THE TREATMENT OF SPASTIC PARALYSIS IN CHILDREN.

BY

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It is generally agreed that a spastic condition of one or more limbs of a child can result from one of the three following causes: (1) prenatal damage to the brain, (2) intracranial haemorrhage at birth, and (3) inflammatory injury to the brain after birth—for example, poli-encephalitis or syphilis. It is the relative frequency of the first two that is in dispute.

James Collier¹ has done much to convince medical opinion—including, we believe, the majority of the neurologists—that the damage in most cases is done before birth. He attributes the lesion to "primary neuronie degeneration." Some physicians, notably Hector Cameron,² are still unconvinced, and regard intracranial haemorrhage as being a common cause of this condition.

Fortunately this question is not of practical importance to the orthopaedic surgeon, as he is concerned with the results of the lesion rather than with the lesion itself. It is, however, important that he should be satisfied that the lesion is not progressive. In some non-syphilitic cases—both pre- and post-natal (Collier)—as well as in those in which syphilis is the cause, the case may become progressively worse; this is very rare in my experience. The surgeon should, however, exclude these cases by a careful history and the Wassermann reaction before considering surgical treatment. If we accept Collier's conclusions, and I think we must, we must necessarily doubt the possibility of doing any good by a decompression operation as practised by Sharpe.³ I have no experience of this method of treatment; it did not seem to me called for in any of my cases. We may take it, therefore, that in the majority of cases the lesion is not a progressive one, but, on the contrary, any case will in all probability tend to improve. The surgeon's business is to see whether he cannot hasten the improvement, or, indeed, make possible an improvement which otherwise would be out of the question. What, then, are the chief effects of the lesion or lesions, and how do these influence the question of surgical treatment?

SYMPTOMS.

Mental.—All grades of mental defect are met with: there may be gross idiocy or what appears to be normal intellect. The mental affection seems to go more or less hand in hand with the severity of the limb affections in the majority of cases. It is uncommon to see a case which is not more emotional than the average, but occasionally the child is quite normal. On the other hand, mental deficiency associated with very marked spasm or uncontrolled movements may even prevent the child from sitting up, while walking is, of course, impossible. Such a case is unsuitable for operative treatment, and should be re-examined after a lapse of from six to twelve months. There is no doubt, as Cameron and Osman⁴ have insisted, that most cases show a marked improvement, both mental and physical, as they grow older. It is noteworthy that every surgeon who advocates a particular line of surgical treatment, whatever this may be, states that the mental condition improves to a decided degree after his operations. Any treatment which lessens the difficulty in walking will undoubtedly lead to mental improvement, and for two reasons: the less the difficulty in walking the more can the child get about, mix with other children, see things for himself, and thus undergo normal unconscious education; while in addition his brain is freer to receive impressions instead of being concerned entirely with trying to move one leg in front of the other. Mental deficiency should not be considered by itself as a contraindication to operative treatment, provided there is a reasonable chance of this enabling such an imbecile to walk.

Fits.—Epilepsy is more commonly associated with hemiplegia than with the other forms of spastic paralysis (Batten⁵). If the fits are recurring with any frequency,

operative treatment should be delayed, but if no fit has occurred for a year or more a history of such is no bar to operative treatment. It is our custom to give bromides in all cases for a few days before and after operation, however small this may be, and whether fits have occurred or not.

Paralysis.—The paralysis is for the most part spastic in character, but not always or entirely so. Certain muscles or groups of muscles may, indeed, be flaccid and partially or completely paralysed. That is not uncommonly seen in the arm. Great weakness of a muscle group can undoubtedly result from overstretching caused by the spasm of their so-called opponents, but in the forearm both opposing groups may be equally affected by flaccid palsy in a case in which the leg or legs show a typical spastic condition. Nothing can be done for this flaccid hypotonia. The type of case here referred to is quite distinct from the "atonic" group of diplegias with general hypotonia of the limbs and which usually exhibit grave mental defects (Batten⁶). It is the spasm and deformity resulting from the cerebral lesion, whatever its nature, with which the surgeon has to deal. This spasm is increased by handling the limb, and more importantly by any attempt at voluntary movement on the part of the patient. There is yet another factor which may play a part in the child's disability. While in most cases it is obvious that the spasm—which involves certain muscles as soon as impulses are transmitted to the limbs to produce movements—is responsible for the failure to accomplish the desired movements, in others there seems to be a lack of power to originate the necessary impulses. This again is more frequently seen in the upper limb, and is most marked in those with the greatest amount of mental affection, but is by no means confined to them. It is not always easy to estimate how much of the imperfect function of a limb should be attributed to spasm of certain muscles and how much to a want of voluntary initiation of impulses which should be transmitted to their opponents. A correct estimation of these various factors in any given case is of great importance in deciding the prognosis, and therefore has a distinct bearing on treatment.

