



Flow Analysis, midway between past dreams and future challenges

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Most current users of continuous-flow techniques with a long experience in them started with FIA. To many, the advances achieved since its inception are simply nice history, being as they are more concerned with future challenges, which will call for redoubled efforts and intact hopefulness. Such challenges can be as large in number as users and their wishes.

The history of flow analysis techniques started with a pioneering stage where researchers constructed their own systems from relatively inexpensive parts and adapted flow-cells in available instruments for use in the new assemblies.

Those romantic years of FIA were beautiful and shared by a relatively small scientific community. At the time, the word *automation* was freely used to refer to such simple exploits as dispensing the operator with the need to mix solutions and reagents for measurement at the detector; surprisingly, the *automated* procedure was more reproducible than its traditional counterpart. Some of us were bold enough to speak of total *automation* when we succeeded in integrating a new operation such as precipitate dissolution, solid-liquid reaction or gas separation into an FIA system.

The extension to other *children* of FIA raised the need for computer controlled conduct of the whole process, which in turn required the development of appropriate electronic interfaces. The lack of electronic and computer science training of analytical chemists delayed the process of expanding the use of flow-analysis and its applications. Computer control was the logical, pertinent pathway to automation or, specifically, to complete automation of the analytical process; this is our ultimate goal, however distant it may still be in most cases, and it is there that we are heading.

Computer-controlled automatic operation by itself can hardly be useful unless it is accompanied by other achievements such as *miniaturization* with a view not only to reducing sample and reagent consumption in conditioning and reaction operations, but also to

developing dedicated detectors which are largely to be designed.

The combination of miniaturized system components for constructing compact, robust assemblies with complete automation constitutes our third cornerstone: effective, robust systems for *in situ* analyses.

And now that we are dreaming, we could think of two more goals. One is to extend flow-based methodologies to uses other than the typical determinations of contents and including those of stability constants, stoichiometries or technological parameters, for example. Our pharmaceutical colleagues have already provided some such applications (*e.g.* constructing dissolution profiles, studying membrane permeability). The new applications are still anecdotal, however, so more effort is required on our part with a view to having the term *Flow Chemistry* consolidate just as *Flow Analysis* has after FIA.

We should give credit where credit is due. As widely agreed upon at the latest Flow Meeting, held in Porto, having our achievements officially endorsed should be an immediate priority. One way is by having flow-based methods approved and published in official compilations of standard procedures from pharmacopoeias and related bodies. In this way, flow analysis will eventually emerge a strong contender from Analytical Chemistry and subsequently expand to areas currently in the hands of other professionals (*e.g.* clinical analyses, metallurgy, mineralogy, agriculture).

We should place less emphasis on achieving increasingly lower detection limits—most are already low enough—and focus on things such as improving selectivity in non-separation processes in order to facilitate the application of new methods to real samples rather than only to laboratory samples doped with the target analyte. I myself would be quite happy to succeed in this respect. Finally, linking with the previous paragraph, why do we not seriously commit ourselves to finishing our work with a thorough validation of each method we develop? This might facilitate its adoption as a standard.