With the exception of one patient who was treated with bovine tuberculin, Koch's new tuberculin was used in all the cases. In future tuberculin of bovine origin will be given a trial in a certain proportion of cases. This method of selection for treatment by tuberculin in cases of pulmonary tuberculosis has been found useful and practical. It is safe and easily applied in the ordinary routine of sanatorium work.

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CONTUSION OF THE LUNG WITHOUT EXTERNAL INJURIES.

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As it appears to be incredible to some that contusion of the lung may result from an accident without visible signs of injury to the chest wall, I think it well, before describing a case which recently came under my observation, and which resulted in an action under the Employers' Liability Act, to cite some of the authorities upon which I based the opinions which I expressed, and defended in the witness box, in respect to it. That the condition is recognized by the Registrar-General as a cause of death is shown by the fact that the phrase "Contusion of heart or lung without wound" is included in *The Nomenclature of Diseases*.

W. J. Walsham, in his *Surgery*, says:

Contusions of the lung without an external wound may be produced by a severe crush or blow upon the chest. The visceral layer of the pleura may or may not be lacerated. . . . Pneumonia or abscess or gangrene of the lung occasionally ensue" (pp. 398-399, ed. 1890).

Erichsen in his *Surgery* (vol. i, p. 829, ed. 1884) says:

Contusion of the lung without injury to the pleura covering it may happen from severe blows on the chest, as from falls from horseback or kicks on the side. It may be complicated with fracture of one or more ribs; but this is not necessarily a concomitant of the injury.

Stonham in his *Surgery* (vol. ii, p. 324, ed. 1899) says:

Contusion and rupture of the lung may result from simple concussion of the chest.

And further (p. 327):

Slight localized pneumonia may result from simple injury to the lung with or without wound of the chest wall. In such cases the inflammation is very limited in extent, produces few physical signs and but little constitutional disturbance. It may, however, be very dangerous in the aged or enfeebled.

Holmes in his *Surgery* (p. 204) says:

In severe contusions of the chest . . . the lung is sometimes lacerated without the chest wall sustaining any visible injury.

Osler in his *Principles of Medicine* (p. 109, ed. 1901) says:

"Contusion-pneumonia." Pneumonia may follow directly upon injury, particularly of the chest, without necessarily any lesion of the lung. Litten gives 4.4 per cent., Stern 2.8 per cent.

Taylor, *Medical Jurisprudence* (ed. 1844, p. 292), says:

The lung may sustain serious injury from a blow or fall, and yet there may be no external marks of violence or symptoms indicative of damage for some hours.

Hoffman, *Atlas of Legal Medicine* (Plate 13), says:

A direct contusion of the lung occurs, especially in cases of fracture of the ribs, but is usually accompanied by laceration of the pleura, and even extensive laceration of the pulmonary parenchyma, but may take place without such associated lesions.

If, then, we can place any reliance upon classical authors, it appears that:

1. There is such a thing as "contusion of the lung."
2. The lung may be contused without being lacerated.
3. Contusion or laceration of the lung may occur without there being any visible injury to the chest wall.
4. The lung may sustain dangerous injuries, and yet no alarming symptoms may show themselves for some hours.
5. Contusion of the lung may give rise to a dangerous form of pneumonia.

I will now proceed to describe my case.

History of Accident and Illness.

On September 11th, 1908, I was requested by my assistant, Dr. Allan, to see, in consultation with him, a man named P. McV. I saw him at about 12.30 p.m. He was quite conscious, and gave me his own account of what had happened.

He told me that on September 8th he felt quite well, and went to his work at about 7 a.m. He came home to dinner at noon, and returned to his work still feeling quite well. The accident occurred at 3.30 p.m. He was working on a roof and fell over a spar or beam of some sort on his right side. Not feeling very seriously hurt at the time, he continued his work until about 5.30 p.m., when he went home. By this time the pain in his side was so bad that he went straight to bed. Fomentations and such home remedies were applied, and the man remained in bed, gradually getting worse in his breathing until the morning of September 11th, when, his friends getting seriously alarmed, at last sent for my assistant. Dr. Allan informed me that when he first saw the patient he was lying on his left side in bed. His breathing was shallow and quick, and he complained of great pain in his right side, towards the base of the lung. The temperature was 103°, respirations 33, and the pulse 120, small and irregular. The heart sounds were audible but distant; there was no bruit. There was dullness at the right base. The tongue was dry and foul.

