Advanced Education 1972

We have been searching for the Holy Grail of cerebral palsy for the past forty years. Our search has embodied all the many pathways of education and medicine that have emerged in those years.

From the antibiotics of the war years – to the CAT scan of the nineteen seventies. From the RH blood groups, the radical orthopaedic surgery, splinting of the nineteen fifties – to the neurophysiology of the nineteen sixties and seventies. Last of all, from the Mothers and Babies Programmes of early treatment – to engineering and employment of cerebral palsied in Centre Industries in the nineteen sixties and seventies.

We were always conscious of our total inadequacy for this search, but as long as our children, with all their tremendous handicaps, were prepared to fight on, we could do no less. Like all parents, we were searching for a magic answer. Microtechnology is not magic, but for the CP it is an excellent substitute!

Everybody can work. There are no limits by the severity of physical handicap that education, training and adaptation cannot meet. This leaves a problem that can be solved by the use of standard techniques of technical engineering and rehabilitation therapy. In factory work, however, the CP workers are competing with their impaired hands against the sinews of able bodied workers – they can be more faithful, work harder, be more careful, have fewer rejects, but in the final analysis they cannot work as fast.

What they can do, however, is to compete where they are not handicapped, substituting intelligence for hand function. Competing with 'know-how' at sophisticated levels, and aided by advanced education.

At The Spastic Centre our children are surrounded by the loving care of their parents, but babies grow up very quickly to be adults, and this is an adult world. Spastic babies are children for the first twelve years of their life, and then they face fifty hard years of survival as an adult. They are fated to spend the later years of their lives without the assistance and care of their aging parents. They must prepare in advance for an independent lifestyle, before it inevitably happens.

For the adult handicapped CP, especially, daydreams are an essential ingredient of future success in mastering the disability, daydreams in which they perceive the certainty of attaining a chain of small successes, set against the risk of sustaining a heavy defeat in the first major adult objective, that of work. Learning is not dependent on age. If you have the motivation you can do anything, but you need the discipline of employment to drive you along. Equal in importance is the need for intensive adult education, to make up the gaps in CP education which has been erected by his slower-paced learning, due to defective speech and other handicaps and the hours lost by surgery and therapy.

Unemployment and lack of opportunity to participate in life's activities, socially or educationally, may be difficult for many of the able bodied who are out of work, but this, surely, cannot be compared to the frustration suffered by a CP who is seriously disabled,

when faced with permanent uselessness. Even though social and cultural values are ignored, and human happiness and independence do not have a dollar value, on economic grounds alone, the CP must be given their chance.

Previously, we thought that walking was the principal target of the CP medical therapy. Now we realise that lack of speech is the major hurdle. Most of the CPs are unable to speak intelligently to a stranger, but can make themselves understood among their familiars. They may have limited hand function, and they may need to use a head probe instead of their hands; they may be deaf or hard of hearing, but our heavily handicapped CP have proved that standard industrial training practices may validly be applied to the handicapped. In Centre Industries, our CP trainees have been accepted without difficulty in the normal world of the able bodied worker.

Since 1948, we had been using three old IBM electric typewriters in our schools, and an electric Burroughs bookkeeping machine adapted so it printed alpha letters instead of figures because our CP children had difficulty in using a manual typewriter keyboard. In 1958 when portable electric typewriters came on the market, Miss Brereton used them for our CP children who were unable to form the letters by hand. In 1963, our speech therapist, Miss Grace Ellis, at our Mosman school had the idea of using a clockface with moveable hands upon a face of alpha letters. It was a fairly primitive idea, and at Centre Industries we improved its function, by an arrangement of relays to point to the letters in question. Then we added a light for an indicator, and arranged for its return to the 'home' position when the appropriate letter was struck on a pressure switch. We finally evolved a device, based upon the electricomechanical relay, and were successful in designing and manufacturing the Clockface Selector. This provided the mechanism, which replaced the electric keyboard as a means of operating a power driven typewriter. The next step was to electronically replace the keyboard of the typewriter or microcomputer altogether.

In 1968, we started to inject adult education into the CP area. We set up CENTACS (Centre Industries Technical and Academic Courses), a school operating from the shop floor, aimed at improving the low standard of adult CP education in the past years.

