influenced by the pulse during the last three to four minutes of its course. The ache begins in the forehead, and, while remaining most intense there, tends, at its height, to invade the temples, the convexity of the calvarium, and occasionally the occipital region.

Thus the results of injecting histamine intravenously appear to be divisible into two phases. The first is that in which vaso-dilatation begins and progresses to a maximum; this phase is not accompanied by headache. The second phase, that of the decline of vaso-dilatation, is marked by the onset and progressive development of headache, which persists, though lessening, when all objective evidence of vaso-dilatation has disappeared. The beginning of headache appears, therefore, to be related to the decline of vaso-dilatation. That this is not fortuitous is shown by the following observations. While the histamine headache is at its height a second injection of the substance quickly abolishes the headache, which returns about twenty seconds later. A similar transient relief of histamine headache is produced by amyl nitrite. Again, if, instead of making a single injection of histamine, the substance is infused into a vein at a steady rate for long periods, then in the majority of subjects, but not in all, headache does not appear so long as the infusion is continued, but begins about thirty seconds after the infusion is stopped.

From the facts already described we are able to dispose of several possible explanations of the histamine headache. Thus the headache is not due to simple rise of intracranial pressure. This is shown by the lack of coincidence between the rise and fall of lumbar pressure and the onset and disappearance of headache. Moreover, if, when the headache is fully developed, the jugular veins are compressed in the neck, a rise in lumbar pressure occurs, but simultaneously headache is relieved, to return when compression is stopped. The same relief is obtained by artificially raising the intracranial pressure in other ways. It is also clear that headache does not directly result from an expansion of the brain due to dilatation of its vessels, for the headache is absent when this process is at its height, appearing only as vaso-dilatation subsides. The curve of intracranial pressure recorded from a cranial defect follows the same course as does the lumbar pressure curve in response to an injection of histamine, indicating that pressure is raised both above and below the tentorium. Thus on the two sides of the tentorium no pressure difference is established which would tend to stretch this membrane.

There are, however, some indications of where and how the headache arises. That the headache arises in the meninges is suggested by the observation that it is always very greatly increased by a rapid oscillatory movement of the head about either a horizontal or a vertical axis. In such movement, the brain, poised as it is in a bath of cerebro-spinal fluid, must tend to oscillate out of phase with the calvarium, and hence to strain the meninges, which separate it from its rigid case. It has already been pointed out that raising intracranial pressure relieves an established headache; a similar effect is produced by artificially lowering the arterial blood pressure. These facts suggest that the headache arises from stretching of the walls of the cerebral arteries or the tissue in their immediate neighbourhood, for the headache is inhibited either by a rise of pressure outside these vessels or by a fall of pressure within them. Entirely consistent with a simple mechanical effect, such as stretching of a sensitive meningeal structure, are the sudden rise in the intensity of the headache which occurs with the pulse beat, the very quick relief effected by raising the intracranial pressure, and the striking effects of shaking of the head. The outstanding fact for explanation is that while the development of the mechanical stimulus is

related to vaso-dilatation, it long outlasts the objective signs of this process. There seems to be more than one way in which this may be explained. First, the dilator action of histamine on the cerebral arteries may conceivably outlast its action on the minute vessels. If this were so, then the loss of tone of the cerebral arteries might not at first result in their expansion, since this would be prevented by the rise of pressure outside these vessels and the fall of pressure within them; the expansion of the arteries would occur as intracranial and arterial pressures returned to their normal levels. On this hypothesis over-expansion of the cerebral arteries would be the cause of histamine headache. In the second place, cerebral vaso-dilatation may redistribute cerebro-spinal fluid in a manner that is not immediately reversible when vaso-dilatation subsides. This redistribution of fluid might be supposed, if unbalanced by vaso-dilatation, to set up a state of tension in the vascular meninges and thus to produce headache. It is impossible in the present state of knowledge to decide which of these hypotheses, if either, is correct.

The present account of our observations has been made as brief as possible and is in many ways incomplete. It is hoped, however, that enough has been said to show that one variety of headache has quite definite attributes, and that it may be ascribed to a state of tension set up in the meninges. We do not claim, or indeed believe, that all headaches arise in this way; but before this question can be answered it will be necessary to define more closely the attributes of the headaches peculiar to different diseases. Although this work is in progress it is too early to speak of it here.

REFERENCE

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THE USE OF A MODIFIED DOUBLE THOMAS FRAME IN THE TREATMENT OF THE PARALYSES OF POLIOMYELITIS

BY

JEAN MACNAMARA, M.D. MELB.