When I saw the man, a few hours later, Dr. Allan remarked that his condition seemed to have slightly improved. The decubitus was exactly as above described, and the patient still had the pain in the right side, but he said it was not quite so acute. The temperature was 101°, and the pulse about 100, but it was small and difficult to count. The heart sounds were scarcely audible, and there was marked dyspnoea. I could find no signs of external injury to the chest, except redness and tenderness on pressure over a region towards the base of the right lung, where the patient complained of the internal pain. There was marked dullness on percussion in this region, and râles could be heard on both sides of the chest, especially towards the upper lobes. The tongue was furred, and the eyes were bloodshot and somewhat jaundiced. The general impression was, a man in the second stage of pneumonia; the immediate anxiety was cardiac failure. The patient died at 2.30 p.m. the same day, exactly seventy-one hours after the accident.

In view of the recent accident I refused to give a certificate, and, by order of the coroner, the body was removed to the mortuary.

Necropsy.

An autopsy was conducted by my friend Dr. Bannister, in the presence of Dr. Allan and myself. There were no signs of injury to the thoracic walls, no ribs were fractured, there was no laceration of the soft tissues. The heart was flabby and light coloured.

Both lungs were more or less generally congested, and at the apices were a few very small scars, indicative of old headed tuberculous lesions. Extending inwards, from the surface of the lower lobe of the right lung, was a patch of red hepatization, about the size of the palm of the hand, and about one to one and a half inches thick. It was judged that this patch *in situ* would just correspond with the spot indicated externally by the patient as being the place where the pain was so acute and continual, and where he had received the blow in falling. The liver, kidneys, and spleen were somewhat congested, and the coats of the stomach reddened.

Taking all the circumstances into consideration, I arrived at the conclusion that the man died of pneumonia, secondary to contusion of the lung, contracted by the accident. This also was the verdict at the inquest, on which occasion Dr. Bannister was the only medical witness called.

An action for damages against an insurance company followed. The case was tried on November 16th, 1908, at Blackburn County Court by Judge Hamilton, assisted by Dr. R. Hunt as medical referee. The contention was that the man died from pneumonia following contusion of the lung caused by the accident. I was the first medical witness called, and maintained this opinion, in which I was supported by Drs. Bannister and Allan.

The defence was that the pneumonia was due to natural causes, and was a mere coincidence, that it could not have been due to the accident as there were no visible signs of external injury. This view was supported by Drs. R. A. Gray and Walter Rigby, the only medical witnesses called by the defence. The judgement of the Court was that there had been an accident, that the man died of pneumonia, and that the accident had nothing to do with it.

I will now capitulate the grounds on which I formed the opinion that the pneumonia was the result of the accident.

1. The man goes to his work in the early morning feeling perfectly well, comes home to dinner, and returns to his work feeling perfectly well. He falls and hurts his side, not very badly, as he thinks, and manages to finish his job, which is not a very heavy one; but by the time he arrives home, after about two hours, the pain is so bad he

goes straight to bed. He gradually gets worse and worse and dies just seventy-one hours after the accident. Before he dies it is found that he is suffering from inflammation of that part of the lung which exactly coincides with the site of the accident. All this is confirmed by an autopsy. I find that many eminent medical and surgical writers assert that pneumonia may be caused by such an accident. I naturally conclude that the pneumonia was caused by the accident in the present case.

