

# Splints/Braces

1949

In March 1949 I proposed the organisation of the Splint Division. Orthopaedic splints in one form or another are required by 80 per cent of our cerebral palsied children. Despite our four years intensive therapy, and following the lessening of radical orthopaedic surgical operations, we needed orthopaedic appliances in order to follow up the surgery and the consequent physiotherapy. The operations implicit in surgery of the lower limbs were dependent in the first place on plasters or metal supports, followed by leg irons which were mild steel, half oval in section, and bent into shape. We needed to have those splints properly fitted on the child before the surgical operation, not a year or two years later when the child would have already grown out of them.

The words 'splint/brace' are used synonymously. 'Splint' is used in England and 'brace' in the U.S.A.

Following the war, people skilled in splint-making were hard to find, so we tried to make do with some part time work from the Technical College students. While this reduced the time of waiting for prescription bracemakers from twelve or even eighteen months, we were only able to give our technical students simple short irons, without ankle joints or foot plates.

Apart from the delay in delivery and the high price that we were paying for unsatisfactory splints, they were atrocious from an engineering standpoint, because they nullified the full effect of the surgery. They were simple calipers, with no effective hip or knee hinges, except those produced by hand-filing for individual cases. Mostly there was no ankle joint at all, which meant that the whole of the foot structure was distorted, with each step taken, against the 'T' leather support. There was no metal sole plates, and this meant a further distortion in the foot, from the coiled spring toe lift, or heel lift. Dr Carlson, who visited us in October 1948, expressed dissatisfaction with the standard of our splinting with good reason.

We needed something better and the only solution was to enter the splint manufacturing field ourselves. We needed to provide for the manufacture of our own splints according to the Medical Director's prescription. If fully skilled splintmakers were unavailable, we would train them ourselves.

I was in touch with two American organisations, which had done a significant amount of research in this area. One was the Mellon Institute of Industrial Research of Pittsburgh, which had set up a Scaife Fellowship for the purpose of making an authoritative survey of present knowledge on the subject of braces. The Pope Foundation of Kanakee was a non-profit organisation and formed for the purpose of providing good cheap braces, by developing and manufacturing prefabricated standardised parts, which were sold commercially to splintmakers in the U.S.A. They were designed for victims of polio, then rampant in the U.S.A. and I had hoped to adapt them for use with our CP children.

We had arranged for the importation of a full range of samples of these parts, together with tools and jigs. The intention was that local manufacturers should be invited to make a quantity of individual parts as a donation to The Spastic Centre, and that production should be on normal production engineering methods.

My Board agreed that I should attend the Second Annual Symposium on Orthopaedic Appliances in September 1949 in the United States, sponsored by The Mellon Institute of Industrial Research. Their press release stated: 'The program will be planned and carried out for the benefit of mankind through the medical profession. Under the guidance of orthopaedists, and with the co-

operation of leading organisations in the field, as well as of manufacturers of orthopaedic appliances, the fellowship will conduct broad scientific investigation and development relating to such appliances. Particular attention will be accorded to problems of mechanical design, improvements in materials of construction and methods of fitting braces and similar orthopaedic devices.'

This symposium was an attempt made to involve three hundred orthopaedic surgeons of the United States and an equal number of their manufacturing bracemakers. It lasted for a week, full time, and it was not until the end of the session that the doctors and bracemakers overcame their antipathy towards one another. The bracemaker suggested that the surgeon scribbled a few lines on an envelope, from which he was expected to know exactly what the brace was meant to accomplish; the surgeon countered this by saying the bracemaker had no idea of human anatomy and less of engineering standards. As a result of the symposium, an American body was set up to provide a register of all members of the newly-formed Orthetists Association and the registration of workshops and labour employed. The registration was to be subject to a four-year apprenticeship, to be in the hands of a central national body of orthetists.

I was an interloper. I was neither a doctor nor a bracemaker, not even a governmental expert. It was true that I bore a letter under a red wax seal with red ribbons from the Prime Minister, the Honourable J. B. Chifley, stating I was a worthy citizen of Australia and seeking my protection. Other than that, the only qualification I had was my complete and utter absorption with the subject of making and fitting braces for the cerebral palsied. I was lonely and nervous of the doctors and the bracemakers, in equal measure to the lecturers. It was my first trip abroad and I wanted to know about everything. I was somewhat surprised that I made friends very easily and at the end of the week I was accepted, in spite of my outlandish Australian speech.

The symposium was held in the Mellon Institute building, which was framed by sixty-four columns of white marble, each twelve metres high, supporting each of the four walls. It was a Grecian design, and more space was needed than was available from the agreed facade, so they excavated another three floors below the ground, lit by a central courtyard for natural light and ventilation. Those three floors housed the laboratories, each of which was equipped with inbuilt services for power, gas, oxygen, acetylene, dionic water, with fume chambers, amongst other facilities.

Starting at 8.00 a.m., with evening sessions included, the week was spent attending multiple lectures from fifty or more staff, and comprised engineering specifications, 'how to do it', metallurgy, anatomy and lectures on every aspect of brace making. They were followed by in-depth discussions with the orthopaedic doctors and practical bracemakers themselves.

