after ovipositing, the eggs are usually fertile; where flies do not lay their eggs all at the same time, they do not succumb till some days later and the chances of their eggs maturing is much lessened.

Examples.

In the third generation of laboratory-bred flies, one fly hatched on January 18th, 1914, and died on the 25th of the same month, having completed oviposition, a length of life of seven days; from her eggs 40 larvae hatched on February 1st and 2nd—that is, all eggs were fertile. Another fly of the same generation, hatched on January 19th, 1914, laid eggs from the 28th of the same month for some days; the first lot of eggs produced 2 larvae on February 3rd, and the fly died on February 5th. Here out of all the eggs only 2 were fertile.

The longest life of a fly in these experiments was 25 days, and all her eggs were unfertile.

The average length of life of female tame flies is 12.5 days, of males 4 days.

The average longevity of both sexes of wild flies in captivity has been worked out at 4.2 days, and is inferred to be one half the viability. In this experiment, which was continued for a month, the true viability works out at 8.4 days.

On warm sirocco nights the flies appear just before sunset; leaving their haunts, they are attracted to inhabited dwellings, where they cause annoyance by their persistent biting. Flies bite both warm and cold blooded animals. At sunrise they disappear, either to their breeding haunts, which they can be seen to enter, or they retire to dark corners of rooms, where they are to be found seeking shelter behind hangings; on windy nights they do not leave their haunts. The flies dislike sunlight, but are attracted by artificial light, and are to be found in considerable numbers on and around paraffin lamps.

The only way in which the distance of their flight has been worked out has been from a knowledge of the habitats of the different species—that is, knowing that *P. papatasi* bred out in a certain cave, it was found that this fly was present in dwellings within fifty yards of the cave, but only rarely beyond this limit. They do not fly high, and the top rooms of houses which are not shut in by high walls are comparatively free from flies.

In the course of breeding experiments it has been found that abnormalities occur, the most noticeable being varying degrees of malformation of the male claspers, up to complete transposition of superior and inferior claspers. At present the males are identified by their claspers and by the number and arrangement of hairs thereon; these minute details being inconspicuous characters are stated to be uninfluenced by adaptation; however, the fact of these abnormalities occurring is rather against such a classification. Among the females there is a gradual loss of fertility, due probably to in-breeding; the eggs of such flies assume abnormal shapes, but the pattern of the reticulations does not appear to be altered.

The fly possesses one fairly common ectoparasite, a mite, which hatches out in the woodlouse excreta, and is to be found hanging on to the thorax of the fly; apparently it is not a true parasite, as it lives in dishes in which no flies have been present and it does not injure the larval stage. On the other hand there is a minute pseudoscorpion which does injure the larval stage.

Work is being done on the bacteriology of the various stages. Mention will here be made of a fungus only. This fungus is pathogenic to the fly and is provisionally called *Empusa papatasi*. A fly so infected is recognized by the fact that ingested blood appears to remain in the thorax, causing it to appear nearly as red as the abdomen. On dissection of such a fly the salivary glands show motile forms, "swarm spores," whilst the mycelial form is seen in the intestines. When such an infected fly is dipped in absolute alcohol and flamed till the wings and legs are burnt off and is then emulsified in 10 per cent. citrate, a flocculent growth is obtained, consisting of mycelium and spores. Subcultures from the citrate on to Sabouraud's medium and on to glycerinated egg medium give rise to a white fungus; in this stage spore formation is by intercalary formation. When the growth in citrate is subcultured into N.N.N. highly motile forms are seen, corresponding to those seen in the salivary glands. Experimental inoculations with the motile forms into rabbits and guinea-pigs give rise to symptoms. The white fungus under certain conditions gives rise to yellow bodies (ascospores); here apparently spore formation is by aecogenous segmentation, which would allow of its being

included in the Entomophthoreae, to which family the *Empusae* belong.

In conclusion, it is thought advisable to make a note of the effects of inoculation, as this *Empusa* appears to have pathogenic properties, and involuntarily the thought arises that it is quite possible that the *Empusa muscae domesticae* may be the cause of infantile diarrhoea.

NOTES ON THE TRANSPORT OF CASES OF FRACTURED THIGH.

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THE provision of satisfactory methods of fixation for cases of fractured femur has proved most difficult in the present war.

It is not surprising that adequate results have not always been secured in these cases, for all the appliances in common use for fractures of the femur have been developed in order to deal with cases under stationary conditions and, in general, for simple fractures.