Involuntary Movements.—There may be involuntary movements which interfere more or less with the use of the affected limb. These may be of the rhythmic athetoid type developing some time after birth, of the more explosive and erratic choreic type, or they may belong to the so-called "perverse movement" group. It is not always easy to classify a particular involuntary movement. For instance, a case was recently seen with a typical monoplegia of one leg with only a mild degree of mental affection. The child had the typical spastic equinus, but when she began to walk the tibial muscles took complete charge of the foot till it rested on the outer border. After a few moments, during which the child stood with a self-conscious expression on her face, this spasm passed off and she was able to continue her progress with an equinus deformity only. Handling the foot would sometimes bring on this inversion spasm. The temporary nature of the spasm was the peculiar feature of the case. The presence of athetoid or other involuntary movements is generally considered to be an absolute contraindication to operative treatment. This is unquestionably sound in the vast majority of the cases displaying these complications, but occasionally in carefully selected cases operation is justifiable and is followed by definite improvement in the use of the affected limb. This was so in the case referred to above, where the varus spasm was completely cured by tenotomies.

DEFORMITIES.

The deformities which arise are the result of spasm of the stronger groups of muscles (for example, the gastrocnemius and soleus), or of those which act at a mechanical disadvantage (for example, hamstrings), aided in some cases by gravity (for example, drop-foot, etc.). It should be remembered, however, that in the ordinary case all the muscles of the affected limb are a potential source of spastic deformity, and that, as Stoffer⁷ has pointed out, a spastic deformity in any direction can be produced by fixing the limb in a particular position for a sufficient

time. This is a most important point to remember in the after-treatment of cases treated by operation. I have more than once seen spastic calcaneus result from injudicious after-treatment, where the tendo Achillis has been divided or lengthened, while similar overcorrection of other deformities has been met with occasionally. Once started, the want of balance between opposing groups of muscles tends to increase, the muscles which gain the battle and deform the limb tend to become stronger, while their stretched opponents tend to become weaker. At first these deformities can be fully overcorrected in a few moments by firm manual pressure—that is, the deformity is entirely due to spasm; but sooner or later a secondary contracture (anatomical shortening) occurs, so that the deformity can only be partially corrected by manual force. The time this secondary contracture takes to develop varies considerably: while in some it is surprisingly late in development, in others, for no apparent reason, it develops much earlier. For instance, an equinus may be accompanied by real contracture requiring lengthening of the tendo Achillis at the age of 3 years, whereas another case may reach the age of 6 and still the deformity be due to spasm only. With the anatomical contracture of the muscle also occur accommodative changes in the ligaments, fasciae, etc. In some cases, however, with an atypical deformity, the excessive spasm of the particular group of muscles involved would appear to result from an unusual distribution of the lesion. Otherwise how can we account for the occasional occurrence of internal rotation of the whole leg?

The usual deformities met with are the following. In the arm, flexion of the elbow, pronation of the forearm, flexion and ulnar deviation of the wrist, and flexion of the fingers and thumb. In the leg we see adduction of the thigh, flexion of the knee, and drop-foot. In addition a valgoid deformity is common, especially after correction of equinus, and in a few—particularly, I think, hemiplegias—internal rotation of the whole leg is seen. Less commonly is there a varus tendency which may or may not be corrected by correction of the drop-foot. Only once have I met with a primary bilateral calcaneus deformity, though this has been seen on a few occasions as a result of overcorrection of the equinus. The hips may show a flexion deformity, the extensors being weak and the child having great difficulty in maintaining the erect posture when standing.

