COMPUTER HELP FOR HOSPITALS

The installation of a B5500 computer unit in the Monash University Computer Centre by the Victorian Hospital Computing Service marks a major step forward in the application of this sophisticated management tool to the increasingly complex pattern of financial, administrative, laboratory, and medical activities in public hospitals.

A recent decision to continue the present close ties between the University Centre and the Victorian Hospitals and Charities Commission highlights the mutual benefits that have accrued from the association in the past. The computer work-load imposed by school and university examinations and other scholastic activities varies seasonally throughout the year and its daily peak occurs during normal working hours. The hospital demand for computer time is greater at those seasons when the scholastic demand is least and its daily peak occurs after midnight, thus creating a situation in which maximum and continuous 24-hour use can be made of the expensive computer equipment. Substantial cost savings both to the Hospitals and Charities Commission and the University have resulted from complementary use of the facilities.

The second gain from the close association is not immediately apparent, but could well prove more important to the community in the longer term than the immediate cash savings. The location of the Victorian Hospital Computing Service in a major university will encourage and facilitate the wide range of academic studies upon which the development of more efficient community hospital and medical services should be based.

Some economic investigations are already in progress and a number of medical researchers are involved in investigations relevant either directly or indirectly to increasing the efficiency of hospital and other health services in Victoria. The need for personnel with a knowledge of both medicine and computer science is underlined by the Hospitals and Charities Commission's creation of a Fellowship in Medical Computing, to provide computer training for graduates in medicine.
Eight of Victoria's 12 largest public hospitals are now linked in some manner with the computing service. Telex terminals have been installed in Alfred, the Royal Melbourne, Prince Henry's, and Warrnambool Base Hospitals; a further five are on order. These allow rapid low-cost transmission of data between the Monash Computer Centre and the hospitals. They are also used for communication between hospitals.

In addition to these terminals, small PDP-8 computers have been installed in the clinical biochemistry laboratories of the Alfred and Royal Melbourne Hospitals for monitoring results from automatic chemical analysing instruments.

The first computer system was implemented in the Alfred Hospital in 1969. It processes admission and discharge statistics and current status figures; each day's figures are processed overnight, seven days a week. The system carries out a tremendous number of operations, quickly and accurately. For example, it passes a file of 10,000 records, updates them by the current day's transactions, and extracts details of 400 patients in hospital—all in four minutes!

Further systems have since been added; a number of computer programmes are now run daily and further series at varying intervals. Nine hospitals are progressively converting their personnel records and payrolls to a computer system. Even this elementary task is not an end in itself, but will provide a base for research on hospital personnel and management systems.

Nevertheless, the interest in the use of computers in the field of hospital administration has been stimulated more by their potential for raising standards of medical care than by improvements in accounting efficiency and similar management functions. The use of computers to process the medical records of individual hospital patients would undoubtedly facilitate co-ordination of the many different care and treatment procedures operating in a large modern hospital.

The use of computers for the day-to-day running of hospitals, for clinical research, and for direct patient care was first contemplated by the Victorian Hospitals and Charities Commission about 10 years ago. The development of hospital services within the Monash Computer Centre dates from its inception in 1963, when Professor H. A. F. Dudley and Dr C. J. Bellamy, its present Director, foresaw the potential benefits to both parties of sharing both the "hardware" and the skilled personnel and other "software" that would become available as the Centre developed.

Mechanics of living tissue

A research term led by Professor J. D. C. Crisp, head of the Engineering Dynamics group in the Monash Department of Mechanical Engineering, is applying the principles of solid mechanics to explain the physical behaviour and elastic properties of soft tissues, including the brain and the membranous walls of the blood vessels.

The results of such research, together with advances in knowledge in other areas of the fast-developing field of bioengineering, are having a stimulating influence on relevant aspects of medicine and surgery.

Tendon surgery

Members of the team have applied engineering skills to the design of instruments for monitoring the tension and stretching of tendons of the hand during surgery. Collaboration with Mr. J. A. Snell, Honorary Plastic Surgeon at the Alfred Hospital, who is also a Research Associate in the Department of Mechanical Engineering, led to the development of a new mechanical tool to facilitate the restoration of severed tendons.

Differences between patients, due to age, sex, and individual variations, complicate the rejoining of severed tendons at their original tension. Unless the surgeon is able to restore a tendon to its original length, it will not function effectively. An error of as little as half a centimetre can seriously affect the functioning of the finger that the tendon actuates.

Although workers elsewhere have exhaustively measured the mechanical characteristics of muscles of living animals, the Monash bioengineering team seems to be the first to study those of living human muscle-tendon systems. Two undergraduate students, Mr. P. Bunker and Mr. J. Brown, were prominent in the design of a special extensometer for the purpose. It consists of a calibrated helical spring compressed by a plunger, which can be attached by a wire suture to the exposed end of a severed tendon. The value of an opposing force applied to the plunger's other end and the spring's deflection provide measures of a common tendon-muscle force and of the extension at the free end of the tendon attached to the passive muscle. The prototype unit is already being used with success in surgery at the Alfred and other local hospitals.
**Blood vessels**

An important field of investigation is the elastic behaviour of the arteries, arterioles, and capillaries that reticulate blood throughout the body. By applying the theoretical principles of solid mechanics to elastic membranous cylinders, Professor Crisp has simulated the deformation, closure, and bursting tendencies of blood vessels that occur both normally and abnormally in such circulatory disasters as blow-out leading to haemorrhage.

