material which might interfere with the transparency of the fluid to be tested. The washed tissue in amounts of 5 grams was soaked for a definite time in 100 c.cm. of the various solutions (mercuric chloride, phenol, or acriflavine) and the concentration of drug remaining in the solutions estimated. After soaking 5 grams of the treated muscle in 1 in 1,000 mercuric chloride for twenty-four hours the antiseptic could not be detected in the fluid. Five grams of minced muscle after soaking in 100 c.cm. of 4 per cent. phenol for twenty-four hours reduced the strength to approximately 3.7 per cent. A solution of acriflavine 1 in 1,000 was reduced in strength after one hour to 1 in 1,200, and after twenty-four hours to 1 in 1,400, and a solution of acriflavine 1 in 5,000 fell in an hour to a concentration of 1 in 8,000 and in twenty-four hours to 1 in 10,000. Thus, as measured by such methods, the amount of antiseptic which is fixed by the tissues is in the case of acriflavine much the same as that fixed by gauze; phenol, although not fixed by gauze, is markedly fixed by tissue, whereas mercuric chloride is very powerfully fixed by the latter.

Conclusions.

1. In the treatment of wounds with an antiseptic such as acriflavine allowance must be made for the considerable affinity of cotton dressings for this class of antiseptic. (On the other hand, phenol and mercuric chloride have practically no affinity for cotton.)

2. The concentration of the acriflavine solution should be such that after the gauze has satisfied its affinity for the antiseptic there is still a sufficient concentration left free to act in the tissues. It follows, therefore, that the swab must be applied dripping wet and not wrung out. Quantitative experiments have been carried out by soaking gauze swabs in approximately three times the amount of solution which can be taken up, and estimating the concentration of the antiseptic in the fluid expressed. It has been found that after three minutes' soaking in 1 in 1,000 acriflavine solution the fluid expressible from the gauze contains 1 in 1,600 of the antiseptic, and even after twenty-four hours' soaking the fluid expressed contains 1 in 1,800. When a 1 in 5,000 solution is employed under similar conditions the fluid expressed from the gauze after three minutes' soaking contains 1 in 9,000 of the dye, and after twenty-four hours' soaking the fluid expressed contains 1 in 20,000. The above concentrations employed according to this procedure have been shown to give a dressing which is very satisfactory for treating septic infections without inhibiting healing.¹

3. When a lesser proportion of the solution is used, or when swabs are soaked successively in the fluid, there is great danger in the case of the 1 in 5,000 concentration that the amount of antiseptic available may be reduced to an ineffective level.

4. Experiments on the fixation of antiseptics by tissues have shown that minced and washed muscle, while it absorbs mercuric chloride very actively, has a definite though much less marked affinity for phenol and acriflavine, the last being absorbed to a slightly less extent than by gauze.

I have to thank Dr. C. H. Browning for his criticisms and suggestions in the course of the work.

REFERENCE.

¹ Bennett, Blacklock, and Browning: BRITISH MEDICAL JOURNAL, 1922, ii, p. 205. Graham: *ibid.*, 1925, ii, p. 826.

CURVATURES OF THE SPINE FOLLOWING ENCEPHALITIS LETHARGICA.

BY

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IN addition to the characteristic attitudes which are so frequent a sequel of the disease, encephalitis lethargica in young patients is occasionally followed by definite localized spinal curvatures. Only these definite curvatures are here considered. They have their origin in abnormal muscular contraction, and in this respect differ from all other forms of spinal deformity; for spastic conditions such as hemiplegia and spastic diplegia do not give rise to spinal curvatures.

Five examples of the condition have come under my observation: in four the symptoms of the preceding illness were characteristic of encephalitis lethargica; in the fifth

the initial symptoms, although probably due to that disease, were of a somewhat anomalous nature. All the cases were in children or young adolescents.

Antero-posterior Curvatures.

