a green center. The same percentage of colorless colonies developed after the application of pressure for 2 hours as after application for 20 minutes.

Of the cells streaked on agar plates after exposure to 500 atm for ½ hour or 2 hours, only 1 percent showed color mutation, indicating that the phenomenon is pressure-dependent though apparently not time-dependent. Further study is required however, before definitive conclusions can be drawn. Although the mutant colonies appeared white on agar, they appeared yellow-orange when grown in liquid, thus reflecting synthesis of carotenoids (*10*).

Two additional "pressure" mutants, designated PR-2 and PR-3, were isolated. Mutant PR-2 synthesized about twice as much carotenoid as did PR-1 or PR-3 on the basis of the dry weight of the cells. This relationship is based on the $E^{1\%}_{1\text{-cm}}$ (*11*) value of 2500 for β-carotene (*12*) measured from the absorption spectrum of the total carotenoids extracted in 95 percent ethanol. The carotenoids have not been isolated or identified.

Neither in Cattell's review (*13*) nor in the studies cited by Johnson, Eyring, and Polissar (*14*) are there references to pressure-caused mutations. Whether the effect reported here is a reflection of a chromosomal or cytoplasmic gene change cannot be stated with certainty. However, there is evidence which suggests a lack of direct nuclear control over chloroplast formation. Furthermore, several studies show that both DNA and RNA are present in chloroplasts (*15*). Such evidence favors cytoplasmic mutation, rather than chromogenic mutation, as the probable mechanism upon which hydrostatic pressure acts. Also, Hedén's studies (*16*) suggest that nucleic acids are probably targets of hydrostatic pressure. It can be postulated that pressure acts on a stage of chloroplast formation in which there is an increase in volume (*14*) of either the structural organelle or some molecular phase vital to its development.

J. A. GROSS

Life Sciences Research Division,
IIT Research Institute,
Chicago, Illinois 60616

References and Notes

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