

THE RADIOLOGICAL DIAGNOSIS OF FOREIGN BODIES
IN THE PHARYNX AND OESOPHAGUS.

by

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INDEX.

	Page.
I. Introduction.	4.
II. Materials Required.	5.
III. Technique of the Examination.	
a) History and Symptoms.	6.
b) Radiological Technique.	12.
IV. Radiological Anatomy.	14.
V. Radiological Physiology.	15.
VI. Radiological Pathology.	23.
VII. Differential Diagnosis.	
a) Variations within Normal Limits.	27.
b) Mucosal Injuries.	31.
c) Organic Lesions.	32.
VIII. Summary.	35.
IX. Conclusions.	36.
X. Bibliography.	38.
XI. Illustrative Cases. 1-38.	

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I. Introduction.

This paper is an endeavour to illustrate the value of a radiological examination in cases of swallowed foreign bodies, with particular reference to the pharynx and oesophagus, as being the commonest site of impactions, such impactions being attended with considerable danger unless promptly diagnosed. It is based upon the experience gained at the Manchester Royal Infirmary, where all such cases are sent for X-ray examination as a routine procedure. In the out-patient department, a preliminary inspection of the pharynx is made with a laryngeal mirror, and if the foreign body can be seen it is removed. In a large number of cases however, the distress produced by the foreign body is so great that the patient is unable to co-operate, and satisfactory direct examination is impossible. Even the use of a local anaesthetic may fail to permit adequate inspection. These cases then, together with cases in which nothing can be detected in the pharynx, are sent for immediate X-ray examination.

The report on the X-ray examination is of extreme value to the doctor in charge of the case. If negative, further active measures are, in general, contra-indicated, and the immediate responsibility rests on the radiologist's shoulders. If positive, a large amount of information is at his disposal. He is told the nature of the foreign body, its shape and size, and the exact site of impaction. He is warned of the possible presence of an organic lesion which, if unsuspected, might produce fatal results following instrumentation. Moreover, in most cases, the nature of such an organic lesion can be accurately diagnosed. He is thus in a far better position to decide whether interference is necessary or not, and if necessary, what procedures best meet the case, and against what potential sources of danger he must be on his guard. Where he deems interference unnecessary, the progress of the case can be studied by a repetition of the examination. The assistance rendered by an X-ray examination is especially useful in the type of case under discussion, since, without it, diagnosis rests almost entirely upon the

history and symptoms - the value of which it is extremely difficult to assess. The X-ray examination provides the signs - the only trustworthy basis for a diagnosis.

From the patient's point of view, the examination is highly desirable. It is simple, he can cooperate to the best of his ability unhampered by the dread of instrumentation or anaesthesia. The discomfort is minimal, and there is no risk to life. A negative report sets his mind at rest, for even the mere thought that a foreign body may be lodged in the throat can produce extreme mental distress. A positive report will ensure correct and adequate treatment with a minimum of delay. To the hospital, it means a saving of valuable beds. There is no necessity to admit patients for observation, with the concomitant labour and expense of taking full notes, case histories, etc. Negative cases can be sent home at once.

Such an X-ray examination however, must give reliable information, in a short time, or it loses much of its value. It must not permit any positive cases to be dismissed as negative, whilst at the same time it reduces to a minimum the possibility of the less serious error of diagnosing negative cases as positive. Moreover, from the hospital's point of view, the examination must not be too costly. It is the aim of this paper to show that all these demands can be met. The results are extremely good, the time expended on each case is less than thirty minutes, and the cost is very low.

II. Materials Required.

The materials required are simple, consisting of the standard barium sulphate powder mixed into a stiff paste with water. The consistence should be such that if a spoonful is held upside down, the whole mass just adheres to the spoon. When freshly made, it is practically tasteless and well tolerated, and has less tendency to provoke nausea, retching, etc., than if flavoured. The addition of a sticky material such as mucilage of acacia, though it enables the mixture to adhere more firmly to a foreign body, may defeat its object, as the barium sticks all over the normal mucosa and obscures the portions on the foreign body. Further, whilst it is less readily removed by drinking water, this may also become an objection for the same reason. The

writer finds the simple paste to be perfectly satisfactory for this type of work, and considers that the disadvantages of special mixtures outweigh their advantages.

The swallowing of teased out cotton wool, dipped in, or followed by barium paste, may be useful in locating a foreign body, but there are serious disadvantages attached to this method. If subsequent instrumental removal is necessary, it may be impossible to see the foreign body if it is covered by wool and barium. Even if it is not totally obscured, its exact position or the direction in which it is lying may be masked. For example, traction may be made on a fish bone impacted point upwards, producing disastrous oesophageal lacerations. For that reason, sufficient in itself, this method should be reserved for exceptional cases, but the possible risks entailed must be taken into consideration.

As the writer has personally observed on several occasions, the presence of even a small amount of simple barium paste is quite sufficient to obscure the foreign body completely, when making an oesophagoscopic examination. This, however can be removed satisfactorily by suction leaving a reasonably clear field. This is a still further argument against the use of a sticky paste which is more difficult to remove. The use of barium filled capsules has been given up almost entirely. The reasons against their use are many. They are difficult to swallow, and are very liable to stick at various points even in normal persons, thus increasing the possibility of error, in cases of swallowed foreign body. Finally they can do little more than indicate the point of obstruction, and fail to give any further information about the existing conditions. Should oesophagoscopy be necessary, their presence may hamper the operator considerably.

III. Technique of the Examination.

a) History and Symptoms. Before commencing the examination, as full a history as possible is obtained. This is often extremely difficult where children are concerned, and even with adults it is frequently vague and unreliable. The following points however, are looked for as being of some assistance.

Firstly, the nature of the foreign body. In children this may be literally anything. In adults

fish and meat bones are the commonest, but again the possibilities are endless. This point is important because the nature of the foreign body appears to be the chief factor in determining the site of impaction thus giving the examiner a hint as to its probable location. Irregular foreign bodies, e.g. bones, tend to lodge comparatively high up, and remain impacted at this point, probably due to their projections catching in the mucosa, and to the spasm thereby induced. This is caused by the type of muscular contraction of this part of the alimentary tube. The pharynx very definitely contracts as a whole, tending to force its contents both upwards and downwards into any of the passages connected with it - quite a different action from the typical peristaltic wave preceded by a zone of relaxation seen in the rest of the gut. Irregular or sharp foreign bodies rarely impact in the sub-diaphragmatic part of the alimentary canal, as they are, so to speak, pushed on ahead of the actively contracting part. Even should they lodge temporarily, at any given spot, successive onward impulses are applied from behind, tending to force them forwards. The pharynx, on the other hand, may be said actually to seize and contract down on its contents, and sharp or irregular foreign bodies are therefore likely to have their projections driven into the mucosa. Further contractions being applied, not only over the intruder, but above and below as well, so far from forcing it onwards, actually prevent its dislodgment, and force its projections still deeper into the mucosa.

Smooth objects, e.g. a large piece of meat, are apt to work downwards owing to peristaltic action, spasm not being a pronounced feature. If heavy, as well as smooth, e.g. coins, the influence of gravity is an added factor in carrying them downwards. (Case 1). This is particularly noticeable in adults who maintain the erect posture, but not marked in children who are often carried in for examination. Notably in children, a large percentage of swallowed objects (of the small coin type) lodge just above the sternal notch. The foregoing is possibly a partial explanation. Regarding this point, Barclay considers that the extremely rapid action of deglutition carries the foreign body immediately and forcibly down to this point, where it then impacts. Jackson and Abel consider it is due to the pressure from the adjacent structures confined within the superior opening of the thorax. None of these explanations covers the observed fact that in adults, relatively large objects of the same type seldom lodge here, much more frequently impacting in the lower half of the oesophagus. (Cases 2 and 3).

As a rational explanation of these diverse findings, the author puts forward the following on anatomical grounds. In the child, the superior thoracic opening contains, in addition to the structures found in the adult, a more or less well developed thymus gland. That there is very little room to spare at this point, is shown by the severe dyspnoea which may be produced by quite slight thymic hyperplasia. It seems probable therefore, that even with a normal thymus, the relatively narrowest part of the oesophagus, is just above the level of the sternal notch. This relative narrowing will disappear at or before puberty. Similar conclusions were arrived at by Jesberg, after investigating a large number of cases, to account for the preponderance of coins and discs which lodge at the sternal notch in children. He did not include adults among his cases however, and therefore his researches do not cover or explain the different findings noted in older people.

When the exact location of a foreign body has to be stated prior to removal, it must not be forgotten that occasionally its position may alter in the interval between the examination and the operative procedure, which therefore should be carried out with as little delay as possible. Two other eventualities may arise - the patient may vomit the foreign body after the X-ray examination, or the barium paste may carry it down into the stomach. (Case 4). The first can be confirmed by re-examination, the second by actually seeing it happen, and by the disappearance of abnormal findings. The actual anatomical narrowings of the oesophagus, excluding relative narrowings due to extrinsic causes, have very little influence on the point of lodgment of a foreign body, except in the region of the cardiac sphincter, where arrest is probably due to the fairly well developed circular coat at this point, rendering this area less distensible and actually of smaller calibre than the remainder.

Secondly, the lapse of time since the object was swallowed. As a rule positive cases come soon after the accident. They may try drinking water, eating stale bread, etc., but unless they obtain prompt relief, they consult a doctor within a few hours. The negative cases - especially where the nervous element is pronounced - often give no history at all. They may have some persistent pain in the throat, and ascribe this to something they think they have swallowed. The time interval before seeking

medical aid may be considerable - it may even run into days, the patient stating that the usual meals have been eaten in the interim. Certain of the cases seen by the author (which showed no evidence of foreign body) seem to be in the group of cases showing spasm of the upper end of the oesophagus, which has been fully described by Abel and others. The trivial nature of the foreign bodies, in one case a Yeast-Vite tablet, and in another a piece of bread - suggests that such a spasm existed and the difficult passage (and perhaps resultant pain) of a large or hard object convinced the patient that impaction had occurred. Again, chronic catarrhal pharyngitis or laryngitis frequently causes a sensation as of something stuck in the throat, which cannot be removed even by repeated acts of swallowing. In a neurotic person, the persistence of the sensation over a period of several days, may so prey upon his mind that he may present himself for examination, thoroughly convinced that a foreign body has lodged in his throat.

Thirdly, the symptoms when the foreign body was swallowed. Coughing and dyspnoea suggest that initially, at any rate, the foreign body was inhaled, perhaps subsequently swallowed. Choking and vomiting suggest that it was swallowed. If these symptoms were violent, the foreign body may have been ejected unnoticed.

Fourthly, the present symptoms - notably the subjective localisation of the foreign body. It is astounding with what accuracy, adults and intelligent children can indicate the exact level at which the foreign body is lodged. Moreover the sensation is felt as being deeply situated and is referred to the gullet. In the pharynx this is to be expected, as the mucosa down to the level of the upper border of the cricoid is sensitive to tactile stimuli.

The oesophagus, however, is completely devoid of tactile sensation, but, as has been demonstrated by Hurst, oesophageal pain or sense of obstruction arises from stimulation of the sensory nerves of the involuntary muscle fibres, due to increased tension, produced by forceful contraction of the muscular coats attempting to overcome the cause of obstruction; or from stretching due to the presence of a large foreign body. It is impossible to increase this tension by direct palpation, but if done indirectly e.g. by swallowing, the sensation may be

instigated or increased. In the neck where the local tension can be so increased by palpation, this causes an increase in the pain felt at the site of the lesion - Tucker's sign. Further, Hurst found that minimal distension produced sensation felt deeply beneath the anterior surface of the body - never posteriorly. Extreme, i.e. painful distension, produced in addition, a less deeply situated posterior pain at the same level. He explains this pain distribution thus:- The oesophageal nerve supply is mainly vagal, and vagal stimulation is felt deeply beneath the sternum in the oesophagus itself, analogous to the subjective localisation of the "hunger pains" of gastric or duodenal ulcer. (Carlson). There are but few sympathetic fibres, hence they are only affected by severe stimuli - and these produce the posterior sensation which is a true referred pain, the afferent impulses being conveyed by the sympathetic to the segment of the cord which supplies the sensory nerves to the muscles and other tissues in which the referred pain is felt. These conclusions would appear to explain satisfactorily the exact subjective localisation of a foreign body when this is causing obstruction or stretching of the muscular coats.

In the author's cases however, pain was felt anteriorly only, no posterior sensation being felt. Moreover, the sensation was equally well felt if no demonstrable obstruction or stretching was present, if only a mucosal tear existed (the foreign body having passed on) and even if no abnormality could be detected - the presumption being that an undiscoverable mucosal injury was producing the symptoms. Hurst found that in his inflation bag experiments the sensation disappeared a few seconds after the removal of the exciting cause, but of course no organic injury had been produced in the oesophagus. It must therefore, be assumed that mucosal injuries however slight, or the presence of even a small foreign body will evoke a continuous degree of spasm sufficient to increase the tension in the muscle fibres and thus give rise to pain - even though this spasm is not demonstrable. Two of the author's cases were exceptional in that the posterior referred pain was the only symptom, no anterior sensation being present at all. In both cases however, the foreign bodies were extremely angular, touching the mucosa in a few places, and may have

chanced to stimulate only sympathetic nerve endings. (Case 5). One of the cases was even more remarkable, as the foreign body was in the pharynx and evoked no tactile stimuli, presumably because its sharp points touched no sensory nerve endings in the mucosa. (Case 6). This explanation of the abnormal findings in these two cases is far from satisfactory, but the writer has been unable to find a better in the literature studied for this paper.

Continuing then, when the foreign body has lodged in the neck, the patient points to one or other side of the pharynx or trachea, rarely to the back of the neck in the mid-line. When the foreign body is at the sternal notch this level is indicated in the mid-line in front, rarely in the mid-line on the back. Below the sternal notch the level is usually indicated in the mid-line on the front of the chest, rarely in the mid-line on the back. This subjective finding constitutes a reliable guide to the site of impaction, and special attention is paid to this point during the examination. It should be noted, however, that the site indicated may only correspond to an injury of the mucosa, the causative agent having passed into the stomach, or having been vomited. Such a mucosal injury may produce symptoms for three or four days.