We were unable to use existing Technical Schools because of stair traffic, slow speech, and the absence of special staff and transport arrangements. We thought that the Technical Schools could assist us in our planning and also the provision of teaching staff. However, they displayed a callous disregard, saying that they had limited funds to meet their own Departmental needs. A submission to the Board of Adult Education met a similar fate.

At Centre Industries, we were then on the threshold of a major change from metal fabrication to electronics, via the printed circuit board. It was steadily becoming apparent that we had gone as far as we could go in mechanical answers to our rehabilitation problems. For the first time in history, engineering technology was moving towards rehabilitation of the physically handicapped CP, and we hoped to share in that. The future of CP people is changing rapidly by the introduction of microtechnology - we must educate and train them to meet the new challenges of the electronic field. Technical education for the able bodied is important - for the cerebral palsied it is vital. These are intelligent people whose control of various muscle groups is impaired, and who may have associated difficulties in speech and hearing. Some may have no hand movement at all, but can walk, others in a wheelchair, can rely on a head probe or a switching device operated by their foot. Most have been debarred by their disabilities from a normal education.

We set ourselves the task of entering a dynamic world of electronics in 1971, with a proposal to manufacture the A14 and the A15 diode for the General Electric Company in America. Correspondingly, in 1972 the General Telephone and Electric Company engaged Centre Industries to manufacture radio microwave units for Telecom. These two projects were well worthwhile, because they encouraged our CP to take a role in the microtechnology of the future, and introduced them to the printed circuit board (PCB).

Then in 1975, negotiations commenced between Centre Industries and SAGEM for production of the SAGEM teleprinter by Centre Industries under sub-contract. Australian production started in February 1979, with an annual target of 4000 TX-20 teleprinter units.

The importance of the new technology is to understand the implications, particularly for the severely handicapped CP. Cheap, simple and readily available Micro devices are already on the market. It is our responsibility to make use of them in education, at primary and technical levels, in the problems of speech, deafness, hand function, work training and functional assessment. Today, our CP can operate a wider range of devices, due to the introduction of a variety of sensors, which activate the equipment by responding to light, heat, or friction, setting off an electronic impulse. So that a single nod of the head, or even the blink of an eye, provides the signal to operate the equipment. Very many of the longstanding communication problems can be solved by the increased use of computers, display screens and appropriate sensors. This opens up a new world to the CP. For these, microtechnology offers not just hope, but real opportunities to change their whole lives.

Unfortunately, in 1974 in Australia, we were entering upon a ten year cycle of increased inflation and unemployment and economic doldrums. So those years, which should have been rewarding years for many of our CP charges, have been eroded by the economic locusts.

At Centre Industries, apart from the production work of the factory, we have had outstanding results from the introduction of CP into our computer department. In 1974, we installed a Honeywell punched card computer, which gave a tremendous boost because it appealed to the more heavily handicapped, who were unable to achieve productivity in the factory lines for want of an effective hand function. Because of the CP success in adapting to computer usage, we duplicated the Honeywell installation in 1976. Today twenty CP workers service the Facom M14OF, a computer installed in 1980; it is pleasing to note that these are among the most heavily handicapped. It has proved to be a most important step in rehabilitation of the cerebral palsied. It removes the card punching, and subsequent card reading and sorting, and replaces it with the VDU (visual display unit) which is used for programming and data input. It is a joy to operate, because it is built with every operating control at wheelchair level, including the tape machines and the Hi Speed Printer.

We know that our cerebral palsied are capable of being 'stretched' beyond the demands that their past work performances have made upon them physically, and intellectually. We know that they react well to the challenge. We are prepared to plan on the assumption that they can do more and better work than they have previously accomplished, that they will continue to be happier and more responsible, under an increasing load of work and responsibility in the future.

May I reiterate that the development of the space age technology of electronics has made a wonderful world possible for everybody, but for the CP it has proved to be a vital component of the real rehabilitation in education, neurophysiology, and employment. We have not made use of it as we should have done because of its high cost, and every day's delay means, in humane terms, a day of further unnecessary imprisonment for the CP person.

Can I now take a peep into the future that affects every CP worker: At Fujitsu Laboratories in Japan for the first time in the world was fabricated a new type of transistor, called a High Electron Mobility Transistor – HEMT. Fujitsu assess the speed characteristics of the conventional transistor thus – a Silicon Field-Effect Transistor, SIFET, possesses the speed of a motor car, 50 km per hour; a GaAsFET has the speed of a Bullet train, 250 km per hour. A HEMT device has the speed of a Boeing 747, 1000 km per hour; this will be used in computer logic elements and memory about 1985.