I do not propose to discuss the difficult and much-disputed question of the nervous mechanism on which muscular tone depends, nor the neurological problems involved in the production of the spastic condition of the limbs. Reference must be made, however, to the experimental work of Hunter and Royle,⁸ as a new method of treatment was the outcome of it. To put it briefly, these workers came to the conclusion that, in part at any rate, muscular tone is under the control of the sympathetic system, and on this they founded a method of operative attack for spastic cases—namely, ramisection or division of the grey rami in the cervical and lumbar regions. The conclusions they drew from their experiments have met with severe criticism at the hands of the neurologists, while the results of the operation of ramisection for these cases have been universally disappointing both in this and other countries (Bankart,⁹ Lewin, etc.).

TREATMENT.

It may be said at once that I agree with those (Bankart, for instance) who say that massage, commonly ordered for prolonged periods at great expense, is absolutely valueless. Apart from operation, if such be necessary or advisable, treatment should be directed towards patient daily training in the movements which are performed with the greatest difficulty, and gentle but firm manipulation to stretch the muscles chiefly affected by spasm; this corrects the deformity and thus prevents secondary anatomical contractures. It is often surprising how much a child will improve under the above treatment. It is well known that these children learn to sit up later than the normal; they stand and walk late; they have to contend with difficulties unknown to the normal child. It may be that a patient never walks until by operation the chief obstacles to locomotion are removed. But whether operation is necessary

or not, in all but the less severe cases an immense amount of patience is required to make the child walk reasonably well. To return to the question of massage, while condemning its general and prolonged use as being waste of money, it must be admitted that it may be useful under certain conditions. For instance, applied to weak muscles after an operation designed to weaken their opponents, it is rational; while in hemiplegias, where an annoying amount of shortening of the affected leg may be found, massage to improve the nutrition of the limb, and thus limit the amount of increase of the deformity, is again rational. In both cases, however, massage falls far short of systematic exercises in usefulness. Fixation of the deformed limb in plaster-of-Paris is not advisable; in fact, plaster is not of much use in these cases except occasionally after operations, particularly those on the nerves or muscles of the forearm.

The aim of operative treatment is to reduce the excessive spasm in certain groups of muscles, and thus to correct deformity and restore as far as possible the balance of the opposing groups. We cannot make a spastic limb normal, but we can improve, often to an enormous extent, the patient's control over the limb in selected cases.

Three years is a suitable age for operation, though in the case of the upper limb it is probably wiser to wait until six years, as the co-operation of the child in the after-treatment is necessary. The patients must be able to sit up alone, and exhibit a definite desire to walk. If they can sit alone they almost invariably manage to put one leg in front of the other alternately when supported, however severe the adductor spasm may be. If the child cannot sit it is useless to try and make it walk, and operation should be delayed.

What operative methods are at our disposal? Only two methods are worth discussing in detail: (1) operations on the tendons and muscles themselves, and (2) exsection of some of the motor nerve fibres passing to the spastic muscles. Förster's¹⁰ operation of division of the posterior spinal roots—that is, division of the afferent paths to the cord—has been given up for this class of case, even, I believe, by Professor Förster himself. It is a difficult operation which gave many disappointing and some fatal results. I have already referred to Royle's operation, or ramisection. My small experience of the results of this operation agrees with that of other surgeons; as a method of treatment in the cases under consideration it is unfortunately useless.

Operations on Tendons and Muscles.

The operations on the tendons and muscles include tenotomies and myotomies, tendon lengthenings, exsection of portions of tendon and muscle, and tendon transplantations. The last has been used more for the upper limb, but in the few cases in which it was tried it has not been successful in my hands, possibly for the reasons which are given in discussing the treatment of the arm. Simple tenotomies and myotomies constitute the oldest method of treatment and are still used extensively by some surgeons. The method is of the greatest service in many cases, particularly an open tendon lengthening; when there is real anatomical contracture of a muscle an operation on the tendon or muscle is often imperative. Operation on the afferent paths (Stoffel's operation) is the other method which has proved of real value. In common with several other surgeons in this country, I am indebted to Mr. Blundell Bankart for my introduction to this method. Stoffel and others have done an immense amount of work in mapping out the various recognizable nerve bundles composing the main nerves of the limbs and in tracing them to their destinations. In some cases a knowledge of the arrangement of the nerve bundles in a main nerve is not necessary, as the branches after they have left the parent trunk are more easily attacked; while in others—the median, for example—a knowledge of the minute anatomy of the larger nerves is of distinct service. By exsecting a length of motor nerve fibres a spastic muscle or part of a muscle is permanently paralysed and the balance between an overacting group and its opponents is restored. The method has the advantage of lending itself to careful adjustment, with experience, the exact amount of paralysis