Fifthly, the degree of dysphagia, if the patient has tried to eat or drink. If a foreign body is present, the obstruction is usually marked, food or fluid passing only with pain or difficulty, or not at all. A painful mucosal injury, while often causing considerable discomfort, produces little or no actual obstruction. The history on this point is very variable in negative cases, but if normal meals have been consumed, there is very little likelihood of finding any evidence of a foreign body. Jackson states however, that it is not uncommon to find a history of acute dysphagia of two or three days' duration, which passes off, deglutition again becoming normal, although the impacted foreign body, if smooth and non-irritating (small coin type) is still present at the site of the original impaction. For this reason a full examination should be carried out, even though from the history, the possibility of finding a foreign body seems remote.

Sixthly, a history of previous difficulty in

swallowing. Intermittent attacks of dysphagia suggest a spasmodic origin either alone or rendered acute by a foreign body. A history of gradually increasing dysphagia, now acute, suggests an organic stricture, alone or rendered complete by a foreign body. Even if the history is negative in this respect, the possibility of a spasmodic or organic lesion co-existent with, or simulating a foreign body must be borne in mind.

A further type of case is occasionally encountered. Here long-continued symptoms are due to a foreign body, the ingestion or inhalation of which has been forgotten or not considered as a possible cause of the trouble. These cases are nearly all due to foreign bodies in the respiratory tract, as a patient will not long survive an undetected oesophageal foreign body. Still, such cases do occur, for example, one described by Mather, in which a piece of bone, swallowed unperceived in a state of intoxication, caused severe symptoms for eighteen days - these symptoms being ascribed to acute tonsillitis. This emphasises the fact that a history, however unsatisfactory it may appear, should be taken, and every effort made to ascertain all the details, however trivial. Jackson, from a large series of cases of overlooked foreign bodies, is insistent on this point, as close questioning almost always elicited at least a hint of having swallowed or inhaled a foreign body.

b) Radiological Technique. The radiological examination consists of a preliminary screening in the erect position (infants and children under 10 years of age more easily managed recumbent) commencing with the neck which is examined in the postero-anterior, oblique, and lateral planes. For the last, the patient clasps his hands behind his back, braces back his shoulders, as if standing to attention, and extends the head and neck. This gives the optimum visualisation of the upper food and air passages. One should not omit to examine the naso-pharynx as it is not unknown for a swallowed foreign body to be driven up into this situation by vomiting. The chest is next screened in all positions to exclude the presence of the foreign body in the air passages. If the foreign body is non-opaque, the diaphragm and mediastinal movements, partial or total lobar collapse, etc., are looked for. The details are outside the scope of this paper, but the clinical signs have been fully discussed by MacRae, and the X-ray signs

by Manges. The region of the oesophagus is scrutinised in the postero-anterior, and both oblique diameters of the chest. Finally the abdomen is examined to see if the foreign body can be detected in the stomach or intestine. Films may be taken of any suspicious shadows, as desired, but in practice, unless the foreign body is opaque and readily seen (in which case, screen examination is usually sufficient) a 12 x 10 film is made of the neck in the right lateral position, as described above, and a 15 x 12 film of the oesophageal area in the right anterior oblique position. These two films satisfactorily cover the whole area under examination.

A dessertspoonful of the barium paste is then given and the patient instructed to "chew it up and swallow it!" This is more natural and less likely to result in gagging than an effort to gulp the whole mass. It also provides a series of small, regular boluses, which enable any point to be studied repeatedly with one mouthful of paste. The actual act of deglutition is carefully studied as it may provide a clue to the position of the foreign body. The progress of the medium down the oesophagus is watched, and any irregularity in its passage confirmed by further mouthfuls, films being taken in two planes if the findings are persistent. As soon as most of the barium reaches the stomach, the patient should be encouraged to go through the act of swallowing several times. The saliva swallowed and the peristalsis evoked thereby, tend to drive down the remainder of the paste clinging to the walls of the pharynx and oesophagus, and render more visible any barium left adhering to a foreign body or mucosal tear. Any persistent flakes of barium are examined with further mouthfuls of the paste, and if confirmed, radiographed in two planes.

The patient is then requested to drink, slowly, about half tumberful of water, and is screened during the process. His chest is placed in the right anterior oblique position, the head and neck in the right lateral position, and the glass is held in the left hand. This serves the double purpose of allowing the patient to drink unencumbered by the screen, and of keeping the left arm from overlapping the field of examination. If now apparently all traces of barium pass into the stomach, films are taken in the two positions previously detailed. Should these films

reveal a persistent flake of barium not seen on screening, the examination is repeated and a special study is made of the suspicious area. If, however, a previously noted persistent flake of barium is not washed away, or if the removal of the excess paste now reveals a persistent flake, films should be made of it in appropriate positions. It goes without saying that all films are immediately developed, and studied while wet, before the patient is allowed to leave.

IV. Radiological Anatomy.

The normal pharynx and oesophagus show the following appearances when studied radiographically, either on the screen, or on the films. The pharynx and upper end of the oesophagus are best studied in the lateral position. (Case 7). In the postero-anterior view owing to the superimposition of the cervical vertebrae, little can be seen distinctly other than the sides of the thyroid cartilage and the air-filled trachea. In the lateral view, the boundaries of the pharynx are easily made out, owing to the contrast produced by the presence of air within it. Posteriorly it is bounded in its entire length by the prevertebral muscles and fasciae, and behind these the upper cervical vertebrae. Anteriorly, the pharyngeal part of the tongue bounds it at the upper end. Next, about an inch below the mandible, it is encircled by the hyoid bone, a horse-shoe shaped structure, consisting of a body, two greater and two lesser cornua. Overlying the shadows of the greater cornua, is the slightly curved epiglottis rendered visible by contrast with the air in the two epiglottic valleculae, situated a little in front of and on each side of the base of the epiglottis. About one inch below the hyoid bone is the large square shadow of the thyroid cartilage. The air column in the pharynx turns sharply forwards at its upper border, outlining the laryngeal aperture. Overlying this are the air filled piriform sinuses, one on each side of the upper border of the thyroid cartilage. Immediately below this is the typical signet ring shadow of the cricoid cartilage. The shadows of the arytenoid cartilages lie just above the posterior part of the cricoid, but are not distinguishable as a rule. The small nodules of cartilage, the cuneiform and corniculate tubercles lying within each ary-epiglottic fold are not seen on X-ray examination. Below the cricoid is seen the air-filled trachea bounded

anteriorly by the shadows of its rings.

About the level of the posterior surface of the cricoid the pharynx becomes the oesophagus. This does not as a rule contain air, and merely indicates its presence by an increase in width of the soft tissue shadow lying between the trachea and the spine. In some cases, the introitus of the oesophagus remains patent and air-containing, in which case the lumen can be visualised. This is an occasional finding, as the normal tone of the cricopharyngeus muscle keeps it closed, but it does not appear to be related to any specific abnormality, and is therefore probably of no significance (excluding of course, an organic lesion, actually involving this region, and producing this abnormal finding).

From the level of the clavicles downwards, the oesophagus is best visualised in the right anterior oblique diameter of the chest, the most favourable angle for each individual being determined by screen examination. The oesophagus itself cannot be seen as it offers no contrast to the surrounding tissues, but in this position it lies in the more or less clear area bounded on the observer's right by the trachea, great vessels, ascending aorta and cardiac shadow in that order from above downwards. (Case 8). On the observer's left, the area is bounded by the thoracic vertebrae overlapped by the descending aorta. Crossing the central area near its upper limits is the aortic arch which however casts a barely discernible shadow. Extending into the clear area from each side about its mid-point are seen the ill-defined shadows of the structures constituting the hila of the right and left lungs. In general these are not particularly noticeable but the presence of calcification in the hilar glands may render them distinctly visible.

V. Radiological Physiology.

Using barium paste, the normal act of swallowing as seen on the screen, consists firstly of a pulling upwards and forwards of the larynx until its aperture appears to be in contact with the base of the epiglottis and the tissues forming the base of the tongue. (Case 9). This has the further effect of obliterating the cavity of the pharynx which thus closes momentarily. The contents of the mouth are set in motion by a movement of the tongue. The tongue does not rise as a whole - its action takes a curious form appear-

ing almost as a ripple, when seen on screen examination. Commencing with the anterior part, the tongue rises until it presses against the roof of the mouth. This zone of contact passes rapidly back until practically the whole tongue is touching the hard palate, having pushed the food back into the pharynx.

The first part of the bolus encounters the pharynx in a closed state, and invariably therefore, turns forwards and enters the valleculae. This filling of the valleculae appears to be the stimulus for the pharynx to open and receive the rest of the food. It fills and then contracts, the posterior wall remaining stationary, forcing its contents down the oesophagus. The material which first entered the epiglottic valleculae shows a curious action. It seems to wait there until the pharynx is filled, and then simultaneously with the contraction of the pharynx, it is deposited on top of the food therein, becoming the hindmost part of the bolus - its action seen on the screen closely resembling a small "tipping hopper". Usually a small trace of food remains behind in the valleculae. This preliminary filling of the valleculae has received little attention by the writers on the subject, but it seems to the author to be of considerable importance, and to play a very definite part in the complicated action of swallowing.

The pharyngeal contraction tends to force its contents into any of the natural passages opening out of it. Food is prevented from passing back into the mouth by the firm pressure of the tongue against the hard palate. This pressure can be felt during the act of swallowing. The naso-pharynx is shut off by the action of the soft palate, and the larynx is guarded both by actual narrowing of its aperture, and by the aperture being carried upwards and forwards against the base of the tongue. The upper end of the oesophagus is normally closed by the cricopharyngeus which relaxes when the inferior constrictor contracts, hence the food passes into it as being the path of least resistance. This is probably a physiological relaxation of the type preceding a peristaltic wave as seen elsewhere in the gut. Gravity is a distinct aid in swallowing, as a much greater muscular contraction of the pharynx is necessary in the inverted position, as anyone may demonstrate for himself by trying it.

Mosher has suggested that a very definite

factor in the closure of the upper end of the oesophagus, is backward pressure of the cricoid cartilage, pressing it against the spine, and in support of this, has pointed out that the 5th or 6th cervical vertebrae (or both) often show a depression on the front of their bodies, due to this repeated pressure. This view has not received support. Study of a large number of cervical spines shows that this depression is not nearly constant enough to be due to a cause which must have been acting in every case. Such cases as showed this change were middle-aged or elderly, and in these it was probably due to the "waisting" of the vertebral bodies which accompanies osteo-arthritis of the spine. As the 5th and 6th cervical vertebrae are notoriously the most frequently affected bodies, the author feels this is the true explanation of Mosher's findings.

The bolus passes more or less rapidly down the oesophagus, until its entire length is outlined by the barium. In the erect position, peristaltic waves in the normal oesophagus cannot be distinctly made out as a rule. These can be studied if desired, by examination in the prone or supine positions using large amounts of thick paste. They may be accentuated by lowering the head of the table. The observation of these waves, however, is of no great significance in the particular type of work under discussion. In many cases, bubbles of air can be seen passing down with the stream of barium. This is a normal occurrence, and is only of importance when extreme. (Aerophagy). A small indentation on the anterior border of the oesophagus can usually be seen at the level of the aortic arch, due to extrinsic pressure from this structure. A little lower down a similar indentation is occasionally seen, due to pressure exerted by the left main bronchus as it passes in front of the oesophagus. This, too, is without significance. (Case 10).

In its lower third, the oesophagus is in close relation to the left auricle and will frequently show a smooth curve, convex posteriorly, due to pressure from this. Such pressure and displacement may become extreme if the left auricle is much enlarged. (Case 11). Moreover the lower third of the barium column shows a definite antero-posterior movement, en masse, due to transmitted pulsation from the left auricle. If the opaque mixture is rather fluid, this pulsation, by rhythmically compressing the oesophagus, will cause the barium column to oscillate up and down

as well. This is a normal finding and should not be confused with regurgitation.

So much difference of opinion exists concerning the action and even the structure of the lower end of the oesophagus, that it is well to consider the most recent views on this subject before going further. Most observers agree that the narrowest point is not at the anatomical cardiac orifice of the stomach, but is situated about one inch above this - at the oesophageal opening in the diaphragm. Jackson calls this the "diaphragmatic pinchcock" and considers it to be due to fibres of the left crus encircling the oesophagus and compressing it in a sphincter-like manner. Abel objects to this view because these fibres have no independent nerve supply, and because he has been unable to demonstrate, by dissection, a definite localised thickening of the circular coat of the oesophagus at the level of the oesophageal opening of the diaphragm which he considers a true cardiac sphincter. These two writers again hold different opinions regarding the tightness of the closure of this specialised part of the oesophagus, Jackson claiming that it remains tightly closed except when food is actually passing through it and Abel postulating an "acid control of the cardiac sphincter" - a rhythmic regurgitation of the stomach contents into the oesophagus which then contracts, driving them back again, the process ceasing when the gastric contents become definitely acid in reaction. The writer has never witnessed "acid control of the cardiac sphincter" as described by Abel. Such a phenomenon is impossible in the erect position as the oesophageal orifice opens into the air cap and even if stomach contents are forced up into the cardia by manual pressure, they practically never enter the oesophagus. Not uncommonly some barium remains in the lower end of the oesophagus after a barium meal, which, on account of transmitted cardiac pulsations, will oscillate up and down the oesophagus in time with the cardiac impulses. But it seems impossible that this should have been mistaken for rhythmic regurgitation of the stomach contents.

In the supine or prone positions, a small amount of gastric contents may occasionally run back into the oesophagus, but not rhythmically, nor does the oesophagus drive them back into the stomach, and they always flow back into the stomach when the erect position is resumed. In any case, such a regurgitation is quite infrequent and is of no significance,

beyond indicating possibly a diminished tone of the cardiac sphincter. (This regurgitation may be a diagnostic feature in exceptional cases - e.g. in actual organic disease involving the lower end of the oesophagus, rendering it rigid, and therefore permanently patent as in some types of carcinoma of the pylorus).