Perhaps the most striking and characteristic deformity, seen in two cases, is an arched curve of the cervical spine, convex backwards, which carries the head forwards; the arch of the curve may be of so high a grade as to bring the chin into firm contact with the front of the chest. It is clearly evident that this posture is not due to a mere falling forwards of the head by its own weight, but is brought about by a contraction of the anterior and antero-lateral muscles of the cervical spine, which can be felt as firmly contracted muscular masses on each side of the neck; the sterno-mastoids remain perfectly lax. On attempting to bend the head still further forwards, and thus increase the curve, the posterior spinal muscles are found to contract. Thus the head is held in its new posture by the combined action of the muscles at the front and the back of the spine. A lateral view of this deformity, with the strongly arched neck and powerfully contracted muscles, presents so unusual an appearance as to suggest the designation of "pony neck." By steady manual pressure the resistance of the muscles can be overcome in a few moments, and the deformity partly or completely reduced. The passive raising of the head is accompanied by the appearance of a deep depression in the neighbourhood of the seventh cervical vertebra; this is due to the pivotal movement backwards of the cervical spine as a whole upon the rest of the spinal column.

Another type of deformity is a curve convex backwards in the dorsal region—a dorsal kyphosis. By this curve an inclination forwards of the upper part of the body is brought about, somewhat resembling that seen in the cognate condition of paralysis agitans; but the curvature is of a more localized character than that seen in paralysis agitans.

Lateral Curvatures.

Lateral curvatures may occur in any region of the spine, causing very diverse deformities; they are associated with rotation, but are not accompanied by regular compensatory curves such as are seen in scoliosis. The curvature may be localized to a few vertebrae, but is never angular.

The deformities produced may be extreme; in one case a lateral curve of the cervical spine brought the ear into firm contact with the top of the shoulder, the curvature being caused by a unilateral contraction of the prevertebral cervical muscles, the sterno-mastoid and trapezius remaining unaffected.

General Characters of the Curvatures.

Notwithstanding their diverse character, the curvatures present certain features in common. In all of the observed cases, examination led to the belief that they were caused by a contraction of a section of the prevertebral muscles; a bilateral contraction causing an antero-lateral curve, and a unilateral contraction bringing about a lateral curve. By traction and pressure the curves may be partly or completely straightened out, but as time goes on the vertebrae tend to become wedge-shaped and distorted, as shown by skiagraphic examination; reduction is thus rendered more difficult and incomplete.

The curvatures are associated with a hypertonus of the muscles of the limbs and the uncurved portion of the spine; the tendon reflexes may be increased; clonic movements may be present, and, occasionally, deformities of the limbs. The mental condition may be fairly good.

Pathology.

In all of the observed cases the contraction of a special muscle group was found responsible for the curves—namely, that of the prevertebral muscles. The explanation of this phenomenon is probably to be found in the tendency of encephalitis lethargica to attack the mid-brain, the substantia nigra, and the lenticular nucleus—that is to say, those regions of the brain that preside over the postural reflexes and automatic muscular movements of the body. Owing to the damage sustained by these regions there is an impairment of the highest and most

lately acquired reflexes—namely, those subserving the erect posture; and there is a consequent release of a more primitive or ancestral form of postural reflex—namely, that approximating to the quadrupedal type; or, more precisely, to a type intermediate between the quadrupedal and the erect—namely, that of the anthropoid. In the quadruped the action of the prevertebral muscles must be of great importance in preventing hyperextension of the spine by the weight of the body, and these muscles must constantly be brought into play in such movements as running and jumping; in the anthropoid in particular the spine is flexed and the head held low.

The contraction of the prevertebral muscles in the cases under consideration may thus represent a return to a more primitive posture of the spine; their sectional and sometimes unilateral contraction corresponds to the scattered nature of the lesions in encephalitis lethargica, and is thus of a focal character.

It may be assumed that the primitive postural reflexes are relatively more potent in the young, and tend to become obsolete as life advances; this explains the occurrence of the localized curvatures in young subjects.

It lies outside the scope of this paper to discuss the relationship of the lesions in the lenticular nucleus, the substantia nigra, and the mid-brain to the hypertonus, the attitudes, and the localized curvatures. Investigation of the morbid anatomy of the type of case here described may perhaps throw light on this question.