HONORARY MEDICAL OFFICER TO THE PHYSIOTHERAPY DEPARTMENT,
CHILDREN'S HOSPITAL, MELBOURNE, AUSTRALIA

The epidemics of poliomyelitis which recurred in Victoria each summer and autumn from 1927 to 1931 left behind them annually from eighty to two hundred persons wounded by the lesions of the disease. Paralysis had usually reached its maximum within ten or fourteen days from the onset. It was realized that the future of these patients depended upon two factors:

1. The degree and extent of the initial destruction of the anterior horn cells of the spinal cord, and
2. The perfection of the detail of the care available from the hour of the onset of paralysis.

The teachings of Hugh Owen Thomas, C. Fayette Taylor, and Sir Robert Jones warned us that deformities were not essential sequelae of the disease, but were in every instance preventable, and that the natural tendency towards recovery of function would be handicapped if measures were not taken to protect partially paralysed muscles from the influence of two factors which inevitably operated in uncared for cases, after the disease has done its worst. These are: (a) the functional disability which follows continued stretching of partially paralysed muscles and the development of contractures in muscles favoured by prolonged relaxation, and (b) the influence of fatigue.

PRINCIPLES INVOLVED

The first principle—that if a muscle is to have the opportunity of achieving the maximum recovery of which it is capable the bones on which it acts should be maintained in such a position that the muscle is continually relaxed—is fundamental to the treatment of paralysed cases. The deformities which develop in neglected cases of poliomyelitis, namely, flexion of the hips and knees, scoliosis, dropping of the fore part of the feet, adduction and internal rotation of the shoulders, are largely determined by the positions habitually assumed—that is, by propping up the head and shoulders with pillows, placing the pillow under the knees, and by the influence of gravity. This is evident when a paralysed patient is allowed, soon after the onset of the disease, to sit in a chair. In such a case the hip flexors and hamstrings—the muscles favoured by relaxation—shorten to contractures, and the patient, when he tries to walk, finds that he is no longer the shape of an erect human, but has grown to the shape of his chair. As the aim of treatment is the return of the patient to the shape and power of a normal human of good posture, it is wise policy to maintain him in that position, and thus to favour by relaxation the muscles of greatest economic importance—the hip extensors, the quadriceps, the muscles of the trunk.

While it is easy to devise splints of plaster-of-Paris or wire outlines, such as the Osgood splint, to relax the dorsiflexors of the foot and the quadriceps, and while an adult may be persuaded to maintain a given position when restrained by sand-bags or pillows, it was found that such splints were not sufficient for children; for, if the muscles of the hip were involved, the lower limbs, by their weight, would fall into outward rotation, and the child would wriggle into the sitting position and thus favour the hip flexors and stretch the important hip extensors. Moreover, fatigue in the affected quadriceps and foot muscles could not be prevented, for the child would try to stand or crawl on the splint applied. As over 70 per cent. of the paralysed cases had some involvement of the abdominal muscles it was essential, in order to reduce the tendency to the development of scoliosis, to maintain the trunk in a position of good posture while the abdominal muscles had the opportunity of recovery by protection from stretching afforded by a well-fitting corset. When the muscles of the shoulders were simultaneously involved the application of any of the abduction splints described tended to induce asymmetry of the trunk when the child was allowed to sit or stand.

THE DOUBLE THOMAS FRAME

To overcome these difficulties encountered in the splinting of some of the cases of the 1925 epidemic, the double Thomas frame was used. This ensured relaxation of the hip extensors and the quadriceps, held the hips in the optimum degree of abduction and rotation, and allowed for fixation of the trunk in a straight position. A foot-piece was attached to a prolongation of each vertical stem, thus protecting the dorsiflexors of the foot. Gradually it became evident that modifications were necessary to obviate the expense and inconvenience of the frequent

adjustments required by the growth of the child, and to allow of simpler variation of the position of the feet as the varying recovery rate of the muscles determined. Moreover, when it was necessary, because of the relative weakness of the hip abductors, to hold the lower limbs away from one another, this frame did not prevent angling at the knees, by stretching of the internal lateral ligaments. The prolongation of each vertical stem to the foot-piece in some cases resulted in pressure atrophy of the calf muscles. To overcome these disadvantages the frame has been gradually modified, and at present it consists of the usual chest wing and vertical stems, but each stem ends at the middle of the thigh, where it is riveted to a transverse thigh support. One end of a bar of metal is welded or riveted to each extremity of the thigh support. Each of these four leg bars extends to a point four inches below the level of the foot. Holes are bored, at half-inch

