From a series of several hundred examinations of the urine my experience has been that T.N.T. is normally present (Webster's test) when a worker is in contact with this substance, and that instead of this being a danger signal, as has been held, it is on the contrary normal and quite compatible with good health; it is not found in the urine of patients suffering from toxic jaundice.

REFERENCE.

¹ Sodium bicarbonate is recommended by Dr. W. H. Willcox for the treatment of toxic jaundice due to tetrachlorethane, BRITISH MEDICAL JOURNAL, February 26th, 1916.

ACUTE METATARSAL OVERSTRAIN (FOOT-SWELLING).

By A. ROCYN JONES, M.B., B.S., M.R.C.S.,

ACTING SURGEON AND SURGICAL REGISTRAR, ROYAL NATIONAL ORTHOPAEDIC HOSPITAL.

ACUTE overstraining of the metatarsals is one of the disabilities to which the marching foot is subject, and even before the war was being increasingly recognized by the military surgeons of the large conscript armies of the Continent as a lesion to which their recruits were liable. The complaint was first described in 1855 by Breithaupt, who gave it the name of "foot-swelling," and attributed it to injury of the metatarso-phalangeal joints and tendinous sheaths. This was the accepted explanation until 1887, when the French surgeon Pauzat, in a very striking paper, suggested periostitis of the metatarsal bones as a cause. Pauzat's explanation still holds good for some cases, but with the advent of *x* rays in 1897 fracture was revealed, and in the *Revue d'Orthopédie* of September, 1898, there is an excellent skiagram by Maunoury of Chartres, showing fracture of the third metatarsal with characteristic callus formation.

The following case illustrates the typical signs and symptoms of overstrain:

W. T., aged 28, entered the army in October, 1914. During his training in England he frequently fell out on the march because of sore feet, but was never completely off duty for this trouble. On May 24th, 1916, he was sent to France, and remained a few days at a rest camp. On May 28th he marched six miles, and at the end began to feel pain in the left foot. Next day he marched another ten miles, after which the foot, being swollen, was bandaged. The following day he again marched a few miles, and both feet became swollen and painful. He was sent to a field ambulance, and thence down the line. He was admitted to the Royal National Orthopaedic Hospital on June 15th, bearing a card with the provisional diagnosis of trench feet.

The feet were swollen, and he complained of pain across the anterior part of the dorsum of each foot, particularly the left. He had distinct pes planus, but, owing to the pain, he objected to any attempt at manual inversion. He was kept in bed and the feet were massaged. At the end of ten days he was allowed up; there was a recurrence of the pain, which he persisted in

An outline drawing of a skiagram showing the three inner metatarsals of a soldier's feet. There is a marching fracture of each second metatarsal with characteristic callus formation.

localizing at the anterior part of each foot. An *x*-ray picture, an outline drawing from which is here reproduced, showed a fracture of each second metatarsal bone just behind the head, with considerable surrounding callus, that on the left being the more exuberant and therefore possibly explaining the greater tenderness on this side. The patient was kept off his feet completely for one month, and during this time was given massage and hot air. He was then by easy stages allowed to get up, and six weeks after admission he could walk with comfort. To prevent relapse it was thought advisable to add a transverse

"football" bar across the sole of each boot, well behind the position occupied by the heads of the metatarsals, to take the weight for the time being off these heads, and for the planus a valgus wedge and prolonged heel were added. He was then transferred to a convalescent hospital.

It is very seldom that marching fractures occur in both feet as in this case. Of 575 cases collected by Nion in two only were both the second metatarsals affected, in one both the third, and in one the second and third. Rarely are there two fractures in the same foot; in the same series four times only were the second and third metatarsals broken and once the second and fourth. Acute metatarsal overstrain is practically confined to the three middle metatarsals. I can find no recorded instance of fracture of the first metatarsal due to marching, and fractures of the fifth are commonly the result of accident due to sudden throwing of the body weight upon the inverted foot. Usually one foot only is affected and usually only one bone; Nion gives the proportions of 112:98:17 for the second, third, and fourth metatarsals respectively. That some bones are more frequently involved than others is due to their anatomical disposition and the relative parts they play in bearing the body weight. The great diversity in the strength and projection of the metatarsal bones is readily apparent on examination of a large number of skiagrams. It seems that the head of the fifth always projects least and the fourth next, but that the projection of the heads of the three inner bones is subject to much variation. The third head may reach the same level as, but never exceeds, that of the second, and either or both of these bones may extend beyond or fall short of the first. The second metatarsal bone is more subject to variation than any other; it may be the strongest, next to the first metatarsal, or it may be the weakest. On the other hand, the third metatarsal is always a weak bone. The metatarsals as a whole are so arranged as to complete the anterior portions of the longitudinal and transverse arches of the foot, the second and third occupying the highest plane. At their bases they all unite with the tarsus, but the first has the widest range of movement, the fifth next, and the fourth next, whereas with the second and third, as Hepburn points out, "an extremely powerful interlocking of parts is provided which places any marked independent movement of these metatarsal bones entirely out of the question." Again, in the *x*-ray picture of a normal foot it will be seen that the second and third metatarsals are practically parallel, and run in a strictly antero-posterior direction, whereas the others radiate obliquely forward.