Mosher agrees with Jackson in stating that the closure of the lower end of the oesophagus is accomplished by the left crus of the diaphragm. Working from frozen sections, he found that the lower end of the oesophagus runs obliquely to the left just as it passes through the hiatus in the diaphragm, and that this portion is encircled by the fibres of the left crus. He therefore considered that the oesophagus is closed by a contraction of these fibres. In many of his clinical cases however, when examined with a barium meal, the pointed lower end of the barium column was found to be definitely above the cupola of the diaphragm. He seeks to explain this by assuming a sort of ptosis of the entire diaphragm, plus (in his cases of cardiospasm) a fibrous stricture of the oesophagus at the narrowed point. He admits the presence of a true sphincter of the oesophagus but ascribes no function to it. Mosher's further dissections on still-born infants lead him to put forward the suggestion that too free movement of the lung tips, especially the left, have the effect of kinking and pressing on the oesophagus, thus producing obstruction. He reports an adult case which showed obstruction apparently due to this cause. Further, he claims that in certain cases the left lobe of the liver may press upon and obstruct the oesophagus. These cases would appear to be definitely pathological and the abnormalities he describes seem unlikely to play any part in the normal act of swallowing.

In a recent paper, Findlay and Kelly have sought to prove that in normal children, during the act of swallowing, a portion of the cardiac end of the stomach is drawn up through the hiatus in the diaphragm by contraction of the longitudinal muscle fibres of the oesophagus, the cardiac sphincter coming to lie several inches above the dome of the diaphragm. (They differentiate this type of phenomenon quite definitely from a small hernia of the stomach passing through the oesophageal opening alongside the oesophagus). They support this claim by the fact that endoscopic biopsies of the mucosa

some distance above the diaphragm show typical gastric mucosa. The author is not qualified to judge the validity of the latter proof, but this has been criticised by various speakers in the discussion on the paper. The X-ray studies submitted however, are far from convincing, and the three following sources of error have not been excluded.

Firstly, as the authors themselves admit, the films were taken in the antero-posterior position, and not in the oblique position. It is therefore impossible to be sure, exactly at what level the oesophagus passes through the diaphragm. Further, the exact point of entrance into the stomach cannot always be made out, as this lies behind and is usually obscured by the cardia in the antero-posterior position.

Secondly, the films have not all been taken in the same phase of respiration. Considering how much the position of the stomach and of the oesophagus can be altered by this factor, it is difficult and unreliable to compare films made on the same case, and still more so on different cases. Further, the rate of the flow of barium into the stomach is markedly altered by the position of the diaphragm.

Thirdly, the films were made with the patient supine. This is absolutely unphysiological. The oesophagus follows the curve of the dorsal spine, and in this position its contents have actually to flow "up-hill" to enter the stomach. Again the stomach lies at a higher level than the oesophagus, and as soon as the cardiac orifice opens, gastric contents tend to flow back into the oesophagus. These two factors then, produce an accumulation of barium in the lower end of the oesophagus, which naturally dilates. If there is a large amount of barium in the stomach, this partly overshadows the dilated lower end of the oesophagus in the antero-posterior views, and makes it appear to rise from the stomach by a broad base - the narrowing due to the cardiac orifice being obscured by the stomach shadow.

In short, the authors' illustrations are exactly what is found in all normal cases seen under their conditions. Oblique studies in full inspiration, in normal cases would show that, although the lower end of the oesophagus is dilated (due to merely physical causes) the usual narrowing just above the diaphragm

is still present though it may be somewhat wider than normal, owing to the increased fluid tension of the contents passing through it.

Meltzer's experimental work on animals (quoted by Imperatori) has received general acceptance and sheds some light on the subject. He showed that the main cause of food entering the stomach was the rhythmic oesophageal peristalsis, and if in any way, e.g. by using thin liquid food, the material reached the lower end of the oesophagus before the peristaltic wave, it did not enter the stomach at once, but collected about one inch above the diaphragm until the wave arrived - then passed rapidly through en masse.

Summing up these views then, primary control of the oesophagus by the left crus of the diaphragm appears to be impossible. For one thing, a constriction produced by contraction of the left crus, could not in any circumstances, lie above the dome of the diaphragm - yet it is here, a short distance above the diaphragm, that the observed constriction is situated. Again, unless one presumes the power of independent muscular contractions of the left crus, it should be possible by holding the diaphragm fixed in full inspiration, to prevent food entering the stomach, as long as this diaphragmatic contraction is maintained - but this does not occur. Whether the theory put forward by Findlay and Kelly is correct or not, their evidence is not sufficiently convincing to outweigh that of other observers. The only rational conclusion that can be drawn from the various studies, is that a true cardiac sphincter does exist as an anatomical and functional entity. It is situated a short distance above the dome of the diaphragm, and it controls the passage of food into the stomach, normally remaining closed, but relaxing in advance of each peristaltic wave.

Turning now to the observed facts, as seen on X-ray examination, these bear out the conclusions reached in the preceding paragraph. Using barium paste of the consistency of well masticated food, this passes down the oesophagus and forms a small collection at the lower end above a constriction which lies a short distance above the diaphragm. A small amount may enter the stomach at once, or slowly trickle through, but a definite accumulation nevertheless occurs above the cardiac sphincter. Oesophageal peristalsis acts on this accumulation, the sphincter remaining closed, forcing it into a more or

less globular shape. This process continues until the sphincter opens, allowing the whole mass to be swept into the stomach by a wave of peristalsis which runs right down to the sphincter - the action exactly resembling that of the pyloric antrum. (Case 12). This whole event is repeated again and again, and the food enters the stomach in a series of fairly well regulated jets or spurts. The exact control of the sphincter, whether it is a definite relaxation in front of a zone of contraction, or whether it has a certain tone which is overcome only when the tension above it rises to a certain degree, is a difficult point to decide, though observations seem to point to a combination of both.

While the foregoing is, in the author's opinion a true description of what occurs in every normal case, it must be remembered that these appearances can be and usually are, profoundly modified by three factors - the consistency of the food, the act of respiration, and the position of the patient. If the material swallowed is fluid, it will flow readily into the stomach, in large jets. The rhythmical action is almost obscured by the amount of fluid, and the secondary effects of respiration. If the food is thick and lumpy, the jets will be irregular both in amount and frequency, for obvious reasons. For the best observation, the food should resemble well masticated food - about the consistency of thick cream. The movements of the diaphragm always have a marked effect on the act of swallowing - inspiration definitely retards the passage of food into the stomach, whilst expiration facilitates it. This effect appears to be purely mechanical - the descent of the diaphragm increases the kinking of the portion of the oesophagus, running obliquely to the left, through the hiatus, and produces a relative narrowing, and a diminution or temporary stoppage of the flow of food - whilst when the diaphragm rises, the reverse occurs. Using fluid media, this diaphragmatic regulation of the flow will predominate, as the muscular action of the oesophagus is unnecessary to force the material into the stomach, and is insignificant or absent. This apparent entire dependence on the diaphragm (under certain conditions) may have led some observers to assume that it was the only or chief factor controlling the entrance of food into the stomach.

If the patient is supine or prone, the diaphragmatic control is very slight. The chief factor in propelling the food into the stomach, is the typical

oesophageal peristalsis. This also departs somewhat, from the standard described as normal. The oesophagus is more dilated, the waves will be more frequent, and the antral type of action less evident, because the oesophagus is actually driving the material "uphill", against the back pressure of the gastric contents.

VI. Radiological Pathology.

Having described the appearances in a normal case, the changes subsequent to the impaction of a foreign body will be discussed. If the foreign body is opaque, and of reasonable size, it is readily seen and the exact position determined by screen examination alone. The localisation, if at all doubtful, can be confirmed by giving one small mouthful of barium paste, and observing the relation of the foreign body to the oesophagus. It is a serious error, besides being unnecessary, to give a large amount of barium. Should the foreign body subsequently pass down through the alimentary canal, it will be accompanied by the barium. This may effectively obscure it, and render its localisation impossible, and should it again impact, days may elapse before the barium has passed on sufficiently to render it visible.

It has been long established that the oesophagus is more easily distensible in its transverse, than in its antero-posterior diameter, owing to its position between the unyielding spine behind, and the trachea, great vessels, and the heart in front. The trachea, on the other hand because its rings are incomplete posteriorly, is more distensible in the antero-posterior plane. Flat foreign bodies (coins) and expansile ones (safety pins) therefore tend to lie in the coronal plane in the oesophagus and in the sagittal plane in the trachea.

If the foreign body, though opaque, is very small it may not be noticed on the screen but it will be observed on the films, and its exact position confirmed, by further examination if necessary. Such a small foreign body may however, be discovered on screen examination by indirect evidence as detailed below.

When the foreign body is non-opaque, or practically so, the diagnosis rests upon various departures from the normal findings. A large foreign body, whether opaque or non-opaque, will produce distension of the pharynx or oesophagus and thus press upon and

displace normal structures. This displacement should be looked for very carefully as it is indisputable evidence of the presence of a foreign body, and of its site of impaction. Most commonly this finding will be seen in the lateral view of the neck as a soft tissue shadow producing a widening of the shadow in front of the spine which bulges forwards into the tracheal air space and perhaps slightly compresses the trachea. (Case 13).

The next point to be looked for is the alteration in the act of deglutition. If painful, difficult, and forced, perhaps even accompanied by movements of the head and neck - a high situation of the foreign body or painful mucosal tear is to be suspected. This is a very typical type of difficult deglutition. The patient makes rapid chewing motions of the jaws and tongue, but hesitates almost against his will to "take the plunge" and make a purposeful swallowing motion - because he knows that swallowing is going to hurt him. When he finally does swallow the bolus, he does so at a gulp, to get the unpleasant sensation over as soon as possible. This bears a superficial resemblance to the rapid chewing and irregular swallowing seen in post-cricoid carcinomata or other lesions causing high obstruction, but it is really quite distinct. In the latter, the patient swallows quite willingly but chews the bolus well and only swallows small mouthfuls at a time, because he knows by experience that otherwise he will choke, due to food entering the trachea.

Next, a non-opaque foreign body may produce obstruction of a varying degree. It may be slight, marked, or even total. The foreign body may appear as a filling defect in the column of barium, either central or to one side; or the stream of barium may be forked or otherwise distorted as it passes the foreign body. If the obstruction is complete only the upper surface of the foreign body will be visualised, but this may be sufficient to allow its nature to be recognised. (Case 33).

The oesophagus is very intolerant of the presence of an impacted foreign body, and responds by the production of a greater or lesser degree of spasm at the site of the impaction. This spasm accentuates the obstruction produced by the foreign body itself. If the foreign body is thin with plane surfaces (e.g. a flat piece of bone) and is impacted in the vertical

plane, it causes practically no obstruction of itself, and from its shape, tends to prop the oesophagus open in spite of any spasm evoked, thus offering a free passage to barium on either side. (Case 5). In these particular circumstances, no obstruction may be produced. Moreover, when the existing cause is small and offers little direct obstruction, spasm alone is seldom sufficient to produce a definite holdup. Usually it will produce a slight delay in the passage of the barium, and the spasmodically narrowed area may be visualised by the fact that it does not dilate in the normal way as each bolus passes. To detect this slight degree of spasm (if no foreign body can be seen on X-ray examination, but the symptoms persist) Patterson strongly urges the use of large barium filled capsules. These will be arrested by the spasm, though paste will pass normally. This method has not found general favour, probably because the results are unreliable - even in normal people capsules are apt to be held up at various points because it is not a physiological bolus and excites spasm by its mere presence.

The next point is the intolerance of the oesophagus to dilatation. Any collection of barium above a partial or total obstruction is subjected to strong peristaltic waves attempting to force it past. These waves are frequently easily seen on the screen. Failure to overcome the obstruction is followed by regurgitation of the material above it. The higher the site of the obstruction, the sooner does this take place. If in the region of the sternal notch, regurgitation occurs almost at once, and if in the post-cricoid region, immediately. Below the sternal notch the tendency to precipitate regurgitation diminishes rapidly, the lower the block, but in most cases if the degree of obstruction is at all marked, regurgitation occurs in about five to ten minutes. In high obstructions the barium paste is occasionally inhaled into the larynx and trachea, and this constitutes the only possibility of danger of the X-ray examination. (Cases 13 and 14). No untoward results have followed, however, in the few cases in which this has occurred. Such a mishap can be avoided by making the initial mouthful of the opaque medium a very small one. After repeated dilatation however, the oesophagus comes to tolerate the presence of food, even to an extreme degree e.g. cardiospasm. If such a tolerance is noted, the presence of an organic lesion of some standing should be strongly suspected. This may have been rendered acute due to inflammatory reaction etc., or through the im-

paction of the foreign body. The higher the point at which dilatation is tolerated, the more certainly is this conclusion to be drawn.

In a large number of cases however, all or most of the foregoing findings will be indefinite. The next part of the examination, namely the clearing out of the residual barium by repeated acts of swallowing may show up a foreign body rendered opaque by small amounts of barium adhering to it. (Cases 15, 16 and 34). This finding is strengthened if such residual flakes persist after drinking water. (Case 17). This appearance can be perfectly simulated by a tear in the oesophageal mucosa, no foreign body being present. Nevertheless all such persistent flakes should be considered as foreign bodies until definitely proved otherwise.

It must be remembered that a foreign body may perforate the oesophagus and be found lying in the soft tissues surrounding it. This is most frequently found in cases where the foreign body has been present for at least twenty-four hours, allowing ulceration and perforation to occur. Such a case presents very acute symptoms and there is usually some constitutional effect as well, owing to the accompanying sepsis. The direct and indirect signs of a foreign body as seen by X-ray examination may be absent but the foreign body itself may be visible lying in close proximity to the oesophagus. Moreover if the perforation has existed for more than twenty-four hours, there will be infiltration and swelling of the soft tissues about the foreign body, perhaps even with the formation of an abscess, together with marked constitutional symptoms. There will be fever, rapid pulse and respiration, and severe pain at the site of the perforation, made worse by swallowing. (Abel). Such a swelling or abscess may betray its presence by displacement of normal structures. Typical of this is the retropharyngeal abscess (though this is rather an uncommon complication - Tucker; Sewell), which produces a marked broadening of the soft tissue shadow lying in front of the spine, and a forward displacement of the pharynx or trachea. Or the abscess may lie to one or other side of the pharynx or oesophagus and cause displacement and perhaps compression of these structures. If barium is given this may fill the abscess cavity and even show the point of perforation in the mucosa. (Case 18). Abscesses may contain a gas bubble, and show a shifting fluid level, which render them more conspicuous by contrast with

the surrounding tissues. (Iglauer and Ransokoff). It is doubtful if a similar process could be detected in the thorax, unless it were very large and extended into one or other of the lung fields; or else contained a definite gas bubble; or unless barium were given which entered and revealed the abscess cavity. A mediastinitis may reveal itself as a marked widening of the central shadow, and an obliteration of the clear retro-cardiac space - but patients in this condition are seldom fit for X-ray examination. (Orton).

