

developed after admission to this hospital in three cases, in all of whom fluid in the chest had been reported from France. In one case only was it found necessary to remove the foreign body from the lung. In all of the cases, except two, the physical signs were quite typical of the condition which was supposed to be present. In both of the cases which presented atypical signs there was increased vocal resonance and tactile fremitus over the abnormal area. All the other physical signs were those which are considered the classical signs of pneumothorax. It was difficult to account for these abnormal findings. In both of these cases there was only a partial collapse of the lung. In the series there was one other case of pneumothorax. There was complete collapse of the lung in that case. At first there was absence of tactile fremitus and vocal resonance. Later there developed slight expansion of the lung and a distinct increase of both of these signs over the normal side.

The progress of the physical signs was carefully noted in relation to the improvement or otherwise of the patient's condition, and in regard to his ability to accomplish physical work. But it soon became apparent that little or no information of value as to this point could be obtained by percussion or auscultation. The most significant finding was the development in a varying degree of a distinct physical deformity, which progressed without any change in the physical signs except those revealed by inspection. This deformity was manifested in various ways. It varied from a simple muscular atrophy with or without pronounced drooping of the shoulder girdle, to conspicuous contraction of the chest wall, with curvature of the spine.

In order to obtain reliable and comparative records of the progress of this deformity it was necessary to adopt more accurate methods than those of ordinary inspection. It was found impossible by observation alone to detect any change of less than  $\frac{1}{4}$  in. in the relative levels of the shoulders, and this was particularly difficult in estimating the improvement or otherwise in the condition. Therefore a height gauge was devised. This consisted of an upright or standard with two sliding arms, as shown in fig. 1. The patient was placed

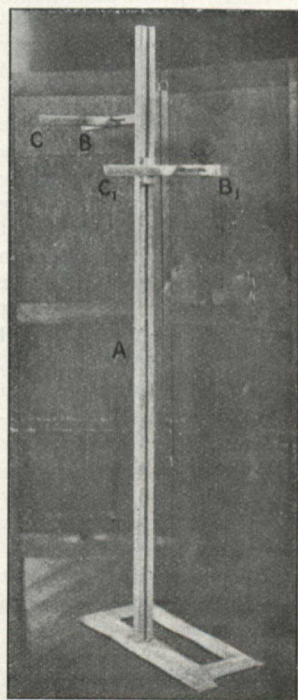


FIG. 1.

in front of this, and the standard (A) was aligned with the axis of the spine. The arms (B and B1) were then adjusted in such a manner that the wedge-shaped pointers (C and C1) rested exactly on the acromioclavicular articulation of each side. On the back of the standard a scale in inches indicated directly the difference in level between the two shoulders.

It was also difficult to determine the shape and relative size of the two sides of the chest, and any changes which might subsequently occur. Therefore a cyrtometer was employed, and the outline of the chest transferred to a large piece of paper. These outlines were then reduced to half-size by means of a pantograph, and filed with the case sheets.

The deformity frequently appeared very early. The earliest was recorded two

weeks after the date of injury. The first manifestation is a muscular atrophy about the points of injury. This may progress in a varying degree, so as to involve all the muscles of the chest wall and the shoulder girdle. It may even extend to the deltoid and muscles of the upper arm of the injured side. As a consequence of this atrophy an early droop of the shoulder becomes apparent. The further deformity follows upon a falling-together of the ribs, which may be finally accompanied by curvature of the spine. At any stage the progress of the deformity may cease.

The determination of the cause of this deformity was recognized as of first importance. In view of the fact that the missile traversed, in all cases, the chest wall, the pleura,

and the lung, it seemed probable that the deformity was the result of the injury to one of these.

In so far as could be determined, direct injury to the muscle produced in itself only slight atrophy, which was confined to the single muscle injured. In cases where the ribs were fractured without signs of the involvement of either the pleura or the lung, any deformity which occurred was strictly dependent upon the local condition. If there had been loss of portions of the ribs, or if the fracture was not in proper alignment, a local deformity of greater or less extent naturally occurred; but if there was no loss of rib substance and the fracture was in good position, no deformity ensued. Furthermore, an analysis of the site of the wound showed that it was immaterial whether the injury was above or below the third rib, as there was practically an equal prevalence of deformity in either case. In no case did any general deformity result unattended by signs of disturbance of lung or pleura.

With regard to injury of the lung tissue, it was found that the presence or absence of a history of hæmoptysis gave no indication as to the future presence and degree of deformity. Likewise in those cases in which the foreign body was retained in the lung substance, this did not appear to have any influence on its development. In so far as local collapse of the lung was concerned, in no case did this occur without a history of the co-existence of either fluid or air in the pleura. In fact, there was no evidence that injury to the lung tissue *per se* had any influence on the development of the deformity.

On examining into the degree of disturbance of the pleural cavity, it was found that in 94 per cent. of the sixteen cases where the pleura was free from all evidence of disease, little or no deformity occurred. In one case the patient suffered from an infected bomb-wound just below the middle third of the right clavicle, which had necessitated an extensive incision through the pectoral muscles. This had healed by secondary intention, and the ensuing contraction of the scar had produced considerable deformity of the right shoulder. The general deformity in this case is accounted for by a strictly localized condition.

TABLE II.

Deformity	Pleura free Per cent.	Hæmorrhax Per cent.	Pneumothorax Per cent.	Pneumothorax Per cent.
Nil ...	57	39.5	7	0
Slight ...	37	39.5	40	50
Moderate ...	6	6	26.5	16.6
Conspicuous ...	0	15	26.5	33.3

It will be seen in Table II that there was a progressive diminution in the number of cases exhibiting no deformity, and increase in those which did, depending upon the manner in which the pleural cavity was involved.

The cases of hæmorrhax presented two well defined classes, determined by the absence or presence of fluid in the pleura when they came under our observation. The former class comprised twenty-five patients. All of these gave a history of hæmorrhax, but in none of them were there signs of fluid after an average period of three weeks from the date of injury. Among these no instance of marked deformity developed. It was at first thought probable that these cases might have suffered from only a small hæmorrhax, and this might have accounted for the fact that no deformity developed. But in fourteen of the cases aspiration had been performed one or more times, although only in six of these was the amount recorded. It averaged about 800 c.c. (240 c.c. to 1,800 c.c.). One of these cases was wounded on August 12, 1917, in the left intercostal space in the axillary line. On the 15th 500 c.c. of blood were aspirated. Another 500 c.c. were removed on the 18th, and on the 21st 800 c.c. more of bloody fluid were aspirated. On admission to this hospital on the 29th the physical signs were practically normal. No deformity developed in this case, except slight atrophy of the thoracic muscles of the back. Therefore this could hardly account for the absence of deformity. The latter class comprises eight cases, in each of which fluid was present when the patient was admitted to this hospital. In one of these the injury had occurred a week before. Shortly after admission 500 c.c. of bloody fluid was aspirated and the signs of fluid soon disappeared. This case did not develop any deformity.

In the other seven cases there were signs of a varying amount of fluid in the pleura, after several months had elapsed, since the time of injury. In three of them aspiration had been done some time before. In all seven cases pro-