produced being varied to suit the particular case. There is, indeed, the theoretical objection that if too much is done there is no possibility of undoing it, except by attacking the nerves to the opponents, but as a matter of fact, as Bankart and others have stated—and the author's experience agrees with this—the error is practically always in the direction of doing too little rather than too much. Crushing a nerve, injecting a nerve with alcohol, or both, and intraneural division have all been advocated with the idea of producing only a temporary paralysis, yet by this means obtaining a balance of opposing muscle groups. It may, I think, be fairly stated that these methods are much more uncertain in their ultimate results; they have not been employed by us to any extent. It is claimed by some that the Stoffel operation produces the result immediately and does away with the necessity for apparatus afterwards. This is, I think, a mistake. It is true of some deformities—for example, adductor spasm, where no splintage is necessary after the wounds have healed—but it is certainly unwise to make it a general rule. In equinus deformity a night shoe to hold the foot in the neutral (that is, the right angle) position is essential for some months after correction, by whatever operative method this be done. The deformity can, and does, relapse after a Stoffel operation on the internal popliteal nerve if care is not exercised. It is our experience that while one deformity is best dealt with by the Stoffel method, another is corrected with greater certainty by tenotomy or an open lengthening of a tendon. In older children with severe deformities neither method yields such good results as a combination of the two.

Drop-foot.

The first essential is to see whether this is due only to spasm which can be entirely overcome by firm pressure against the ball of the foot or whether anatomical shortening of the calf (real contracture) has supervened. If the muscles are short, the tendo Achillis should be lengthened by the open method; if the deformity is due to spasm only, a Stoffel operation on the internal popliteal to paralyse a portion of, and thus weaken, the gastrocnemius and soleus may be done. If the amount of nerve fibres to be excised is judged correctly a very pretty result may be obtained, but not, I think, superior to that obtained by a carefully performed tendon lengthening. After an extended trial of both methods (over 60 operations on the internal popliteal nerve in the last 130 cases operated upon) the author is still unconvinced that the Stoffel method for this particular deformity has any advantages over tendon lengthening. The tendon lengthening is the better operation, but it should be done with care.

After the tendon has been divided by the "Z" method through an incision to the inner side of it and the upper end allowed to retract, the two portions are stitched together in such a position that the upper end is pulled on by the lower just before the foot reaches the right angle as the foot is raised towards dorsiflexion. Before the tendon is sutured the other tight structures—for example, posterior ligaments of the ankle-joint, etc.—should be thoroughly stretched. The foot is held in slight equinus by a malleable iron splint for five or six days and then gradually brought to a right angle and retained in this position till the end of the sixth week. Walking with a shoe wedged up on the inner side, to check the valgus tendency which is usually seen after correction of the equinus, is now permitted, while a rectangular tin shoe is worn at night for several months. A few simple exercises with the object of training the child to control the foot more perfectly and carry it through its full range of movement, particularly dorsiflexion and plantar flexion, are useful.

The Stoffel operation is performed through a vertical incision exposing the internal popliteal and its branches. On the superficial aspect of the nerve are two columns of fibres, lying close together and fusing above. The inner divides into the cutaneous (ramus communicans tibialis), running on in the mid-line, and the branch to the inner head of the gastrocnemius. The outer divides into a large soleus branch (this muscle receives another branch lower down) which runs down in the mid-line deep to the

cutaneous branch, to disappear between the two heads of the gastrocnemius, and a branch to the outer head of the gastrocnemius. The fibres resected depend on the degree of spasm present, and consist of the whole of the soleus branch and a half to two-thirds of the branches to each head of the gastrocnemius. In small children these nerves are difficult to split, and some surgeons prefer to excise them completely and vary the amount removed of the soleus supply. The knee should be kept extended on a splint with the foot at a right angle for three weeks to allow healing of the wound to be complete and the wound free from scabs before flexion is permitted. The scar has shown a curious tendency to crack and become thickened in a few cases, so that eventually a keloid scar develops with ulceration at the flexure.

Varus and Valgus.