I was invited by Dr John Young (the senior of the Orthopaedics Appliances Fellowship) to stay on an extra five days after the conclusion, to review the work of the Fellowship for the two years past. He had worked with spastics and had agreed that much more work needed to be done in the early treatment of the patients, rather than depending on the engineering skill of making braces to correct the damage already done. In the meantime, the braces we made should be as perfect as possible.

Among the many lectures, I have selected three as an outline of the proceedings. The first was by Dr Eugene Murphy, Assistant Director for Research, Prosthetic and Sensory Aids of the Veterans' Administration. Dr Murphy outlined the engineering problems encountered in the production of orthopaedic appliances high loading could be expected.

He covered the general principles of measurement stress and strain loadings, and the characteristics of metal under load, and demonstrated the plastic zone, the modules of elasticity, compression, tension loading, the use of laminates, and shear strength. He said that the loadings in brace joints must be of the clevis or box type. He mentioned that a service brace must stand up to a test of three million cycles with a corresponding load of 150 lbs. Fatigue fractures, or corrosion, always occur at the nicks made by the sharp corners of a vice, or edges not fully rounded

Dr Murphy was a double above-the-knee amputee, and gave an unexpected demonstration when he turned to the blackboard. Making a point, he crashed on his face to the floor. People sprang to his assistance, but by the time they got to him he had climbed, unaided, to his feet and continued his lecture without comment or embarrassment.

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I was very interested in a lecture by Dr Phelps, in full cry. He said that he had been working since 1936 on a hit or miss basis on cerebral palsy. In treatment, he said, in reference to surgery, you cannot tell what will happen with transplants, even in normal muscles. He gave examples of athetosis being transferred to normal muscles following transplants, giving approximately the same athetoid movement. Among the many things on which I wanted more information, were the following extracts:

*'Braces will not cure any CP, but they are a foremost adjunct of treatment. Gesell's work on the pre-walking child shows definite prerequisites to the use of arms and legs in walking. No bracemaker by the most elaborate apparatus, no surgical operation, no drug medication can cure this condition. In polio muscle transplants, the cortical patterns have been previously learned, as also is the case with amputees.'*

*Heel cord lengthening by operation is not advisable except in certain adults after the period of growth has finished. If the operation is done at six years, it will require being done at ten years and probably again at thirteen years. Each operation reduces the strength of the muscle and the mechanical advantage is reduced too. This applies only to cerebral palsy, not other conditions. Tests show that a normal man may be able to lift a single heel off the ground under a load of 200 lbs; a spastic man has been tested at 400 lbs, and a six year old child at 150 lbs. Plaster and plastics are obviously useless for the stress involved.*

*Night splint should consist of a high shoe coming above the ankle so the heel will not slip out. An inside tee strap should be fitted. Elastic or spring joints should not be used to oppose a spastic muscle - it only strengthens the muscle by exercising it continually. There is no difficulty in getting parts that will be comfortable for short leg braces, but extension with the knee straight is not possible unless an allowance of ten degrees is made for comfort. It is best to cut the toes out of a child's night brace and pad the tongue and heels when necessary to fill up the increased space. Rigid brace at knee and plaster wedges will stretch all tissues, but will interfere with circulation in the standing position. In the hip joint torsion of the femur is habit posture defect, caused by sitting/kneeling with lower legs flexed out, and behind at an angle of 45° (tailor fashion).*

*Correction of the hip position – the same apparent conditions. (1) abductor flaccidity; (2) adductor spasticity; (3) internal rotation corrected by straps; (4) bony reduction of the femur. Too much surgery has been done on the long muscles through ignorance of the causative factor.*

*With athetosis, like a wrestler, if one set of muscles is pinned, another and another is tried in turn to break out of control. You cannot expect to eliminate the athetoid movement from the body. All you can do is to control it by rigid braces and watch for a favourable or an unfavourable shift of movement. If it is unfavourable, the control must be removed. Under these conditions, surgery is unsuitable as you cannot undo the shift if it is unfavourable. After a year of rigid control, the muscles have learned a pattern that may proceed for half an hour if the brace is removed. In two years, the time may be extended to three hours. After three or four years, you may have a relatively normal gait taught by the brace. For that reason, skis and similar shuffle movements do not help. The motion taught must be a functional one.*

*Supportive braces used in polio are not needed for cerebral palsy. The hip stop must be set beyond 180°, otherwise the forward leg cannot reach the ground with the trunk upright.*

*Tests of pelvic control braces are best done with the braces off. They are only considered satisfactory if they will stand erect with the hips locked. Do not spread the pelvic band if it is made too small, or boots will not stay still on the ground if the pelvic band is rotated 90°. Similarly, test the knee 90° arc to see that the caliper ends remain same distance apart. Check thigh length of the brace by sitting with legs over the edge of the table, not flat on the table, because this pushes the pelvic band forward. Gluteal pad below the pelvic band is used to straighten up the child who walks with the knees slightly flexed, and with buttocks stuck out behind. Note the angle of the sole of the boot, it is not level with the ground with the braces off, because the pull of the adductors alters the vertical line of the braces.*

