southerly stations within the province of left coiling. They are abundant, however, in the tops of cores from the province of dextral coiling. The same association is maintained in the time dimension of cores from the province of dextral coiling; species of *Globorotalia* are well represented in sediments layers where the coiling of *Globigerina pachyderma* is dominantly dextral, but they are absent or rare where the coiling is sinistral.

By determining similar vertical changes in coiling percentages of *G. pachyderma* in cores from more southerly stations not shown on the chart it will probably be possible to determine approximately the former position of the boundary between right and left dominant populations, and by inference the most southerly position of the April 7.2°C isotherm during the peak of the last glaciation. This information will make possible an estimation of the amount of temperature lowering that occurred in this part of the North Atlantic during the last ice age.

In the meantime, the present data are at least suggestive. The absence of any zone of right coiling at lower levels in the cores from the province of left coiling implies that this part of the North Atlantic during the late Pleistocene has not at any time been much warmer than it is now. Evidence that the boundary between right- and left-coiling populations was farther south during the last ice age favors the conclusion that continental glaciation was accompanied by general cooling of North Atlantic waters, and particularly within this critical region, rather than by marked change in pattern of circulation. This conclusion supports the hypothesis that Pleistocene refrigeration was a result of reduction in total radiation from the sun and not a consequence of some purely terrestrial cause (*6*).

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6. This report is Lamont Geological Observatory contribution No. 355. The investigation is being supported by National Science Foundation grant No. NSF-G6540. I am grateful to Maurice Ewing, director of the Lamont Geological Observatory, who made available the material described in this communication. O. L. Bandy, University of Southern California, has informed me that he has a paper in press which also deals with the coiling of *Globigerina pachyderma*. According to Bandy our respective papers will supplement rather than duplicate each other.

9 April 1959

Virus versus Gene Change in Maize

In maize the *Rrr* kernels from a standard RR♂ × rr♀ (*R*, self-colored aleurone; *r*, colorless aleurone) are dark-colored. However, Brink (*1*) has found that when plants of genotype RR^{st} (R^{st}, stippled aleurone) are test-crossed on *rr*♀, the resulting kernels which receive *R* (from their RR^{st} parent) have aleurone which is weakly-colored mottled. We might indicate these kernels as *R′rr*; the prime indicates *R* of RR^{st} origin, without commitment whether *R′* is different from *R*.

Brink explains the weakly-colored mottled phenotype of *R′rr* kernels on the assumption that in the RR^{st} parent the R^{st} gene causes *R* to mutate, at a 100-percent rate, to a gene ($R^{r:st}$) for weakly-colored mottling (an effect referred to by Brink as "paramutagenesis"). The R^{st} gene itself is apparently unaffected in RR^{st}. When weakly-colored mottled kernels (*R′rr*) from the test cross of the RR^{st} parent are again test-crossed, the resulting *R′rr* kernels are again weakly-mottled. Brink has therefore concluded that *R* is actually altered in the original RR^{st} parent, since the test-cross progeny (*R′rr*) maintain their light color from one generation to the next. On the other hand, when RR^{st} is self-fertilized, the resulting kernels which have at least two doses of *R′* in their aleurone ($R'R'R^{st}$ or $R'R'R$; $R^{r:st}R^{r:st}R^{st}$ or $R^{r:st}R^{r:st}R^{r:st}$, according to Brink's hypothesis), have aleurone almost as dark as that of standard *RR* plants. Brink has therefore concluded that in the kernels under discussion, his $R^{r:st}$ gene reverts, at a 100-percent rate, almost completely to *R*.

In order to rule out the theory that a virus (or other plasmid element) is causing the changed expression in the *R′rr* kernels, Brink crossed the plants grown from these kernels to standard *RR*♂. The resulting *Rrr* kernels would, of course, be the product of an *R* gamete from the *RR* parent and an *r* gamete from the *R′rr* parent. If the latter (*R′rr*) carried a virus, its *r* gametes might also be expected to carry the virus and to transmit it to the *Rrr* kernels in the cross *R′rr*♀ × *RR*♂. However, these kernels are dark, like *Rrr* of standard origin. Brink has therefore concluded that no virus is involved in the changed expression in *R′rr* kernels (weakly-colored mottled).

However, in my opinion this finding relative to the cross *R′rr*♀ × *RR*♂ does not exclude the possibility that a virus is changing the aleurone from dark red to light in the *R′rr* kernels (those derived from RR^{st}♂ × *rr*♀). Conceivably, two substances, *A* and *B*, are necessary for the continued existence of the virus. Gene R^{st} produces both and supports the virus; *R* produces *A* but not *B*; *r* produces *B* but not *A*. Moreover, we must assume that the virus rapidly disappears in a cell which lacks *A* but that it may live for a longer time in a cell which lacks *B* but has *A*, or may even linger on for several generations, largely in an inactive state, in plants which have only *A*. The virus therefore could not be transmitted by the *r* gametes of a plant that grew from an *R′rr* kernel, but it could be transmitted by the *R′* gametes. If the latter fertilized an *rr*♀ (giving *R′rr* kernels), gene *R* would supply the *A* element and *r*, the *B*. The virus would therefore persist, and the kernels would be light (instead of dark, as they would be in the absence of the virus).

Until further tests, involving properly marked chromosomes have been made, it might be well to suspend judgment on the significance of Brink's RR^{st} case in maize (*2*).

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2. This study was supported by a grant (C-2393) from the National Institutes of Health, U.S. Public Health Service.

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Reflectivity Spectrum and Optical Constants of Bituminous Coal; Estimation of Aromaticity

Abstract. The spectra of reflectivities, refractive indices, and absorption indices of a bituminous coal vitrain have been determined for the ultraviolet-visible spectral region. The low values for these quantities support the premise that polynuclear condensed aromatics may be present in coal only in small amounts. Aliphatic and amorphous carbons may predominate.

The spectra of specular reflectivities have been determined in the ultraviolet-visible region for Bruceton coal vitrain (*1*), which is 84 percent carbon. Previously, the absorption spectrum in this

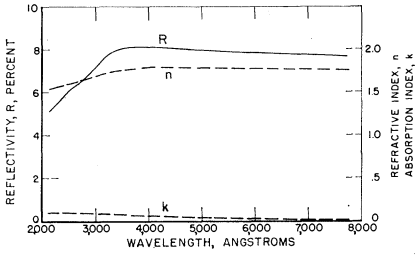

Fig. 1. Ultraviolet-visible spectrum of specular reflectivity and the optical constants, n and k; Bruceton vitrain.