Should the data gathered from some or all of these abnormal appearances justify a positive report, it is desirable that this should embody the following points. (1). The nature of the foreign body. (2). Its approximate size and shape. (3). The level of the site of impaction in relation to some definite structure, and also the number of the vertebra opposite which it is lodged. (4). The degree of obstruction produced. (5). Any other lesion found in the course of the examination or other relevant information.

If all the findings are within normal limits, as shown by full screen examination and a minimum of four films - the technique being as above - the report should state that no foreign body can be detected by X-ray examination. The patient should be reassured that nothing has been found, and should be asked to return for further examination should the symptoms persist. The small number that have returned constitutes the justification of this type of examination. In none has a foreign body been found on re-examination; either the result has again been negative, or an organic lesion, not previously detected has been discovered. In all doubtful cases the report should state that the examination has failed to exclude the presence of a foreign body, and that the case should be treated as positive until proved otherwise.

VII. Differential Diagnosis.

a) Variations within Normal Limits. The foregoing is an outline of the findings in more or less straightforward cases. The normal appearances vary within wide limits and many of the surrounding structures, whose shadows overlies the pharynx or oesophagus, may be mistaken for a foreign body. These points will now be considered in detail.

A possible source of error to the inexper-

lenced, is the retention of barium in the epiglottic valleculae. In the postero-anterior view, these appear as two semi-lunar shadows, convex borders downwards, situated one on each side of the mid-line at the upper border of the thyroid cartilage. In the lateral view they overlap, and appear as a pocket of barium, just anterior to the base of the epiglottis. This appearance is normal, and a considerable amount of barium may remain in the valleculae even after several draughts of water. Barium may also adhere to various structures of the pharynx, most commonly, the ary-epiglottic folds and piriform sinuses. It is usually easily removed from these situations by repeated acts of swallowing, or by drinking water. Little confusion arises from this, as the barium tends to make the structure to which it adheres, more clearly visible and therefore more easily recognisable. Moreover, in the antero-posterior view, especially if small mouthfuls of barium are given, frequently most of it will pass down to one or other side of the mid-line, or a larger amount will remain in one vallecula than in the other. The observer must not assume the presence of a foreign body on the favoured side - Mosher has shown that this asymmetry of the pharynx is quite a common finding. Usually large mouthfuls of food show the pharynx to fill out normally, and this, with the absence of local symptoms, should exclude the possibility of error. Occasionally a small flake of barium will be arrested just where the aortic arch causes a slight relative narrowing of the oesophagus, but this is easily removed by repeated acts of swallowing or by drinking water.

The shadows of abnormally long styloid processes or calcified stylo-hyoid ligaments may be mistaken for a bone, lodged in the pharynx. (Case 7). They can be differentiated by tracing them upwards, when their continuity with the skull becomes evident, and by rotating the patient, thus throwing them clear of the pharynx.

In the lateral view, calcification in the cervical lymph glands may overlies the pharynx, but in the antero-posterior view these may be seen to lie well out to one or the other side. (Case 19). Calcified areas in the thyroid gland might cause confusion but their tendency to be multiple, their density and their irregular outline should make their recognition easy. (Case 20). A single nodule can be excluded by rotating the patient. Where they are multiple however overlying the pharynx in all planes they may obscure

a foreign body which must then be discovered by indirect evidence alone.

Areas of calcification in the laryngeal cartilages frequently cause difficulty in diagnosis, as their posterior parts project into the pharyngeal and oesophageal areas in the lateral view, and overlies them in the antero-posterior view. For this reason the question of calcification in these cartilages will be considered in detail. Commencing usually about twenty-five years of age, (it may occur as early as fifteen) calcification can be detected by X-ray examination, and the deposition increases gradually with advancing years. It very rarely occurs in the epiglottis, cuneiform or corniculate cartilages. (Köhler). The thyroid and cricoid cartilages show calcification as do the arytenoids. The latter, however, are overlapped by the shadow of the thyroid cartilage, and cannot be distinguished. This also holds good for the cuneiform and corniculate cartilages, even if they should calcify.

Calcification commences in the postero-inferior parts of the thyroid cartilage, and in the posterior part of the cricoid, and thence it spreads slowly forwards. At first it is in the form of small irregular areas appearing as dense irregular shadows on the films. These increase in size and become denser until the greater part of the cartilage is calcified. It is impossible to state the age with accuracy from the amount of calcification present, but a sexual difference can often be distinguished - in the male the cricoid cartilage shows more calcification than the thyroid, the reverse being found in females. (Hickey - Clinical lectures). For these two reasons therefore, namely, the irregular way in which the calcium is deposited and the fact that it is most commonly found in the posterior parts of the cartilages, a normal appearance is often mistaken for an impacted foreign body or bodies. Oblique views are of little help in differentiation, and one must depend on experience, and the absence of indirect evidence of foreign body. (Case 21).

An uncommon finding is the presence of two small ring shadows seen just below and behind the greater cornua of the hyoid and just above the superior cornua of the thyroid cartilage. These are small cartilaginous nodules lying in each lateral thyro-hyoid ligament - the cartilagine triticeae. (Gray). Once seen they should be easily recognised

by their typical ring shadow, their position, and the fact that they are bi-lateral. (The author has been unable to find a previous reference to the radiographic demonstration and recognition of these structures). (Cases 22, 23 and 24).

In this connection one must not overlook a clearly visible foreign body which by its position, density, and regular outline, may be mistaken for one of the normal cartilages. (Case 6). Or to those unfamiliar with the appearances of a normal pharynx, it may appear as some normal structure, although none exists in that particular location. A thorough knowledge of radiological anatomy and a careful study of the films taken prevent this type of error.

Arthritis of the cervical spine frequently takes the form of small particles of new bone formation at the anterior edges of the vertebral bodies. These chips of bone, especially if single, may be mistaken for foreign bodies, either in the oesophagus, or lying outside it after perforation. Their actual nature is easily recognised as they are rarely single and the absence of surrounding swelling, and of severe symptoms, together with normal function in this region, should make differentiation easy. (Case 19).

At certain angles in the oblique views of the chest, the ends of the clavicles and the sterno-clavicular joints may throw a dense shadow which more or less obscures the oesophageal area, and may be mistaken for an opaque foreign body. Rotation of the patient will clear up this point. Calcification in the arch of the aorta might possibly simulate a foreign body, but the writer has no experience of this, and it seems unlikely that such a mistake could arise. Not uncommonly, if the aortic impression in the oesophagus is well marked, a small amount of barium may adhere just above the indentation, and simulate a foreign body. Apart from this being an uncommon site of impaction, such a flake is easily removed by drinking water, or even by swallowing a few times.

A much more likely cause of confusion is calcification in the glands of the lung hila. In the usual oblique view, the shadows of the hila lie very close to the oesophageal area. However, examination of the oesophagus with barium, and rotation of the patient will show there is no connection between these shadows and the oesophagus. Another unusual shadow may occasionally be encountered which to the

best of the author's knowledge has never hitherto been recognised radiologically. This is the shadow of the horizontal portion of the vena azygos. It is seen only on films taken at a certain angle, in the right anterior oblique position. Moreover, this angle, as far as can be ascertained, varies for each individual. The structure in question appears as a small rounded shadow lying in contact with the posterolateral aspect of the oesophagus on the right side. It is always found at the level of the fourth or fifth thoracic vertebra, and a slightly variable distance above the shadow of the root of the right lung. It bears no constant relation to the arch of the aorta, which is not surprising in view of the considerable variation in position of the latter due to age or disease. Above and below, the outline of the abnormal shadow is continuous with that part of the shadow of the great vessels formed by the superior vena cava. (Cases 25, 26 and 27). Moreover it may exert enough pressure on the oesophagus to produce a definite indentation in the barium shadow approximately on a level with, but on the opposite side from, the impression of the aortic arch. This shadow, then, is of no significance, but unless it is recognised, it may be mistaken for a foreign body, or the indentation it produces on the oesophageal outline, may be taken for a spasm, stricture, or small peri-oesophageal abscess. (Case 28).

b) Mucosal Injuries. The presence of tears or injuries to the mucous membranes introduces a serious complication in diagnosis. Where they are present accompanying a demonstrable foreign body, they are of little importance and seldom detected, as any changes they produce are overshadowed by those produced by the foreign body itself. When, however, the foreign body after causing such an injury to the mucosa either passes down to the stomach or is vomited up unnoticed, much confusion may arise. A mucosal tear, under these circumstances, may and often does, simulate perfectly all the symptoms produced by an impacted foreign body.

Moreover, the indirect evidence afforded by X-ray examination is very variable. Though as a rule no abnormality is seen, nevertheless spasm, rigidity of the oesophagus or even a degree of obstruction may be noticed. Any such findings, should be reported as suspicious of a foreign body, as error in this direction is less serious than overlooking a foreign

body which might be present. In some instances, a tear may become visible due to barium paste adhering to it and in addition, this may not be washed away with water. In such cases the appearances are not to be differentiated from an actual non-opaque foreign body with any degree of certainty. However, the number of cases where tears, in the absence of a foreign body can be detected at all, is very small and hence the number of erroneous diagnoses is correspondingly few. (Cases 29, 30, 31 and 32).

Differentiation between a tear and a foreign body is extremely difficult - if it must be attempted the following indications should be looked for. Mucosal injuries are usually produced by irregular objects, which by their very nature tend to lodge in the upper part of the oesophagus - hence abnormal findings in the lower part of the oesophagus are in favour of foreign bodies rather than tears. Moreover spasm, obstruction, etc., are much less marked with tears than with foreign bodies. Also while a foreign body produces signs both with paste and fluid, tears, though they may produce similar signs with paste, usually give no evidence of their presence with fluid, as then the oesophagus is more or less a passive tube and a tear alone can produce no alteration in the appearance of the barium column.

c) Organic Lesions. It is vitally important that any organic lesion present be discovered and its nature at least suggested. Especially so, as those cases which present the greatest difficulty in differential diagnosis by radiological examination, because of marked oesophageal obstruction, are the very cases which present difficulties in oesophagoscopy for that identical reason. The oesophagoscopist's already restricted field of vision is further obscured by retained secretions, food fragments, and barium paste. Under these adverse conditions, it may be extremely difficult to recognize a foreign body, and the danger of mistaking an organic lesion for a foreign body or of perforating a diseased oesophagus, is a very real one.

If an organic lesion becomes acute, for any reason, but the symptoms are erroneously considered as being due to an impacted foreign body (though in fact, none is present) the diagnosis is based upon the known appearances produced by the lesion in question. This is usually easy if some of the barium paste passes the obstruction, and satisfactorily out-

lines it. It is much more difficult where obstruction is complete. Here the main point on which reliance can be placed is the amount of dilatation tolerated by the oesophagus. Where this is considerable and especially if located high up one is almost certainly dealing with a condition of some standing. Moreover, the presence of residual fluid diluting, or of food fragments causing irregular filling defects, in the barium column indicates a long standing obstruction of some kind with certainty, though not revealing its nature. When the barium outlines only the upper end of a stricture, the type of deformity of the lower end of the barium column may be of assistance - narrow, pointed and irregular in malignant stricture, smoother in benign or spasmodic obstruction and displaced or distorted by extrinsic pressure. The soft tissue shadow of the lesion may be visible on the films, thus aiding diagnosis.

When an organic or functional stricture and a foreign body are both present, it may be extremely difficult to detect the true state of affairs. The danger lies in the fact that one or other may be missed; the stricture alone being diagnosed and serious complications arising from the undetected foreign body; or the foreign body only being discovered, and the stricture traumatised by subsequent attempts at removal. One of two findings will be noted. (1) Total obstruction. When this is due to stricture itself, it may be recognised by the appearances detailed above. The foreign body lying above the stricture, if opaque, is readily detected. If small or non-opaque, it may not show on the preliminary films, and will be completely obscured by barium, when this has been given. If large, even though non-opaque, it may produce a filling defect in the barium column permitting of its recognition. (Cases 35, 36 and 37).

When the total obstruction is due to the foreign body, the outlining of its upper surface by the barium may be sufficient to indicate its nature, but the stricture below it cannot be detected, though it may be suspected if the oesophagus is tolerant of dilatation. This may be the only clue to the stricture obtainable, but it is a very dependable one. Every attempt should be made to induce some barium to pass the obstructing point by dilution with water, and by encouraging the patient to swallow as forcibly as possible. Failing this one should give a very guarded report.

The diagnosis is easier when there is (2) Partial obstruction. Here, as a rule, the stricture can be outlined. The foreign body as before may be obscured by the barium, but it is now possible to clear this away by drinking water, and reveal any which has coated the foreign body. It may possibly occur that while the foreign body is recognised, insufficient barium passes it to indicate definitely a stricture lying below it. Here the toleration to dilatation and perhaps retained fluid and food fragments, may provide a clue. In all cases however, where for some reason the entire oesophagus has not been fully visualised with barium, this fact should be reported, and the possibility of a double lesion suggested.

The commonest organic lesion found is carcinoma, much more rarely a benign stricture, spasm or diverticulum. Carcinoma of the oesophagus shows a predilection for certain sites, and this may be of assistance when the nature of the stricture is in doubt. According to Boyd, the commonest sites are the upper end and post-cricoid regions, where the left main bronchus crosses the oesophagus, and at the lower end. Moreover, the upper end is more often affected in women, the lower in men. Malignant stricture of the gullet is a relatively acute disease, a gradually increasing dysphagia being the first symptom noticed. In a certain number of cases, however, the first indication that the patient receives of anything being the matter with him, is the impaction of a piece of food of a size he is accustomed to swallow. The patient may thus be considered (and so considers himself) a frank case of impacted foreign body, until the X-ray examination reveals the true state of affairs. On clinical grounds the presence of a carcinoma may well be unsuspected, and the danger of instrumentation is obvious, unless the operator is forewarned by the radiologist's report.

Extrinsic causes of obstruction are seldom mistaken for foreign bodies on account of the progressive character of the lesion and the other clinical evidence presented. However, an oesophagus narrowed by such an extrinsic lesion may become acutely obstructed by a foreign body. Among the possible causes are a pharyngeal diverticulum (as described by Zenker) or an oesophageal pouch, filled with food and obstructing the oesophagus; retro-pharyngeal abscess; extra-oesophageal tumour, including thyroid gland enlargement; aneurysm, and even an extremely dilated left auricle in mitral stenosis. (Rigler; Paterson). Diagnosis rests

upon the individual features presented in each.(case38)

VIII. Summary.

For the purpose of this paper the data of about five hundred X-ray examinations have been investigated, but only those having a particular bearing on the subject will be classified. In cases where no direct confirmation is possible, the author has adopted the following expedient.