*To summarise, it is of chief importance that the brace must be stronger than the individual. It must be free running; weight is not of importance, no elastic to be used against spastic muscles. It is inexcusable to use toe springs which are, however, perfectly all right for polio.'*

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These are notes on a lecture given by the doyen of hand orthopaedic surgeons in America. It interested me because of its adaptation to cerebral palsy patients, from the point of view of hand function at all costs and the unexpected poetry he used to emphasise that point:

*'Dr S. Bunnell, Consultant to the Office of the Surgeon General, United States – 'Disabilities of the Hand in Principles of Splinting'.*

*The hand is the most versatile of all members. On injury it assumes a position of non-function. Keep it in the position of function and keep it moving, otherwise the shortening and thickening of the ligaments prevents function. Then oedema, with its protein deposits, leads to fibrous precipitation of the hand tissue from swelling organisation occurring in the blood vessels. Remember, the position of function with the fingers at their natural degree of flexion and the thumb opposed.*

*Physiotherapy – be very careful – passive treatment is not much good, the patient must do the work. Forget*

*bubble baths, occupational therapy is now much better, leading to the first paid piecework and then to the job. Occupational therapy should not be used for diversion or exhibit, it should be by prescription.*

*Splinting – immobilise; move to the position of function. On infection a plastic operation with nerve and joint repair, form fitting a circular splint full length on three points of pressure – the joint, proximal, distal points of the arc. Splints should be standardised, not too elaborate, light, easy to make, inexpensive, outriggers to slip through sleeves, web belt not leather; put web belt through slots in the metal for easy washing; leather cuffs are most insanitary things.*

*Holding the hand in a position of function, no tight straps for oedema; dorsiflexion 30°; handpiece curved to the metacarpal arch, rounded at distal crease and for the ball of the thumb crease. Joint should not be put under strain, no banjo splints should ever be used, they are abominations, they ruin the joint, stiffening the fingers, pulling on the tendons, diverges the fingers; the whole hand should not be splinted. Never use a flat splint, that is heresy, it flattens out the metacarpal arch and puts the thumb out at the side.*

*Splints should be spring or rubber elastic, bringing all parts of the hand to position of function. Hand joints are orthopaedic jewellery and should be treated as precious things. Do not let physiotherapists pumphandle fingers in an effort to stretch the tendons and brutalise stiff joints, traumatising little finger joints with their big arm joints. Instead they must be coaxed little by little, not stretched, over a period of a few weeks while the ligament grows in length.*

*Rigid splints make rigid hands. Splints to mobilise not immobilise all bones and joints and other elements moving freely and healthily. Psychological splinting for paralysis – fit a spring splint of the same tension as that of the paralysed muscle.'*

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There was a gala dinner to wind up the meeting, attended by visiting Government representatives and those from the rehabilitation industry and the University of Pittsburgh, so that the number present was close to one thousand people. I was looking forward to the dinner until ten minutes before it started, when I was told that I should sit at the official table and make a ten minute speech of welcome. They explained that they would have trouble if a doctor, or a bracemaker, or a staff member welcomed the gathering. So I was selected, because half of them did not know where Australia was; they said it was somewhere near China.

I stumbled up the steps of the official dais with my Damocles' sword suspended above me, not knowing whether I could make a speech or make an utter fool of myself. The devil looks after his own; I was seated next to Mrs Margaret Pope Hovey, a charming and intelligent lady who at once made me welcome. She had contracted polio in her youth and was in her wheelchair. She was the daughter of Mr William Pope of the Pope Foundation.

I had abandoned the idea that I must get some notes down on paper - time was too short. There was nothing I could do then until the moment arrived, and I stood on my feet with nothing to say. Then quite suddenly I found the words in my mouth. I explained who I was and what I was doing so far from home. Then I said that I was fortunate to be there at all, because before I had left Australia my wife had been pretty cool when I told her about the Symposium, even though I explained how very important it was for the manufacture of braces for the cerebral palsied. She then said, "I know all about the importance of braces and splints, but do you know what a Symposium is?" She continued, "I looked it up in the dictionary; you had better do the same." I did, and read – 'an ancient Grecian after-dinner party with dancing girls and wine.' I then suggested that Mr Weidlein, the Director of the Mellon Institute, had brought me from Australia under very false pretences. That broke the ice, and when the laughter had died away, I made a satisfactory speech.

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In addition to my week at the Mellon Institute, I spent time in visiting fifty-nine places in fourteen cities that had cerebral palsied pupils. These visits were referred to in a full report to the Board.

I visited Dr Earl Carlson, Director of the School of Curative Motor Education in East Hampton, Long Island. I was met at the railway station by a young spastic driver, who drove competently, but fast. I was fascinated to observe that he had a severe tonic neck reflex (TNR) and when it became locked out of position he pulled it back into the driving position with a tug on his left ear. I had not thought that he could do that safely.

