anthracis—carbon particles, or human lymphoid tissue affected with a variety of different pathological conditions, could similarly be injected intracerebrally without in any way reproducing the syndrome under discussion. Histologically, however, the brain of an animal injected with any of the irritant substances mentioned above reveals extensive damage, changes such as severe haemorrhage, necrosis, degeneration, and cellular infiltration being evident microscopically in the brain of a rabbit which was apparently in good health prior to necropsy.

It is thus clear that the encephalitic syndrome cannot be regarded as the outcome of gross changes produced in a rabbit following the introduction of non-specific irritant substances into the brain of that animal.

TOXIN OR VIRUS?

The only unequivocal proof of the existence of a living virus is by means of its demonstration *in vivo* and *in vitro*, the former by serial propagation in the living animal and the latter as evidenced by its multiplication in artificial culture.

Neither condition has been fulfilled in the case of this pathogenic agent. The weight of experimental evidence so far advanced is equally capable of indicating the cause of the encephalitic syndrome to be the outcome of specific toxic activity or to its being that of a living virus. Thus the ability of this substance to withstand desiccation, to resist 73° C. for half an hour, to be annulled by the action of weak antiseptics, and occasionally to give rise to immunity phenomena (Gordon, 1932-3) is a common property of both a virus and a toxin. This agent has been

further stated by Gordon to be non-filterable, but the writer has latterly been able to demonstrate in a series of preliminary experiments that filtration could be effected under certain conditions. He also observed that tissue suspensions appeared to be most active when suspended in broth ranging from pH 6.2 to pH 7.2. This aspect of the subject is under course of investigation and will be dealt with later.

CONCLUSION

It can be stated that the encephalitic syndrome produced in the rabbit is specific for Hodgkin lymphoid tissue, and may consequently be utilized as a biological test for the diagnosis of the condition. The precise nature of the syndrome produced in the rabbit is not the outcome of a simple traumatic and inflammatory change produced in the brain of the animal, but is probably due to the action of either a specific toxin or a filterable virus, derived from the human subject suffering from Hodgkin's disease. The present available data regarding the nature of this pathogenic agent neither confirm the possibility of these effects being the results of a specific toxic activity nor exclude them from being due to the action of a filterable virus.

BIBLIOGRAPHY

- Davidson, L. S. P.: *Medical Annual*, p. 222. 1933. Simpkin and Marshall, London.
Gordon, M. H.: *Rose Research on Lymphadenoma*, p. 46. 1932. Simpkin and Marshall, London.
Idem: *British Medical Journal*, 1933, i, 641.
L'Esperance, E.: *Journ. of Immunol.*, 1930, xviii, 127.
Idem: *Ann. of Surg.*, 1931, xciii, 162.
Twort, C. C.: *Journ. Path. and Bact.*, 1930, xxxiii, 539.
Van Rooyen, C. E.: *British Medical Journal*, 1933, i, 50.
Idem: *Ibid.*, 1933, i, 644.

THE MANIPULATIVE TREATMENT OF PAINFUL FEET *

BY

PHILIP WILES, M.S., F.R.C.S.

There are many causes of painful feet, but, if serious injury and disease are excluded, they nearly all fall within the following classification: (1) chronic foot strain; (2) minor deformities, corns, etc.; (3) chronic arthritis.

Chronic foot strain is a term used to describe those cases in which there are painful feet without radiographic or other evidence of disease. The patient complains of pain, which in the early stages is localized and perhaps only occurs after unusual exertion; later, the pain becomes nearly constant and radiates widely, tending to spread up the leg as far as the knee. On examination, when the feet are passively put through their full range of movements, pain is produced at the extremes of one or more of the movements. A superficial oedema of the feet and ankles is not infrequently present; it gets worse towards the end of the day and disappears during the night. The pain is due to failure of the muscles controlling the joints of the feet, allowing strain to fall either on normal ligaments or on "adhesions." The pathology of adhesion formation is similar to that of any other scar tissue. Some trauma or strain ruptures a few fibres of a ligament, joint capsule, muscle, or perhaps only a few capillaries, and a small haemorrhage into the surrounding tissues occurs. The usual process of repair ensues and ends in the formation of a scar, which at this site is called an "adhesion." Pain is caused whenever such scars or adhesions are placed under tension, and there are only two ways of relieving it. The first is palliative and prevents the adhesions from being stretched. The second is curative; it ruptures the ad-