As already stated, valgus is commonly seen after correction of equinus though not present before operation, but in some it is obvious when the case is first seen, even without any marked equinus being present. Varus is much less common. These are difficult deformities to correct with nicety, and the feet require careful watching to guard against over- or under-correction. The varus may disappear when the equinus is corrected, but tenotomy of the tibials may be necessary. This is best done by the open method, as in these cases the tibial tendons fail to unite after simple division. Valgus may be corrected by either method—the nerve operation or tenotomy of the peronei—and the author has had occasional pleasing results with both. Further experience is necessary before deciding which is the better. As considerable variation is met with in the exact distribution of the peroneal nerve and its branches, the musculo-cutaneous nerve should be followed down in the substance of the peroneus longus till the last muscular branch, to the brevis, is reached.

Knee Flexion.

In most cases a Stoffel operation on the sciatic nerve, or rather its branches to the hamstrings, gives better results than division of or exsection of a portion of the hamstrings. When anatomical contracture is present these tendons must be divided, but even then, particularly in older children (10 to 14 years of age), a Stoffel operation should be performed in addition. The nerves usually resected are the whole of the branch to the long head of the biceps, the whole of the branch to the semimembranosus, and a portion, varying with the degree of spasm, of the branch to the semitendinosus. The knee is kept extended on a splint until the wound is healed; walking apparatus to prevent flexion of the knees is necessary only in quite exceptional cases. Exercises to improve the power in the extensors of the knee are useful.

Adduction of the Hip.

Here the nerve operations are unquestionably better than division of the adductors or exsection of portions of them. Stoffel tackles the obturator nerve in the thigh, just above the upper border of the adductor longus. This approach is necessary when it is desired to exsect only the anterior branch, but when the spasm is severe and the whole nerve is to be divided the abdominal extraperitoneal route is to be preferred. This approach I learnt from my colleague Mr. Tyrrell Gray, who was, I believe, the first to use it in spastic cases. The wound is less likely to become contaminated than one on the thigh by a child with dirty habits, and the whole nerve can be removed with greater certainty. The presence of an accessory obturator is the only possible source of error; this was met with twice—in a unilateral case and on one side of a bilateral case. It is an easy matter to isolate the nerve on the lateral wall of the pelvis as it approaches the obturator foramen. After the operation the thighs should be held in moderate abduction, just sufficient for nursing purposes, until the wound is healed. The two sides can be reached through a single paramedian incision, the peritoneum being stripped from the parietes in a downward and outward direction till the pelvic brim has been reached and passed. The results of this operation are extremely satisfactory and much more certain than after division of the muscles. Very rarely is there any suggestion of overcorrection.

Internal Rotation of the Leg.

Operation on the Stoffel principle would seem to have advantages over detachment of the muscles from the ilium as originally suggested and practised by Sir Robert Jones. The object of the former of these two procedures is to paralyse the internal rotators of the hip—namely, the tensor fasciae femoris and anterior fibres of the gluteus medius and minimus. Some surgeons excise the superior gluteal nerve as it enters the buttock, but I prefer to limit the paralysis to the portions of the muscles named, and thus avoid weakening the abductors unnecessarily. A vertical incision is made from the iliac crest to the great trochanter down to the periosteum. The terminal part of the superior gluteal nerve is found between the muscles, and a portion excised. The incision in the muscles must necessarily divide any other twigs of the nerve passing to the anterior parts of the glutei muscles. The result is entirely successful. There may be internal rotation of the tibia below the knee due to spasm of the popliteus muscles. The obturator nerve should always be resected when the superior gluteal is divided.

Flexion of the Thigh.

At present we only have division of the muscles—namely, the tensor fasciae femoris and psoas—as a possible means of dealing with the deformity.

The Arm.