It is true that reasonable comfort of the patient is usually secured by the administration of morphine. On the other hand, in the later course of these cases a good many amputations have been necessary, and the mortality has proved surprisingly high. It seems probable that the complications of severe infection and haemorrhage—both reactionary and secondary—should be attributed in some degree to the unsatisfactory fixation of the injured limb during the necessary period of transport. Laceration of muscles and vessels is bound to occur under such conditions, and, unless efficient extension is exerted on the limb, any wound, unless very large, becomes plugged by ruptured muscle. This obstruction to free drainage in the early days of the injury obviously assists the development and spread of any infection present in the wound track.

It is noticeable that the patients themselves seldom complain of great discomfort during the journey. This is undoubtedly due to regular and proper use of morphine. Yet the position of the limbs in such cases by the time they reach the base generally leaves much to be desired. The foot is usually rotated inwards, and the thigh is commonly telescoped owing to the lack of proper extension.

I propose to show that the method in common use of fixing these cases in some form of long outside splint is not satisfactory, and that in the majority of instances a modified form of Thomas's knee splint gives much better results.

Requirements to be Fulfilled.

If one defines the ideal requirements of a method of fixation suitable for use in the transport of these cases from the field ambulances to the base and thence to England, one would set down the following requirements—the first four apply to the present conditions in relation to the rapid handling and transport of large numbers of wounded; the last two are more purely surgical:

1. The splint should not be cumbersome, and should be standardizable.
2. The standard pattern should be easily adapted to all varieties of individual cases.
3. The application of the splint should be simple, and effected with the least possible disturbance of the patient.
4. After application of the splint, movement of the patient and his transfer from stretcher to bed should not displace the splint.
5. The apparatus should secure steady extension in the long axis of the limb; the fulfilment of this requirement presupposes fixation in the natural position, and secures the comfort of the patient.
6. When the splint is in position, access to any part of the limb for the purpose of changing dressings should be possible. Nursing duties should be rendered simple.

At the present time, for the transport of cases from the front to the base, an interrupted or bracketted long outside splint with an adjustable foot-piece is generally used. If one compares the features of this apparatus with the

standard above set out, it may be said to conform to the first requirement, and very imperfectly to the second.

As to the third, in order to apply the splint, considerable movement of the patient's body is involved, and to fix it properly an anaesthetic is necessary.

It very frequently fails to comply with the fourth

Fig. 1.—The skeleton splint, padded.

requirement in practice, as the upper end of the splint tends to rotate forward on the trunk.

The fifth important requirement, of extension of the limb, is seldom attained with this splint; theoretically it is effected by the use of a perineal band, but this appliance is usually very uncomfortable, and seldom efficient in its action; moreover, the fixation of the thigh is not in the natural position—any outside splint is bound to lateralize the fragments. The splint is firmly attached to the foot and leg, and so to the lower fragment, but as its hold of the upper fragment and trunk is at the best approximate, and is often unsatisfactory, such an arrangement often fails to prevent rotation of the foot and lower section of the leg.

As to the sixth requirement, of accessibility, the fixed interruption by no means gives free access to all wounds, while the splint is in position. The use of the bedpan is an awkward problem.

Method Recommended.

I will now detail the features of the modified Thomas's knee splint which I described in the BRITISH MEDICAL JOURNAL (May 15th, 1915). This splint is made from the standard aluminium material supplied in the regulation

Fig. 2.—The splint padded and with slings in position for application.

field fracture box. It has, with slight modifications, been in use for the majority of the cases of fractured femur admitted to this hospital since January last, both for their treatment here, and for their transfer to England.

Reports of the medical officers of hospital ships, and from the hospitals at home, support the value of the method.

The form of the splint is shown in the figures (Figs. 1, 2, and 3). As before described, it is made by joining together two standard lengths of splinting suitably bent. The only material addition is that of a wide based prop, attached as shown in figure. This prop is bent, when necessary, so as to project inwards and downwards, so that, in spite of the sagging of the canvas of the stretcher, no rotation of the splint takes place.

Jaconet covering of the tow padding on the crutch has not proved durable. If, instead, a length of Paul's indiarubber intestinal tubing is rolled on like a cricket bat handle, the result will be found good.

As stated in the first article, for application of the extension stirrup, a plaster-of-Paris bandage gives satisfactory results, but if that or an ordinary adhesive extension are not available, a simple anklet strap will give sufficient hold for a few days.

This splint will be found suitable for use in any case of fractured femur in the lower four-fifths of the thigh.

One can enumerate its claims to comply with the above requirements as follows:

1. The splint is made and its application can be completed from the materials supplied in the Standard Field

Fracture Box, with which all the units concerned are equipped. One of two standard sizes of the splint can be adapted to fit any case. A certain stock can be made and padded ready for use in times of pressure.