hesions and prevents them from being re-formed. The customary method of treating chronic foot strain has been the former; arch supports are fitted which aim at stopping any strain falling on the adhesions. The relief given by supports, however, is only temporary, because they fix the feet in such a position that the adhesions can contract yet further until, eventually, even the small amount of movement permitted by the supports will cause pain. The rational treatment is curative. The adhesions should once and for all be ruptured, and should then be prevented from re-forming by massage and exercises.

Minor deformities and chronic foot strain are not infrequently found to be associated. For example, a painful hammer-toe may cause the weight to be thrown on the wrong part of the foot and thus give rise to a chronic strain. If the strain only is treated it will continue to recur until the primary trouble is remedied. In the opposite way a chronic strain may result in a painful callosity forming on the ball of the foot, but, however often the callosity is cut, it will continue to re-form until the chronic strain is cured and ceases to cause misuse of the foot. Each case of painful feet requires most careful consideration of the factors involved, so that all the causes of pain may be removed and recurrence avoided.

Chronic arthritis of the feet is common in patients over 45 years of age. It is often of the "rheumatoid" type and may be part of a generalized condition, or it may be localized to the feet. X-ray photographs seldom show more than some bony rarefaction, and the outstanding feature is stiffness due to infiltration and contraction of the periarticular tissues. Manipulative treatment should be used with caution, but in selected cases it may give great benefit. By a careful combination of manipulation, physiotherapy, and suitable footwear it should be possible to make every patient at least tolerably comfortable, while a number can be freed of all symptoms for many years.

* Read in the Section of Orthopaedics at the Annual Meeting of the British Medical Association, Dublin, 1933.

FLAT FEET

Painful low-arched feet do not present a problem greatly different from other cases of painful feet, but there is such confusion of thought on the subject of flat feet generally that it requires separate consideration. The foot is designed with multiple bones and joints which give it a considerable range of movements under active muscular control. The posture of the foot within this range of movements is normally determined by its muscles. The ligaments play no part in the maintenance of posture, and only serve to check the extremes of movement. The foot is usually described as having two "arches," the one longitudinal between the os calcis and the metatarsal heads and the other transverse across the metatarsal heads. In a normal foot the existence of these "arches" depends entirely on muscular action. The arches can be raised and flattened at will, and if they cannot be flattened the foot cannot be regarded as normal. This is well seen in ballet dancers who have been trained from early childhood and have retained supple feet; when examined standing with muscles relaxed their feet are absolutely flat, but preparatory to and during movement the arches are very apparent. The customary method of judging flat-foot by examining the extent of contact of the sole with the ground gives a fallacious result. Judged by this standard flat-foot is a natural condition, not a pathological one. It only becomes pathological when the instep cannot be raised either because the foot is stiff or because of inadequate muscular control.

The shape of the foot, like any other part of the body, is subject to a wide range of variation, but the high arch which is often regarded as normal is largely the product of modern conditions. The stiff shoes we wear restrict mobility and allow the foot to stiffen, the shape of the shoes tending to cause an arched position. The ligaments and periarticular tissues contract, thus limiting the range of movements until eventually it is no longer possible to flatten the foot. If in these circumstances the muscles become tired or their action is for any reason inhibited, the weight of the body falls on the contracted tissues, which are stretched and give rise to pain. The treatment of such a condition is obvious as soon as the mechanism of its production is appreciated. The foot must be mobilized and its range of movements restored. It is only temporizing to fit arch supports which, even if they give relief at first, will in the end aggravate the trouble by causing further restriction of movement and consequent stiffening.

