SECTION 4: CHEMICAL TAXONOMY

INTRODUCTORY REMARKS BY THE HONORARY PRESIDENT OF THE SECTION

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First of all I should like to express my warmest gratitude to The Organizing Committee for providing me an opportunity to have the very great honour to address you at this section on chemotaxonomy.

It is always a pleasure to address an enthusiastic audience. Regardless of opinion about chemotaxonomy, everyone must admit that this young discipline is crowded with enthusiastic scientists. In my opinion the term chemotaxonomy was selected somewhat arbitrarily. Taxonomy in the proper sense of the word is a science with one main goal "to achieve order in contemporary living plants". As a consequence of some of its methods, it has brought forward results also of phylogenetic importance. This was not aimed at, and so taxonomy as such dismiss all criticism not to be entirely phylogenetic.

Taxonomy is a remarkable science. Its techniques are, relative to other natural science approaches, relatively simple and rapid. As the only scientists who take care of all taxons it is understandable that taxonomists look sceptically down on all other sciences, which try to reach conclusions on a more or less restricted amount of material whether these be embryology, palynology, or chemotaxonomy. Of these related sciences, chemotaxonomy without doubt is in the worst position.

Professor Hegnauer in one of his reviews has requested *that the structure and distribution of all plant constituents must be investigated.* If we should have to follow Hegnauer on this point, we obviously have to admit that the complete chemical investigation of the first species is still not finished.

What characterizes our present situation is that each chemistry school is looking for one class of compounds, or one type of metabolite; all other compounds go down the sink. I suppose this looks to a real taxonomist as if plant classification was done by one botany school on leaves; by another on flowers, etc.

Then, is there any valid excuse for chemotaxonomy to exist? Personally I can think of at least three.

The classification of any plant should always be done on as many characters as possible. The characterization of the substances occurring in a

plant is thus a desired extension of the classical macroscopic and microscopic characters down to the level of molecules. In lichen systematics this extension has long been a necessity.

The famous botanist H. Hallier named *the elucidation of plant constituents and their distribution "Descriptive chemotaxonomy"*. As parallell developments in related genera in numerous cases lead to overlap in gross morphology, this "Descriptive chemotaxonomy" may be useful also for classification purposes if some chemical characters are very conservative and remain unchanged when morphology runs into overlapping. Cases of this type are known with different classes of chemical compounds and so chemists might be of some use.

I have to remind you, however, that in many cases the chemical characters are not at all constant. It should suffice to mention that the types of rape recently developed in Canada produce seeds devoid of erucic acid which was once one of the chemical markers of the Cruciferae. Anders Kiær has found mutant of *Capsella bursa pastoris* (L) Moench devoid of sulphur glycosides, another chemical marker of this family. Finally I may mention that *Conium maculatum* (L)—ill-fated since the days of Socrates—becomes devoid of all coniin when growing at higher altitudes, or, in other words, under long day conditions. Numerous phenomena connected with behaviour of plants under short or long day conditions are obviously due to a balance between synthesis and respiration. Edaphic influences, of which relative length of day and night is only one example, should not be allowed to blur our use of natural products in plant systematics.

It is very remarkable that Hallier in 1913 clearly defined another branch of chemotaxonomy the *"Dynamic chemotaxonomy", comprising the biochemical pathways leading to parallel or diversified development of chemical characters*. Hallier realized that this "Dynamic chemotaxonomy" could on one hand simplify the "Descriptive chemotaxonomy", on the other be a tool in phylogeny. And here I think we reach the second point where chemistry may be useful.

In recent years some botanists have introduced the "joke" talking about "equal weighting of characters". Although most of you are only chemists, you have long ago realized that a lot of the characters selected by botanists are absolutely decisive.

What I think is behind this "joke" is that just while the purpose of these characters is to divide for the sake of creating order, *these same characters* must be quite unsuitable to indicate any phylogenetic relations.

Ralph Alston of Texas—may I name him our "royal convertite" from classical botany to chemotaxonomy—divides natural products into: Basic Metabolites, Secondary Compounds, and Macromolecules. The remarkable achievements of our biochemical colleagues tell us not only that some of these macromolecules, *viz.* the *nucleic acids and their functional translations the enzymic proteins* decide whether "basic metabolites" shall accumulate as natural products—as do, *e.g.*, isocitric acid or sedoheptulose—as well as their transformations into our various types of secondary plant products. From this recent biochemical research emerges the evolutionary diversification of some fundamental proteins among them some enzymes. The aspect of "Dynamic chemotaxonomy" in the hands of these biochemists may develop into a new independent tool in phylogeny—and just the possibility

of getting a new independent tool in this science will be highly appreciated—even if the evidence is fragmentary.

The third excuse I see is applied science, and as the A in IUPAC stands for Applied, I feel allowed to mention it.

Agricultural products present in crops to the extent of 10–30 per cent in pure form cost somewhere between 0·3–2 Sw. Kr./kg. This is a price range in which only products available through large scale petrochemistry may be manufactured. Many secondary compounds are useful to mankind either as such or as starting materials; practically none of them are available through any reasonable form of petrochemistry. The importance of the problem of concentration of secondary compounds may be enlightened by mentioning only two cases: Would there have been any steroid industry if some *Dioscorea* species had not happened to contain 4–5 per cent of diosgenin? Or where would prices or applications have found their limitations?

In this splendid review Dr. Karl Folkers mentioned the use of some alkaloids from *Vinca rosea* L. (*Cataranthus roseus* G. Don) against some types of cancer. Vincristin seems to be most promising, but the content in *Vinca rosea* is only 0·0025 per cent. Better principles may be found but at the moment the task of obtaining a plant source producing vincristine in reasonable yield is imperative.

In my opinion it is only if the natural product chemist develops the science of "Dynamic chemotaxonomy" that he will be fit to join the genetisist and the plant breeder for the development of a diversified natural products industry; I suppose this third excuse is a rather valid, although much ignored, excuse for chemotaxonomy.