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 (dorsolumbar 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

most apparent in the two upper interspaces near the sternum, and has been termed the dimpling of the hilum.⁴ At the same time the scalmi and sterno-mastoid of the same side—incidentally of both sides—may be seen to contract. Simultaneously, with care, a unilateral hardening of the rectus and obliqui may be felt. This sign may be suggested as a test for the determination of the presence of incomplete expansion of the lung. A sudden rigidity of the intercostals may also occur (Pottenger's sign of early phthisis). In conditions of insufficient pulmonary dilatation there appears to be a struggle between opposing muscular groups—the sterno-mastoid, scalene, external intercostals and diaphragm on the one hand, and the rectus, obliqui, and internal intercostals on the other.

9. In hilum phthisis some impairment of expansion exists at least in the terminal areas supplied by the three chief upper bronchi. These should correspond to the inner and outer ends of the superior interspaces anteriorly and to the apex of the lower lobe behind at the fourth rib, near the spine of the scapula. In ordinary and in stereoscopic radiograms we have been able to trace conspicuous linear shadows to these three areas.⁵ In addition to venous and lymphatic stasis induced by the pressure of enlarged glands (often the right tracheo-bronchial group) on vessels at the root of the lung, there may be a condition of partial atelectasis in these situations produced by pressure on the bronchial wall. Before the absolute termination of a deep inspiratory movement, when the limit of expansion is prematurely reached, the auxiliary inspiratory muscles are called into activity, but their contraction will be readily overcome by the auxiliary expiratory muscles, since the inspiratory impulse is now on the wane and rapidly approaching its normal conclusion. In other words, if mechanical conditions forbid further dilatation, the expiratory muscles contract forcibly. The resistance of the chest to further expansion probably excites end organs within the tendons of the inspiratory muscles, the effect of which leads to the reflex contraction of the recti, obliqui, and others. Moreover, in a similar manner, a very small difference of pressure within and without the lungs renders inspiration impossible.⁶ Dr. Steuart, late chief assistant in the x-ray department at St. Bartholomew's Hospital, found in some cases, which exhibit the sign, if the breath be held for a few seconds after a deep expiration, the movement of the diaphragm in the succeeding inspiration is apparently normal.⁷ The explanation appears to be that during the longer pause the blood within the centre itself becomes increasingly loaded with carbon dioxide, so that the next inspiratory discharge becomes excessive. Reinforced by the inspiratory reflex from the pulmonary vagus itself this is able, under suitable circumstances, to overcome any expiratory muscles which might otherwise prove efficacious in curtailing the diaphragmatic movement. If the experiment fails, a real mechanical hindrance to full dilatation is present.

10. It has been stated that when the locus of disease is situated posteriorly, the diminished excursion is more evident in the dorsal half of the arch.⁸ In other words, the spinal part is affected more than the sterno-costal. The muscles which oppose the crural fibres may be the deeper muscles of the back and possibly the quadratus. In any case, the effect of this reflex must be a reduction in duration and amplitude of the ordinary inspiratory wave, and its object the attainment of a definite measure of rest and protection for the diseased area of the lung.

NOTE.—In this communication the occurrence of an early expiratory reflex (proceeding from nerve-endings of the vagus in alveoli or in unstriated muscle in the manner described) is not sufficiently emphasized. The necessary condition is the presence of diseased and hypersensitive areas within the lung. Actual proof might be afforded by the determination of the time relations of the antagonistic muscles by means of tambours and a revolving drum. When the loci become quiescent, the second and later expiratory reflex, under suitable conditions, would still persist.

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BETA-NAPHTHOL POISONING OCCURRING DURING THE TREATMENT OF ANKYLOSTOMIASIS.

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AN obvious instance of this complication has recently been the subject of inquiry at Sandakan, British North Borneo. As it is only one of a series coming under the writer's notice, the time is apparently ripe for a word of warning.

Beta-naphthol was introduced at a much later date than thymol and eucalyptus, Nicol probably being one of the first to use it on a large scale in Natal (*Transvaal Medical Journal*, June, 1910). Beta-naphthol was particularly welcomed as by reputation it was safe, and in 1911 it was common to see it exhibited in the Federated Malay States in three doses of 20 grains each, preceded and followed by Epsom salts. Among thousands of cases treated with these doses, in the writer's memory only one fatal case occurred. Of late, however, it has become the fashion to use it in enhanced doses, three portions of 30 grains each being quite usual, and even larger being exhibited by some. We are inclined to deprecate such large doses as a routine administered by dressers in native hospitals. In the fatal case about to be recorded the medical officer, had he been at hand and able to see the patient two or three times daily, would have reduced the dose. I may add that two other fatal cases have come under my notice, though, unfortunately, notes were not recorded; both resembled the present case very closely.

L. T., a Chinaman, 28 years of age, was admitted on August 26th, 1914, into the Gaol Hospital, Sandakan, for a trivial abscess on the knee, and being somewhat anaemic his faeces were examined for ova, the result being recorded as follows: Ova of *Ankylostoma*, of *Clonorchis*, and of *Trichuris trichiura*. On the same evening 5 grains of calomel were given. Half an ounce of Epsom salts was administered two days later, and on August 29th 30 grains of beta-naphthol were taken at 7 a.m. and at 9 a.m., and again at 11 a.m. At 1 p.m. the patient took Epsom salts, and the resulting stool contained seven ankylostomata.

The treatment was repeated on August 30th. When the dresser visited the hospital at 7 a.m. on August 31st the patient was given his first dose of the beta-naphthol mixture, but as he began to vomit shortly afterwards the second and third doses were not administered. Whenever the gaol dresser has finished his morning duty he leaves, in order to take up the non-working hours at the Sandakan Civil Hospital—namely, 11 a.m. to 2 p.m. and 4 p.m. to 7 p.m. This being the case, second and third doses are left in charge of an attendant, who in this instance did quite correctly in not giving the second and third doses, but unhappily did not mention this fact to the medical officer nor call his attention in any way to the patient.

At 6 p.m. another dresser was at the Gaol Hospital and recorded the patient's temperature as 102.8° F. On the morning of September 1st the fever had fallen to 99° F. Vomiting continued, the urine became extremely dark in colour, and slight jaundice showed itself. In the morning the medical officer found the patient in so collapsed a condition that $\frac{1}{10}$ grain of strychnine was ordered at 11 a.m., 4 p.m., and 9 p.m. The temperature in the evening, however, again rose to 101° F., and in the early hours on September 2nd the patient died.

On the bed head ticket being examined, it was found that, as usual, before such treatment the urine had been tested, the record being: Specific gravity 1010, acid, cloud of albumin.

It is felt that the presence of albumin is of paramount significance, as it was also found in the other fatal cases mentioned above.

At the post-mortem examination it was found that the liver weighed 3 lb. 5 oz., was deep yellow in colour, and contained numerous *Clonorchis sinensis*. The right and left kidneys weighed respectively 4 and 5 oz. The capsule peeled off without tearing the tissue beneath. The most characteristic feature was the colour of the cortex on section. It had much of the aspect of the liver itself, though it was less deeply stained and was rather narrow. The cut surface was quite dry, and appeared somewhat fatty. A sample of urine which was removed after death