If the patient did not return to hospital following a negative X-ray examination (or examinations) this is considered as substantial proof that the X-ray report was correct. In no case was oesophagoscopy deemed necessary when the X-ray report was negative, and in no such case was an oesophagoscopy performed subsequently. A few cases originally reported as negative were re-examined, but in none was a foreign body found. The cases may be classified as follows:-

a) In 98 cases, the X-ray report was negative, and no oesophagoscopy was performed.

b) In 63 cases, the X-ray report was positive, but the location of the foreign body rendered interference unnecessary.

c) In 15 cases, the X-ray report was positive, and the foreign body was confirmed and removed by oesophagoscopy.

d) In 5 cases, the X-ray report was positive, but no foreign body was found on oesophagoscopy examination.

e) In 3 cases, the X-ray report was positive, and in addition a co-existent organic lesion was reported. In these, both the foreign body and the organic lesion were confirmed by oesophagoscopy.

Total number of cases investigated - 184

It will be seen from these figures that a complete X-ray examination as outlined in the foregoing, performed with due care, gives extremely accurate results. In only five cases was a needless oesophagoscopy performed, thus erring on the side of safety, from the patient's point of view. In no case did the

much more serious error occur of overlooking a foreign body when one was present. A closer analysis of these five failures (from the oesophagoscopy standpoint) emphasises the fact that a foreign body may pass downwards in the interim between the X-ray examination and the oesophagoscopy, and therefore the interval should be as short as conveniently possible. In four out of the five cases (Cases 30, 31, 33, and 34) a foreign body was indisputably present at the time of the X-ray examination, and though not found on oesophagoscopy, confirmatory evidence in the form of mucosal injuries was discovered in one of them. (Case 31). In the remaining case, the X-ray examination raised the possibility of a mucosal injury, but could not completely exclude the presence of a foreign body. As the other evidence was in favour of a foreign body, an oesophagoscopy was performed but only a mucosal tear was found, and this was confirmed by subsequent X-ray examination. (Case 32). Taking these explanations into account, therefore, one may take it that four out of five cases were correctly diagnosed and that the fifth failed only in being unable to exclude the presence of a foreign body in the mucosal tear that was found as reported. This standard of accuracy seems to the author to justify complete reliance on the X-ray examination.

IX. Conclusions.

1) The X-ray examination as detailed in the foregoing can be done rapidly, at small cost, and without inconvenience or risk to the patient.

2) The information given by such an examination is extremely valuable. The presence of a foreign body, its nature, and the site of impaction can be accurately diagnosed in almost 100% of cases.

3) Moreover it will reveal the presence of an unsuspected organic lesion, simulating or complicating a swallowed foreign body, and give in addition valuable information concerning the nature of such an organic lesion.

4) The X-ray report is of great value to the doctor in charge of such a case. It assists him to decide whether or not intervention is necessary. If not necessary, the progress of the case can be followed by a repetition of the examination after a suitable interval. Where it is necessary, he is able to

base his procedures on definite information, protected from the danger of unsuspected organic disease.

5) As an alternative to holding the patient for observation, to diagnostic instrumentation, with or without anaesthesia, or even to visual examination of the pharynx, the X-ray examination is to be preferred as giving almost as much information, and this without risk to life or even discomfort to the patient.

6) The advantages of the X-ray examination as indicated above, provided it is thorough and carried out by an experienced observer, suggest that it should be adopted as an essential preliminary in all cases of swallowed foreign bodies.

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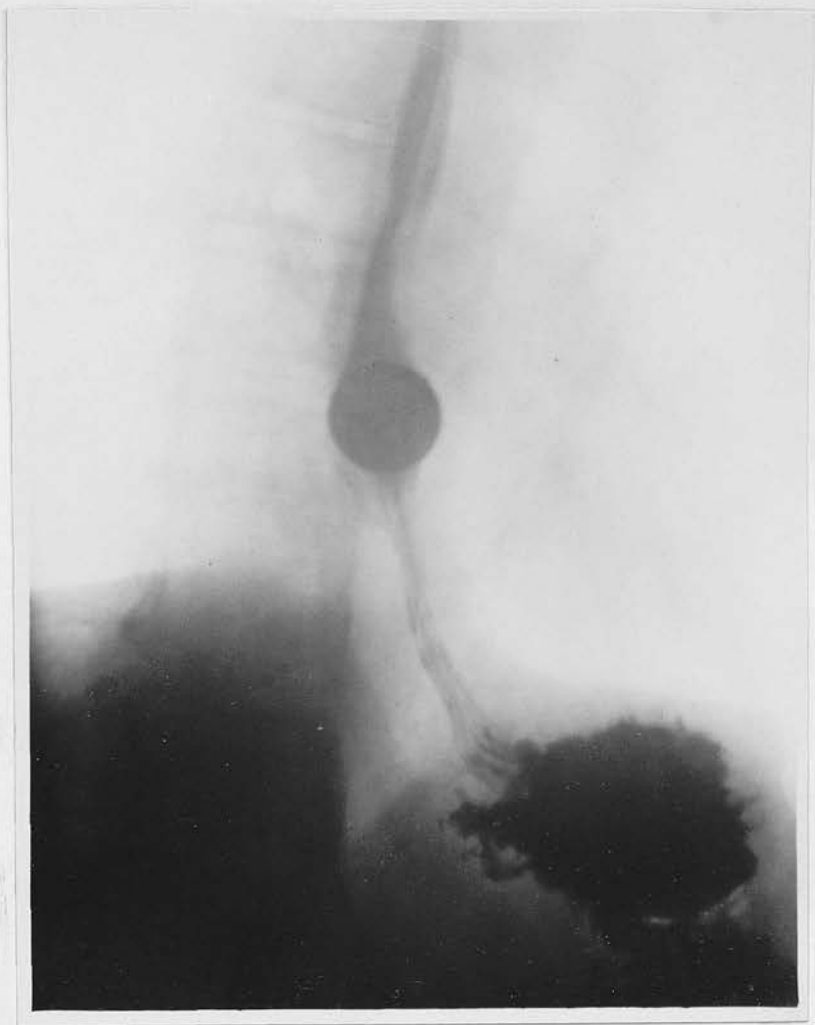
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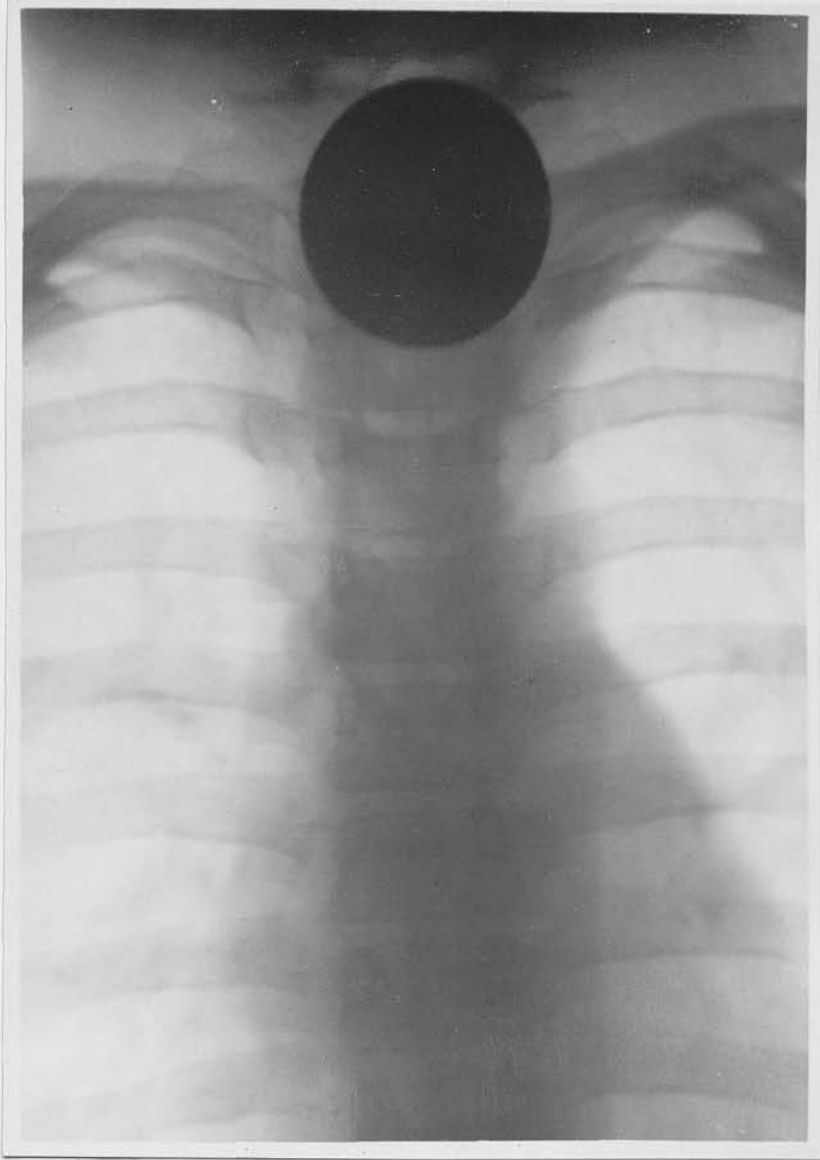
XI. Illustrative Cases.



Case 1. T.M., male, aged 49 years.

Right anterior oblique film.

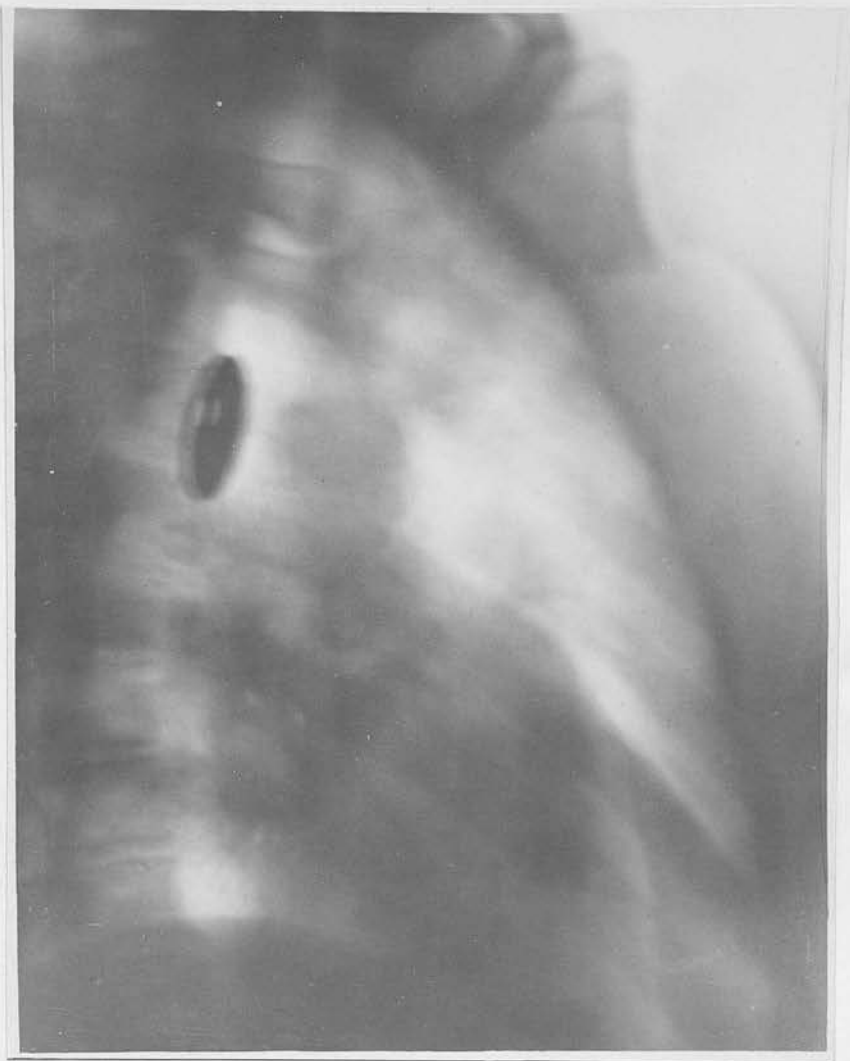
A shilling impacted in the lower third of the oesophagus. Its position has been confirmed by giving barium paste. Confirmed and removed by oesophagoscopy.



Case 2. C.E.J., male, aged 11 years.

Antero-posterior film.

A penny impacted in the oesophagus at the sternal notch, lying in the coronal plane. This was confirmed and removed by oesophagoscopy.



Case 3. J.L., male, aged 31.

Right anterior oblique film.

An identification disc impacted in the middle third of the oesophagus, opposite the eighth dorsal vertebra. The apparent movement of the disc is due to transmitted pulsation from the arch of the aorta. Confirmed and removed by oesophagoscopy.



Case 4. E.P., female, aged 51 years.