Treatment.

Treatment is of more avail than the appearance of the cases would suggest. Corrective apparatus should be employed, having for its object the gradual overcoming of the resistance of the muscles, the reduction of the curve, and the prevention of osseous deformity. For the cervical

FIG. 1.—Antero-posterior curve of cervical spine.

FIG. 2.—Effect of chin-strap in correcting deformity. The chin-strap is attached to a jury-mast (not shown in illustration).

FIG. 3.—Posture after two months' treatment. Retentive apparatus is still necessary.

curves a poroplastic or celluloid jacket should be used, with a jury-mast and Sayre's chin-sling; in some cases (as, for example, when salivation is present) a frontal band passed round a pulley at the top of the jury-mast is better tolerated. Reduction should be by stages, the straps being gradually tightened; at the beginning it may be advisable for the apparatus to be worn only for a period each day. Patience and some ingenuity may be required, but the results reward the trouble; in two cases in which the carriage of the head had brought the chin into contact with the front of the chest, the children can now hold their

heads erect unaided. For the kyphosis and the lateral curves a poroplastic jacket should be used, applied with the patient suspended; as the curve improves, the jacket should be remodelled. The jackets should be well perforated, as the patients sweat freely.

Prognosis.

The general prognosis appears doubtful. In one case the condition progressed

in spite of treatment; the child became bed-ridden and died of intercurrent disease. Two cases show improvement, and in two the condition remains stationary.

Several cases have been observed in which, after an anomalous acute illness, children have developed an extreme lateral curvature, which has disappeared in a few weeks. Such cases are probably examples of an aberrant type of encephalitis lethargica, but their nature is at present doubtful.

Conclusions.

The spinal curvatures following encephalitis lethargica are due to a localized contraction of the prevertebral muscles, brought into play by the release of a primitive postural reflex, locally restricted in its operation. Treatment by means of corrective apparatus is followed by material improvement.

TETANUS IN A BOY: RECOVERY.

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THE following details of a case of tetanus in a boy who, while on a visit to Newfoundland, met with a slight accident, appear to merit publication in view of his complete recovery after prolonged treatment.

On August 11th, 1926, a schoolboy, aged 15 years and 10 months, fell on some stones in pasture land where animals had been grazing, and received a wound on the back of the right forearm. This was cleaned immediately and tincture of iodine applied, but ten days later he noticed stiffness of the jaw and difficulty in chewing. On August 22nd the stiffness had increased, and by the next day had become so definite that he could open his mouth very little. He was then on board ship returning home, and was treated by Dr. McCarthy until August 30th. Stiffness of the jaw muscles continued the same until August 24th, when it increased and he became unable to chew. Tetanus was diagnosed, and an

injection of 1,500 units of antitetanic serum was given, this dose being repeated two days later.

On August 25th, the fourteenth day, it was noticed that he had bitten his tongue, and on the 27th he felt stiffness between the shoulder blades. On August 28th the stiffness of the back increased, and on August 30th he received an injection of 3,000 units of serum. An extra effort was made to speed up the ship to enable larger doses of serum to be given.

The boy was seen by one of us (J. D. C.) on August 30th, late in the evening, when it was obvious that it was a case of tetanus, but no spasms were noticed that night. On the following morning he was seen again and one spasm of the masseters was noted. He was then examined by both of us: marked rigidity of the masseters was present, and the boy was unable to open the mouth more than a quarter to half an inch. He was examined for erupting wisdom teeth, but none were seen. He was able to flex his neck, but contraction of the facial muscles caused the appearance of risus sardonicus. There was some rigidity of the spinal muscles, but no spasms were noted round the muscles of the arm at any time, even on exciting the muscles. The knee-jerks were then fairly active. The pulse was slightly increased, but the temperature was normal. Active tetanus was diagnosed, and energetic treatment was considered necessary.

A general anaesthetic was administered on August 31st, the twentieth day, in order to inject serum intrathecally. On this occasion some difficulty was experienced in getting into the cerebro-spinal canal. An anaesthetic was given again on the