I met Dr Carlson at lunch and he drove me to the school. I was interested during lunch when he asked for two glasses of sherry, saying, "After two sherris I behave normally, but if I don't have a sherry, people assume that I am drunk."

I met some Australian children at the school, and I met the Principal of the school, another spastic aged about forty-five. He had

had an academic career in his university, but he never qualified. He just switched courses into a new faculty and went on from there, because he felt there was nothing at the end of his academic career. The university authorities finally caught up with him and he was retired. Dr Carlson approached him in his unsuccessful attempts at suicide and gave him the job of School Principal. He had been with the school for ten years at the time of my visit. Sitting in with a group of spastics at a group discussion, I was amazed at the response he got from all the people there. The subjects ranged from geography to mining, and then through the minerals and finally to the manufacture of steel. He did not take the floor himself, he just provoked others and controlled the argument very effectively for a two-hour session. Most of the pupils had a speech defect, but their teacher understood their meaning. When he did not, there was always someone else who would translate for them. As a stranger to them, I understood about a quarter. This was my first lesson on CP communication.

Dr Carlson introduced me to the members of the American Academy for Cerebral Palsy - and it was very interesting talking to doctors who had so much advice to offer. Very little progress was made in the treatment of patients following Dr Little's description of the disease a century before, because of the poor outlook. Although a few physicians began to take an interest in the problem and felt that many of the children could be helped. In 1932, Dr Phelps published the first definitive paper on the subject and proposed that the term 'cerebral palsy' should take the place of 'spastic paralysis'.

In December 1946 in Chicago, following a year of correspondence and discussion (especially among Doctors Carlson, Phelps, Perlstein, Crowthers and Fay) – six remarkable physicians of diverse interests met, in order to form the American Academy for Cerebral Palsy. As members of the newly formed Cerebral Palsy Advisory Committee, they felt the need for an expanded, improved and uniform approach to the treatment of the neuromuscularly handicapped child.

There was an interesting relationship between some of the founders. Dr Crowthers was the senior of the group, and had developed an interest in the therapeutic approach because of his contact with a therapist at Boston Children's Hospital. Dr Phelps, during his Fellowship at Harvard, was influenced by Dr Crowthers, and in turn used this training to help Dr Carlson physically during his medical student days at Yale, and then to encourage him to develop treatment centres for the handicapped. When Dr Phelps moved to Maryland he had considerable contact with Dr Fay in Philadelphia. Dr Deaver was involved initially because of his long interest in children's rehabilitation in New York, and Dr Perlstein had earlier developed a programme in pediatric neurology at Cook County Hospital.

Dr Carlson received the MD degree from Yale in 1931. As a student at Yale, he had a relationship with Dr Phelps. Later Dr Carlson established a Cerebral Palsy Clinic at the Neurological Institute in the Presbyterian Medical Center, in New York. In 1949, he became Director of the Lago del Mare School of Corrective Motor Education in East Hampton, New York and Pampano, Florida. He was President-elect of the American Academy for Cerebral Palsy in 1950. In May 1974, shortly before his death, he was awarded a Certificate of Appreciation by the Academy.

Winthrop M Phelps, MD, the son of an Episcopal priest, was born in 1894 and died in 1971. He served as a Teaching Fellow in Orthopaedics at the Harvard Medical School in 1923, and while there he developed a relationship with Dr Bronson Crowthers. He became Professor of Orthopaedic Surgery at Yale in 1926, and Chairman of Orthopaedics in 1933, which he continued until 1936. Earl Carlson was a student and patient of Dr Phelps, and this contributed to their later relationship in the field of cerebral palsy. At about this time Dr Phelps detected signs of intelligence in a young athetoid woman, tied with rope to a chair in a mental ward. He found on investigation that the restraints originally applied to control her athetoid arm movements had, with staff changes, come to be regarded as a safety measure because she was 'dangerous'. In 1937, he established the Children's Rehabilitation Institute, outside Baltimore, and trained many professionals in the field of cerebral palsy at the Institute. Dr Phelps was the first President of the Academy, serving from 1947 to 1949. He was involved over the years in Academy activities. In addition, he was an accomplished musician, especially as a violinist.

Dr Carlson was primarily interested in neurology and education. Dr Phelps of Baltimore, on the other hand, was more interested in physical measures. He concentrated his efforts on surgery, bracing and plaster. He was a terrific salesman for the rights of the cerebral palsied. I tried to get samples of the Phelps pelvic control brace, from his commercial bracemaker, but I was unsuccessful. He was reluctant to give his designs to a competitive bracemaker, and when I mentioned Australia he was not impressed. All the people I met throughout the United States were very helpful, but this man was an exception. Dr Phelps was much more amenable and I got the designs from him.

Dr Phelps said, "The original failure to observe cerebral palsy as an improvable disease had been largely due to the neglect to differentiate between spastics and other cerebral palsied children, and in technical circles there will be no improvement in conditions until that differentiation is made. In the past, surgery has unfortunately been adapted from polio surgery, such as ankle stabilisation and dislocation of hips. It may be broadly stated in the light of present knowledge that anything that is good for polio is bad for CP, or nearly. For instance, pools are of great value in polio treatment, but no advantage for CP whatsoever,

therapeutically. They may have a psychological value to enable the child to learn to swim, but therapy, no. Of course it must be admitted that the psychological aspect is a good half of the battle, but do not confuse that with treatment'.

