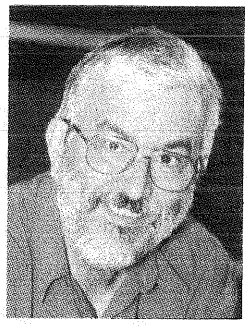
The Renaissance of Spectrophotometry



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The development of spectrophotometry during the first decades of last century was amazing, since this instrumental technique proved to be an excellent alternative to classical gravimetry and volumetry, as well as to electroanalytical techniques. New reagents became available, a number of methods were proposed and instrumental achievements were relevant. Among these achievements, the advent of single-beam, double-beam and double-beam/grating instruments during the 30's allowed a better exploitation of the real possibilities of spectrophotometry and an appreciation for what it was worth. Nevertheless, spectrophotometric procedures involved intensive solution management in order to accomplish several steps such as pipetting, diluting, reagent adding, pH adjusting, solute focusing, cuvette filling and rinsing *etc.*; moreover, measurements were usually done under static conditions. The glassware typical of the XIX century was generally used. As a consequence, and especially after the 40's, spectrophotometry was considered as more and more old-fashioned in relation to other advanced instrumental techniques.

With the advent of flow analysis, spectrophotometry experienced a renaissance, since the flow analyser is an excellent solution management system. The analytical figures of merit inherent to spectrophotometric procedures were greatly enhanced, especially after the emergence of unsegmented flow analysis during the seventies. In fact, the flow system offers a "temporal window" that permits the development of analytical procedures under non-equilibrated conditions. This opens the possibility to efficiently implement different strategies for chemical analysis involving *e.g.* monitoring of reaction rates (catalytic procedures), control of sample dispersion, partial development of chemical reactions, and exploitation of concentration gradients.

As a consequence of the happy marriage between spectrophotometry (and related techniques) and flow analysis, applications in different fields underwent an exponential increase, several analysers appeared on the market, text books and academic thesis were prepared and the number of communications in symposia and in scientific or technical journals experienced a pronounced growth.

Nowadays, the flow analysers with spectrophotometric detection are becoming progressively more versatile, rugged and miniaturized, and this tendency will certainly continue. Large scale *in situ* and *in vivo* assays is a reality. Micro-sensors have been developed and applied. Other similar techniques, better run in flowing media (thermal lens spectrophotometry, turbidimetry, chemi- and bio-luminescence), as well as hyphenated techniques involving spectrophotometry are experiencing a "boom". As a consequence, spectrophotometric flow-based procedures are now accepted worldwide.

Finally, it should be stressed that the analytical figures of merit of the flow-based spectrophotometric procedures are in general comparable with those inherent to other modern instrumental analytical procedures. In this context, it is strongly recommended that the concept of *specific mass* as an indicative of detection limit be extended to spectrophotometry. In view of the high sensitivity associated with most of the spectrophotometric flow-based procedures and the low inner volume of the analytical path of a typical flow analyser, the required sample volume is minimal. The scientific community will be then surprised with the very low values estimated for the specific mass.