Preface

The use of automation and computers in pathology is in its initial stages. In clinical biochemistry, the subject most advanced in using such techniques, there are several pointers to the probable organization and future of the service but it is important to realize that the particular direction we are taking is not yet certain. We need many more hospital laboratory workers in the field of automation and more communication of ideas between those experimenting with developments. We need to be emphatic in our dealings with our administrative colleagues in stating that the mere use of automation and computers and centralization will not in themselves solve all our problems. It is for this reason that we feel that this Symposium was timely. It was really a demonstration of attitudes to a problem and possible solutions rather than a Symposium in which the detailed way ahead was clearly marked.

In the past, the pathological laboratory has been the link between the physical scientists and our clinical colleagues but today there are more and more signs that the pathological laboratory is fulfilling this role less and less, and I believe that this is to the detriment of the service. Clinical workers may increasingly turn to the physicist or to the computer scientist who are not to be found in our laboratories, and we should welcome such developments. Where I feel the situation is dangerous to our discipline is where developments in science are not accepted or looked for by the hospital pathological laboratory worker and applied, either because of conservatism, indifference, too close an involvement in conventional routine work, or lack of financial support by his hospital.

The introduction of automation into hospital pathological laboratories has, and will, increasingly enable us to be freed of what has become a crushing load of routine work so that we can develop further the applications of science to the care of patients.

Inevitably a great deal of discussion during this Symposium was concerned with whether equipment can quickly and easily provide us with precise and accurate results, but what is important to us as pathologists and clinical biochemists is how the information is used when it is provided. The computer must in the future play an important part not only in increasing the flow of precise and accurate data but also in interpreting such data for the benefit of the patient. Results of tests provided by the computer can only be interpreted by ourselves, and the computer over the next few years will certainly increase our work and be a hard taskmaster.

In this Preface it is impossible to point out the importance of all the subjects which were discussed. However, the following aspects of the subject are worthy of special comment.

THE INTERDISCIPLINARY APPROACH

The boundaries between the four main branches of pathology are becoming increasingly blurred. We are beginning to share techniques in a manner that would have been difficult to forecast even a few years ago. The obvious example is in data processing. For example, in my own hospital, there is so
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much common ground in the data processing of results that three previously autonomous departments are at present building a unit to encompass data processing in the three disciplines and share a laboratory computer. Two other examples: most of the original work on phenylketonuria was based upon biochemical techniques of amino acid chromatography but the most convenient technique for the screening of large numbers of infants is at the present time a microbiological technique (Guthrie and Susi, 1963). We are, at the present time, following the lead of Schersten and Fritz (1967) who are detecting bacteriuria in supposedly normal subjects not by microbiological techniques but by estimating the very small amounts of glucose—between 3 and 20 mg in 100 ml of early morning urine. In the presence of bacteria the level is often below 1 mg glucose/100 ml urine. The method of determination has been automated using a fluorimeter (Schersten, 1968). It requires scientific openmindedness if we are to benefit from all developments in our disciplines.

WHEN AND HOW TO INTRODUCE AUTOMATION AND DATA PROCESSING INTO A LABORATORY

There are certain tasks or techniques which are at their most efficient when performed by hand and eye. The worship of automation for automation’s sake is often economically and professionally dangerous. Let me illustrate with a very simple example. The laborious task of separating serum and plasma from blood specimens stimulated me to make preliminary sketches of a piece of apparatus in which we could load blood after centrifugation. The proposed apparatus would have automatically detected the level of the red cells in the sample tube and cleanly and automatically removed the plasma or serum. The estimated cost of the apparatus was a few hundred pounds. A professional work study engineer, whom we eventually consulted, showed that it would reduce labour time by only 5%, whereas if we put timing switches on our centrifuges at a total cost of £22 we could save 33% of labour time. Naturally we chose the latter.

The gradual introduction of sophisticated apparatus and techniques is also important. There is ample evidence from many parts of the world that suddenly interfacing laboratory staff, who have been educated and trained in a particular laboratory approach, with complex automatic and data processing techniques can be catastrophic. Step-wise development is essential and, in addition, conversion is always better when it involves development by hospital laboratory staff. We are still not in a ‘black-box’ era and the help of engineers and programmers actually working in some of our hospital laboratories, is, in my opinion, essential. Hence it is often important to go through intermediate stages of development, which may be inefficient or uneconomical, in order that staff may become educated in new techniques.