In 1949, the shortage of physiotherapists and occupational therapists was restricting further work for CP. Dr Phelps was intent on correcting that failure by opening a \$US10 million school and training centre. He planned to train sixty-eight physiotherapists, one hundred and thirty occupational therapists and thirty-six doctors yearly at Haverstraw, New York.

In 1963, Dr Perlstein was concerned about the Programme of the Institute for the Development of Human Potential, and recommended preparation of a statement. However, the executive committee felt that it could not recommend one treatment over any other. In December 1964, a statement was sent to the membership indicating that there was no evidence that any one approach was superior to another. In March 1968, a statement was issued jointly with eight other organisations criticising the system, emphasising the lack of proof of superiority. Following publication of this, the secretary of the committee which prepared the statement, Roger Freeman, MD, a member of the Academy, was sued by the Institute. The Academy gave some support to Dr Freeman and solicited support from other groups. The court later dismissed the case.

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I also visited the Kabat-Kaiser Institute for Neuromuscular Rehabilitation, Washington, which provided outpatients treatment only, no schooling. They handled a large number of adults – multiple sclerosis, old polio, spina bifida and paraplegics, and about fifty cerebral palsied patients of all types. Physiotherapy was concentrated mainly on resistive plinth work with weighted pulleys of all kinds – ships' steering wheels, cranks and bicycles with friction brakes. Painted lines on the floor were for crutch positions. There were sandboxes with iron dumbbells for resistance to finger and wrist movement in the sand, and walking bars and crutch training ladders.

In speech therapy, a great deal of carefully arranged muscle resistive exercise was persisted with for perhaps a year before speech sounds were attempted. The speech therapist used her hands for resistance against the movement required and to check overflow of eyebrows, mouth, jaw or neck, and used a great deal of force in controlling athetoid jaw movements. In breathing control for a 'snorting' athetoid, she shut off breathing for about fifteen seconds and then, with a wide open windpipe, quickly threw her weight on the intercostals and obtained perhaps five good inhalations before interruption occurred. She used tongue depressors and sticks with cotton pads to manipulate the soft palate and larynx, and used a number of tongue instruments to apply resistance to all tongue movements required and to manipulate the muscles on the floor of the mouth, which were so often too tight to allow the tongue to lie properly. Drooling was controlled by activating the saliva glands by finger pressure, and when a good mouth supply was obtained moved the larynx sharply upward with her fingers and commanded the child to swallow, establishing a conditioned reflex.

Similarly, a wooden stylus was used to position the tongue and assist it in some sounds such as 'ng' etc. The work was done on a plinth or chair before a mirror, and was quite strenuous. The therapist was quite rigid in her demands upon her patients, but was able to impose a fairly harsh treatment in such a pleasantly cheerful manner that she obtained full co-operation even from small children and severe athetoids. With the latter she also used a teasing and joking technique to bring on their overflow and teach them to relax and overcome it. You will remember that this was 1949, when little experience had been gained in speech therapy for the CP. The modern speech therapist in the 1980s would perhaps be horrified at the heavy resistance exercises then promoted for tongue control.

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Mr William Pope was a manufacturer of nylon stockings, and both during the war and afterwards he made a fortune designing and welding stainless steel forms for the heating of nylon stockings. One of Mr Pope's engineers, Mr Klenzak, had designed a lightweight brace for Mr Pope's daughter, who was Margaret Pope Hovey referred to previously. After some years of research and a series of tests, he provided the design and the materials for the Pope brace. Its oval tubular construction and the ease with which the modular, clevis joints could be fitted on the hip, knee and ankle, gave us the leg and foot control that we needed for our cerebral palsied. Mr Pope established the Pope Foundation, which was to make the Klenzak braces available through brace shops in the United States.

Mr Pope and his General Manager gave me authority to redesign the Klenzak brace under Australian conditions, and provided me with the engineering drawings and the component parts. I made a 16 mm movie version of their production facilities.

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In the course of three months, I visited all the treatment centres for cerebral palsied in the United States, and learned a great deal. None of these centres was serving as many children in one unit as we were doing at The Spastic Centre. Consequently, the intensive treatment techniques, which our medical therapy and teaching staff had developed over the four years, compared very favourably with the best rehabilitation units in America. On the other hand, our diagnostic facilities for bracing and our speech

training and psychological work lagged far behind the American trends. The new types of aircraft steel and aluminium orthopaedic braces were developed for the purpose, not of supporting a weakened limb as you might do with polio, but in order to hold a limb in the best position of muscle function whilst a new skill was being learned.

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In July 1949, California brought in legislation to provide a \$US500 bonus per annum for every cerebral palsied child brought into a spastics' school. I had visions of getting the same treatment from Mr Heffron, our Minister for Education, but that was a forlorn hope.