2. It is well known that pneumonia proceeds in three well-marked stages—congestion, red hepatization, grey hepatization. According to Hamilton,¹ the stage of congestion lasts from twenty-four to thirty-six hours. The stage of red hepatization lasts from four to five days; moreover, the red stage is *crimson* red at first, and changes to a *granite* red as it is about to pass into the grey stage. Now, at the *post-mortem* examination the hepatization was crimson; it showed no sign of entering upon the grey stage. It seems, therefore, to be pretty certain that the patch of hepatization was not less than one or more than three days old. Now, if it was three days old, the man must have been suffering from pneumonia in the congestion stage for twenty-four or thirty-six hours *before* the accident; that is, all the time he was getting up early in the morning, returning to dinner, and doing his work, and feeling perfectly well, which seems to be highly improbable, to say the least of it. On the other hand, if the patch was only one day old, or less, then the pneumonia must have come on *after* the accident to which the man attributed the pain in the side, in which case it seems difficult to deny that the accident had anything to do with it.

Having given my reasons for connecting the origin of the pneumonia with the accident, it is now necessary to answer the main objection raised by the defence, namely, that it would be impossible for the lung to be injured by an accident which did not at the same time cause serious visible injuries to the chest walls.

The most striking answer to an objection of this sort is a case in point. Taylor² quotes the following case from the *Lancet* (November, 1842).

A young man, while riding, fell from his horse on his left arm. He complained of no pain for five hours, but in twelve hours he was seized with an alarming flow of blood from the mouth. He died in the course of a few days. After death there were no marks of injury to the chest, but the right lung was ruptured posteriorly throughout its length and much blood had become extravasated.

As it appears to be difficult for some to believe that there can be contusion of the lung without injury to the chest wall, I have endeavoured to find what has been written on the mechanism of this condition. The only author to whom I have access who has written anything on this subject is Hoffman. He says (*loc. cit.*):

A direct contusion of the lung occurs especially in cases of fracture of the ribs; but is usually accompanied by laceration of the pleura and even extensive laceration of the pulmonary parenchyma, but may take place without associated lesions.

Most frequently, however, such lesions appear to develop indirectly—that is, not at the place where the force was applied, but at some distant point, thus: from the part of the lung which becomes suddenly compressed by the external force the air and the blood contained within the vessels are suddenly driven towards the peripheral parts of the lung. There thus results a more or less extensive laceration of the lung tissue with hæmorrhage and interstitial emphysema.

Now, although this explanation appears to be partially correct, more especially in respect to the effect of blows upon the chest, upon the air in the lungs, it does not, in my opinion, take into sufficient consideration the effect of gravity upon the blood and tissues in the case of falls.

As this appears to be a very important subject, I venture to give the results of some experiments I have made.

Let us first consider the effects of gravity upon the blood stream.

We know that when a body falls its velocity continually increases, according to a certain law, until it reaches the ground. The formula is:

$$v^2 = 2 g h.$$

where

v = the velocity, in feet per second.

g = the effect of gravity = 32.2.

h = the height from which the body falls.

If a man falls on his side from a height of only 4 ft.,

when his body touches the ground it will have attained a velocity of more than 16 ft. per second:

$$\begin{aligned} v^2 &= 2 g h. \\ &= 2 \times 32.2 \times 4. \\ &= 257.6. \end{aligned}$$

$$\therefore v = \sqrt{257.6} = 16 \text{ approximately.}$$

That is to say, the velocity would be nearly twelve miles an hour, so that the blow would be equivalent to what the man would receive if he were struck by a tramcar running at full speed.

According to Volkman and Vierdosh³ the blood in the large arteries near the heart flows normally at the rate of about 10 or 12 in. per second, and at about 2½ in. per second in the arteries of the foot. We may, therefore, assume that the blood normally moves in the vessels of the lungs at the rate of not more than 1 ft. per second, and that in the arteries it flows towards, and in the veins from, the periphery.

During the fall this state of things continues relatively, that is, if we regard the blood stream with relation to the body, but they are not the same absolutely, that is, if we regard the rate and direction of the blood stream in relation to the ground, towards which the body is falling.