2. The malleability of the material and the system of staples by which the pieces forming the splint are joined together make it possible to fit any case accurately.

3. For the application of the splint the only movement of the patient called for is a slight raising of the injured leg from the stretcher. The application is completed in two or three minutes as follows: An extension stirrup is fixed to the injured leg; long axis traction is then made on the limb, and it is steadily raised through about 30 degrees. The splint, with slings in their approximate place, is then laid below the leg, the crutch of the splint is bent open, and made to abut against the ischial tuberosity. The limb is then lowered on to the slings. The crutch is moulded round the hip and the lateral limbs of the splint are bent in so as to support the leg evenly. A webbing strap is applied round the bottom notch of the splint and the extension stirrup. The slings are then adjusted so that the limb lies comfortably in

Fig. 3.—The splint applied. The extra strap passing across the front of the thigh is unnecessary.

about the midplane of the splint. Two webbing straps are carried across the front of the limb, one between the extremities of the crutch and the other just below the knee. These two straps need only be tight when the patient is being moved about or rolled on his side for dressing; the extension strap should always be kept taut.

4. The splint does not become readily displaced when once applied if the above directions are carried out—the continuous fixed extension, acting between the notch of the splint and the stirrup and countering against the ischium, makes a single manageable unit of the limb and splint.

5. As above described, steady fixed extension in the natural line of the limb is provided. The amount of tension necessary to secure the limb for transport is not very great, but sufficient pull to prevent any shortening of the leg during treatment is easily obtained. The position of the leg in the splint is the natural one, and so lateral displacement of the fragments cannot occur. The question of flexion of the fragments is alluded to below.

6. Dressing of wounds in any part of the leg is easily accomplished owing to the detachability of the slings and the ease with which the patient can be rolled on his side. The side members of the splint can be bent so as to avoid

Fig. 4.—The splint applied and held in flexed position.

any lateral wound. Use of the bedpan is simple owing to the mobility of the trunk.

As before stated, this splint is suitable for fractures in the lower four-fifths of the femur. For injuries near the hip-joint it can be used if there is no wound where the crutch would lie. The latter, so long as it bears centrally on the tuberosity of the ischium, can be bent downward or arched forward in order to avoid wounds in its vicinity.

In some cases of high fracture, flexion of the upper fragment of the femur may be present, though this is not as common in gunshot injuries as in those due to indirect violence. For purposes of transport this will not affect the satisfactory action of the splint. In such cases, when the patient is stationary, the fragments can be brought into line by bending the splint at the level of the knee as in a Hodger's splint. The leg should thereafter be suspended, as in fact it usually is during hospital treatment in straightforward cases.

REMARKS ON THE MOVEMENT OF THE DIAPHRAGM IN EARLY PULMONARY PHTHISIS.

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A DIMINUTION in the extent of the inspiratory depression of the diaphragm accompanies many diseases of the lungs and pleura, including pulmonary phthisis. This loss of movement in tubercle occurs at an early stage on the affected side, and is known as Williams's sign. It is by no means universal.

1. The origin has been attributed to several causes, and it will be profitable, in the first place, to subject each of these to a brief examination. (a) It is assumed that there is a diminished power of retraction or loss of contractility in the tissues of the implicated lung. (b) The diaphragm may be intimately connected with pleuritic adhesions, which hinder its excursions. (c) The terminal branches of the vagus are involved, being unduly exposed to the effects of pressure or strain. A reflex follows which inhibits inspiratory movements or stimulates broncho-constrictor fibres. (d) The phrenic nerve becomes invested in pleuritic thickenings at the apex of the lung. This idea was more acceptable some years ago, when hilum phthisis was little regarded. (e) Toxaemic conditions arise as the result of the disease.

2. *Average Position of Diaphragm.*—In the erect posture the highest point of the arch in front lies near the upper border of the fifth right and lower border of the fifth left rib. In recumbency the position is slightly higher—namely, the lower border of the fourth right and upper border of the fifth left rib. Behind on standing, the level is about the lower border of the ninth right and lower border of the tenth left rib; in the horizontal position the lower border of the eighth right and lower border of the ninth left rib. In quiet normal breathing the amount of movement is practically half an inch; in deep inspiration about two inches, being rather more on the left side in both conditions.