FIG. 1.—A modification of the double Thomas frame for the treatment of the paralyses of poliomyelitis. (Note: The frame may be lengthened at either end, and the position of the foot-pieces may be adjusted.) a, Vertical stems; b, chest wings; c, pelvic grip; d, thigh support; e, leg bar; f, foot-piece; g, transverse rod which carries the foot-piece; h, stay-piece; i, connecting bar between the medial leg bars; j, supporting troughs; k, head-piece; l, rod of malleable iron for arm-piece; m, trough for upper arm; n, felt pad.

intervals, in their distal four inches. Troughs of strong material pass between each pair of bars to support the knee and leg, as in the Thomas hip splint used for fracture of the femur.

Foot-pieces.—The foot-pieces, with their lateral flanges, are made of sheet aluminium from tracings of the feet. A rod of metal is secured transversely to the centre of the plantar surface of each foot-piece. Each end of this rod

is passed through a hole in the leg bar and secured by a butterfly nut. By passing this rod on each side through the next distal pair of holes the frame may be lengthened by half an inch, the buttocks still resting in the curve designed to hold them. Inversion or eversion of the feet can be obtained by passing one end of the rod which carries the foot-piece through a hole in one leg bar more distal on one side than on the other. The required degree of plantar flexion may be obtained by altering the angle of a stay-piece—a bar of metal which passes from the lateral margin of each foot-piece to the lateral leg bar, where a screw secures it to any hole selected.

Pelvic Grip.—A band of leather, four inches wide, is attached to each vertical stem posteriorly, proximal to the buttock curve. It passes below the anterior superior spine, gripping the pelvis. Its attachment to a webbing band on one side and to a buckle on the other completes the circle around the pelvis.

Arm-pieces.—A rod of iron is secured by a flattened metal prolongation to any hole selected of those bored at intervals, through the cranial end of the vertical stem. Covered, moulded troughs of sheet aluminium are secured to the rod to provide support for the arm, the forearm, wrist, and hand, on their dorsal aspect. The screws which secure the prolongation to the vertical stem will also secure the prolongation of the metal outline of the head support. To this outline is sewn the leather or webbing which supports the head. When the cervical muscles of one side are involved it is possible to hold the head in the mid-position by attaching an outrigger to the head-piece to prevent torticollis. When the muscles which abduct and rotate the shoulders are involved, arm-pieces are attached to the vertical stems and the degree of rotation required is determined by the relative strength of the internal and external rotators. As this varies from

time to time it is often necessary to modify the position of the arm-pieces, and the metal should be malleable enough to allow this to be done by hand. The patient shown in Fig. 2 had stronger internal rotation than external rotation of the shoulders; therefore the external rotators were relaxed by the splinting.

FIG. 2.—The frame applied for generalized paralysis.

THE FRAME IN USE

If frequently supervised a mother readily learns to care for a child in such a frame. Instruction should be given in the method of applying bandages to hold the knees out and the ankles in without inducing rotation, and thus to prevent the tendency to genu valgum which, in neglected cases, often follows involvement of the quadriceps extensor when the tensor fasciae femoris has escaped. By the adjustment of bandages pulling to the leg bars it is possible gradually to correct any pre-existing tendency to bow-legs or knock-knees. To anticipate a genu recurvatum she should be taught the importance of maintaining at the correct tension the slings which support the knees.

The mother should recognize that the child is not placed correctly in his frame unless the line between the two superior iliac spines makes a right angle with the central vertical line of the trunk, and she should detect and correct any tendency to hitch the pelvis on one side

FIG. 3.—The frame applied. (The corset is applied before the patient is placed in the frame. Note that, when rotated through a right angle, the posture is that of a normal, erect person. The common deformities are prevented.)

when the iliac crest of that side approximates more closely to the costal margin than does the crest of the other side.

When the essential muscles—the hip extensors and the quadriceps—have escaped or recovered completely, it is possible, if the hip flexors or hamstrings are paralysed, to favour their recovery by relaxation. Fig. 4 shows a modification of the frame to relax the abductors of both hips, the flexors of the right hip and the hamstrings on the left, when the right hip extensors and the left quadriceps are normal but the left hip extensors are still paralysed and therefore demand relaxation.