During the descent the blood acquires a velocity, with regard to the earth, of 16 ft. per second. But the blood in the arteries running towards the surface of the lung has already at the commencement of the fall an intrasomatic velocity of 1 ft. per second, which must be added to the velocity accrued by the fall, making a total of 17 ft. per second. On the other hand, the initial intrasomatic centripetal velocity of the blood in the pulmonary veins must be deducted, making the sum of 15 ft. per second.

Now, as already indicated, during the fall these changes in the velocity of the blood in respect to the earth have no effect on the body, because the velocity of the whole body is increasing in a like ratio, just as, when we are travelling in an express train, our blood may be travelling at the rate of 100 miles an hour but we feel no difference, because the whole body is travelling at the same rate. When the fall is arrested, however, the relations of things are instantly changed. The solid elements of the body are brought to a sudden state of rest, while the blood, being a fluid, continues to press onwards with its accelerated velocity. Now this sudden change in the relative velocity and, in the case of the pulmonary veins, of direction of the blood stream must have a disastrous effect upon the capillaries at the periphery of the lung. Not only are these organs suddenly engorged on the arterial side by a flow of blood of seventeen times the normal velocity, but that flood, instead of finding its escape through its accustomed exit, is met by another flood, of almost an equally high velocity, forced back through the pulmonary veins. It seems impossible that the wall of these delicate organs could escape rupture.

Let us now consider the effects of the fall and its sudden arrest upon the solid structures of the thorax and its contents.

The thorax is a sort of bony cage, bound together and lined by muscles, fascia, etc. All these materials being highly elastic, the chest walls are capable of sustaining considerable stress without fracture of the ribs or break in the continuity of the soft tissues. The intrathoracic organs, which for our present purpose we may regard as one mass, are attached securely but not rigidly in their position, mainly by the trachea and great vessels and other organs and tissues of the neck and by the walls of the anterior and posterior mediastina. That the attachments are elastic enough to allow of considerable lateral movement is proved by the fact that in cases of left pleuritic effusion the heart may be pushed so far to the right that the apex beat may be found well to the right of the sternum.

During the fall the velocities of the thorax and its contents increase equally; but when the wall of the chest suddenly stops on reaching the ground the intrathoracic organs endeavour to continue in motion, and the surface of the lung is flung upon the pleura costalis, being at the same time compressed by the weight of the rest of the intrathoracic organs straining to overcome the resistance of their somewhat elastic attachments. The intrathoracic organs and the blood they contain cannot weigh less than 5 or 6 lb.—say 5 lb.; but $5 \times 16 = 80$, so that the momentum acquired by the fall would equal 80 ft. lb. What would be

the net effect of this impulse upon the surface of the lung I cannot say, but it would not be a negligible quantity. Probably the greatest danger from this source would be the stress upon the organs forming the attachments.

Of far greater importance, in my opinion, is the effect upon the surface of the lung of the impulse due to the fall of the body and conducted through the chest walls at the place of impact. These walls consist of a series of elastic bony rings, bound together by soft tissues.

If a ring made of an elastic material falls from a height, having its plane perpendicular to the earth's surface, what effect has the momentum acquired by the fall upon a body resting upon its inner circumference at the point opposite to the point of impact?

Let A B represent a wire tightly stretched and fixed perpendicularly between a point, A, in the ceiling, and another point, B, in the floor of a room. Let B D F be an iron ring, having an external diameter of 12 in. and an internal diameter of 11 in. Through the circumference of the ring, at opposite extremities of the diameter, B F, are holes, through which the wire, B A, passes, so that the ring can be drawn up to any desired height along the wire, and allowed to fall freely to the ground.

Let C be a ball of porcelain, or any hard substance, having a hole through it, through which the wire passes, so that it also is free to move up and down upon the wire within the iron ring.

Now, without lifting the ring B D F, raise the ball C as far as it will go along the portion of the wire B F, and let it fall.

It will be observed that, owing to the momentum which it has acquired in falling, it perceptibly rebounds, but not very much.

