Amides, Imides and Peptides

PROTEIN chemistry has its origins in physiology. For the last half-century the group formed by condensing the carboxyl group of an amino-acid with the amino group of another amino-acid has been called a peptide group, and the long molecule formed by condensing a number of amino-acids, a polypeptide. Protein molecules contain numerous peptide links (—CO.NH—) in the backbone of the molecule; they also in most cases carry amido groups (—$CO.NH_2$) as terminal groups of certain of their side-chains.

'Nylon' chemistry has its origins in organic chemistry. Unfortunately, some 'Nylon' chemists have chosen to call the link formed by condensing adipic acids with hexamethylene diamine an 'amide group', and to describe 'Nylon' as a 'polyamide'. 'Nylon' chemistry is now beginning to have an influence on protein chemistry, and the use of the term 'amide' as a synonym for 'peptide' in a field of chemistry where it already has a definite and different meaning is causing considerable confusion.

Surely, in any event, to call the group —CO.NH— an 'amide' or even an 'amido' group is wrong. By general agreement substances carrying an —NH_2 group are amines, or an >NH group, are imines. Equally, substances carrying a —$CO.NH_2$ group are amides, and surely if carrying a —CO.NH— group should be imides.

To use the term 'imide' as a synonym for 'peptide' and to call 'Nylon' a polyimide would be correct in the language of classical organic chemistry, and would bring clarity into the relations of protein chemists and 'Nylon' chemists. 'Polypeptide' could well be reserved as a term to describe a product obtained by condensing amino-acids, and 'polyimide' for the products obtained by condensing all other carboxylic acids with organic amines.

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Chemical Terms, with Special Reference to 'Oxidation', 'Acid' and 'Base'

THE words we use in everyday life often mislead us, because the same word (say 'democracy') means different things to different people. It is clearly desirable that scientific words should mean the same thing to all those who use them, and, so far as possible, that they should signify now what they signified in the past.

We say "so far as possible". When the mechanism of a process, such as the corrosion of iron, becomes better understood, the word 'corrosion' acquires a fuller meaning. This is inevitable and desirable. It would be undesirable, however, in our view, if a particular reaction of iron were considered a corrosion by one chemist and not by another.

There is a tendency to extend the scope of a word to include phenomena which were formerly excluded. This has happened in the past; for example, in the case of the word 'oxidation'. The term, originally applied to processes such as the change of ferrous oxide to ferric oxide, was extended to include the change of ferrous chloride to ferric chloride. This extension took place so long ago that it causes confusion now to none except beginners (to whom it is still a stumbling-block), and it would probably be futile to suggest a change. It seems to us, however, that it would have been better, when it was realized that there was a similarity between oxidations proper and other processes in which the proportion of electronegative element or radical is increased, to coin a new term (say, 'adduction') to cover both sets of phenomena, while keeping 'oxidation' for changes involving oxygen. All 'hydrogenations' are 'reductions', but not all 'reductions' are 'hydrogenations'.

It is impossible to extend the scope of a word to include more phenomena without diminishing its sharpness. In the language of the logicians, increase in the extension of a term leads inevitably to decrease in its intension. The term 'oxidation' now conveys a less precise meaning than 'hydrogenation'.

If this were the only example of the phenomenon it would not be worth while writing a letter about it; unfortunately the process is still at work. There was little disagreement among early chemists about the scope of the words 'acid' and 'base'. When hydrogen ions were discovered the words acquired a fuller meaning, but were still applied to cover approximately the same range of substances.

In the last twenty years, however, the recognition that there is a similarity of action between all substances capable of giving up protons or taking up electrons during reaction has led to the extension of the term 'acid' to include all such, and we have now reached the very undesirable position that, while *A* and *B* are agreed that hydrochloric acid in aqueous solution is an acid, *A* applies the word to $NH_4^{\cdot}$ and water also, while *B* thinks of $NH_4^{\cdot}$ as the electropositive ion of an important series of salts and of water as the most typically neutral substance in existence.

In a recent paper[1] the following sentence occurs, "We conclude that almost any substance may behave as an acid or a base". The extension of 'acid' and 'base' has become so great that the intension has become practically nothing at all.

We think it is probable that a majority of chemists feel uncomfortable at the application of the term 'acid' to water or 'base' to the chloride ion. Perhaps it is not too late to recognize the undesirability of the process and to agree upon the use of some pair of terms (such as 'proton donor' and 'proton acceptor', or 'electrophilic' and 'electrodotic', or others suggested from time to time) to describe all substances (including acids and bases) which can give up or receive protons (or attract or supply electrons), while preserving 'acid' and 'base' for the compounds which have been described by these words for centuries.

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[1] Luder and Zuffanti, *Chem. Rev.*, **34**, 346 (1944).

Thermal Expansion of Diamond

THE measurements of the thermal expansion of diamond made by Dembowska, which according to Grüneisen[1] appeared to support his well-known formula connecting the specific heat and thermal expansion coefficient of simple solids, covered only