There is a large group of cases often labelled "flat-foot" but more accurately described as "valgus foot," in which the forefoot is pronated and everted at the mid-tarsal and subastragaloid joints, so that an appearance of flat-foot is given. There are several causes of the condition. One is weakness of the invertors of the foot, and treatment should be directed towards strengthening these muscles. Arch supports do not correct the deformity, but some strain may be taken off the muscles by wedging the soles of the shoes. Another cause is contraction, not infrequently congenital, of the calf muscles inserted into the tendo Achillis. The foot should be able to dorsiflex to form an angle of about 80 degrees with the leg in order to permit normal walking, so a comparatively small limitation of this movement is of importance. Such a patient overcomes the disability when walking by everting the forefoot, but the foot returns at once to a normal posture when the ankle is plantar-flexed. It is of importance to recognize these cases because the foot itself is perfectly normal. It is the calf muscles that are at fault, and the treatment is to stretch or otherwise lengthen the tendo Achillis or, alternatively, to abolish the need for full dorsiflexion by wearing high heels. Chronic foot strain is particularly apt to occur in cases of "valgus foot,"

because of the unusual stresses which arise from the constant misuse. It should be treated by manipulation, and steps should be taken to correct the deformity and prevent recurrence of the strain. It must be emphasized, however, that it is the chronic strain and not the deformity itself that calls for manipulation.

Patients with "flat feet" come under observation either for cosmetic reasons or because they have pain. The former should be carefully examined to determine whether they have "valgus feet" or whether they have normal mobile feet perhaps with inadequate or unbalanced muscular development, and the appropriate remedial measures should be instituted. In the latter cases the pain arises as the result of chronic foot strain, which, however, is more common in medium or high-arched feet than in low-arched feet. This is because the medium or high-arched feet have become partially fixed in their contracted position, and any subsequent muscular failure or unusual strain will cause the feet to flatten so that the contractions are placed under tension. There is only one rational treatment for chronic strain in any type of foot, and that is mobilization by manipulation.

END-RESULTS

I have carried out a "follow up" of patients who have received manipulative treatment in the orthopaedic department of the Middlesex Hospital and in my private practice. In all, 146 consecutive patients were communicated with and 100 results obtained, seventy-two patients being seen personally and twenty-eight replying by letter. The results in these 100 cases have been classified as follows:

Cured, no further foot trouble of any sort	75
Much improved, usually free from pain, but occasionally get tired or aching feet	19
Improved	5
Unchanged	1
	100

Chronic Foot Strain

There were thirteen cases of chronic arthritis, the remainder being classed as chronic foot strain. There is a considerable difference between the results in these two groups, which are therefore separated. The following results and all figures hereafter refer only to the eighty-seven cases of chronic foot strain.

Cured	72 = 83%	Improved	1
Much improved	13 = 15%	Unchanged	1

There were seventy women and seventeen men, and there was no appreciable difference between the results. Age had no influence on the results. It so happened that all the twelve patients under 20 and ten out of the eleven patients over 50 were cured.

The mobility of the feet was the most important single prognostic factor. The more mobile the feet to start with

Mobility	Number Treated	Result			
		Cured	Much Improved	Improved	Unchanged
Good	26	25 = 96 per cent.	1	—	—
Fair	37	32 = 86 per cent.	5	—	—
Bad	24	15 = 62 per cent.	7	1	1
	87	72 = 83 per cent.	13	1	1

the better were the results. This is only to be expected, for in mobile feet there is probably only a single adhesion causing pain, while in stiff feet there is a more general periarticular contraction. The degree of mobility has been classified into good, fair, and bad; this is quite an arbitrary division, but it should be fairly constant for one observer.

