthesia; electrodes in No. 18 needles were passed into the brain and used to find intracerebral motivational systems in experiments lasting up to 7 days.

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Basis of a Genetic Change Which Invariably Occurs in Certain Maize Heterozygotes

Contrary to the well-established Mendelian principle that alternative genetic elements in heterozygotes do not merge into, or otherwise regularly transmute, each other, the entire class of R^rrr seeds resulting from rr ♀ × R^rR^{st} ♂ matings are weakly pigmented, whereas standard R^rrr kernels within the same inbred strain are darkly mottled (*1*). The atypical phenotype recurs in orderly fashion in subsequent testcross generations, and thus is heritable. Corresponding change in the stippled character, if any, is slight, and hence is difficult to establish (*2*). Subsequent to these observations it was found that a similar, but not the same, change in pigment-producing potential occurs in R^r derived from R^rR^{mb} (marbled) heterozygotes also (*3*).

Theoretically, the basis of the alteration in R^r phenotype could be either cytoplasmic or chromosomal. It is the purpose of this report to present data which exclude the cytoplasm as the site of the hereditary change in question.

One might postulate that stippled (R^{st}) maize plants carry a pollen-transmissible plasmid or cytoplasmic genetic element (E) which is capable of shifting the R^rrr phenotype from the standard to the altered form. Thus R^rrr nuclei would give darkly mottled aleurone in standard cytoplasm but weakly colored aleurone in E cytoplasm.

It had previously been shown that the effect of stippled on the R^rrr aleurone phenotype, whatever its basis, did not appear at once after $R^{st}R^{st}$ ♀ × standard R^rR^r ♂ matings (*2*). That is to say, no change in R^r expression occurs in stippled cytoplasm immediately after fertilization. The possibility remained, however, that the postulated cytoplasmic element (E) becomes effective, in terms of altering the R^r phenotype, only after R^r and E have been present together during development of the sporophyte. An adequate test of the plasmid hypothesis required that allowance be made for this contingency.

Standard R^rR^r individuals were pollinated by $R^{st}r$ ♂♂. The R^rR^{st} and R^rr offspring were identified retroactively by the kernel phenotypes resulting from self-pollination. Each such R^rR^{st} and R^rr plant also was testcrossed on standard rr ♀♀. A control set of testcrosses was made by using, as the staminate parents on rr ♀♀, R^rr plants from standard rr ♀ × standard R^rR^r ♂ (that is, stippled was not in the ancestry). The R^rrr kernels resulting from the three kinds of testcrosses may be designated as follows, giving effect to the assumed plasmid (E). (i) $A = R^rrr$ (E) from rr ♀ × R^rR^{st} (E) ♂. (ii) $B = R^rrr$ (E) from rr ♀ × R^rr (E) ♂. (iii) $C = R^rrr$ from rr ♀ × R^rr (control) ♂.

The B and C ears were coded, and a random sample of 100 R^rrr kernels from each was scored for aleurone pigmentation. The scoring was done at 13 × magnification and involved determination of the proportion of seeds in each ear sample in which pigmentation in a predetermined area exceeded that of a particular kernel of intermediate grade selected as a reference specimen.

Expectation on the plasmid hypothesis is that the control kernels (C) will show the dark mottling characteristic for standard R^r in single dose, and that both the A and B kernels will be weakly pigmented. This is based on the proposition that, if stippled plants carry a pollen-borne plasmid capable of changing the R^r phenotype from the standard to the altered form, this cytoplasmic element will be transmitted with the sperm to the eggs, and thus to the ensuing sporophyte, by the r as well as the R^{st} pollen grains formed by $R^{st}r$ plants. The significant question, therefore, is whether the B and A testcross kernels conform in phenotype.

The experimental results showed that (i) the A and B kernels did not conform to each other in phenotype but, on the contrary, were widely unlike and (ii) the B kernels did not differ significantly in aleurone pigmentation from the controls (C). Thus, there is no evidence for a plasmid (E) accompanying the r gene in the r class of pollen formed by $R^{st}r$ plants.

All the R^rrr seeds on the nine A testcross ears were much more weakly colored than the reference kernel, a result in accord with earlier observations. Scoring of the 100-kernel samples from the 10 ears in the B group gave the following percentages of seeds darker than the specimen kernel: 76, 29, 74, 48, 65, 38, 58, 57, 46, and 50. The average is 54.1. The corresponding values for the ten control ears (C) were: 43, 48, 76, 31, 31, 43, 30, 47, 59, and 42. The average in this case is 45.0. Thus, the B kernels were somewhat more darkly pigmented, on the average, than the controls. The difference between the means, 9.1 ± 10.21 kernels, however, lies well within sampling limits.

The data, therefore, negate the hypothesis that the change in R^r pigment-producing potential arising in R^rR^{st} plants is attributable to a plasmid. The breeding facts, on the other hand, lend positive support to the conclusion not only that the phenomenon is chromosomal but also that it is the R^r region which is involved. Assortment of the capacity to promote heritable change in R^r action with R^{st}, but not r, gametes formed by $R^{st}r$ plants shows that the stippled allele, or a neighboring factor, induces the transallelic effect. Similarly, the regularity with which the change induced in the homologous chromosome subsequently follows R^r in inheritance demonstrates that it is the R^r allele, or a closely associated element, which is genetically altered in R^rR^{st} heterozygotes (*4*).