With these modifications the double Thomas frame has been as useful in facilitating the splinting of the victims of epidemics of poliomyelitis as the

Thomas splint proved to be in warfare. The frame can be made cheaply. Most of it may be prepared as stock before an epidemic occurs, only the vertical stems, chest wings, and foot-pieces requiring accurate fitting. When the frame is no longer required it may be re-covered and used again for another child of approximately the same size. Alterations demanded by growth or by the variation in the rate of recovery of affected muscles may be carried out by the doctor or physiotherapist equipped with a screwdriver and "King Dick." It is an advantage to have the screws which anchor the head-piece and arm-piece of the "Meccano" size; these are often obtainable in the patient's home. In Victoria many requests for help in splinting were received from doctors in outlying districts, and from simple tracings the frame could be made, leaving the finer adjustments to the doctor when the frame was fitted to the child. The frames are light, and a child may be carried about in his frame while the desired position is maintained.

MEASUREMENT AND FITTING

To make the frame a mechanic requires tracings of the chest wing, thigh wing, vertical stem, the arms, and feet, and measurements of the total length of the patient, the distance from the top of his head to the chest wing, the circumference of the chest

FIG. 4.—The frame modified to relax the abductors of both hips, the right hip flexors, and the left hamstrings.

and pelvis, and the distance between the posterior superior iliac spines. The tracing of the chest wing is obtained by moulding a strip of lead or aluminium to the dorsal two-thirds of the chest, one inch below the angle of the scapula. The outline of the lead, traced on paper, gives the mechanic the pattern for the metal of the chest wing. The circle is completed by webbing and a buckle. Similarly, the pattern for the vertical stem is taken from a lead strip moulded to the back, extending from a point an inch below the angle of the scapula to the mid-point of the thigh when the patient is lying on his side, with hips extended, and steadied to prevent rotation of the trunk. The distance between the vertical stems should be such that the posterior superior iliac spines will lie between

them and miss their pressure. The tracing for the thigh support should conform to the outline of the dorsal two-thirds of the thigh at its mid-point. For infants it is well to use non-corrosive metal for the portions of the splint likely to be soiled. If iron is used this part may be electro-plated, or an additional covering of waterproof tissue can be carefully applied. The chest wing, vertical stems, and thigh supports are neatly covered with felt and basil leather. The other metal parts of the frame are painted with "duco" or aluminium paint. When the arms are normal, shoulder straps of webbing are usually necessary to restrict all attempts to sit up. When the child undoes the buckles of the shoulder straps or chest wings one or two padlocks and keys are usually effective. The corset may be anchored to the frame by

additional webbing bands. It is often necessary to overcome a tendency to hitch the pelvis on one side by the traction of webbing attached to the fitting pelvic portion of the corset to the foot of the frame. When it is probable that the abductors of one hip will need temporary relaxation, it is economical to insert a joint in one vertical stem, as in the Jones abduction frame, when the bar which joins the medial leg bars must be adjustable.

The metal which has been used in the frame is given below, but heavier metal, as advised in Thomas's original

DETAILS OF CONSTRUCTION

Part of Splint	Material	Under 2 Years	2 to 6 Years	Over 6 Years	Thomas's Original Description
Chest wing ...	Galvanized iron under 6 Spring steel over 6	Inches $1 \times \frac{1}{16}$	Inches $1 \times \frac{1}{16}$	Inches $1 \times \frac{1}{16}$	Hoop iron $1\frac{1}{2} \times \frac{5}{8}$
Vertical stems...	Mild steel	$\frac{5}{8} \times \frac{1}{8}$	$\frac{3}{4} \times \frac{9}{16}$	$\frac{3}{4} \times \frac{9}{16}$	Malleable iron $\frac{3}{4} \times \frac{1}{4}$ Adult $1 \times \frac{1}{4}$
Thigh supports	Mild steel	$\frac{5}{8} \times \frac{1}{8}$	$\frac{5}{8} \times \frac{1}{8}$	$\frac{3}{4} \times \frac{9}{16}$	$\frac{5}{16} \times \frac{1}{8}$
Leg bars...	Mild steel	$\frac{5}{8} \times \frac{1}{8}$	$\frac{5}{8} \times \frac{1}{8}$	$\frac{3}{4} \times \frac{9}{16}$	—

description, is necessary to restrain very active, heavy children.