The disability suffered by the patient had no influence on the results, but it is interesting to note that there were thirteen non-arthritis who had been obliged by pain to give up their work. Treatment gave ten cures and three cases much improved. With one exception these patients were back at work within a month of manipulation. The duration of symptoms varied from a few weeks to several years, but this was without prognostic significance. Over half the cases came for treatment within three months of the onset of symptoms, but nearly a quarter waited for over a year.

The site of the lesion can often be accurately determined as, at any rate in the early stages, each group of joints has its own localization of symptoms. As time passes, however, the pain and aching spread diffusely over the whole foot and up the leg, but even so the primary site can usually be found.

Site	Number Treated	Result			
		Cured	Much Improved	Improved	Un-changed
Mid-tarsal	43	36	6	—	1
Internal lateral ligament	11	10	1	—	—
External	8	8	—	—	—
Anterior metatarsalgia ...	12	8	3	1	—
Others and unknown ...	13	10	3	—	—

The mid-tarsal joints, those between the os calcis and the cuboid and between the head of the astragalus and the scaphoid, are the most commonly affected joints and account for about half the cases in this series. Pain is usually referred to the inner border of the foot and, on examination, is produced by full inversion or eversion. These patients usually complain that they have flat feet or that their arches are dropping, and they have nearly all tried arch supports of some kind without obtaining permanent relief. The results of manipulation are almost uniformly good if only the patients can be persuaded to throw away their supports and maintain the suppleness and improve the strength of their feet by exercises.

Chronic strain of one or other of the lateral ligaments of the ankle-joint almost invariably follows an acute strain—it may have been months or years previously—which has been neglected. Pain and tenderness are located in front of the malleoli, and pain is produced by passively stretching the ligament. There were nineteen cases in this series, and they were all cured except one, which was much improved and would probably have been cured by further manipulation.

Anterior metatarsalgia is pain under the heads of the metatarsals, usually the outer metatarsals. It is due to misuse of the foot caused by ill-fitting shoes, minor deformities, or even a chronic strain in some other part of the foot. As Bankart has pointed out, the first metatarsal is a large strong bone designed to transmit the body weight; the other metatarsals are slender bones which serve to maintain balance. The latter are quite unsuited for weight-bearing, and if too much weight is constantly placed on them pain is sooner or later bound to result. In support of this view it may be noticed that in these cases it is almost invariably found that the outer sides of the shoes are worn down, while the inner part under the big toe is unworn. The shape of certain types of women's shoes is a common cause of anterior metatarsalgia. Those with a high Louis heel are especially bad offenders; they are usually shaped so that the sole slopes directly as a continuous inclined plane from the back of the heel to the ball of the toes. There is nowhere for the heel to obtain a purchase; the foot slides into

the shoe, the toes are cramped up, and the whole body weight has to be borne on the heads of the metatarsals. Shoes can be designed to overcome this trouble without any loss of elegance. It is only necessary for the heel of the shoe to be made more or less parallel with the ground so that there is a flat surface for the heel to stand on.

Chronic arthritis is used here to include all types of arthritis except that affecting only the big toe-joint and causing hallux rigidus, and also excepting tuberculosis and gout. There were thirteen patients in this series; three were "cures," while six were much improved and four improved. It is necessary to exercise care in selecting cases for active treatment, as indiscriminate manipulation may do more harm than good. In a mild case with but little damage to the articular cartilage it may be possible to restore normal function to the foot. In more severe cases, however, the object of manipulation is to give sufficient movement to the feet to prevent constant tension on the infiltrated and contracted periarticular tissues.

