Substances, Molecules and Symbols in the ICT Age

J. D. Bradley *

RADMASTE Centre, University of the Witwatersrand, Johannesburg, South Africa

*Author for correspondence e-mail; John.Bradley@wits.ac.za

Alchemists were often accused of communicating in cryptic fashion in order to claim knowledge without disclosing details that others could test and understand. Chemists today would claim that communication is open and unambiguous; indeed with symbols and formulae chemists have developed a universal language that will carry us forward into the ICT age.

For beginners, learning this universal symbolic language of chemistry is important. Understanding it can be achieved at different levels. First and foremost, a chemical formula is a symbolic name. Like children learn other languages, one usually begins by linking a formula to a substance, which may be really familiar.

Systematic naming followed upon Lavoisier's definition of elements and compounds and, with quantitative analysis and Dalton's atomic theory, this led to systematic formulae. Molecular knowledge was however limited and only gradually became available. Organic chemistry, a comparatively late developer, presented new challenges in communicating with formulae. Inevitably, organic chemists rather quickly adopted molecular formulae, and later on projection and structural formulae. By contrast, this evolutionary path has not been completely followed in inorganic chemistry, and we find plenty of examples of formulae that are far from molecular. (Familiar examples are NaCl, S, SiO_2, Cu.)

These historic traces of chemistry from two centuries ago are all the more problematic for chemistry teaching and learning because the examples are often of substances traditionally encountered in school chemistry. But the problem of the late recognition of the all-pervasive significance of molecules extends to more than just names and formulae. The descriptive language of chemistry is also handicapped by the inadequate recognition of molecules. Substances may boil or melt, but what do molecules do? We do not have words to describe! Even when we want to say something that is unequivocally molecular, we ignore the molecules: for example, we may say that acids are proton donors, when we should say molecules of acids donate hydrons.

Despite the wonderful efforts of chemists in general, and IUPAC in particular, our chemistry communication is still lacking in many ways that are important for teaching and learning chemistry (and by implication for public understanding). Our group has devoted some efforts to this problem area, particularly in developing cost-effective tools to cope. However, the origin of the problem lies in some of the terminology and symbols of chemistry itself. I therefore call for IUPAC, and in particular it's CCE, to address this problem for the benefit of chemistry education in the ICT age.