Next, without touching C, raise the ring B D F along with it until C is about a foot above the ground (that is, about as high as it was raised separately in the first experiment) and let the whole system fall freely to the ground. It will now be observed that the ring itself rebounds but little, but that the ball C will rebound, probably the whole diameter of the ring, proving that a large portion of the momentum acquired by the weight of the ring and the ball taken together has been reflected by the floor, passed through the rim of the ring, and expended in raising the ball C. The exact height to which the ball is raised depends chiefly upon the following conditions:

- The weight of the ring;
- The weight of the ball;
- The modulus of elasticity of the materials of which the ring and the ball are constructed; and, lastly,
- The height from which the ring and ball fall.

Taking the case of an iron ring weighing 12 oz. and a piece of porcelain weighing 2 oz., I calculate that about one-quarter of the momentum generated by allowing the system to fall 1 ft. was expended in raising the porcelain 9½ in. It is obvious that if the weight of the ball is known, the height to which it rebounds is a measure of the momentum passed through the ring, minus the momentum which the ball itself has acquired during its fall, and which begins to exert itself independently and in a direction contrary to the reflected force, the instant the ring touched the ground. For although the ring and the ball during their fall are not physically one, they are acting in strict partnership during that time, and the whole of the momentum which they generate is communicated to the floor when the ring touches it; at that instant, however, the partnership is dissolved by the momentum of reaction passing through the ring, which, in acting on the ball, has not only to impart it an initial velocity sufficient to raise it to the given height, but also to overcome the effect of its own momentum downwards which it acquired in its fall, and which continues for a moment after the dissolution of its partnership with the ring.

It is needless to say, the intensity of the rebound varies with the height of the fall; thus, when the ring was lifted

about 3 ft., not only did the ring itself rebound, but the porcelain struck the opposite side of the rim with such force that it was fractured.

The point upon which I would lay especial stress is, that the amount of force impinging upon that part of the porcelain ball contingent to the rim of the ring, consequent upon the impact on falling, depends not so much upon the weight of the ball as upon the weight of the ring and ball taken together.

The general application of the dynamic principles I have endeavoured to illustrate, to the case of an injury to the lung resulting from a blow or fall upon the thorax, is obvious. It is true that the modulus of elasticity of a rib with its coverings differs from that of an iron ring, but it must be very considerable, especially in the case of a strong middle-aged man whose bones are hard. If such a man fell heavily upon his chest, and the ribs did not fracture, a large part of the momentum generated by the weight of the body and the fall would undoubtedly be conducted through the chest wall, and, impinging upon the surface of the lung, damage it considerably, even if it did not cause the rupture of the organ, as happened in the case quoted from the *Lancet* above.

Now note a seeming paradox—if the ribs are fractured the danger to the lung may be less.

For the iron ring on the wire was substituted one of wood. Inside the ring was strung a piece of porcelain, as in the previous experiments, the holes through the ring for the wire being drilled parallel to the grain of the wood. When the ring and the porcelain were raised to a moderate height and allowed to fall the porcelain rebounded energetically, as it did in the case of the iron ring, and the rebound was a measure of the amount of force conducted through the ring at the moment of impact. The ring and the porcelain were now raised to such a height that the momentum on falling was sufficient to fracture the ring. In this case, although the ring was fractured, the porcelain rebounded but little, showing that it was but little affected by the force of impact.

As the result of many experiments with wooden rings I have arrived at the following conclusions:

Each ring has a coefficient of fracture of its own, so that of two similar rings, one does not fracture as easily or in exactly the same manner as the other. This results from small differences in hardness and direction of grain, etc.

A ring does not fracture easily, and the porcelain rebounds but little, if the holes through which the wire passes are drilled, not parallel to, but across the grain, showing that the force is conducted more easily along the fibro-vascular bundles than across a fasciculus of such bundles.

The phenomenon is also accounted for partly by the fact that a wooden ring is more easily flattened or rendered ovoid by a force applied at right angles to the grain, than by a force applied parallel to the grain, and that the force expended in flattening the ring does not pass through it. For example, two small wooden rings were compressed in a vice, until they fractured; in the first case the force was applied parallel to the grain, and fracture occurred when the diameter had been reduced 2 per cent.; in the second case the force was applied across the grain, and the diameter was reduced more than 10 per cent. before the ring suffered fracture.