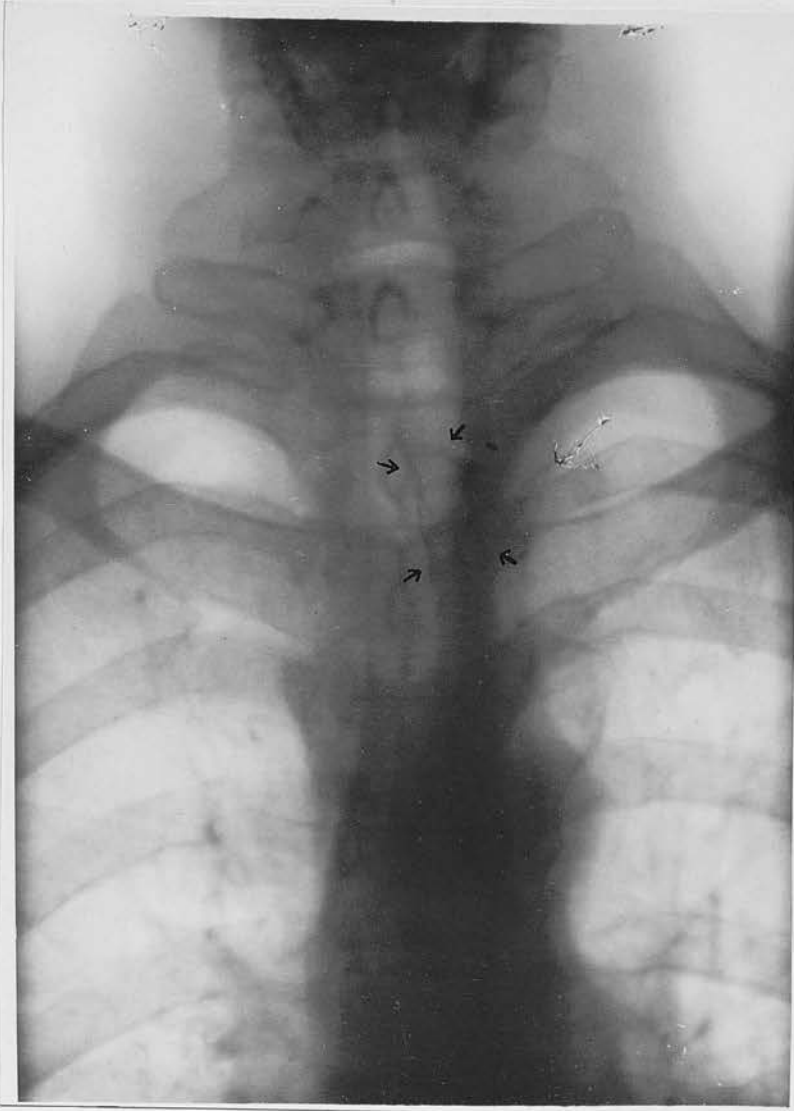
(a) Right lateral film.

A piece of bone, casting a dense shadow, impacted in the upper end of the oesophagus, opposite the 7th cervical vertebra.



(b) Right lateral film.

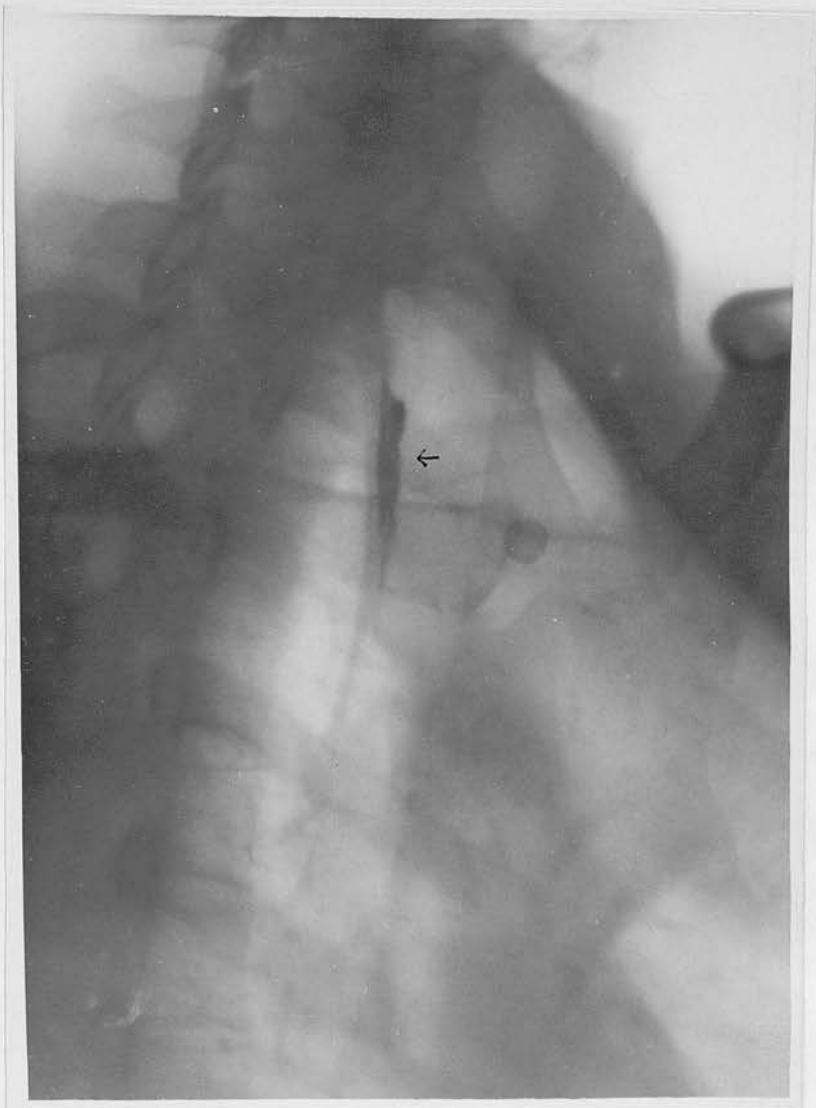
A mouthful of barium paste was given. This carried the foreign body down into the stomach. Note the disappearance of the shadow of the foreign body and the normal lumen of the oesophagus at the point where it had lodged previously.



Case 5. R.W., female, aged 35 years.

(a) Antero-posterior film.

Large triangular piece of a chicken's breast bone impacted in the oesophagus at the sternal notch, lying transversely in the vertical plane, thus propping the oesophagus open and causing no obstruction to barium. The foreign body could not be seen until barium paste followed by water had been given. The barium left adhering to the bone then rendered it visible.



(b) Right anterior oblique film.

The foreign body, coated with barium, is well shown. Note that the pain was referred to the back, between the shoulder blades. There was no anterior sensation referred to the oesophagus itself. The foreign body was confirmed and removed by oesophag-
oscopy.



Case 6. A.H., female.

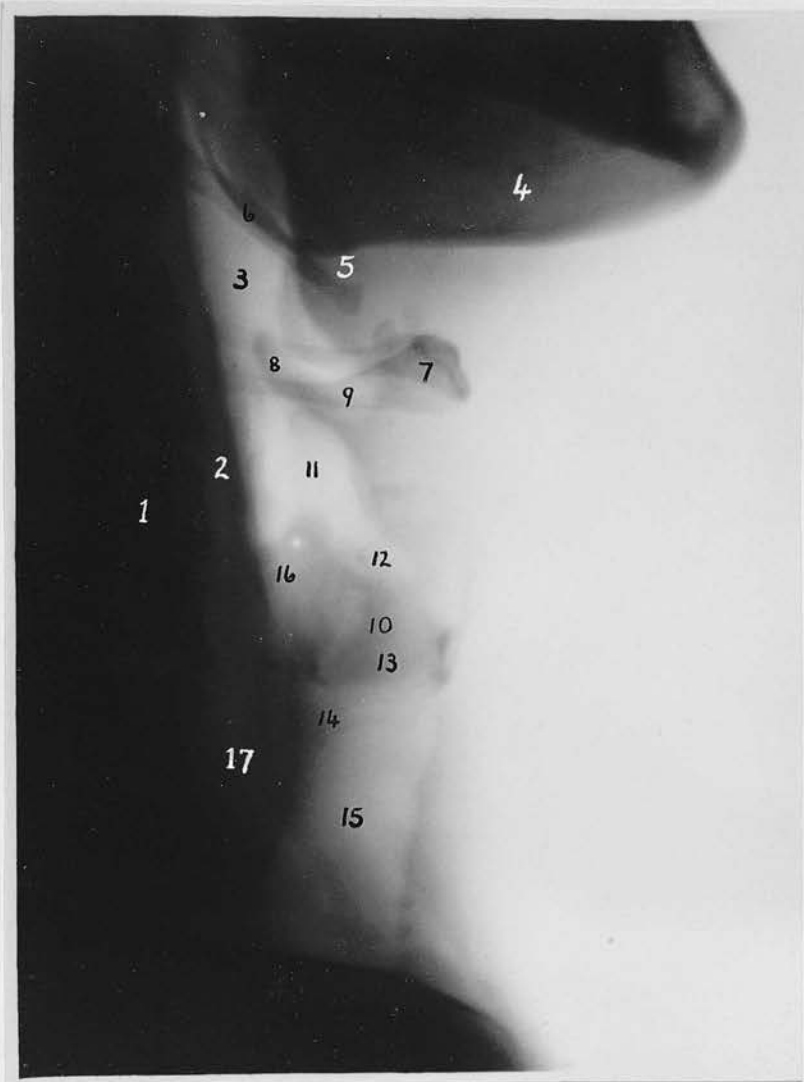
(a) Right lateral film.

A portion of a chicken's fibula impacted transversely in the pharynx. Pain was referred to the back of the neck in the mid-line - no pain being felt in the pharynx itself. Note the regular outline and disposition of the foreign body which might lead the inexperienced to mistake it for a normal structure.



(b) Right lateral film.

After swallowing barium paste and drinking water, the foreign body is rendered more distinct by the residual barium adhering to it. Note the abnormal amount of barium retained in the epiglottic valleculae due to the foreign body propping the pharynx open and preventing it emptying normally. The foreign body was confirmed and removed by oesophagoscopy.



Case 7. W.W., male, aged 33 years.

Right lateral position.

Normal case. 1) Cervical spine. 2) Prevertebral muscles. 3) Pharynx. 4) Mandible. 5) Tongue. 6) Styloid processes. 7) Hyoid. 8) Epiglottis. 9) Epiglottic valleculae. 10) Thyroid cartilage. 11) Laryngeal aperture. 12) Piriform sinuses. 13) Larynx. 14) Cricoid cartilage. 15) Trachea. 16) Laryngeal pharynx. 17) Oesophagus.



Case 8. G.S., female, aged 50 years.

Right anterior oblique film.

The oesophagus cannot be seen until filled with contrast medium. It lies in the clear area between the spine behind, and the heart, aorta and great vessels, in front. Note the lung hila overlapping the oesophageal area about its mid-point.



Case 9. L.F., female, aged 41 years.

(a) Right lateral view.

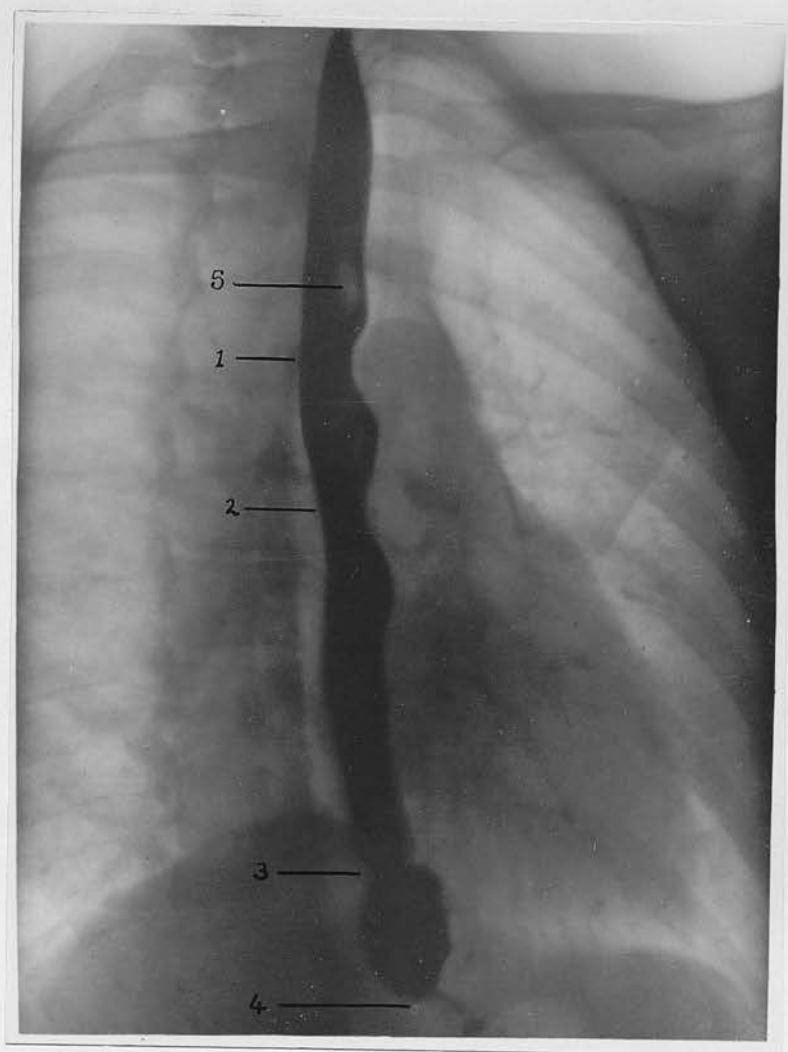
Normal pharynx. Compare with the two following films.



(b) Normal pharynx, after swallowing a mouthful of barium paste. Note a small amount of barium in the epiglottic valleculae and traces adhering to the back of the tongue and walls of the pharynx.



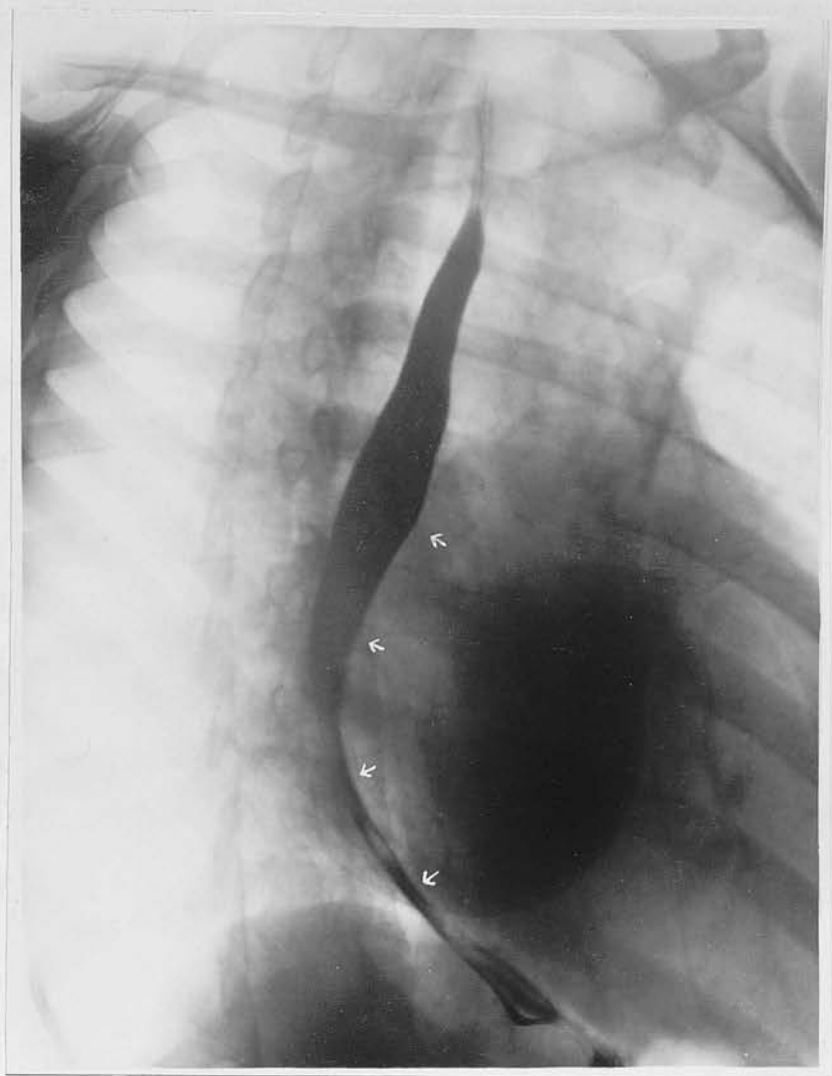
(c) Normal pharynx, after swallowing barium paste and drinking water to remove the excess of barium left adhering to the pharyngeal walls. Note that the valleculae are now practically clear and only minute traces remain elsewhere in the pharynx.