MANIPULATIVE TECHNIQUE

An anaesthetic is essential to successful manipulation in all but the slightest cases, as complete muscular relaxation is required. A straight gas is enough for a simple case, but more severe cases need rather longer time than is given by gas alone. The amount of force used by the manipulator is considerable, but, if the feet are very stiff, it is not advisable to do too much at one sitting, because the bruising and reaction may then be so great as to make it impossible for the patient to maintain the improvement, and fresh adhesions will form. It may be necessary to manipulate the feet two or three times to restore the full range of movements; the amount to be done each time can only be judged by experience. After-treatment is an integral part of all manipulative therapy. It consists of massage and exercises to ensure that the whole range of movements gained by manipulation is maintained without the adhesions re-forming, and to strengthen the muscles of the feet, thus protecting them against fresh injury.

Manipulation should be performed in a controlled manner, avoiding sudden jerking movements which are necessarily uncontrolled. The operator's elbows are held close to his sides, and power is obtained from his whole body weight. First, the knee is flexed, the foot is grasped just below the ankle with one hand, and the leg held above the knee with the other. Traction is then made in the direction of the long axis of the leg; this slightly separates the joint space of the ankle, and permits a small amount of antero-posterior and lateral movement. Next, with the knee still bent, the ankle is fully dorsiflexed. The knee is now straightened and held steady by an assistant. The leg is still held above the ankle with one hand, the forefoot is grasped with the other, and full plantar flexion, inversion, and eversion are obtained. If necessary greater power can be brought to bear on the astragalo-cuboid ligaments and the lateral ligaments of the ankle by holding the heel with one hand, the mid-tarsal region with the other, and adducting or abducting the foot round the thumbs as a fulcrum. The grip is now shifted so that the foot is held with one hand on each side of the line of the tarso-metatarsal joints, and, while tension is maintained to open up these joints,

movement can be obtained by pressure of the fingers and thumbs. Finally, the toes are manipulated, but if they are really stiff damage can easily be caused unless proper attention is given to technique (a point which applies equally to the fingers and the knees).

The metatarso-phalangeal and the interphalangeal joints are usually described as ginglymus or hinged joints. This is not a good description, because their movement is really a circular gliding movement about a circle with a centre nearly half an inch proximal to the joint surface (Fig.—A). A common method of manipulating such a joint is to bend it about the point B. This is not a natural movement, and, if forced, can only result in breaking something. The correct method of manipulating a metatarso-phalangeal joint is as follows. Fix the metatarsal head between the fingers and thumb of one hand, grasp the toe with the fingers of the other hand, placing the thumb on the dorsum of the base of the first phalanx. Now pull in the direction of the long axis of the first phalanx to separate the joint surfaces and stretch the lateral ligaments. While still maintaining traction push downwards with the thumb on the base of the phalanx, thus causing it to slide round the head of the metatarsal in the natural way.

I wish to express my thanks to Mr. Blundell Bankart, to whose teaching I owe my interest in manipulative surgery, for permission to refer to the cases treated in the orthopaedic department of Middlesex Hospital.

Memoranda

MEDICAL, SURGICAL, OBSTETRICAL

PLEXIFORM (CIRSOID) ANEURYSM OF THE SCALP

The above condition, although uncommon, is of importance because of the annoyance and danger it may entail for the patient and the difficulties and disappointments it may bring the medical attendant. Undue encouragement is not given by the standard modern surgical textbooks to those about to undertake its treatment, nor is optimism as to the outcome very marked. References in the literature to its occurrence in various parts of the body are not infrequent, but personal experience in the practice of individual surgeons is probably not great. Some notes of an apparently successfully treated case may therefore be of interest.

CASE RECORD

A man, aged 26, was referred to me on account of a vascular swelling on the forehead, which he had had as long as he could remember. It was slowly increasing, and gave rise to no pain. He had taken an active interest in such games as football, so far without detriment. Two enlarged supra-orbital veins were very evident in the forehead, and just inside the hairy scalp almost in the mid-line was an elongated, rather tortuous, pulsating swelling about $3/4$ in. in width and 2 in. in length. The hair was thinned over it, and no naevoid formation was visible. The swelling could be emptied easily by pressure. A systolic bruit was audible over it. Pulsation appeared to be stopped completely by firm pressure on the superficial temporal arteries at the zygoma and on the supra-orbital and frontal arteries at the superior orbital margin. Treatment by injection of coagulant substances was considered, but not adopted because of the large veins and their communications indirectly with the cavernous sinus. Operative treatment was advised, and the patient was admitted to the National Temperance Hospital. On re-examination of the shaved scalp the condition appeared to be more extensive than at first estimated, and opinion was more guarded as to the ultimate result of treatment by ligature, although control of pulsation was still obtainable by pressure upon the arteries, as described above.