Fujitsu are also applying the HEMT techniques of Molecular Beam Epitasy, MBE. to developing microwave and fibre optics semiconductor devices. They are also making a major effort in the field of Josephson junctions, to introduce computers with switching speeds, more than ten times faster than today, but it will also have power dissipation characteristics less than one-thousandth of today's computers. The Josephson computer will be as small as a shoe box and will be housed in a special refrigerator, because it must operate at minus 100ºC.

Corresponding advances are being made in software. The computer will need no special language or code on the part of the operators – just normal speech or written characters. It will translate, say, from English into Japanese and, instead of a written programme or sets of instructions on how to solve a problem, it will create its own software or solution path to fit the data given to it.

How does this hyperbole affect our CP, at present working in the computer section? Five CP have been trained to programme the mainframe computer and one has recently been promoted to Systems Analyst. Two share the responsibility of operations, and even the most heavily handicapped CP can provide on-line computer input for data preparation. As they do not have the deft fingers of the able bodied, they use a head probe, or one finger control, to insert information. All the data preparation for the whole organisation is handled unassisted by cerebral palsied operators.

Microelectronics can help CP with special needs. It includes educational programmes for the classroom, speech, deafness and hand function, and is limited only by our lack of foresight. Microelectronics cannot replace the skills of the trainer in planning the learning programme. This is a highly complex and critical aspect of special education; microelectronics serve in this process, they cannot replace it. If we employ the computer as a servant, we have to be clear in the orders we give it. Technology is compatible with a personal caring approach. It will be used by the teacher and therapist only as an extension of their own skills.

Centre Industries has an electronics laboratory with all necessary facilities. So when a CP is faced with a lack of hand function, we can replace the conventional keyboard with a circular scanning device which is our own design. It includes all the figures and letters of the alphabet, and appropriate control functions are ranged in a circle, each illuminated by LED lights. These are divided into eight sectors, each of which has eight positions. So that two operations of a switch can give each one of the sixty-four digits. This has opened up avenues for many CP, previously denied communication through lack of ability to use a conventional keyboard.

If hand function permits, a simple pressure pad switch is required for the input to the typewriter or microprocessor. Deaf people can use the scanner, but the hard of hearing pupils have successfully used it by making use of a tonal variation for the sector and the final digit.

In eighteen year old Adam Rennie's case, exhaustive tests were carried out to find a muscle in his body which we could use on a biofeedback basis, to replace his lack of hand function. The researcher detected an imperceptible movement controlling the base of his left little finger – a muscle flexor of 5 mm was enough. The biofeedback switch detects changes in electrical potential in a muscle of Adam's hand. An electrode is attached to either side of the muscle and a third acts as an earth. The change in electrical potential is detected by the electrodes, so that when he moves his finger imperceptibly the switch is operated. Adam has an additional problem; his neck goes into a spasm to the right (TNR) and he can no longer see the scanner. Adam is completely without speech, so he must carry a picture of the scanner in his mind. He has been using this switch for almost two years. The switch was developed by the Action Reflex Laboratory at Centre Industries. It is anticipated that in the near future, a voice synthesiser will be attached to the scanner so that Adam will be able to hear immediately what letter he has typed and, if necessary, correct it. The electrodes and a biofeedback meter were all he needs to communicate with his world. This is a practical application of the biofeedback principle. His speed of input is automatically handled by the computer, so he can work up to high speed on a good day and, when he tires, the speed of input is automatically slowed down.

Kim Brierly operates the same scanner using a touch switch. Kim is twenty-six years old, with very limited speech, which she makes up for with a brilliant smile. Prior to the development of the scanner, she was unable to type at all. Kim uses her chin to operate the switch and must put a lot of effort into typing even a single word. However, the effort is worthwhile for both Kim and Adam, for without the biofeedback switches and the scanner, they would not be able to express themselves very well at all. Despite the fact that Kim and Adam are severely handicapped, both are quite active intellectually, and it is only through the use of this electronic equipment that they are able to further develop their intellectual skills and demonstrate their abilities and knowledge to the world around them. They quite admirably demonstrate the possibilities being made available today at Centre Industries. Both of them are very severely handicapped, and electronic technology is offering them a future very different from the one they both would have dreamed of years ago.