Case 10. M.P., female.

Right anterior oblique film.

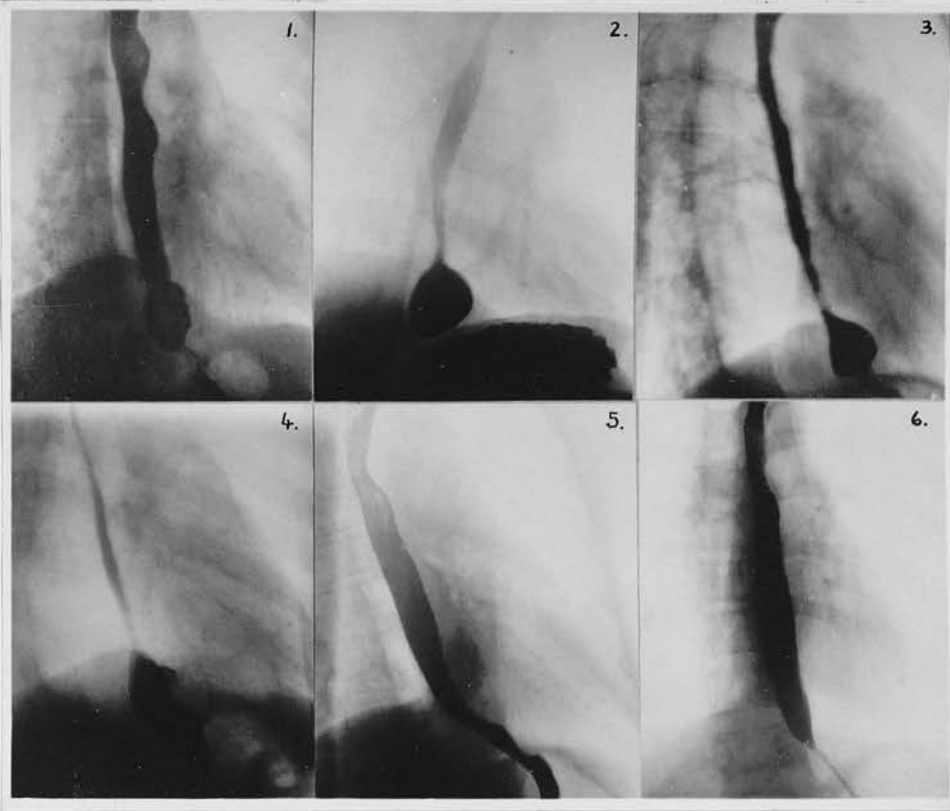
Normal oesophagus outlined with barium paste. Note its relation to the other structures in the thorax. Note also, (1) the indentation produced by the arch of the aorta, (2) the indentation produced by the left main bronchus, (3) a peristaltic wave, (4) the cardiac sphincter, and (5) a bubble of air swallowed with the barium.



Case 11. E.B., female.

Right anterior oblique film.

Well-marked mitral stenosis. The oesophagus is outlined with barium paste. It is displaced backwards and to the right, and definitely compressed and obstructed by the dilated left auricle.



Case 12. Studies made from a group of cases to show the action of the lower end of the oesophagus. It is impossible to show all these phases in one case owing to the rapidity of the process. 1) The oesophagus is outlined with barium. Cardiac sphincter closed, barium collecting at the lower end of the oesophagus with peristaltic wave just above it. 2) Peristaltic wave forcing barium into globular shape, cardiac sphincter still closed. 3) The sphincter is commencing to open and a small amount of barium is entering the stomach. 4) Sphincter widely open, peristaltic wave forcing barium rapidly into the stomach. 5) The next mouthful of food is filling the oesophagus above the peristaltic wave which is forcing the last of the previous mouthful into the stomach. 6) Complete emptying of the lower segment of the oesophagus. The cardiac sphincter is again firmly closed. Barium is passing down the oesophagus for the next cycle.



Case 13. S.L., female, aged 56 years.

(a) Right lateral film.

Large lump of meat impacted in the oesophagus, on a level with the 6th cervical vertebra. Note the widening of the soft tissue shadow in front of the spine, bulging forwards into the tracheal air-shadow. This is produced by distension of the oesophagus by the foreign body.



(b) Right lateral film.

A mouthful of barium paste has been given. There is complete oesophageal obstruction at the level of the foreign body. Most of the barium has been regurgitated and a small amount has entered the trachea. The foreign body was confirmed and removed by oesophagoscopy.



Case 14. W.O., male, aged 66 years.

Right lateral film.

Carcinoma of the oesophagus with complete obstruction and the formation of a tracheo-oesophageal fistula allowing all the barium paste to enter the trachea. Note how completely this is prevented, by coughing, from entering the lungs, thus showing that no danger attends the inhalation of barium into the larynx.



Case 15. E.T., female, aged 36 years.

(a) Right lateral film.

A small piece of bone impacted in the oesophagus in the post-cricoid region.



(b) Right lateral film.

After giving barium paste and drinking water to wash down the excess barium. Note better visualisation of the foreign body due to the residual barium adhering to it. Confirmed and removed by oesophagoscopy.



Case 16. A.G., female, aged 48 years.

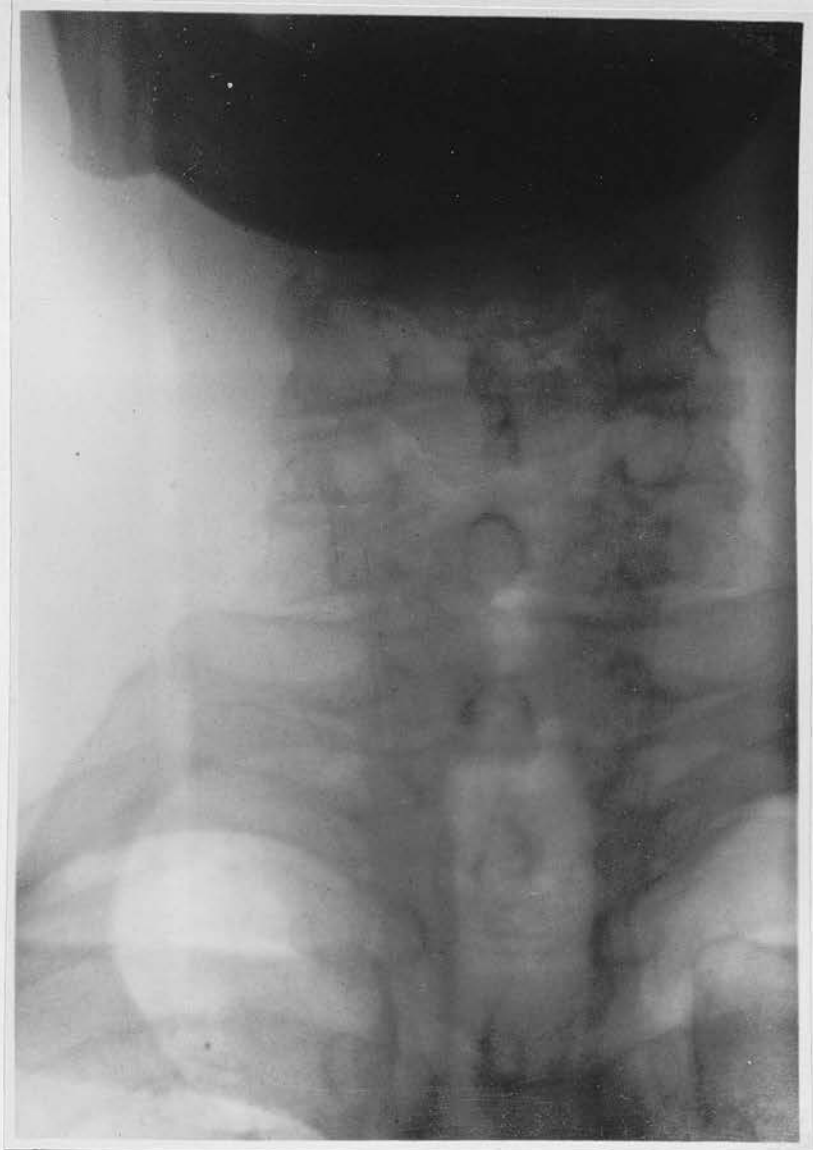
(a) Right lateral film.

A small piece of bone impacted in the oesophagus in the post-cricoid region.



(b) Right lateral film.

After giving barium paste and drinking water to remove the excess. Note better visualisation of the foreign body due to the residual barium adhering to it. Note the irregular calcification in the laryngeal cartilages which might cause confusion, and the presence of the cartilages triticeae. Confirmed and removed by oesophagoscopy.



Case 17. A.B., male, aged 51 years.

(a) Postero-anterior film.

Piece of meat-bone impacted in the oesophagus just above the sternal notch. It is not sufficiently opaque to cast a shadow on the preliminary film.



(b) Postero-anterior film.

After giving barium paste, some of this coated the foreign body and rendered it visible. There was no oesophageal obstruction.



(c) Postero-anterior film.

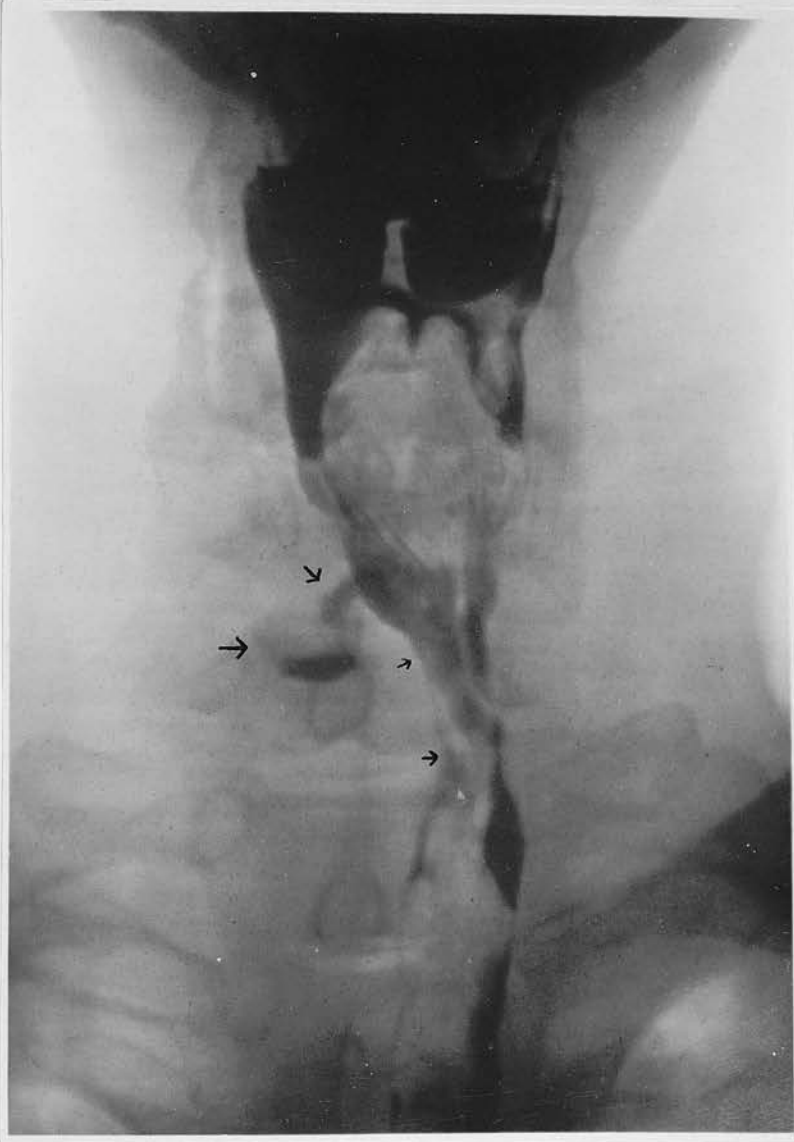
After clearing away the excess of barium by drinking water, the exact shape, size and position of the foreign body are clearly shown. The foreign body was confirmed and removed by oesophagoscopy.



Case 18. J.B., male, aged 54 years.

(a) Right lateral view.

Large lump of meat impacted in the oesophagus in the post-cricoid region, producing almost complete obstruction and appearing as a partial filling defect in the barium column. It was confirmed and removed by oesophagoscopy but a stricture was found just below the site of impaction and the patient was sent back for further investigation.



(b) Postero-anterior film.

On re-examination, barium passed freely down the oesophagus. A large amount remained adhering to the pharyngeal mucosa, probably due to the trauma produced by the oesophagoscopy. In the post-cricoid region, the oesophagus was displaced to the left and slightly compressed by a soft tissue infiltration around a barium filled abscess in the peri-oesophageal tissues in the right side of the neck. The barium in the abscess shows a fluid level with air above it. The track of the abscess and the point of perforation can be seen.



(c) Right lateral film.