This disposition of the bones provides for the transmission of the body weight by the astragalus along a line passing through the second metatarsal head.

When standing the weight is borne by the two feet, the chief points of support in each foot being the os calcis, the shaft and head of the fifth metatarsal, and the head of the first metatarsal. During ordinary walking, however, the main points of contact with the ground are continually changing. First the heel is brought down, then the sole, and then the body is levered forward on the metatarsal heads. During this last part of the step the four inner metatarsals and their toes are the chief points of contact, with the second and third forming the most direct anterior supports of the longitudinal arch of the foot, and consequently subject to very direct pressure. That this is so is shown by the boots of people with normal feet, from which it appears that the sole is most worn about the middle, at a point corresponding with the heads of the second and third metatarsal bones. Frequently there is also a callosity in the corresponding position on the sole of the foot. It is during the successive weighting of the metatarsal heads that overstrain is produced. The feet of the vast majority of recruits quickly accommodate themselves to the rigours of route marching, but occasionally there is a breakdown, either in the direction of flat-foot or metatarsal overstrain, or both. In these the extra loading due to the pack, the fatigue induced in the small muscles of the foot, and the roughness of the ground traversed are cardinal causes. With every unevenness of the ground the sole of the boot becomes slanting, and the tendency is for the mid-metatarsus to become more heavily weighted, and occasionally one bone more burdened than the others. This is further promoted by the lessened co-ordination between the metatarsal bones as the result of tired muscles and the generally diminished sensibility of the foot induced

by fatigue. The frequency of fracture of the second and third metatarsals is due to their commonly slender length, their fixity, their direct forward projection, their lie in the transmission line of body weight, and the part they play in the leverage action of the foot. The fourth is less often affected because it is more mobile, and subject to less direct stress; the first escapes because of its strength and mobility, while the fifth, which is fairly strong and mobile, likewise escapes because it is the least strained during the forward lifting of the body.

In the diagnosis it should be remembered that the usual history given is that the symptoms developed gradually during a march, and that rarely is there any account of the accident. The pain is localized to the metatarsus, and by running the fingers along the bony shafts a very sensitive spot will be found in one of them. If a fracture occurs discoloration of the skin due to extravasation of blood may be present, and possibly crepitus elicited. Swelling of the foot is usually a prominent feature, whence the name "foot-swelling," given to the complaint when its pathology was still uncertain. The diagnosis can only be definitely established by the *x* rays. A skiagram may show a fracture and possibly even callus formation, the break generally being in the anterior half of the shaft. If there be no fracture, periostitis may be present, shown by vagueness or irregularity of outline, or swelling of the shaft of the bone. In this connexion it is interesting to note that Momburg found in some old-standing cases definite spindle-shaped thickenings of the shaft of a metatarsal, and he also notes thickening of the compact bone at the expense of the cancellous tissue by a process of osteo-sclerosis. These osseous thickenings may occur by way of compensatory adaptation in the feet of soldiers who have never complained of any symptoms or of any unusual difficulty in marching. It may be mentioned that statistics show that troops drawn from mountainous districts suffer less from metatarsal overstrain than those from the lowlands, for hill climbing tends to strengthen the metatarsus and pedal muscles, and possibly to promote a better power in dorsiflexing the foot. This climbing influence is best seen in Alpine guides, who usually have an extreme range of movement at the ankle-joints.

The broad lines of treatment have already been given in the case quoted—that is, complete rest off the feet for four weeks and the application of massage and hot air. The heating chamber should be at a temperature of 300° F., and the limb well protected by wool and flannel bandages; the treatment should occupy from thirty to forty minutes daily. As an alternative treatment passive hyperaemia may be adopted. A Martin's bandage is applied around the leg just above the ankle, so as partly to obstruct the venous flow from the foot. The bandage should be arranged so as to cause no discomfort, and the foot must feel warm during the whole sitting. This treatment should be applied at first for an hour daily and gradually extended to several hours; at Spandau it is even persisted in for twelve hours continuously.

At the end of one month, or less in the case of periostitis, the patient is allowed to get on his feet gradually. Ten days after this, if there is no pain and no swelling, he is allowed to walk freely. In the case of fracture, the transverse "football" bar, referred to above, is worn for a few weeks, and may then be discarded. Care should be taken that a properly fitting boot is provided. The present army boot is a fairly good shape and it has to be strong, but one sometimes sees, after much wear, either a distorted upper or a "rocker" sole—that is, a sole which is extremely convex from front to back. These faults, which interfere with the proper play of the toes, are easily remedied by stretching and straightening the shoe on a last.

I am indebted to Dr. R. L. Rawlinson for enabling me to examine a large number of skiagrams.

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THE French Government has decided to establish a school of medicine at Dakar, French West Africa, on the same lines as those already in existence in French Indo-China and Madagascar.

THE VALUE OF AMYL NITRITE INHALATIONS IN THE DIAGNOSIS OF MITRAL STENOSIS.

By R. A. MORISON, M.D., LIEUT. M.R.C., U.S.ARMY.
(From the Military Heart Hospital, Colchester.)*

MITRAL STENOSIS develops insidiously and symptoms of a really incapacitating nature are frequently absent until the lesion is well advanced. In soldiers it is often discovered accidentally during the routine examination of a man reporting sick for a trivial complaint. In young soldiers, when very early and uncomplicated, it is unaccompanied by subjective symptoms which characterize the state.† The number of border-line cases seen appears to be remarkable, until it is remembered that the strains to which the men are subjected are precisely those calculated to call forth symptoms in early cases. Advanced mitral stenosis has been largely kept out or sorted out of the army, and patients who suffer from "irritable heart" in the absence of structural change very frequently present such signs as accentuation of the first heart sound, accentuation or reduplication of the second heart sound, signs which are credited with significance in the early diagnosis of mitral stenosis. In dealing with military patients a clear decision is most desirable; it is imperative when, in sorting cases bearing cardio-vascular diagnosis, tolerance of exercise is largely relied upon.‡ Men with structural heart disease are to be guarded against over-exertion. We may take a diastolic (presystolic) rumble or thrill, or both, to be the most positive and convincing sign of mitral stenosis, and it is at present inadvisable to diagnose this lesion in the absence of such a murmur. Any method, therefore, which accentuates such a murmur, or discovers it, must be of considerable value.

Amongst patients who fall near the diagnostic border-line (a border-line which it should be clearly understood varies according to the skill, experience, and opinion of the observer) there are a number of patients who present no suggestion of mitral stenosis when they are examined standing, but who present unequivocal signs while lying down; there are a number who present inconclusive signs of stenosis while standing, but signs of stenosis become clear on lying; still a further number who exhibit no conclusive signs standing or lying, but in whom the diagnosis is no longer in doubt while they lie after exercise. At the Military Heart Hospital at Colchester all cases are auscultated standing and lying, and lying after exercise, and a considerable number of presystolic murmurs are detected which would otherwise escape observation.

Amyl nitrite is used as a further test in doubtful cases; its action, like that of exercise, is to increase the flow of blood through the A-V ring, a change which favours the production of the murmurs in question. We desire to give our early impressions of the experience with amyl nitrite. The observations are not based upon *post-mortem* evidence, but upon the assumption that a clear presystolic murmur signifies stenosis in the absence of aortic disease. On that assumption, it is clear to us that amyl nitrite will often bring to light a clear presystolic or full diastolic murmur in a patient lying on his back, who had exhibited no murmur previously, and will thereby render an early mitral stenosis diagnosable.

In twelve cases in which presystolic murmurs were suspected, but in which they could not be recognized with any degree of certainty, amyl nitrite (inhaled from a 3 minim capsule until a reaction was evident) brought forth unmistakable murmurs in six instances. Amongst the first signs of early mitral stenosis is an accentuated first sound; from this sign the sounds pass to a simple reduplication with accentuation; to perhaps a triplication, and thence to what may, or may not, be termed a murmur, according to the idiosyncrasies of the examiner.

The point which is to be emphasized is that amyl nitrite, in a large proportion of cases, will raise the scale of the signs, bringing them nearer to a point where a diagnosis becomes certain.

* Observations undertaken on behalf of the Medical Research Committee.

† The actual proportion of clearly diagnosable mitral stenosis amongst such patients is approximately 4 per cent.

‡ It is inadvisable that the exercise tolerance tests should be applied in mitral stenosis, and those who suffer from this lesion are to be sifted out.