OPHTHALMOLOGY IN GENERAL PRACTICE*

BY

D. V. GIRI

SURGEON, ROYAL EYE HOSPITAL, EASTBOURNE

The chief aim of medical training is to produce efficient general practitioners for the service of the community. An overburdened curriculum which tends more and more to fill the mind of the student with encyclopaedic vagueness rather than circumscribed precision, to make a memorizing machine rather than a thinker, is ill calculated to achieve its object. Of the special subjects ophthalmology is so advanced, progressive, and vast that it has become more than a whole-time job for the best of us. It has been said that the general practitioner ought to know ophthalmoscopy because some general disorders produce changes in the fundus. Woe be to the patient who has to wait for the detection of his ailment until his doctor discovers pathological change in the fundus! For our help to be efficient, disease must be recognized at its onset. Minute ophthalmoscopic abnormalities call for the expert eye, and now and then escape notice even with the pupil dilated; in some cases they can never be seen through the undilated pupil. Ophthalmoscopic signs due to general disorders appear mostly in the decades of life when it is risky to use mydriatics, and also late in the course of the disease. Apart from the impracticability of finding time for it, therefore, the careful routine examination of the fundus in each case is of very doubtful value to the general practitioner. He is asked to learn refraction as though it consisted just in prescribing glasses that give the patient normal acuity of vision in each eye. To do justice to refraction a sound knowledge of ophthalmology is required; one has to assure one's self that there is no disease in the eye before deciding that correcting the error of refraction is all that is needed. Each case has to be judged on its own merits, and considerable experience, skill, patience, and time are essential to deal with it satisfactorily. If the student intends to become a general practitioner the time and trouble in-

involved in getting a vague smattering of refraction and ophthalmoscopy is ill spent. Ophthalmic surgery is by general consent the province of the specialist.

CONGENITAL DISEASES OF THE EYE AND BIRTH INJURIES

The work of the general practitioner is mainly preventive, that of the specialist mainly remedial, particularly in regard to the eye. The aetiology of congenital abnormalities of the eye is obscure, but if steps are taken to ensure the mental and physical well-being of the expectant mother during the whole period of gestation, the chances are that their occurrence will be minimized, especially if care has been taken to deal with, and eliminate, venereal diseases where present in the parents. The latter precaution safeguards the infant both from congenital syphilis and from ophthalmia neonatorum. To save the eye from birth injuries, which range from trivial contusions, ecchymosis, and abrasions of the lids and globe to complete destruction of the eye, it is essential that difficult labour be prevented by timely induction in cases of contracted pelvis, by correction of malposition of the foetus, and by avoidance of instrumental delivery whenever possible. During the passage of the infant through the genitals the eyes remain as a rule well closed, so that only the lids are contaminated externally. To prevent ophthalmia neonatorum, therefore, it is essential to remember to leave the eyes alone until the rest of the body has been washed in the bath. After drying the baby, the lids should be carefully wiped with a clean wet swab without opening the eyes; the lids should then be separated and a drop or two of 1 per cent. silver nitrate solution instilled into each conjunctival sac. The importance of keeping the hands free from genital contamination should be impressed not only on the parents, but also on the nurse, who has been known to be the source of infection. As a further precaution a couple of drops of a 10 per cent. solution of protosil (Parke, Davis and Co.) may be instilled into the eyes thrice a day for a week or ten days.

OPHTHALMIA NEONATORUM

Ophthalmia neonatorum is a general term applied to conjunctival inflammation of the newborn. Unless proper treatment at home is really practicable, these cases are best sent at the very outset to specially equipped clinics. If it is decided, however, to treat the case at home the two guiding principles are: (a) to take scrupulous care not to traumatize the cornea in the slightest in the process of treatment; and (b) to maintain the general condition of the mother and child at its best. To achieve these ends it is preferable not to let the mother have the responsibility and anxiety of carrying out the treatment. If the inflammation is mild, instillation of a couple of drops of 1 per cent. solution of silver nitrate into each eye once a day, followed by instillation of 10 per cent. solution of protosil every two or three hours will do. The irrigation of the conjunctival sac to wash out the discharge and the instillations are best done before each feed; in this way the feed comforts the child and its sleep between feeds is not disturbed—conditions of at least as much importance in maintaining the resistance of the cornea to the invading micro-organism as the local treatment. The case should be carefully watched, and as soon as the inflammation shows signs of becoming severe 1 c.cm. of unadulterated cow's milk, boiled for five minutes and cooled to body temperature, should be injected into the buttock under aseptic precautions. If necessary, the injection may be repeated once or twice at intervals of twenty-four to forty-eight hours. This masters the inflammation better than anything else, especially where the gonococcus is concerned. Protecting

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