If a ring be taken, having one of its sides already fractured, and the holes be drilled parallel to the grain:

(a) If the fracture is on the upper side of the ring, the ring on falling will be fractured on the lower side, and the porcelain will not rebound.

(b) If the fracture be on the lower side of the ring, so that the porcelain is resting on the fracture, the ring on falling may suffer no further fracture, but the porcelain will not rebound.

I therefore conclude that rings which are compressible in the direction of the force applied, or rings which are fractured, conduct the force of impact less readily than rings which are whole and less compressible.

Applying these results to the case of the ribs, I conclude as follows:

If the ribs are soft and pliable, as in the case of young persons, they are less liable to fracture, but, as they bend, the force expended in bending them is absorbed, and therefore does not so easily pass through them and injure the lung.

If the ribs are hard, as in elderly persons, they are more liable to fracture. If they do not fracture, on account of their hardness, a large part of the force applied is conducted through their substance to the detriment of the lung. If they do fracture, the force producing this result is saved from the lung.

It may thus happen that a greater fall may be less dangerous than a lesser one, for, if the fall be just sufficient to break the ribs, but little force will pass through them and there will be less danger to the lung. On the other hand, if the fall be just not sufficient to fracture the ribs, a large part of the force accrued by the fall will pass through the chest wall and there is danger of contusion of the lung.

These results appear to be in agreement with clinical observation, fatal contusion of the lung being of more frequent occurrence in elderly than young persons.

It is needless to say we are not here considering those cases in which the substance of the lung is penetrated by a fractured rib.

Space will not allow me to discuss fully the interesting question whether the consolidation found in cases of contusion of the lung is identical with that of ordinary croupous pneumonia. I will content myself by stating that there are two opinions on this point. The first is that the portion of the lung contused is rendered a suitable nidus for the pneumococcus, and that ordinary pneumonia results. The second is that the solidification is simply due to the coagulation or "organization" of the blood poured into the air cells as the result of the contusion. As Hamilton⁴ says: "It must be remembered that there are pneumonias and pneumonias; that a croupous exudate may be poured into the lung through a multitude of exciting agents, and may even result from purely mechanical causes which lead to embarrassment of the pulmonary circulation."

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¹ *Textbook of Pathology*, vol. ii, p. 102. ² *Medical Jurisprudence*, p. 392, Ed. 1844. ³ *Kirk's Physiology*. ⁴ *Loc. cit.*

A NOTE ON BODY-WEIGHT IN RELATION TO PULMONARY TUBERCULOSIS.

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It is generally acknowledged (and to some extent acted on in regard to life assurance) that, both in families in which there is supposed to be a predisposition to tuberculosis and in those in which there is none, the overweight members are less likely to develop consumption than the underweight members. C. L. Greene¹ quotes the combined experience of the Washington and National Life Assurance Companies (3,548 cases), showing that in persons apparently without special predisposition to consumption the percentage of deaths from consumption was 5.20 for weights above the standard, 15.67 for standard weights, and 24.20 for weights below the standard; whilst in persons supposed to have a predisposition to consumption the percentage of deaths from consumption was 5.59 for weights above the standard, 25.91 for standard weights, and 42.51 for weights below the standard. Greene² likewise quotes the experience of the Connecticut Mutual Life Insurance Company (1846 to 1895 inclusive), showing that the percentage of deaths attributed to tuberculosis was 22.0 in underweights and only 1.9 in overweights.

C. Muirhead, when studying the causes of death among the assured in the Scottish Widows' Life Assurance Society (1874 to 1894 inclusive), looked up the height and weight as tabulated on admission into the life assurance society (1) of 524 males who ultimately died of pulmonary tuberculosis; (2) of 502 who were said to have died of "apoplexy." Amongst those who died of apoplexy, 59.87 per cent. weighed, on admission for life assurance, above the normal standard for their height and age (as calculated according to Dr. W. Robertson's standard table),

and 40.13 per cent. weighed below the standard; whilst of those who ultimately died of pulmonary tuberculosis only 19.30 per cent. weighed on admission above the standard, the large proportion of 80.70 per cent. weighing below the standard.*

We wished to ascertain as far as possible what the average weight of consumptive patients in a large hospital for consumption was (1) in comparison to their height and (2) in comparison to the average of their former ordinary weights.

