METHODS OF TEACHING FORMULA-WRITING

BY

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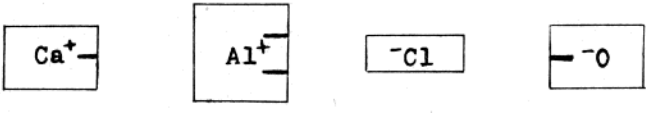
Often teachers attempt to present chemistry by methods completely contrary to the way people naturally learn. The result can not be wholly satisfactory. To improve methods the Research Committee of the Illinois Association of Chemistry Teachers directed by Dr. Rosalie M. Parr of the University of Illinois is making a special study, collecting and distributing methods that have been found successful.

One topic considered has been formula-writing. For this topic the lesson assignment is often a certain number of pages, including certain exercises at the end of the chapter. However, to get results, students need a challenge to their ability to think. So why not challenge them to explain why compounds have definite formulas? Point to a number of familiar formulas and lead the students to observe these two facts: first, that one atom of a certain element usually holds the same number of atoms of another element, as one of calcium holds just two of chlorine; second, that the atoms of different elements hold different numbers of atoms of other elements, as one of zinc holds two of chlorine, but just one of sulphur. Then ask: "Why is it that calcium can hold only two chlorine atoms, while aluminum can hold three? Why is it that zinc can hold two of chlorine, but only one sulphur atom?" The challenge thus thrown them, whether they can meet it or not, will be a mental stimulus toward their later getting the accepted solution.

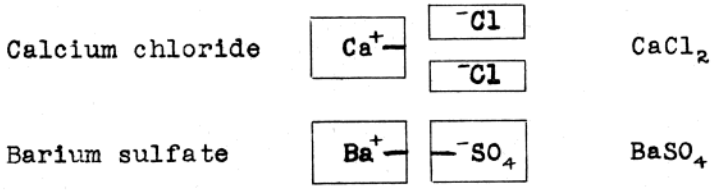
Furthermore, the challenge must be answered. If the student can not here explain in terms of the atomic structure and the electron theory, then the teacher should give a rational basis on which to build. The students will thus see the amount of holding power of an atom depends upon its structure. They will see why some elements are inactive, while other elements, such as calcium, aluminum, and carbon, will have two, three, four, etc., times the holding power or valence of hydrogen. They can now work intelligently. Without understanding, valence and formula-writing become mechanical and lead to confusion, just as in algebra transposition often leads to a hopeless muddle. With understanding, the principles of formula-writing will be intelligently applied, and the periodic chart will become a useful tool.

An abstract presentation will not be clear for all. So by way of adding light for the less brilliant students H. R. Hortin of Atwood, Illinois, suggests this scheme. He would compare elements to boys and girls on a dance floor. As some girls and I suppose some boys are more attractive than others, there will be quite a variation in the way the boys and girls couple off on the floor or group together along the side. Some handsome boy may have two girls just as Ca will capture two Cl atoms, and some attractive girl may hold three or four boys. Similarly C holds four H. Such bright mental pictures for high school students will undoubtedly make valence and formula-writing clear.

The students now think they understand. However, formula writing is not yet learned. That can only be accomplished by writing. After showing how to write simple formulas by means of valence signs, challenge the class to write formulas for themselves, allowing perhaps two or three of the apt students to write on the board. The students will thus speedily meet their difficulties, ask questions, and gain some mastery of the work. Just here it seems to me is a proper place to make use of another device used by Miss S. Aleta McEvoy of Rockford, Illinois. Students usually understand better if they have something to visualize or to manipulate. So, to make formulas more tangible, Miss McEvoy would design sets of cards for the students. (The cost of printing is very little.) The size of the card for each element or radical shows the valence, thus,



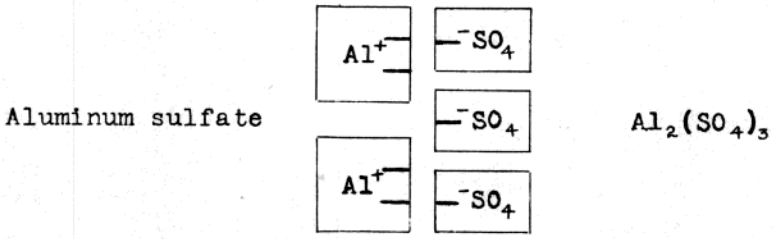
Getting the correct formulas is just a matter of matching cards, thus:



After experimenting with these cards and writing formulas, the students gradually acquire the ability to think the formula abstractly. Then the cards may be dispensed with.

The more difficult formulas, as for aluminum sulfate and calcium phosphate, can later be taught in the same way pointing out that the

positive and negative valences must always be equal and that they can always be made equal by the least common multiple of the valences, thus:



Carl D. Althoff of Depue, Illinois, uses another device. He writes the symbols without the necessary subscripts to make the valence balance. (Thus Al So.) Then he saparates the two positive and negative parts by a perpendicular line and writes the valence above each in Roman numerals. (Thus $\begin{matrix}\text{III}\\ \text{Al}\end{matrix} \mid \begin{matrix}\text{II}\\ (SO_4).\end{matrix}$ Then he tells the students to write subscripts that will make equal products with the numbers representing valence above. Thus, $\begin{matrix}\text{III}\\ Al_2\end{matrix} \mid \begin{matrix}\text{II}\\ (SO_4)_3.\end{matrix}$

To give speed in writing formulas Mr. Dorr Simer and Miss Mary Brock of Decatur High School use flash cards, drawing them at random from a bowl or container. Students that are slow, or fail, come in during vacant hours or after school and are coached by brighter students.

Briefly we may sum up the method of teaching formulas in these steps. Present the students the problem, challenge their ability to explain, give them a rational basis for work, explain the method of writing the formula, and lastly give them practice, making the work as tangible and concrete as the needs of the students demand.