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At the end of that tour, I paid a duty visit to my employer, the Burrough Corporation in Detroit. This was to be a fleeting visit, but they took advantage of my presence to put me into an instructor school for six weeks, and that was a change of pace. Ray MacDonald was the manager of the export division (afterwards becoming the President of the Corporation), and I prevailed upon him to give me six secondhand electric bookkeeping machines, to be allocated to cerebral palsied schools throughout the United States. These were altered with specially designed letters and syllables to replace the numbers on their keyboards, and they gave the American CP a chance to express themselves, which was denied by the manual typewriter.

I had my first sight of snow in Detroit. I did not wear a hat and my overcoat had been mislaid earlier in my tour. I was too poor to buy goloshes, so I toughed it out. I can still recall the expression on a policeman's face when I approached him on the snow-laden sidewalk, hatless and without an overcoat - what a weirdo!

It was snowing on one occasion when I stumbled into the Museum of Modern Art to get out of the wind, and there I fell instantly in love with a young girl who was born in the fourteenth century. She was grey eyed and two metres in height, and was dressed in a dark green silk brocade gown with spun gold embroidery. Her brown hair was bound in a filigree of a golden diadem. Her painter had used the available light to its fullest extent on her face, with a dark background, and the general effect was vibrant joyous life as it would have been had it been painted yesterday instead of six centuries ago. I visited her as often as I could in my Detroit stay, and I would have smuggled her among my baggage but I did not know how my wife would respond to a fourteenth century member in my family. I never saw her again.

I left in an arctic blizzard, with Ray MacDonald's second best overcoat. I hope he got it back.

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When I arrived in San Francisco my baggage, which I had sent on ahead by rail, had not arrived; the plane departed at 10.00 a.m. the next day, and I faced a mountain of Christmas luggage two hundred metres long and piled two metres high. My Christmas presents were all in the luggage and I could not go home without them, so I got permission to ferret among the heap. I had my first success at nine o'clock that night, and I had promised a bottle of Scotch to the luggage hands. At midnight we found the second case. I got up at six the next morning before the luggage staff had arrived, and it looked quite hopeless. I went into the empty freight office to deposit a note and my promised bottle of Scotch to the luggage handlers, and behind the door was my third case. I just made it to the airport bus, which was fortunate, because I was down to my last dollar and could not afford a taxi. I arrived back in Sydney on Christmas Eve 1949, with a twenty-nine hour flight behind me, and with a collection of samples of Pope braces and adjustable tubular aluminium crutches, my precious Christmas presents, including a 'Wettems' doll for Jenny and a child's ambulance kit for Robin.

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As an indication of the standards of treatment then obtaining, I list hereunder the recommendations I made to my Board following my visit to America:

*'That the Medical Director, Dr Claudia Burton-Bradley, should be invited to undertake training in the United States of America and such training should include: Short course for doctors in cerebral palsy by Dr Meyer Perlstein in Chicago; two weeks at the Mellon Institute Laboratory in orthopaedic appliances; a twelve-week course at the Children's Rehabilitation Institute, Baltimore, under Dr Winthrop Morgan Phelps; and a minimum of two weeks at Dr Carlson's School of Corrective Motor Education.*

*That improved diagnostic examination facilities should be provided at The Spastic Centre. All children should be processed to ascertain: degree of hearing loss and type of hearing aid to be fitted; sight difficulties and corrective measures; X-ray facilities should be provided by The Spastic Centre to check anomalies; femur rotation, ankle and wrist distortion and chest examination and orthodontic programmes; soft tissue X-ray and physical examination of the speech mechanism of all children under speech therapy to include pharynx, larynx, uvula, hard and soft palate, tongue and teeth; six monthly scoliosis check on all*

*non-walkers and children placed in long braces.*

*That The Spastic Centre employ male therapists and teachers.*

*That the Physiotherapy Department be responsible for schoolroom, bus and home posture of all children.*

*The Occupational Therapy Department to work in closer liaison with the schoolrooms with the object of merging preschool activities. The OT to be responsible for upper limbs and facial training to specific and immediate target under the Medical Director.*

*General arts and crafts work to be abandoned except for specified muscular functional objectives, and general child development and stimulation to be transferred to the classroom.*

*Speech therapy should aim to unload group work by closer liaison with the schoolrooms and therapy department. The speech therapists to use facilities of the schoolrooms and OT Department instead of setting up speech training elsewhere.*

*That the following changes be made in all physiotherapy bracing: Elimination of toe raising springs by the substitution of loaded ankle joints; elimination of present heel stops and substitution of sole plate stops; provision of heavy athetoid control braces; provision of bilateral pelvic band brace, with lock knee, and lock hips, as routine preliminary to balance and walking training; provision of lead sole ataxic balance shoes (it was thought at that time that lead weight in their shoes may be an advantage for the ataxic cerebral palsied child; however, nothing came of this approach); elimination of caliper ankle joint for all children and the substitution of jointed ankle joints; development of head and back support; elimination of plaster, foot drop night splints, and substitution of single iron night boots; elimination of night time adduction spreaders as uncomfortable and archaic, and substitution of adduction control braces for day work; elimination of plaster hamstring stretching, and substitution of control brace and standing table work daily; provision of working arm splint, adjustable for pronation, elbow extension and wrist dorsiflexion; work on swivel head brace, and continued collar development; work on Bakelite fibreglass plastic spinal braces and chin supports.'*

These recommendations made our Medical Director extremely happy and the Board approved them all.