In the Mount Vernon Hospital for Chest Diseases it is the rule to enter the height and weight of every patient on admission, and likewise to note what the former ordinary weight was whenever information on that subject can be obtained.

We determined, therefore, with the consent of the medical staff, to collect these data from cases in which the former ordinary weight was mentioned.

(A) In a series of 500 male patients 25 years old and upwards, all of whom had tubercle bacilli in their sputum, we found that the average height was exactly 5 ft. 7 in.; that is, the figure obtained by adding together the heights of all the patients, as entered in the notes on admission, and dividing by 500. Their average weight on admission, obtained in the same way, was 9 st. 1 lb. 13 oz.; 53 of them (10.6 per cent.) weighed more than 10½ st., 3 (0.6 per cent.) weighed exactly 10½ st., and 444 (88.8 per cent.) weighed less than 10½ st. The average of their former ordinary weights was 10 st. 5 lb. 9 oz.; 204 of them (40.8 per cent.) used to weigh more than 10½ st., 16 (3.2 per cent.) used to weigh 10½ st., and 280 (56.0 per cent.) used to weigh less than 10½ st. It seems, therefore, that the average of the former ordinary weights of these male patients (presumably their weights as far as they knew before their illness) was below standard, though of course not so decidedly "underweight" as their average weight on admission was.

(B) In a series of 100 female patients 25 years old and upwards, all of whom had tubercle bacilli in their sputum, we found that the average height was exactly 5 ft. 3½ in.; that is, the figure obtained by adding together the heights of all the patients, as entered in the notes on admission, and dividing by 100. Their average weight on admission, obtained in the same way, was 7 st. 9 lb. 13 oz. Eighteen of them weighed more than 8½ st., 1 weighed exactly 8½ st., and 81 weighed less than 8½ st. The average of their former ordinary weights was 8 st. 8 lb. 12 oz. Fifty-four of them used to weigh more than 8½ st., 1 used to weigh 8½ st., and 45 used to weigh less than 8½ st. It seems, therefore, that, though the average weight of these female patients on admission was much below standard, the average of their former ordinary weights (presumably their weights as far as they knew before their illness) was scarcely below standard, certainly not so "underweight" as that of the male patients (Series A).

(C) We likewise collected similar data from a series of 100 male patients in their 30th year or upwards, who whilst they were in the hospital presented undoubted physical signs of old pulmonary tuberculosis, though they had no fever and no tubercle bacilli in their sputum (patients in whom, in fact, the tuberculosis appeared to be quiescent or not very active). Their average height was 5 ft. 6½ in. Their average weight on admission was 9 st. 7 lb. 5 oz. Twenty of them weighed more than 10½ st.; 3 weighed exactly 10½ st.; and 77 less than 10½ st. The average of their former ordinary weights was 10 st. 6 lb. 11 oz.; 48 of them used to weigh more than 10½ st., 1 used to weigh 10½ st., and 51 used to weigh less than 10½ st. It seems, therefore, that the average weight in this series of male patients on admission and the average of their former ordinary weights were both below standard, but not so much so as in the series of male patients (Series A) showing signs of active pulmonary tuberculosis and having tubercle bacilli in their sputum on admission. This may be taken, perhaps, to signify that a generally more robust habit of body accompanied their resistance towards tuberculosis, a resistance shown by the relative quiescence of the disease.

Probably the preference shown by pulmonary tuberculosis for "underweights" would have been more strikingly illustrated by our cases had it not been that

* See C. Muirhead, *The Causes of Death among the Assured in the Scottish Widows' Fund*, Edinburgh, 1902, p. 44.