Instabilities in elastic tubes depend on the stress characteristics of the membranous walls, and on the mechanical constraints arising from connection to other vessels and from surrounding tissue in which they may be embedded.

When an engineer knows the elastic constants of a tube he can predict its stability or instability accurately. Furthermore, if he also knows the wall thickness and other geometrical values, he can calculate the pressures that lead to excessive distension.

Professor Crisp found that formulations derived from elastic tubes provided realistic guides to the behaviour of the larger blood vessels. However, the smaller vessels, including the arterioles and smaller capillaries, are more affected by the properties of the tissues which confine them. They behave in a more complex fashion, and more information about the elasto-mechanics of the surrounding tissues is required if their behaviour is to be predicted.

**Brain injuries**

Mr. P. D. Joseph and Professor Crisp have made theoretical studies, based on the elastic response of a simulated "brain" and its supporting fluids to external forces. They have well influenced significantly our knowledge of brain damage in car accidents, blows on the head, and even everyday motions such as nodding.

They simulated the mechanical situation by considering the forces set up in the interior of the "brain" by rotations about each of three planes, while maintaining uniform pressures over its surface similar to those caused by the fluid that embraces the brain.

These studies located 12 sites on the interior surface of the "skull" at which the "brain" experiences maximum shearing stresses. They suggested, too, places at which a relative sliding of the brain over the interior of the skull is most likely to be severe. The role of the supporting fluid in minimizing tensile stresses in the brain was also highlighted.
Sight and sound from left and right

Most normal people identify faces and other non-verbal patterns faster when they are presented to the left of the line of sight rather than to the right. Furthermore, our right and left ears differ in their capacity to handle competitive and disruptive sounds.

These and related differences could have important implications for human efficiency in many everyday tasks and situations. Psychologists believe that an understanding of their causes and of the relevant sensory and motor pathways in the forebrain should shed light on a number of instructional and signalling situations and on certain medical and surgical problems.

The right and left hemispheres of the forebrain in the lower animals appear to perform identical functions, with the right more concerned with stimuli from the left side and vice versa. However, in Man the evolutionary process has advanced a further step: the cross-over effect has persisted, but the functions of the left and right sides of the forebrain are no longer identical.

For example, in normal right-handed people, the left hemisphere has a primary role in speech and language while corresponding sections of the right forebrain are dominant in situations involving visual and auditory patterns, such as the recognition of faces and the perception of music.

The effects of brain injury illustrate the functional differences. In the majority of people, speech, numerical, and other processes involving verbal comprehension are most likely to be affected by injury to the left side. By contrast, injury to the right hemisphere is more likely to affect recognition of music and faces.

But people are not all alike in this respect. For example, the functions of the hemispheres are sometimes reversed, particularly in left-handed people. Thus, loss of language functions does not invariably indicate damage to the left hemisphere of the brain. A fast, reliable means of identifying the roles of the two hemispheres in individual patients would greatly facilitate treatment, particularly when surgery may be required. The diagnostic technique currently in use involves blocking one hemisphere with drugs—an involved, and sometimes hazardous, procedure.

A research team in the Monash Department of Psychology, comprising Dr. J. L. Bradshaw, Mrs. Gina Geffen, and Mr. N. Nettleton has recently made substantial progress in this field and obtained new insight into the way our brains process what we see and hear. One immediate practical outcome is the development of a test that may allow us to determine the dominant hemisphere in individuals more simply and with greater certainty than is possible using current techniques.

The team is examining the nature and degree of specialization of function in the two halves of the forebrain, and also determining the extent, nature, and speed of communications between the two hemispheres.

In one significant experiment the researchers played back an individual's speech, with a lag of 0·2 seconds, to each ear in turn. Such delayed auditory feedback normally disrupts a person's articulation. Under the conditions of the Monash experiment, the feed-back disrupted speech more when played to the right ear (that is, to the left hemisphere) than it did when played to the left ear.

But when piano-playing and other simple musical-patterns were substituted for the speech feed-back used in the first experiment, the situation was reversed; disruption of speech was greater when the musical sound was played to the left ear than to the right one.

These experiments confirmed the dominance of the left hemisphere in processing speech signals and that of the right hemisphere in dealing with sound patterns such as those of music.

Dr. Bradshaw now believes that the differences in function between the hemispheres of the human forebrain may not be as sharply defined and inflexible as thought previously. For instance, in many everyday tasks which involve both language and pattern processing, the relative involvement of the two hemispheres may vary according to a person's intentions, his voluntary control, and his anticipation.

Nevertheless, the recent experiments have provided a basis for a behavioural test to determine which side of a patient's forebrain controls a particular function. The psychologists are now relating various patterns of sound to one or other of the hemispheres. They have found that control of rhythmic hand clapping is primarily a right-hemisphere function. That or a similar type of rhythm might provide a simple, practical testing tool.