Operative Treatment

On November 1st, 1932, ligature of both superficial temporal arteries at the level of the zygoma and of all the obvious pulsating feeding vessels on each side and posteriorly was carried out through short incisions. The vessels were defined by blunt dissection after division of the scalp, doubly ligatured with strong chromic catgut, and divided between the ligatures. The vessel walls appeared to be thinned and were easily torn. Where tearing occurred bleeding was stopped by passing a suture around the vessel with a round-bodied curved needle. At the end of this procedure there was doubtful pulsation in the aneurysm, but at the first dressing after operation there was neither doubt nor optimism, for pulsation was as free as ever.

In these circumstances further operation was advised—excision, if at all possible, being in mind—and was undertaken a week later. A rubber tube was applied as a tourniquet around the head just above the auricles. A rather narrow flap containing the aneurysm, and having its base anteriorly about the margin of the hairy scalp, was now outlined by a horseshoe incision down to the pericranium. There was a free flow of blood from an unexpectedly large number of wide-mouthed, thin-walled vessels on both margins of the wound in spite of the tourniquet. The bleeding was easily controlled by the application of Sargent's scalp forceps, and the flap was turned forward. The forceps had been applied to the posterior and outer margin of the wound in the first place, and, as a consequence, the aneurysmal cavity had been allowed to empty and its definition was far from easy. The site of the aneurysm was incised from the deep aspect of the flap through the occipito-frontalis aponeurosis. The cavity was opened up and a director and the finger introduced. It was only then that its complexity was appreciated. It appeared to twist about in various planes of depth in the scalp, recalling the complicated tracks of some ano-rectal fistula. It was laid open—just as the latter are—and the mouths of the feeding vessels sought and surrounded from the inside by chromic gut sutures. The upper ends of the large draining veins were surrounded by ligatures passed from the deep aspect of the flap, and the open mouths of all vessels visible on both margins of the original incision were similarly dealt with. The tourniquet was released, and with a feeling of considerable relief one found that only a few bleeding points remained to be secured, none being in the aneurysmal cavity. The flap was replaced and sutured in position with silkworm-gut.

Further Progress

Two days after this operation the flap, forehead, and eyelids were swollen, but there was no return of pulsation. By November 15th the swelling was gone for the most part, and half of the stitches were removed. On November 17th the remaining stitches were taken out, and the patient was allowed home on November 19th. Except for a feeling of faintness at the early dressings, and in preparation for return home, convalescence had been uneventful. On December 2nd the flap was still a little swollen but was firm, and no pulsation or bruit was detectable. On April 13th, 1933, all scars were sound and not noticeable, there was no pulsation, and the hair had grown thickly over the flap where it had been thinned before operation. The former large veins in the forehead were now apparent only immediately after stooping. On June 21st the scalp, apart from scars, was normal, and showed no sign of return of pulsation or swelling. The large veins in the forehead were still apparent after stooping.

DISCUSSION

The typical appearance of the disease in the scalp is as described in the above case. It usually occurs in the branches of the superficial temporal artery.

It has been suggested that this condition arises—sometimes, at any rate—in naevoid tissue. It consists of thin-walled varicose arterial channels which communicate directly with large veins, often associated with naevoid tissue. It has a great tendency to increase in size, to recur if removed, and eventually to communicate with channels in the skull bones. Treatment advised ranges