3. A reduction in the amount of shortening, after extension of the elastic fibre, or a condition of atony in the unstriated muscle will be followed by an increased volume of the lung, since the force of contraction of the diaphragm during the act of inspiration, which opposes the stretching of the elastic tissue, will be less restrained. On relaxation, moreover, the vigour of the elasticity which apparently assists in the preservation of the convex outline of the diaphragm being lowered, the height of the latter is diminished. The neutral position will be depressed, and during quiet breathing the excursions will be deficient. But there is no such general downward displacement of the diaphragm; on the contrary, it may be somewhat higher during the pause than in the normal. A jerky or stammering movement is occasionally observed. In some endothoracic growths—lymphosarcomata, etc.—at times an expiratory fluttering also is noticed, and some of these cases appear to exhibit a diminished elasticity.

4. Diaphragmatic pleurisy manifests itself either as a marked prominence in the curve during inspiration, or as a series of small irregularities in the contour. But in

cases where Williams's sign is obvious the shadow of the diaphragm is often quite smooth and regular.

5. The vagus is a nerve endowed with great possibilities. The area of its distribution is extensive, and it is the motor (cranial autonomic) as well as the sensory nerve of the lung and pleura. It transmits from afferent end organs—the nature of which is still unknown—inspiratory and expiratory impressions to the medullary respiratory centre. It is possible that the inspiratory inhibiting impulses differ from the purely expiratory. When the central stump of the vagus is excited with weak stimuli inspiratory movements are inhibited, partially or completely, producing either small movements or—in a condition of narcosis—complete cessation of respiration with the thorax in a state of passive expiration.¹ It has also been suggested that the nerve-endings of the vagus may become hyperaesthetic in inflammatory conditions like pneumonia,² and produce rapid breathing by affecting both halves of the respiratory centre. Where small unilateral lesions exist a similar condition of hyperaesthesia of the terminal fibres may arise, producing a greater reaction during the inspiratory dilatation of apical alveoli; or vagal branches caught in diseased and enlarged glands within the hilum and along the extra-pulmonary bronchi may be subjected to increased pressure or tension during the same phase of respiration. The vagus also contains broncho-constricting fibres. Afferent impulses from the nasal mucosa produce reflexly broncho-constricting effects. In the same manner irritation may be transmitted from sensory areas of the lung and pleura. On the other hand, efferent vagal branches, situated in the immediate vicinity of enlarged glands, may be affected directly by pressure. Irritation of the sympathetic (dorso-lumbar autonomic) is followed by bronchial dilatation. It is also conceivable that excitation of afferent vagal branches during inspiration, either by pressure of glands or on account of pleuritic adhesions at the apex, might induce a reciprocal expiratory reflex with cessation of the inspiratory act before its full completion is reached.

6. Paralysis of the phrenic on the same side has been mentioned. But the effect of division of the nerve results in a unilateral paradoxical movement of the diaphragm; moreover, it is difficult to see why the nerve should be implicated at all. Conditions of toxæmia would influence both sides equally and indiscriminately.

7. The elasticity of the lung appears to play a passive part only in the act of expiration.³ During this phase a hardening of the upper part of the rectus may be felt.³ When a healthy individual is breathing quietly and deeply, the extent of movement of the diaphragm can be estimated by means of the fluorescent screen. If now, after a long pause following expiration, both mouth and nostrils are closed, and an attempt be made to inspire, the halves of the diaphragm move scarcely at all, or move in the reverse direction (paradoxical movement). There is an inhibition of the diaphragm, due, it has been asserted, to the production of a negative pressure within the pleural cavity. As a matter of fact, this negative pressure is produced by the contraction of the inspiratory muscles themselves, and is the effect, not the cause. On further investigation it will be found, first, that the sterno-mastoids, scaleni, and intercostals harden, and the muscles closing the glottis also come into play; secondly, that the auxiliary muscles of expiration commence to contract, and, so far as can be ascertained by the fingers, at the same period of time. These are the recti, obliqui, and inner intercostals. Moreover, both sets of muscles continue to contract with the perseverance of inspiratory effort, so that there is here no question of reciprocal reflex action. The result must be an inhibition of the diaphragm.

It is an error to suppose that the auxiliary expiratory muscles are easily exhausted, since in reality the recti and obliqui, at least, pass into a state of tonic activity whenever the erect posture is assumed and maintained. In cases of unilateral extensive pleuritic adhesions, hypertrophy of the abdominal muscles on the same side is sometimes observed. These facts may assist in the explanation of certain signs of early phthisis, and of the behaviour of the diaphragm in the various types of pneumothorax.

8. In the hilum and peribronchial phthisis of children there is occasionally noticed towards the end of a deep inspiration an apparent retraction—really an incomplete expansion—of the lung on the diseased side. This is