Computer Assistance in the Chemical Pathology Laboratory

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Current clerical procedures in the clinical chemistry laboratory not only create a bottleneck in laboratory operations, but can be shown to be wasteful of the time of technically skilled personnel, prone to error and liable to produce records that leave much to be desired in terms of presentation, retrievability and even legibility. These problems have been tackled at University College Hospital by making use of a computer to aid the necessary manipulation of data.

Operating in an off-line mode with the hospital's Elliott 803 computer and with equipment that automatically or semi-automatically captures the significant part of the analogue output from Auto-Analyzers in machine-readable form, substantial benefits have been demonstrated. The amount of clerical work for the technical and scientific staff has been cut, the frequency and magnitude of laboratory errors have been decreased, results have been produced more rapidly, the interpretation and presentation of results have been improved, quality control has been made more sophisticated and results have been analysed for research purposes in a way and on a scale that was not possible previously.

A comprehensive automatic data-processing system is now being implemented with an Elliott 903 computer that is sited within the laboratory. The configuration includes a special data-acquisition unit that enables 24 AutoAnalyzer channels to be connected on-line to the computer. With this system the task of monitoring analytical performance has been transferred to the computer, which samples and digitizes all the analogue signals at 2s intervals and validates the peaks by software. Analytical errors due to such faults as incorrect calibration standards or abnormal degrees of instrumental drift are consequently promptly brought to light. With this system the scheduling of analyses in a manner that gives priority to urgent specimens and to those that must be repeated after dilution has been made automatic. Final results become available at short intervals during the run of analyses and are promptly entered into the appropriate patient's laboratory record, which is held on magnetic tape. After the input of results of the manually performed tests via paper tape, the system will link all the current results on a patient with past results and print cumulative reports with appropriate flagging of unusual findings.

Small versus Big Computers for Data Processing

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The question that first arises in discussing the subject of small versus large computers is what the terms 'small' and 'big' mean in this context. Obviously they could describe the physical dimensions of the machine, but since technological developments have considerably diminished the size of computer components this definition would mean that the most powerful modern computers are small relative to the early machines. Common-sense shows that as far as their capabilities are concerned this is not true, and so a more realistic definition of 'small' and 'big' is required. For the present purposes it is assumed that these terms describe the relative size of the computer word of a machine having a reasonable size of core; it may also happen that economic factors limit the total extent of the computer complex in terms of extra peripheral devices, but this is incidental to the definition. In principle, however, it is possible to expand a small computer by the addition of peripheral devices until it measures up to the size of a large computer as far as physical dimensions are concerned, but the unit would still be regarded as a small computer within the definition of the word size. The effect of this rigid constraint on the computer is to limit both the precision of the integer arithmetic and the range of programming languages that can be usefully employed in programming the computer.

The arithmetic precision is defined by the rounding error of the machine and for a small computer this can be appreciable. A common word length for small computers is 12 binary bits (equivalent to between three and four decimal digits), and it is normal when using these machines to use three words for a floating point variable within a program. Of these three words one holds the characteristic while the other two are used as one unit to hold the mantissa, so increasing the precision to 23 binary bits (approximately equivalent to six decimal digits). This may seem sufficient for all normal computations, but experience shows that unless the algorithms for many numerical exercises are correctly formulated the result is prone to considerable errors (see, for instance, the example quoted by Sapega, 1967). This extension of the word size is necessary, but it can only be made possible by decreasing the usable number of core words, and this in turn means that the programming and variable space is corresponding less than expected from the total core size. The effect of this is that both the programming language and the algorithms must be chosen with care in order to use the available