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So in 1951, we set about making our own splints. We built a Splint Shop and a Transport Garage on parkland, provided on a temporary basis by the Mosman Council. We set up the machines we needed, drills and capstan lathe, power saw and other items, and engaged a group of fitters and turners, and leather workers with their machines. Apart from the splints, we were inevitably involved in the manufacture of special orthopaedic boots; some of them needed special adaptations and some were rebuilt from the ground up. Bespoke bootmakers were available in Sydney, but that meant a trip to the bootmaker and delays in fitting new boots, and after delivery we needed to dismantle the sole and heel entirely for those people who needed sole plates fitted.

Then we initiated a programme of getting voluntary help from 178 engineering firms, each of whom took the responsibility for one operation, for a batch of component parts. Some of these components were made by the firm using their own labour, and some were made by volunteer labour in their own time, on the weekend, or after hours. In all cases, the Company provided the machines and the material if available. These were assembled in our own Splint Shop from Dr Burton-Bradley's orthopaedic prescription for those children who needed them, without charge, on the understanding that the brace would be returned when no longer needed, so that the joints could be refabricated for another child. We had no compunction in asking people to do this work for our children and we knew that most engineers were sincerely glad to be able to help with this product. I coined a slogan: 'A Helping Hand to a Child Now Avoids a Wheelchair for Life'.

First of all, I talked to the Managing Director of British Tubemakers, who had promised me that they would manufacture the molybdenum steel oval tube required without cost, subject to a six months delivery schedule. It comprised twelve thousand feet of adult molybdenum oval tube and five hundred feet of the lighter oval tube for the pre-school children.

With this measure of the problem solved, I then approached the Australian Forge Company for the forging of the special Vanadium steel, in lots of two thousand for each ankle, knee and hip joint. They had promised that it would not cost us anything if they could fit it into the usual forging contracts.

The Americans were using a special aircraft aluminium, ST24, which could be brought from 5000 lb strength to 80,000 lb strength, by appropriate heat treatment. The ST24 was not available, but a substitute was – ST65 without heat treatment  $\frac{1}{4}$ " plate was available from the Australian Aluminium Company.

The fourth significant call was to General Motors at Fishermen's Bend, Melbourne. They had the necessary one thousand ton press for the coining operation of the ankle, knee and hip joints.

Among the companies engaged in the splint making project, Lysaghts Limited provided the roll spring steel for the assembly of ankle stirrups, calf and thigh cuffs, Technico provided three thousand hip lock plungers, and Burns McKay two thousand hip lock levers, and machinery blanks for three thousand, while Anderson Spring Works provided three thousand knee lock springs. AWA provided two thousand plungers, eight thousand nuts and screws and one thousand ferrules, CSR Chemicals provided bandsawing blanks, Armco provided two thousand levers and lever housings, Consolidated Wire two thousand cables, Fletcher Spring provided six thousand ankle springs, G. W. Marner provided two thousand adjusting screws, W. H. Hole provided four thousand spring straps, W. C. Stephens provided one thousand splint knee pads and nuts. These are only representative of the 178 others who shared in the project, over a period of five years from 1949 to 1953. It will give you some idea of the size and complexity of the undertaking.

I think that the following letter would sum up the degree of co-operation everybody in industry exhibited in order to achieve success in this difficult programme:

**GENERAL MOTORS-HOLDEN LIMITED  
MELBOURNE  
2 September 1949**

*Although we will be extremely busy for many months, particularly with Holden production, we are anxious to do what we can for this very worthy cause, therefore I telegraphed you yesterday indicating that we will be pleased to assist you. There will, of course, be no charge for this work.*

*We will undertake the designing of the coining dies, and the drawings when completed will be sent to you, as it is our understanding that you will have the dies made to our design. It is also our understanding that you will supply us with approximately 8000 forgings which will be coined in our plant at Fishermen's Bend, and when completed despatched to Sydney.*

*No doubt you will provide us with details as to where the coined forgings are to be sent.*

*We do require you to supply us, to help us with our design work, with the specification of the material to be used for the forgings. Doubtless you can obtain this information from the people who will be doing the forge work.*

*You can be assured that every effort will be made to expedite the work that we have undertaken but, on the other hand, we feel sure you will appreciate that there will be occasions on which it will be necessary to give preference to our own production as, naturally, we cannot afford to in any way jeopardise the output of the Holden cars.*

*I would like to thank you for your telegram which arrived this morning, and I hope that what we plan to do for you will in some small measure assist you in carrying on with the valuable work you are doing.'*

And my telegram in reply:

*Horn, General Motors, Fishermen's Bend, Melbourne. Thank you for your generous and ready help which now assures the success of our initial splint project. We appreciate your disregard of your own production demands upon the output of these vital presses.*

In 1953, we set up a school for six already qualified fitters and turners who we wanted to qualify as splintmakers in our Splint Shop. There was four weeks full time lectures in anatomy and fitting the child to the Pope or Phelps measurement jigs and full scale layouts, a short course in physiotherapy, and 'how to do it' lectures in the aluminium splint and the child's and infant's splint component parts. The course included leather padding and boot repairing. This was followed by eight weeks practical work and then a final examination. Four of those in the original school are still at Centre Industries, and we have the satisfaction of knowing that others who trained with us have set up the splint making facility on a professional basis.