The scanner can also be attached to the computers, enabling very handicapped people to carry out their own academic pursuits or recreational activities without requiring a person to act as a scribe or assistant.

Dennis Stabback who, like Kim, has limited speech, uses his head probe with a conventional keyboard. Dennis uses a word processor disc to prepare the news journal that is distributed throughout Centre Industries. Dennis is thirty-four years old and has been taking considerable advantage of this piece of equipment over the last few months. The word processor disc enables Dennis to independently correct and edit his own work. Without this piece of equipment it would be necessary for Dennis to constantly require the services of another person to assist him with his work. Unlike Kim and Adam, however, Dennis has the head probe to type on a conventional keyboard. The value of this independence to a man of Dennis's intellectual ability cannot be overstated. Independence, that allows a person to sever some of his reliance ties with other people, is an immeasurable gift. He operates his electric wheelchair with his head probe, fitted onto a cup on the joystick. Dennis also uses a Cannon communicator to communicate with people; his communicator enables him to type a message and provide his 'listener' with a written copy of whatever he has typed. Once again, Dennis uses his head probe to operate the communicator. For Dennis, not having hands that he can use, and not being able to talk, does not prevent him from communicating and pursuing his interests as a reporter and editor of the Centre Industries monthly journal. Not being able to speak gives him far more time to listen to what other people are saying. Time to understand, and reflect on what has been said.

At Centre Industries, by using modern technology in their own training school and in their production line, they have been able to utilise the disabled workers' productive abilities. It is most important to train them to work in the technological arena. These people demonstrate the marvellous opportunities that electronic technology now offers to the heavily handicapped.

Thus we take pride that our CP are exploiting, instead of being exploited by, the very technology which many people fear.

In the short time that microprocessors have been available, two streams of development have emerged. On the one hand, the microprocessor has permitted the creation of sophisticated devices such as the modern teleprinter or teaching aids for the handicapped, while on the other hand it has provided comprehensive business systems which can handle the requirements of a small business, or be used on a departmental basis by larger organisations.

We have an interest in both fields, since we can see a large number of aids for the handicapped which can be created around the microprocessor, and at the same time we see that handicapped people might well be trained as computer operators around the small business system. In both cases, the need will exist for programmes to be written, and this would provide another avenue for the employment of the handicapped.

Since the formal mathematical education of many disabled people is poor, we are attempting to introduce general programming concepts by teaching the high level language 'BASIC'. This gives the student the opportunity of operating the computer for himself right from the start of the course. Once the student has become aware of such programming concepts as conditional branching,

sorting and looping, we intend to move him on to the use of MPL (a subset of PLI) and perhaps to Assembler. We will train operators to use the system in such a way as to be part of the factory production control network. In addition, the machine can be used as a training aid with the educational packages already written.

In the longer term, we believe that microprocessor-based aids will play a major role in the rehabilitation and comfort of the handicapped. This technology forms part of the learning environment, or as an aid to communication in a variety of ways, but the appeal for the CP lies in its motivational qualities. This mode of teaching attracts an interest in learning. A trainee who has bypassed the normal education because of his lack of hand movement, or speech, or through deafness, benefits substantially from adult education. But I wonder if people generally, and politicians in particular, realise just what this technological revolution means for the CP; if its real potential is appreciated. Do we care sufficiently to explore its potential, for other than personal gain?

Apart from education for those adult CP who missed out on primary school levels in the nineteen fifties and sixties, we must, for the future, provide work training and employment of CP trainees in electronic technology, microprocessors, testing production machines, and computer data control. We must assume advances in speech, in hand function with biofeedback, Action Stretch Reflex training and, for the deaf, education in speech therapy by signs and symbols, and aided by electronics.

God's gift of technology can help to adjust the balance, but there is still a long, long way to go. We have not yet seen a person whose physical handicaps are so great that he could not be significantly improved by applied treatment and technology. If we concentrate on what they can do, what they cannot do becomes irrelevant. Microtechnology is here, let us take advantage of it. We may not succeed in restoring the hand of a CP to its fullest function, but there is nothing wrong with the spastic's intelligence. It is the mind with which we shall deal in the years to come.

Hooked wire electrodes into 19 muscles of the face and tongue provided a simultaneous computer recording of cerebral palsy speech