ACCURACY AND PRECISION IN THE HOSPITAL LABORATORY

Accuracy and precision is a real and pressing problem in hospital laboratory work. The introduction of many different types of discrete chemical analysers over the next few years is going to demand very careful testing and evaluation schedules. These will be essential so that we do not in any way increase the
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problem by sacrificing the present position and, because of speed and ease of analysis, accept less precision and reduced accuracy.

An off-line computer plays an important part in the quality control techniques used in my laboratory. Although clinical chemistry is the forerunner in this aspect of the use of the computer there are similar advantages to be found in other branches of pathology. Dr Stirland’s work in microbiology is of particular interest in this respect.

In our work, the computer is of particular use in calculating the mean value of a day’s results. All results, or those within a specified range, are used. In many determinations the mean daily figure is reasonably constant and any wide variation or ‘drift’ in results is usually, in our laboratory, indicative of analytical variance. Our reaction to such changes is usually a defensive one, that is, that ‘the population of patients must have altered’ and sometimes they do, but the commonest cause is analytical error.

With my co-workers I have published several examples of the use of such data in improving laboratory precision. The latest, and to me the most important example, was when we realized that low mean serum calcium results occurred on certain days without explanation. A considerable amount of investigation led us to discover the rather disturbing fact that the plastic sample cups which we used in AutoAnalyzer techniques can, under certain conditions of storage, adsorb over 1.0 mg/10 ml calcium from the serum.

The handling of data by computer also gives increased facilities for just looking at data in a variety of ways. Simple histograms of results can be conveniently printed by the lineprinter of a computer, and we can now have results printed for a particular disease state, hospital, or speciality. It is rare that such histograms are studied without interest and benefit.

Our quality control work highlighted, for the first time, the obvious fact that if you are going to produce more information then somebody has to look at it. Our daily quality control programme produces 180 figures each day. These are of little use in the form the computer prints them, and have to be manually transferred to graphs. We, at present, identify trends by eye. This is a great labour and we have not been successful in getting the computer to print the graphs in a useful way. We are now planning to use the computer to indicate when we are required to study the figures it prints. This ‘management by exception’ is very demanding on programming expertise but even more demanding on the laboratory workers’ ability to state logical objectives.

METHODS OF REPORTING LABORATORY RESULTS

The work load of all branches of pathology increases annually and the collecting together of all reports on a patient and the most convenient method of displaying these in his notes is an ever-present problem. The computer industry could be of considerable help in this respect because file handling techniques are an important part of the computer’s role in hospitals. A system of requesting laboratory tests on a punched card is in use in my laboratory (Whitehead, Becker, and Peters, 1968), and this system means that at the end of each day all our results are associated on punched cards with a patient’s identity and these are taken to the Queen Elizabeth Hospital Computer Centre where they go through various processes of validation and then are associated with previous results, if any, for that
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particular patient. This validation, file searching, and printing out process only takes a few minutes of actual computer time. Such methods of cumulative reporting are an important advance on the attempted grouping together of single reports in the patient’s notes. Particularly with those patients who are under care for a long period and who have had a lot of laboratory work performed, they are of considerable help to ward and laboratory staff. The form of printout is not ideal, as the computer’s lineprinter is far from ideal as a printing system.

PATIENT IDENTIFICATION

The use of data-processing equipment in hospital laboratories can be of considerable help in the transfer of patient identity from ward to laboratory. There is evidence from a variety of sources that if this is done by manual transfer of information there is a very high rate of error. Handling of data using a computer in a manner that associates today’s result with previous findings on the same patient demands accurate identification of the patient otherwise there will be incomplete, and therefore useless, files. In fact, good patient identification systems must be a requirement of laboratory data processing systems at all times.

Our present system has a 94% success rate in identifying patients’ results and associating them with previous results. The 6% of failures all come from a manual system of writing the patient’s name and other identifying data. We are forced to allow such a system to run in parallel with our punched-card system because we do not have a punched-card patient registration service throughout the 24 hours.

CONCLUSION

The emphasis in this Symposium has been directed towards the use of automatic systems to perform laboratory techniques and the incorporation of the computer in that apparatus in order to acquire the result. Symposia, under similar titles, will, over the coming years, contain increasing amounts of information on the use of the computer to interpret the results. Then the full potential of these powerful machines will be realized. Only hospital laboratory workers can ensure this. There is no doubt that automatic methods of analysis are capable of making our lives easier, they reduce labour costs, and increase speed. They are important companions in the laboratory today and will be increasingly so in the future. Not so the computer, it is a hard taskmaster, demanding considerable wisdom and often intuition to interpret its output. It will for many years make our lives more difficult if we are to use it properly. If we do not then we risk ossification in a mass of data.

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