



Indian Paintbrush (Castilleja chromosa) growing near the Boyce Thompson Southwestern Arboretum. Photo by Carol D. Crosswhite.

Selenium and Castilleja. *Castilleja* is a genus of perennial herbs of the Scrophulariaceae. Native to North America, the species are numerous in rugged terrain of the western United States and Mexico, making extremely rapid growth in early spring under adverse conditions. They seldom are noticed except in summer when they become spectacular wildflowers with the name "Indian Paintbrush," as if they had been dipped in bright paint. *Castilleja* is very unusual in several major respects, each of which might be inter-related. First, the tops of the plants display prominent red or yellow (occasionally purplish) pigment in well-defined bands as if resulting from a chromatography experiment in a chemistry class. The pigments themselves differ markedly from the common anthocyanins which are byproducts of normal plant metabolism. Even the manner of deposition of the pigments is anomalous, being concentrated more in the leaves surrounding the flowers than in the flowers themselves. Second, the plants are obligately hemiparasitic, forming attachments to the roots of other plants. Unlike many parasites, however, *Castilleja* retains chlorophyll. Since parasites live on the sugars of their hosts, the possibility exists that *Castilleja*, freed from the need to produce sugar, could be using its chlorophyll to produce something other than normal photosynthate, perhaps involving a chemical compound which facilitates "robbing" or taking over the host's resources. This speculation has never been studied. Third, the plants grow on selenium soils and concentrate this element in their bodies! How is the selenium being used?

Selenium is an unusual red powder somewhat resembling sulfur but with quite unique properties. It has a vitreous form which is black and a crystalline form which is metallic gray. Its neighbors in the periodic table are sulfur, chlorine, bromine, iodine, tellurium, antimony, arsenic and phosphorus, elements which are far from being inert, having strong characteristics,

activities and reactivities. Selenium is an extremely complex substance with multiple valences, isotopes, physical forms and activities relating to light and electricity.

When eaten by animals, *Castilleja* can be so high in selenium as to cause poisoning. Interestingly, selenium has recently been implicated as a factor in human nutrition, its deficiency resulting in physiological problems. Another recent discovery that could possibly prove to be a breakthrough is that selenium appears to have strong anti-cancer activity.

Although the role of selenium in plants and animals is still very poorly understood, the reactions of the element in the chemistry laboratory have led to numerous applications today in photocopy machines, solar cells and exposure meters. Selenium is also used in making rectifiers and semiconductors for the electronics industry. Apparently without selenium many of our modern electronic gadgets simply would not function. Physiologists have clearly shown that plants and animals, and particularly humans, are remarkable machines. Although we know how some of this living machinery functions with regard to photosynthesis, respiration, circulation of the blood, and basic cell metabolism, we still have much to learn concerning regulation and feedback, suppression of discordant growth (cancer), how genes are turned on and off, functioning of the brain, and the relation of sight to experience, memory and perception, to name a few intriguing areas. Is selenium involved? This question is like asking a stone-age cave-dweller to explain the circuitry of a modern electronic gadget. At our present state of knowledge we know practically nothing about the role of selenium in living machinery. With this issue of *Desert Plants* we suggest that the role of selenium may be exaggerated in *Castilleja* to the point where (cf. salivary chromosome banding in *Drosophila*) a phenomenon may be observed which would be difficult to detect in normal living systems.