Discussion : Discrete analysis systems

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We have had two very clear résumés of the two major systems which are now available for automation in clinical chemistry, and it is perhaps helpful to compare them with the two types of motive power we have for aircraft, that is, axial flow jet engines and piston engines.

The piston engine was the most obvious direct way to obtain power out of burning fuel, as the automation of the test tube and pipette might be expected to be the obvious approach to speeding up chemistry, but both in their final forms need a most complicated system of reciprocating moving parts. The jet engine, on the other hand, like continuous flow analysis, is more advanced in concept but relatively simple in practice, with few moving parts. There is a difference in the analogy, however, when one considers the history of development of the engines and the instruments. The engines followed the sequence of the evolution of the simple piston concept before the advanced principles of axial flow were thought of. But continuous flow analysis, embracing as it does many new ideas, has been developed almost to the limit of its potential, while the more obvious automation of the test tube and pipette is only just beginning. This difference is undoubtedly due to the drive and initiative of the Technicon Instrument Company, who saw potential in continuous flow automatic analysis and exploited it to the full.

When one sees the latest instruments using the two principles in action, the similarity to the two types of aero engine is quite remarkable. The SMA-12/60 has the smooth action of the jet while the Vickers M/C 300 is not at all unlike a Merlin engine of the last war running without its rocker boxes. It is no coincidence that in Britain, multichannel discrete analysis is being developed by a heavy engineering firm, since with so many rapidly moving reciprocating parts, engineering reliability is inevitably a major factor to consider.

Each of the two systems we have considered has advantages and disadvantages over the other, and in the long term we shall probably find in our laboratories a combination of both. The continuous flow machines have a limited rate of action at present of 60 or 70 samples per

hour, and although this might be increased to 90, it is slow compared with the capacity of discrete analyzers of 300 samples or more per hour. Interfacing with a digital computer using the older AutoAnalyzer techniques needs a complicated peak-picking system, but the square wave analogue output of the discrete machine is easily digitized. The multichannel continuous flow machine tends to be more rigid than its discrete counterpart when one wishes to change the selection of assays possible, but the large number of precision moving parts in a discrete analyzer is certainly a disadvantage, as is the present difficulty with the removal of protein. However, discrete analyzers are only at the initial stages of their development while continuous flow has almost reached the limit of its exploitation.

When industrial automation experts see our machines, they tend to point out that we are going through the stage industry was at nearly 200 years ago in the mid-eighteenth century when Hargreaves invented his spinning jenny and Crompton his mule. We cannot say we are approaching automation, as the industrialist understands it, until we incorporate some sort of feedback control, and perhaps possibilities in this direction will be apparent when we deal with computers later today and tomorrow. The chemical industry already does product analysis using gas chromatographs which control directly the feed stocks supplying the raw materials required to make a product, and it is not difficult to visualize feedback mechanisms for the clinical laboratory.

There are aspects of automation in clinical chemistry on which unfortunately we have no time to dwell this afternoon but which are leading to many ingenious solutions for the automatic handling of, for instance, the separation of immiscible solvents, the evaporation of solvents from samples, and centrifuging. Many of the ideas being developed are not easily classed as either discrete or continuous, and they probably form a group on their own, specifically to be used in special branches of clinical chemistry such as toxicology and steroid work.

Finally, in considering the ultimate in automation, it must be remembered that for various reasons certain aspects of our work will not be suitable for complete automation for many years, if ever. For these there is the simple form of mechanization termed 'work simplification', development on which has been proceeding in parallel with that on the more complex machines. There are those amongst us who maintain that simplifying as much as possible is more practical than installing complex machines, and they prove their point in their own laboratories most effectively.