

"These were the golden days of cytogenetics," recalls Rhoades. He is not alone when he suggests that McClintock's cytogenetics work was deserving of a Nobel Prize in itself. This, however, was not to be, though her achievements did receive recognition in circles less public, although almost as professionally rewarding, than The Big Prize. In 1939 she was elected vice president of the Genetics Society of America and served as president in 1944. And the following year she was elected as a member of the National Academy of Sciences, only the third woman to be raised to that prestigious status at the time.

Although the classical genetics community never underestimated or overlooked McClintock, the molecular geneticists and molecular biologists were very, very slow to catch up, and it was only when evidence of mobile genetic elements began to emerge from their own endeavors in other organisms that their recognition was bestowed on her. Two years ago, just when the Nobel Prize committee was beginning to consider seriously her nomination, she received two other major awards. Early in October 1981 she shared the Wolfe Prize in Medicine, and a month later she won the Lasker Award, both for the discovery of mobile genetic elements. At the same time the John D. and Catherine T. MacArthur Foundation made her its first Prize Fellow Laureate. And she has recently been the subject of biography.* As a very private person—some describe her as a loner—McClintock has found all this attention diverting and even distressing.

By working for so long without a research group McClintock was reflecting her scientific approach rather than just a solitary personality. "She wanted to be on top of her research. She wanted to be very close to her research material," says Rhoades. Drawing on the title of the recent biography, he adds, "She has a feeling for the organism."

When McClintock first went to work at the Carnegie laboratory at Cold Spring Harbor she was continuing a long tradition in genetics research in studying the basis of variegation of kernel and leaf pigmentation in maize. The most intriguing aspect to this phenomenon was its genetic instability. Although the pattern of pigmentation would generally be passed faithfully from generation to generation, there would be occasional exceptions. These exceptions were the clue to something interesting in the organism's genetics. Both germ line and so-

* *A Feeling for the Organism*, by Evelyn Fox Keller (Freeman, San Francisco, 1983).

Carbon May Break Octet Rule

To anyone who has been exposed to elementary organic chemistry, the octet rule is an immutable doctrine: elements in the first row of the periodic table prefer to be surrounded with eight electrons. This means that oxygen, for example, tends to bond to two other atoms, while carbon bonds to four.

This rule may not be as immutable as was previously believed. John A. Pople of Carnegie-Mellon University and Paul von Ragué Schleyer, Ernst-Ulrich Würthwein, and their colleagues at Friedrich Alexander University in West Germany report in the most recent issue of the *Journal of the American Chemical Society* [105, 5930 (1983)] that five or six lithium atoms can bond stably to one carbon atom. Says Pople: "We have to modify some of our old concepts about valency."

These authors reached their conclusions by performing molecular orbital calculations for the postulated species. They find, for example, that CLi_5 and CLi_6 are highly stable toward all possible dissociation reactions; that is, when one lithium atom is lost from CLi_5 or two Li atoms are lost from CLi_6 , both reactions are highly endothermic. That all of the lithium atoms are bound to carbon is evident because the molecules have very high symmetry and all the C-Li bond lengths are only slightly longer than those in CH_3Li and CLi_4 .

The formal charges on the carbon atoms in CLi_5 and CLi_6 are not much larger than that on CLi_4 . This indicates, Pople and Schleyer say, that the carbon atom "remains content with its normal octet," and that the eight electrons are simply redistributed into five (or six) bonds rather than four. The "extra" electron or electrons contribute to lithium-lithium bonding and help to start building a metal "cage" around the central atom.



Predicted structures

Pople and Schleyer calculate that CLi_5 will have D_{3h} symmetry while CLi_6 will have O_h symmetry.

The nature of this central atom is secondary, the authors say, and hyperlithiation should be a general phenomenon for all first and second row elements. In fact, the two groups had earlier this year reported [*J. Am. Chem. Soc.* 104, 5839 (1983)] that hyperlithiated oxygen compounds such as OLi_3 and OLi_4 are also stable. They also have some preliminary evidence that hyperlithiated nitrogen compounds are stable and that sodium can form similar hypernatriated compounds.

"Expressed colloquially," Pople and Schleyer say, "lithium is a 'sticky' element and binds to many molecules, especially if another lithium already is present. Thus, CH_4 forms only weak complexes with Li or LiH. . . . In contrast, CH_3Li binds both Li and LiH much more strongly; as a result, CH_3Li_2 and CH_4Li_2 are present, and both have pentacoordinate carbons." This tendency, however, will probably make it impossible to synthesize discrete hyperlithiated carbon compounds since adjacent molecules should interact strongly. At the University of Texas at Austin, R. J. Lagow and his colleagues have obtained a solid product, formulated as " $(\text{CLi}_4)_n$," from the reaction of carbon tetrachloride with lithium atoms. This compound probably contains hyperlithiated carbon species.

Lagow's group has also observed many hyperstoichiometric ions, such as CH_3Li_2^+ and CLi_5^+ , that are probably derived from the neutral species. C. H. Wu and his colleagues at the University of Jülich in West Germany have observed CLi_5 and CLi_6 in the gas phase; these were produced by allowing lithium atoms at high temperatures to diffuse through graphite membranes. Wu's group has also observed hyperlithiated oxygen compounds in the gas phase. The ionization potentials and energies of these hyperlithiated molecules, when they can be measured, should provide quantitative data for comparison with the computational results.—THOMAS H. MAUGH II