Among the material I brought home from America in 1949, was some plastic for the casting of back splints. This had been developed by the Mellon Institute with the assistance of the Bakelite Corporation. It was simple to use and could be shaped on any position of a body, and would set firm in five minutes. It was fireproof, flexible, and kept its shape, and it could be drilled, filed or sawn. It is now known as 'fibreglass', and is an industry in its own right.

I was fascinated by the new unbreakable glass which was used for airplane windscreens during the war, and I thought this could be the answer for Jenny's head support. Splintmakers made use of celluloid, which was not fireproof and too dangerous for use by children. The windscreens proved too brittle for use, but I.C.I. Company made me a gift of a sample, which was ductile in hot water. I fashioned Jenny's first collar out of this, it was lightweight and sanitary, and she wore it for some years as a chin support, but it did not support her bobbing head. It was replaced with a succession of leather collars for the next twenty years.

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I think I should finish off this chapter with a summary which accompanied the splint parts sent for examination to the spastic centres in all Australian States:

*We are sending you samples of our aluminium full control brace which is the type best suited to our cerebral palsy training, and which is very similar to the paraplegic type used overseas. The basis of the pelvic control brace is to anchor the splint firmly to the pelvic bone above the trochanter.*

*We are sending also a steel tubular 'Pope' brace. This is only partly assembled, so as to give you a better idea of its construction. It is better suited for use by polios and similar conditions. The joints of this brace are steel forgings which are very hard wearing and can be reused, if the brace is cannibalised, for use on a second patient. The tubing is a hard chrome molybdenum which cannot be bent while cold. It requires the use of an acetylene torch, and care must be used to see that the tube is not overheated, otherwise all its strength will be lost. The 'Pope' brace is assembled with temporary screws. These, of course, would be discarded and the tube would be silver-soldered, brazed, or welded to the forged joints. We cadmium plate all steel parts to improve appearance and prevent rust. Parts for this brace are available only in this size, and in a smaller infant's size. We contemplate increasing the size for adults if the demand for adult parts justifies the \$10,000 tooling cost for the forgings that would be involved.*

*The tubular steel brace would require a bridge to offset the hip joint from the pelvic band, except in the case of a child with snake hips. This would be accomplished by building out a welded vee to offset the hip joint by anything from 1 cm to 4 cm.*

*Most hip joints for normal walking will require a 15 degree stop on posterior extension. This is accomplished on this joint by filing the limit stop on the lower joint.*

*Grub screws to raise the toe raising springs should be set in gasket cement to prevent them coming undone, after final adjustment is made. These ankle joints may be provided with a posterior stop as required. For cerebral palsied cases, we prefer a solid limit instead of a spring, and substitute a nail in place of the spring to provide a solid forward limit.*

*A solid foot plate should be provided in all cases to facilitate effective control of the foot. This is fitted under the sole leather and extended forward to the metatarsal heads. The socket may be brazed or welded to the plate. The stirrup construction makes it possible to put the boots on independently of the brace.*

*The ankle joint as opposed to the caliper type stirrups gives better control of the foot and prevents undue friction from the T-strap, if used.*

*Aluminium braces are fabricated from 65ST aluminium alloy which has a yield strength of about 65,000 pounds as against the 5000 pounds yield strength of soft aluminium. These parts can be bent cold with proper equipment, but are much easier handled if a flame is used momentarily. Just a little too much heat, however, reduces the yield strength sharply.*

*The joints on this brace are ball bearing and some care is necessary in driving the taper pins to their final adjustment to avoid stripping the threads in the soft aluminium.*

*A heavier pelvic band is used in this brace for adduction control.*

*We can supply all parts in the flat of both types of brace. The aluminium is made in three child's sizes: large, medium, infants.*

*The steel 'Pope' brace is, however, available in child's size only, but until adult sizes are made, we made-do by using larger section stirrups as sample sent to you. In this case we weld a solid steel section to the ankle joint for greater strength.*

*We can supply you with all such parts together with aligning and bending jigs to assist in assembly on the basis of cost of manufacture.*

The Splint Shop was the real commencement of Centre Industries, but we had to wait another seven years before Centre Industries came to full fruition in 1961.



The Chromovox was a mechanical TV box. It had pictures and designs on a 4 inch paper tape and it was amplified for our 'hard of hearing' people and was equipped with coloured lights for 'yes' or 'no' and in association with the wire recorder it was used for deaf children.