The arm, as already stated, is much more difficult to deal with than the leg, for various reasons. The movements of the hand and arm are more specialized and finer; we more often find a diminution of the power of initiating impulses to the hand, and, more important still, the patient has little incentive to use the limb, being able to do almost everything with the other hand. A child cannot walk without using both legs, but can do most things with only one hand. A comparatively mild case, in which the voluntary control of the fingers is fairly good but in which the pronation spasm is a distinct drawback, can be considerably improved by dividing the tendon of the pronator radii teres, but an even better result can be achieved by following Stoffel. He attacks the median nerve and excises the branches given off to the pronator radii teres, the flexor carpi radialis and palmaris, all of which are pronators to some degree. It is not necessary here to enter into details of the operation, which can be read by those who wish for further information,⁷ but we would emphasize the importance of using a battery to test the nerves isolated by dissection, as the bundles in the median nerve and the arrangement of the branches are extremely variable. While the internal popliteal is extraordinarily constant in its minute anatomy, the median, in our experience, cannot be relied upon in the least to conform to textbook description. Where the ulnar deviation with flexion of the wrist is marked we have, in addition, attacked the nerve supply of the flexor carpi ulnaris through a separate incision. If the flexor spasm of the fingers and thumb is marked, the column in the median nerve passing to the muscles concerned can be isolated and a fraction of it excised with benefit. The column is situated on the side opposite to the column going to the pronators—namely, on the postero-internal aspect of the trunk. There is no doubt that, as in the leg, the most satisfactory results are obtained in the milder cases. When the control of the hand is not too bad, though the pronator spasm is marked, the results more than justify the operation. Plaster may be used with advantage for holding the forearm in full supination for three or four weeks after operation, the wrist, of course, being dorsiflexed.

After-Treatment and Results.

As already stated, massage by itself is not of any material benefit except possibly, and then only to a small extent, in cases with one leg affected, and this leg showing signs of diminished growth, and perhaps to aid recovery in overstretched muscles after an operation on their opponents. The only thing of real benefit is patient and persevering training in walking and using the affected arm. A rectangular night shoe, with the sole plate inverted to check valgus, or everted if varus is present, should be used for several months after correction of the equinus. A splint to hold the knee extended is also useful in bad cases,

while a removable supination splint of plaster for the arm is also of benefit at times. Walking-irons extending up to the hips are only necessary in quite exceptional cases, usually in older children in whom the deformities have been of long standing; and occasionally a short outside iron and valgus "T" strap are of use. In the vast majority of cases the rectangular night shoe is the only apparatus necessary. The results in the milder cases are most gratifying to the parents and surgeon. In the worst cases the patient may be enabled to walk in some sort of fashion—a thing quite impossible before operation. In the majority that are worth operating upon at all—and most cases fall within this category—a decided improvement, at any rate in walking capacity, can be achieved, and this is usually accompanied by general improvement in the child's mentality.

These cases exhibit a quite extraordinary tendency to the development of a keloid condition of the scars resulting from operations. I am not prepared to state exactly the percentage which show this complication, but that this is unduly high I have no doubt. A scar may be affected in part only or in the whole of its length. In a child in whom some six or more incisions have been made every scar may be more or less affected. As a rule the condition is of moderate severity and gives rise to no trouble of any kind; but in certain situations—for example, the bend of the elbow or back of the knee—cracking and ulceration may occur. Even more rarely the scar is said to be sensitive or painful. Special care in splinting after operation is necessary in these situations. The cause of this curious incidence of keloid is difficult to find. The presence of a low-grade infection seems probable, but sepsis in the ordinary meaning of the word was certainly not the cause in my cases. The habits of these children are far from clean, and they are difficult cases to nurse and keep at rest, but even so one very rarely experiences any trouble as regards the healing of a wound.

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HYOSCINE IN POST-ENCEPHALITIS LETHARGICA;

WITH SPECIAL REFERENCE TO ITS INFLUENCE ON CARBOHYDRATE METABOLISM.

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INTRODUCTION.

THERE is little doubt that investigations into encephalitis lethargica will, as prophesied by von Economo, lead to a better understanding of the neuroses and psychoses, for this recently recognized disease affords us an unexpected insight into the psychological and physiological mysteries of mental mechanisms. This paper is based on clinical and laboratory work carried out at West Park Mental Hospital and the Maudsley Hospital. Being convinced, as the result of clinical experience, that hyoscine is in the nature of a specific in the treatment of post-encephalitic Parkinsonism, it was considered an interesting line of research to try and find objective proof of its action on the bodily mechanisms in such cases. We chose carbohydrate metabolism as represented by the blood sugar curve, and our investigations show how this is influenced by hyoscine.

CLINICAL EFFECTS FOLLOWING THE INJECTION OF HYOSCINE.

(A) *In the Normal Person.*

The subcutaneous injection of 1/100 grain of hyoscine hydrobromide is followed in from ten to fifteen minutes in the normal person by dryness of the mouth and throat;