so that we have had very little opportunity to make accurate comparisons between normals and mutants from a given ear. Those that have been made would indicate that mutants are slightly less vigorous than normal mature plants. However, the chemical data would suggest that the phenotype of this genotype should fall below that of $\frac{Cl^3_M}{}\ \frac{cl_M}{}$ plants. It is obvious from visual observation that this cannot be the case since even to the casual observer mature $\frac{Cl^3_M}{}\ \frac{cl^3_M}{}$ are decidedly pale-green plants with a tendency to have white sheaths and zebra striping while $\frac{Cl^2_M}{}\ \frac{Cl^3_M}{}$ plants are a definite dark green and closely approximate normals. The explanation for the low values for $\frac{Cl^2_M}{}\ \frac{Cl^2_M}{}$ could be due to an increased effeciency of the modifiers as the plants mature so that the seedling values do not accurately reflect performance in mature plants. However, this is not observed to be the case for the other genotypes. Perhaps the low value for $\frac{Cl^2_M}{}\ \frac{Cl^2_M}{}$ is due to some peculiarity in the particular background of the material used for these determinations which came from lines of rather low vigor due to several generations of inbreeding. We are in the process of crossing this gene out to inbreds that do not possess modifiers and re-extracting what we hope to be a more vigorous $\frac{Cl_1}{}\ \frac{cl_1}{}\ \frac{Cl^3_M}{}$ $\frac{Cl^3_M}{}$ line for further pigment tests.

The outstanding characteristic of Figure 1 is that the levels of the three plastid pigments vary together. Since it is known that both the albino mutants and the modified genotypes have a chlorophyll producing mechanism that, as far as has been tested, appears to be normal, it is strongly suggestive that the marked parallelism between chlorophyll content and the carotene and xanthophyll levels is dependent on the amount of one or both of the latter two pigments that can be produced under the influence of a given modifier. This is just what would be expected if carotene is acting here to protect chlorophyll from photodestruction. At low levels of carotene productions only small amounts of chlorophyll can be protected; at higher carotene levels more chlorophyll is protected. These results are in agreement with those of other workers that suggest that one of the functions of colored carotenoids is to protect chlorophyll from photo-auto-oxidation.

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3. Electron microscopy studies of plastid development in mutants at the white endosperm - albino seedling $W_3$ locus.

This past year we have begun an electron microscopy study of plastid development in normal and mutant plant material. In these studies seedlings were grown for 10 - 14 days in the dark at 26.6°C. (80°F.). Others were grown under

normal day-night conditions with a light intensity of 2000 ft. candles. Samples were taken from secondary leaves of dark grown plants and fixed in the dark, after which the plants were exposed to 2000 ft. candles of light and sampled at intervals up to 24 hours. Tissue was fixed with either 4% $KMnO_4$ or 3% Glutaraldehyde post-fixed with 1% Osmium tetroxide dehydrated in an alcohol series, embedded in Epon 812 and sectioned on an LKB ultramicrotome with a diamond knife. Sections were stained with Uranyl acetate in methanol and examined under the electron microscope.

A good portion of the year was devoted to perfecting techniques and to determining normal plastid development. This was determined by studying both dark grown tissue at intervals when exposed to illumination up to twenty-four hours and by sectioning tissue from the apical meristem.

Following these preliminary studies, work has been, and is at present, mainly concerned with the structural development of the chloroplast of the albino $w_2$ and its pale green $pastel_{8686}$ allele as compared with the normal dark green chloroplast. The albino $w_2$ is capable of some chlorophyll production but lacks colored carotenoids so that its chlorophyll breaks down in the light. This mutant when grown in the dark shows a structurally organized prolamellar body similar to that found in the dark grown normal chloroplast. In dark grown normals exposed to light this prolamellar body undergoes a breakdown or disorganization and an increase in lamellar membranes. However, after 1-4 hours of illumination the membranes of the albino begin to break down and become disorganized. This disorganization of lamellar membranes of mutants continues on further illumination up to 24 hours with no formation of grana as observed in normals. In addition, the albino plastids contain numerous starch grains, even in dark grown tissue in contrast to the normal, where starch was not seen until after 24 hours of light. The pale green ($pas_{8686}$), which is presently being studied, shows some lamellar organization after 24 hours of illumination, but its "grana" unlike the normal which have short stacks of membranes, are long lamellar aggregates, sometimes loosely arranged. The developing normal chloroplast, by 24 hours, has numerous well developed lamellae and stacks of grana throughout the plastid.

Further work is planned with these mutants. The above studies were carried out at 26.6°C. However, the phenotypic expression of $pas_{8686}$ mutant is strongly influenced by temperature. Grown at 22°C. it has only about 11.1% as much chlorophyll and 7.9% as much carotene as normals, while grown at 37°C. it produces 59.6% as much chlorophyll and 61.4% as much carotene. The effect of these temperature differences on the development of plastid structures in $pas_{8686}$ and the $F_1$ between $pas_{8686}$ and $w_2$ will be studied in the future.

Further studies on other white endosperm-albino mutants are planned as well as studies on other pigment deficient mutants (e.g., luteus, pale greens, virescents, etc.).

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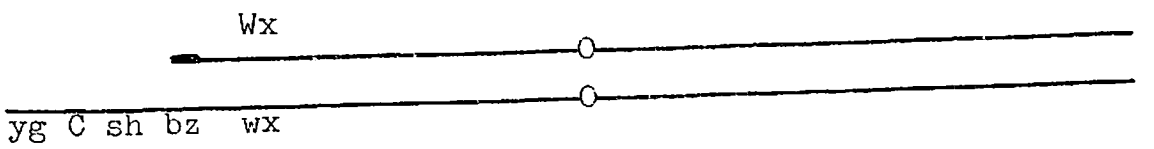
1. Very low cross-over rate between wx and the breakage point of TB-9b.

The position of the waxy locus has been indicated at about 2/5 of the length of the short arm of chromosome 9 taken from the centromere (McClintock). The breakage point of TB-9b has also been given as .4 of the arm from the centromere (Roman).

Since the wx locus is not uncovered by the TB-9b it should be inferred that the cytological distance between wx and the breakage point of such a translocation is quite negligible. Genetical data suggest that the cross-over distance is also very tiny indeed.

Crossing of TB-9b on a multiple tester of chromosome 9 (yg C sh bz wx) permits the easy identification of the hypoploid individuals of the following constitution:




When these plants are backcrossed to the multiple tester, the kernels obtained turned out to be of the following type:

| Wx | wx | Total | % of Wx |
|---|---|---|---|
| 13 | 6053 | 6066 | 0.21 |

Obviously the rate of crossing-over between Wx and the break point could be evaluated also on the basis of pollen grains produced by such hypoploid plants. Provided that the Wx bearing chromosome, because of the terminal deficiency, leads to pollen abortion, normally filled pollen grains possessing the dominant factor should originate only from crossing-over between Wx and the break point.

Staining of the pollen produced by the hypoploid type plant with iodine-potassium iodide solution permitted the following classification: