machine or operator, and cases are then sent to the gymnastic instructor, who begins with three tables of carefully compiled exercises, starting with half an hour's repetition of such simple movements as raising the heels, turning the head, and bending the arms and trunk, going over the body region by region in a definite progression. Here the wounded man is joined by cases of shock who are able to do only the lightest exercise, by men whose neurasthenia, enteric, or dysentery has left them profoundly debilitated, and slowly they progress through this light physical training from stage to stage until they are able to march in quick time, to bend and twist, and use their arms freely. When they are able to do all these movements they are promoted to full physical training, which introduces quick and active movements, running, jumping, and gymnastic games teaching alertness, control, and agility; walking balanced on raised beams, or lifting their feet high as they go through wire entanglements, climbing walls and leaping ditches. Parallel with this course goes graduated walking on level and then on hilly ground, starting with a mile or two at the patient's own pace, and even with the help of a stick, progressing to three or four miles, and graduating finally into the full route march at quick time.

The patient who can do his full physical training and full route march is ready for the final stage of hardening in which he does the full table of exercises required of

FIG. 8.—Machine for circumduction of the ankle. The patient is seated with the foot strapped to the foot-piece. The movement of flexion and extension is given at the joint between the foot-piece and the wooden upright. A movement of eversion and inversion is given between the wooden upright and the gas pipe into which it is inserted. The foot-piece is attached to a crank coming from a shaft which supports a heavy fly-wheel. This is driven by a flexible driving rod terminating in a handle which is turned by the patient himself, or by the operator. The extent of the movement is determined by the length of the crank that receives the foot-piece.

the trained soldier, and a twelve or fifteen miles march in full kit. This test is necessary, for sometimes it is only when the kit is put on that the healed scar or old fracture becomes painful.

Many cases of disordered heart action can be brought up to the full physical training but not into it. After the first day of it their pulse, which has been brought down to a normal of 80 by faradism or subthermal baths and rest, and which remains undisturbed after a gentle slow walk, jumps up to 120 or 140, and can only be reduced by a reduction of the amount of work required. Several cases were brought up to this point on three or four occasions and had to be returned to lighter duty. Not more than 30 per cent. succeeded in passing into Class A. This experience has also been shared by some cases of shock, and bronchitis following exposure to gas is frequently re-awakened by the forced effort of running or jumping, and many cases of frostbite that are quite able to walk a mile or two find themselves unequal to a forced march, and have to be left on light duty.

We shall in future be able to refer suitable cases to the special hospitals now in course of organization for the treatment of different orthopaedic cases, obscure and puzzling nervous conditions, and for the thorough and minute study of the heart, where individual attention can be paid to cases that would otherwise have to be taken in groups.

A glance at the final result obtained in a command dépôt will, I think, show how thoroughly justified the Director-

General has been in establishing them in spite of the difficulties met with in manning and equipping these great camps.

At Heaton Park an analysis of all classified cases sent out up to date shows that out of all men discharged,

Nearly 50 per cent. have been rendered fit for active service, and have rejoined their units in the fighting line.

About 15 per cent. have been sent to lines of communication abroad.

About 15 per cent. have been sent to useful work of a sedentary character at home; and

Over 20 per cent. have been discharged as permanently unfit, many of these being untreatable from the first.

The average time of each man spent in treatment was well under three months, and the fact must not be lost sight of that, even though a man is not sent back in category "A," his opportunities for a useful career in civil life after the war have been enormously increased and the burden on the nation in future pensions correspondingly lightened.

Note.—I wish here to acknowledge the assistance of Captain A. E. Barclay, R.A.M.C., whose help in time, ideas, and money made it possible to make the experimental machines for corrective exercises, and to thank Dr. H. J. Seuwen for notes on cases under his immediate charge for electric treatment, and Dr. Frank Ratcliffe for special and valuable assistance in observing cases under treatment by hydrotherapy.

REFERENCE.

¹ BRITISH MEDICAL JOURNAL, 1916, vol. i, p. 319.

TRISMUS DURING SERUM SICKNESS (SEPTIC FINGER).

By R. F. BOLT, M.R.C.S., L.R.C.P.,
CAPTAIN R.A.M.C.(T.C.).

As the occurrence of trismus fourteen days after the infliction of a wound is calculated to give rise to great anxiety, not to say alarm, I think the following case may be of interest.

An officer of the Royal Army Medical Corps, doing duty at a casualty clearing station, pricked his right index finger on March 1st while operating on a case of empyema the result of a gunshot wound of the chest. On the following day his temperature rose to 102° F., and the finger was incised. On March 3rd a dose of 18 c.cm. of antistreptococcus serum was injected into the right flank. No antitetanic serum was injected. In the evening his temperature rose to 104° F. On the next day the temperature was 102° F., and it fell to normal on the following day.

On March 7th he was transferred to a general hospital, where he came under my care. On admission the wound in the finger was healed. There was a tender enlarged gland in the right axilla. The temperature was normal and remained so for seven days. The gland subsided. He was up and going about and was marked fit for a convalescent home, but on March 14th an urticarial rash appeared on the arms and chest and abdomen. On March 15th the rash was distributed generally over the body; there was severe headache, and the temperature rose to 100° F.

On the morning of March 16th the temperature rose to 102° F., and he had great pain in the neck, back, and limbs. He complained of stiffness in various muscles; there was also some rigidity, especially in the right upper limb. The lower limbs were drawn up and could not be fully extended. The metacarpo-phalangeal joint of the right middle finger was swollen and very tender. He was given a mixture containing sodium salicylate and sodium bicarbonate, 20 grains of each, to be taken every four hours. There was profuse sweating, the eyes were congested, and the same evening trismus developed; the teeth could only be separated by a quarter of an inch. There was no sore throat and no local inflammatory condition of the jaw or mouth.

The case was seen in consultation by Colonel A. Fullerton, A.M.S., and Major A. E. Webb-Johnson, R.A.M.C. The possibility of the symptoms being due to tetanus was seriously considered, but it was decided that, as the patient was already suffering from serum sickness, it was not advisable to give antitetanic serum, but that other methods of treatment should be tried. Accordingly the patient's room was darkened, and he was kept very quiet. He was given 20 grains of chloral hydrate at 7 p.m., and again at 11 p.m. The pain continued, and he was given $\frac{1}{2}$ grain of morphine at midnight. The sodium salicylate and bicarbonate mixture was continued.

On the morning of March 17th he was a little better; the temperature was 102° F., the trismus was less marked, and the pain was subsiding. Chloral hydrate (20 grains) was repeated every four hours alternately with the sodium salicylate mixture during the day. There was still considerable anxiety as to

whether the symptoms were due to tetanus or whether they could not be entirely accounted for by serum sickness.

On March 18th the trismus had almost disappeared and the muscular pains were less severe. He had one dose of chloral hydrate (20 grains) during the day. On March 19th he could open his mouth to the full extent. The temperature was normal and the pain disappeared. Further progress was rapid and satisfactory. He was allowed up on March 23rd, and went to a convalescent home on March 25th.

If the symptoms were due to tetanus the infection might have taken place at one of the following times:

1. When he pricked his finger. Inquiry showed that the patient on whom the operation for empyema was performed made an uneventful recovery. But as he had received an injection of antitetanus toxin it is possible that tetanus bacilli were present in the wound.

2. When the finger was incised. This is almost unthinkable at a place where there is constant operating and a regular surgical technique.

3. From the needle, when the antistreptococcus serum was injected. This is also unthinkable.

4. The serum might have contained some tetanus toxin. This is possible, but unlikely, otherwise one would expect to have heard of other cases of a similar character.

The course of the symptoms and the rapid recovery point to the condition having been due entirely to the antistreptococcus serum.

I am indebted to Lieutenant-Colonel T. H. Goodwin, C.M.G., D.S.O., R.A.M.C., for permission to publish this case.

BABINSKI'S SIGN FROM THE POINT OF VIEW OF COMPARATIVE ANATOMY.

Abridged from a Paper by

M. ASTWAZATUROF, M.D.,

CONSULTING PHYSICIAN TO THE NERVOUS DEPARTMENT OF THE NICHOLAS MILITARY HOSPITAL, PETROGRAD.

In a series of papers published in the Russian *Journal of Psychiatry*, Petrograd, I have brought forward arguments showing that in the explanation of symptoms observed in lesions of the pyramidal tracts it is necessary to call attention to some facts of comparative anatomy.

About twenty years ago Babinski enriched the symptomatology of nervous diseases with a very important sign, the causation of which remains hitherto unexplained.

To say that the extensor plantar reflex is a spinal reflex, while the normal plantar reflex is a cortical one, is no solution of the problem. Such a statement contains no clearing up of the nature of the phenomenon and is but a paraphrase of the question. In fact, the sign of Babinski is somewhat enigmatic; it is neither an exaggeration nor an abolition of a function, but an inversion of it. We must search for some special mechanisms which, being latent in the normal subject, are set in action by a lesion of the pyramidal tract—that is, when the communication between the spinal cord and cerebrum is interrupted.

What is the nature of these mechanisms? A reply to this question is hinted at by the fact that the extensor reaction of the great toe is a quite normal phenomenon in infants who have not learnt to walk. Thus the sign of Babinski appears to be a normal phenomenon during a period of the ontogenetic evolution of man. Hence it can represent a rudimentary function, which is common to an earlier period of phylogenetic evolution, and being manifest in man during a certain period of his ontogeny, becomes latent in the adult individual, to reappear again in the case of lesions of the pyramidal tracts.

To prove the supposed rudimentary nature of Babinski's sign we must consider whether there are facts supporting the assumption that a lesion of the pyramidal tracts is a condition generally suitable for the appearance of any rudimentary signs.

In its long way of evolution from a lower metameric animal to the highest mammals the nervous system has undergone great and complex changes of structure and function. There is, however, a part of the nervous system which, in spite of these great evolutionary variations, has retained its essential anatomic and functional features. This part is the "propriospinal" apparatus (*Eigenapparat des Rückenmarks* of Edinger). Even in the high stages of evolution it remains metameric in structure and reflex in function.

According to Edinger, there are to be distinguished in the central nervous system two parts essentially different from the point of view of their phylogeny—the neencephalon and the palaeencephalon. The increasing functional and structural complexity of the nervous system consists in the overgrowing of the neencephalic—that is, pallial—elements and in the adaptation of the palaeencephalic elements to new functional purposes. In man the neencephalon is represented by cortex and its projection fibres. In the spinal cord of man the part corresponding to the palaeencephalon is the grey matter with its metameric reflex "centres," whereas the white matter of the cord belongs to the neencephalon, and consists of fibres of the neencephalic elements penetrating into the spinal palaeencephalon to communicate with the neencephalon (cerebral cortex). The metamerio spinal segments, thus connected by the pyramidal tracts with the cortex, gradually lose their pure reflex function to stand under the control of the neencephalic impulses—that is, to serve the purposes of voluntary innervation. In addition, the metameric nerves become combined in groups to form plexuses. The first rudiments of plexus formation are observed in the Selachia in the form of the "nervus collector," by which the metameric nerves are connected; in the Selachia, also, we meet the first traces of the neencephalic elements of the cortex.

Thus the propriospinal apparatus, without losing its essential character (reflex action), transmits the cortical impulses to the groups of nerves (plexus) by means of which these impulses spread further to muscles. By this combination of metameric nerves into groups a possibility is created for "neencephalic" innervation of groups of muscles (voluntary movements of extremities). Thus, instead of metameric reflex innervation, arises voluntary innervation by segmental groups of nerves. To get this result the neencephalon suppresses the reflex action of the propriospinal apparatus (cortical inhibition), this latter becoming appropriated to the transmission of the impulses, not from one segment to another, as in lower metameric animals, but to the whole groups of segments according to the groups of the muscles of the extremities. This influence of the neencephalon on the propriospinal apparatus is realized in the main by means of the pyramidal tracts.

In a lesion of the pyramidal fibres—that is, in a case of separation of the propriospinal apparatus from the neencephalic elements of the cortex:

1. The voluntary impulses cannot reach the periphery, whence arises paralysis or paresis.

2. The inhibitory influence of the cortex on the propriospinal apparatus ceases—thence appear: (a) the increase of reflexes, the clonus; (b) the propagation of the reflex irritation from segment to segment in form of "réflexe de défense" and analogous symptoms (the pandiculation of Bertolotti, femoral reflex of Remak, etc.).

3. Lastly, there arise some reflex reactions corresponding to some earlier stage of phylogenetic evolution. These reactions are nothing but effects of mechanisms latent in normal cases and manifesting themselves in the case of loss of the cortical influence on the spinal cord.

And so Babinski's sign comes into existence; the normal flexion of the great toe is neither exaggerated nor diminished after a lesion of the pyramidal tract, but is inverted into an opposite reaction of the extensor type.

We will now try to explain the origin of Babinski's sign from the point of view of the evolution of the function of the great toe. The normal plantar reflex, that is, the synergic flexor reaction of all five toes, is a function peculiar to man. The lower extremity of man, with its purely static function, is evolved from an extremity with the function of grasping. In the act of grasping, the great toe makes no flexion, but a movement of opposition. The transition from the grasping function to the purely static function has been realized by the loss of the function of opposition. In man, unlike almost all other primates, the opponens hallucis muscle is absent, and the first os metatarsale is situated parallel to the other metatarsals, while in the other primates the first metatarsal makes an angle with the others. When, in the process of evolution, the grasping function is lost, there remains in the second, third, fourth, and fifth toes an aptitude for flexion, while the great toe loses its function of opposition absolutely. But for the act of walking a function of the synergic flexion of all five toes together is necessary. This act, as