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References and Notes

1. The gene symbols used are as follows: R^r = self-colored aleurone, except in R^rrr endosperms, which are darkly mottled; R^{st} = stippled aleurone; R^{mb} = marbled aleurone; r = colorless aleurone.
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Measurements of External Environmental Radiation in the United States

Recent interest in the dose to man from natural radioactivity has been stimulated by the assumption by many geneticists of a linear relationship between radiation dose and the incidence of genetic mutations. Although this has not been demonstrated at the low dose rates prevailing in nature, the likelihood of such a relationship has led to the suggestion that geographical variations in the frequency of spontaneous mutations may be correlated ultimately with differences in the radiation dose to populations (*1*). This question has recently been reviewed by Gopal-Ayengar (*2*).

The studies of the dose received by man from naturally occurring ionizing radiations can be divided into that received from external and internal sources. The dose to the germ plasm is primarily due to the external radiation, although one internal source, potassium-40, does deliver a dose to the reproductive organs amounting to about 15 mr/year (*3, 4*).

Studies of the radiation dose from external natural sources have been reviewed by Sievert (*3*), Libby (*4*), and Lowder (*5*), and extensive sets of measurements with particular emphasis on dwellings have been reported by Hultqvist (*6*) in Sweden. Although measurements have been made in this country by Hess (*7*) and Neher (*8*), no systematic study of the environmental radiation dose rate over an extensive area of the United States has been reported previously.

During the summer of 1957 our laboratory made measurements in the United States to establish the approximate range of population exposures to cosmic and terrestrial gamma radiation. An effort was made to obtain results which would be representative of the unperturbed natural background, affected as little as possible by the occasional substantial variations in the observed natural radiation levels produced by localized sources (for example, the proximity of granite buildings, brick paving, and fallout).

Measurements were made with a 20-lit., air-filled, polyethylene-walled ionization chamber at atmospheric pressure inside an automobile under essentially identical field conditions of loading and ionization chamber orientation. It had been established previously that the attenuation by the vehicle did not affect the measured values in an important way (about 5 percent). The ionization current was measured with a vibrating-reed electrometer, connected as a continuously reading voltmeter and driving a pen recorder. To shield it completely against beta radiation, the chamber was mounted in an aluminum container so that, including the polyethylene wall, the gas volume was enclosed by 1.08 g/cm^2 of material, corresponding to the Feather range of a 2.26-Mev beta particle.

As is well known, minute alpha contamination in an ion chamber at atmospheric pressure can produce an ion current which may be of the same order as the ion current being measured. For this reason it is important that the effect of the contamination be measured or that the alpha-produced current be suppressed. Several different methods have been used by previous investigators. In our measurements we have resorted to a technique which relies on the difference in electric fields necessary to effect total collection of ion pairs produced by particles of low and high specific ionization—that is, electrons from gamma or cosmic-ray interactions and alpha particles, respectively (*9*).

Readings were taken at 155 locations in 19 states, between New York and Utah. The natural environmental radiation levels encountered ranged from a low of 8.4 μr/hr along the Pennsylvania Turnpike to a high of 38.6 μr/hr at the summit of Pikes Peak (altitude 14,110 ft). A summary of the dose rates measured in the principal cities along the route is given in Table 1. Of the major cities listed, Denver had the highest natural background, an average of 18.5 ± 1.5 μr/hr; this level is almost twice that found in eastern and midwestern cities.

These measurements were made during part of the period of Operation Plumbbob, the 1957 series of United States continental weapon tests at the National Test Station in Nevada, and these tests influenced certain of the measured values. Elevated levels were encountered in eastern Arkansas (26.0 to 50.2 μr/hr) and in the Black Hills of South Dakota (22.0 to 33.8 μr/hr). That the initial elevated levels were attributable to fresh fallout was demonstrated by the reduction in the measured levels

Table 1. Environmental radiation levels measured in principal United States cities during August 1957. The number of observations for each range is shown in parentheses. Elevated radiation levels produced by localized sources are shown in the last column.

Location	Range of radiation levels (μr/hr)	Mean annual dose (mrad)*	Av. pressure (in.-Hg)	Atypical radiation levels (μr/hr)
Harrisburg, Pa.	9.6–11.9 (2)	88	29.8	
Pittsburgh, Pa.	9.8–13.9 (3)	96	29.2	
Cleveland, Ohio	10.5–11.8 (2)	91	29.4	
Toledo, Ohio	8.7–10.0 (2)	76	29.5	14.9 (over granite paving stone)
Chicago, Ill.	10.3–11.6 (4)	88	29.4	17.0 (adjacent to U.S. Post Office, of granite construction)
Madison, Wis.	10.1–10.4 (3)	84	29.1	
Minneapolis–St. Paul, Minn.	9.1–12.5 (4)	92	29.3	
Sioux Falls, S.D.	11.5–11.8 (2)	95	28.8	
Cheyenne, Wyo.	17.2–17.6 (2)	142	24.4	
Denver, Colo.	16.6–19.4 (10)	147	25.0	22.4 (between U.S. Mint and City and County buildings)
Colorado Springs, Colo.	19.3–22.3 (4)	168	24.2	
Grand Junction, Colo.	15.7–18.4 (3)	138	25.5	
Albuquerque, N.M.	13.8–14.5 (4)	116	25.2	
Amarillo, Tex.	12.9–13.6 (4)	108	26.4	
Oklahoma City, Okla.	9.9–10.5 (4)	84	28.7	
Tulsa, Okla.	10.8–11.6 (4)	92	29.3	
Little Rock, Ark.	12.8–13.3 (2)	106	29.7	
Memphis, Tenn.	9.4–11.0 (2)	83	29.8	13.3 (near brick apartment house)
Chattanooga, Tenn.	11.1–12.3 (2)	95	29.6	14.8 (near brick-faced motel units); 16.1 (on narrow business street; 8th between Broad and Market)

* Dose in soft tissue, assuming constant dose rate. 1 rad = 100 erg/g; 1 μr/hr = 8.152 mrad/yr.