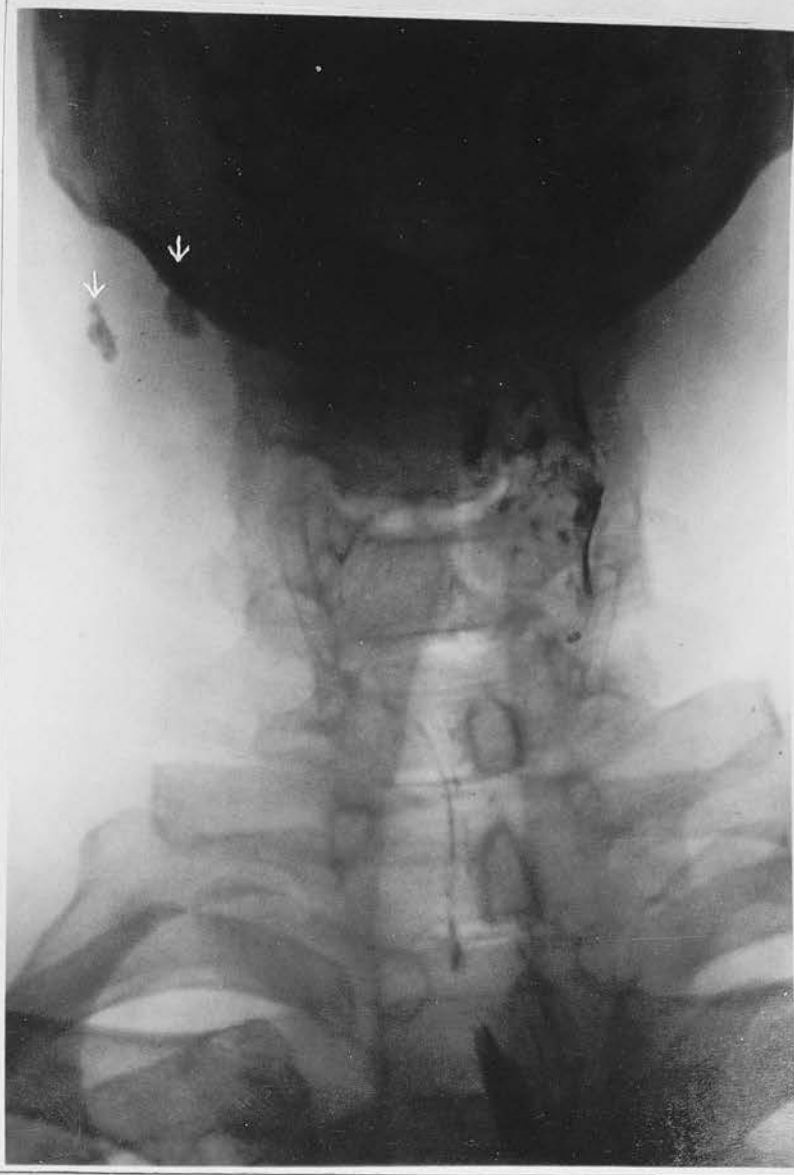
This confirms the previous film. The point of perforation in the posterior wall of the oesophagus can be seen distinctly. The patient recovered in two weeks without surgical interference. Further examination after an interval of six months, showed normal position and function of the oesophagus with no evidence of the abscess.



Case 19. J.B., male, aged 54 years.

(a) Right lateral film.

Normal case. No foreign body present. Two calcified tuberculous glands overlying the pharyngeal and oesophageal areas in this plane, which might be mistaken for foreign bodies. Note also, osteoarthritis of the cervical spine as shown by the small chips of new bone formation opposite the anterior edges of the vertebral bodies. These might also be mistaken for foreign bodies which have perforated the oesophagus.



(b) Postero-anterior film.

In this plane, the calcified glands can be seen lying in the neck, some distance from the pharynx and oesophagus.



Case 20. A.W., male.

Right lateral film.

No foreign body present. There is marked enlargement of the thyroid gland which contains numerous small areas of calcification. If a foreign body were present, it would have to be detected by indirect evidence alone, as its shadow could not be distinguished from these areas of calcification.



Case 21. W.H., male, aged 42 years.

(a) Right lateral film.

There is a large lump of meat impacted in the oesophagus just above the sternal notch, producing complete oesophageal obstruction. Note the large, bulging soft-tissue swelling encroaching on the tracheal air-shadow, due to distension of the oesophagus by the foreign body. The two small, dense shadows were thought to be pieces of bone in the meat. The lump of meat was confirmed by oesophagoscopy but was too friable to be removed, so it was pushed down in the hope it would pass, but impaction again occurred and the patient was sent back for re-examination.



(b) Right lateral film.

On re-examination, the soft-tissue swelling had disappeared proving that the foreign body had passed down. The two small, dense shadows are still present, and are areas of calcification in the thyroid and cricoid cartilages, laid down in an atypical manner. They might very easily be mistaken for foreign bodies but could be differentiated by the absence of indirect evidence.



(c) Right anterior oblique film.

The lump of meat was found impacted about the mid-point of the oesophagus, producing marked obstruction to barium and appearing as a filling defect in the barium column. A second oesophagoscopy was performed and the foreign body pushed right down into the stomach. No foreign body was found in the pharynx on this occasion, thus confirming that the small, dense shadows were calcified areas in the laryngeal cartilages.



Case 22. F.D., male, aged 25 years.

(a) Right lateral film.

Normal case. No foreign body present. The cartilages triticeae are well shown. These might be mistaken for a foreign body unless recognised.



(b) Left anterior oblique film.

Films taken at this angle demonstrate the relative position of the cartilagineae triticeae to the pharynx. They are not sufficiently dense to show against the shadow of the cervical spine in the postero-anterior plane.



Case 23. C.W., female aged 32 years.

Right lateral film.

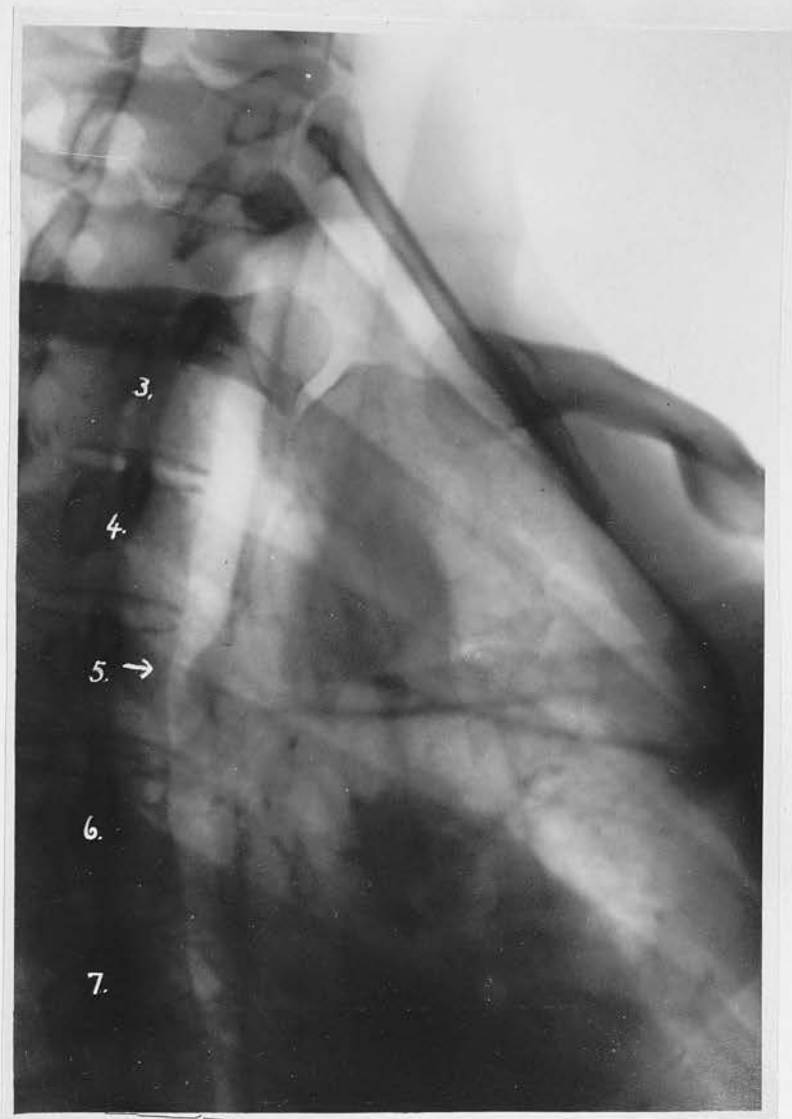
Normal pharynx. No foreign body present. The cartilagines triticeae are well shown.



Case 24. F.S., male.

Right lateral film.

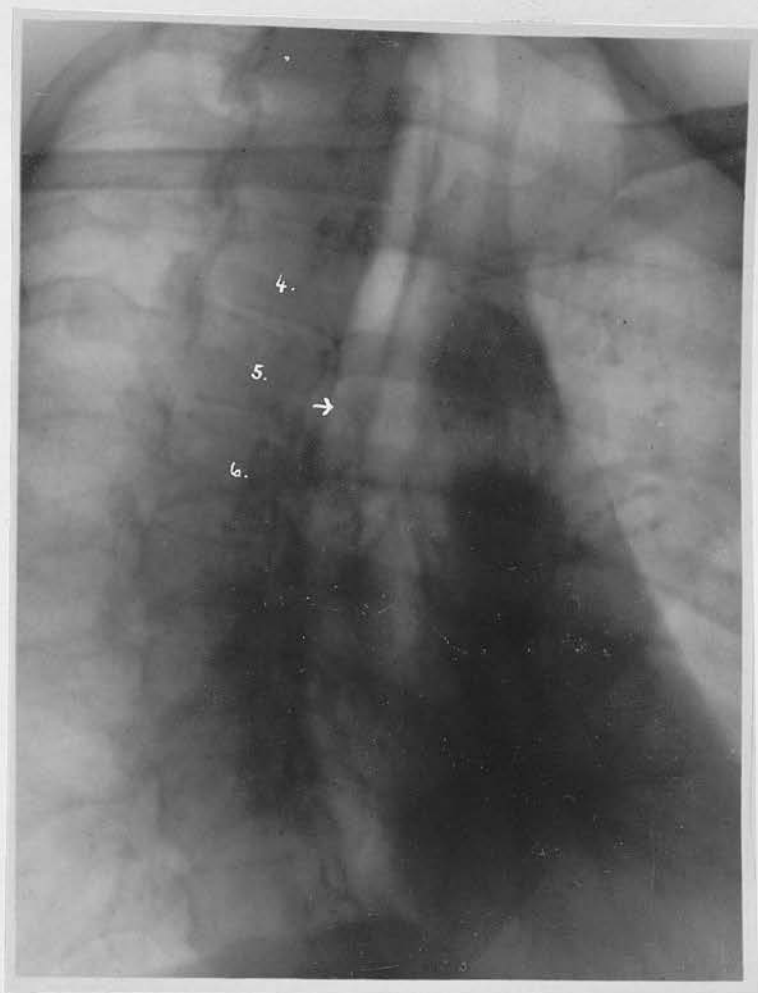
Dental plate impacted in the upper end of the oesophagus. Note the cartilagine triticeae.



Case 25. E.K., female, aged 36 years.

Right anterior oblique film.

Normal case. No foreign body present. Note the shadow of the horizontal portion of the vena azygos, opposite the 5th thoracic vertebra.



Case 26. G.S., female, aged 50 years.

Right anterior oblique film.

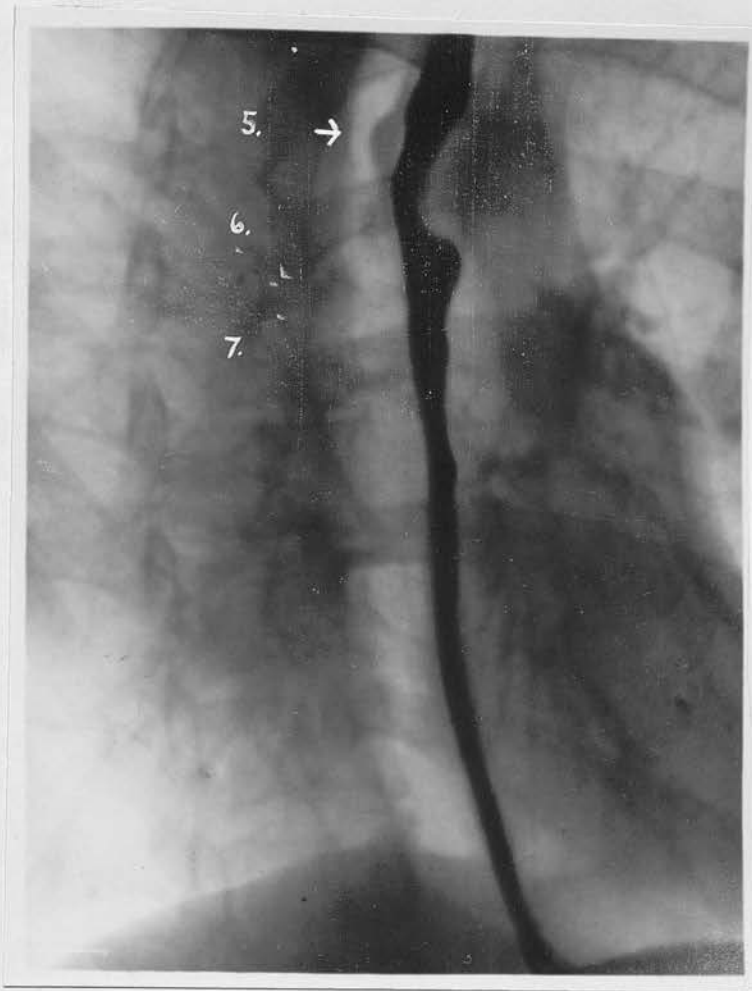
Normal case. No foreign body present. Note the shadow of the horizontal portion of the vena azygos, opposite the 5th thoracic vertebra.



Case 27. H.M., female.

Right anterior oblique film.

Normal case. No foreign body present. Note the shadow of the horizontal portion of the vena azygos, opposite the 5th thoracic vertebra.



Case 28. J.L., male.

Right anterior oblique film.

Normal case. No foreign body present. The oesophagus is outlined with barium. Note the shadow of the horizontal portion of the vena azygos and the indentation it produces in the barium column.



Case 29. A.H., male.

Right lateral film.

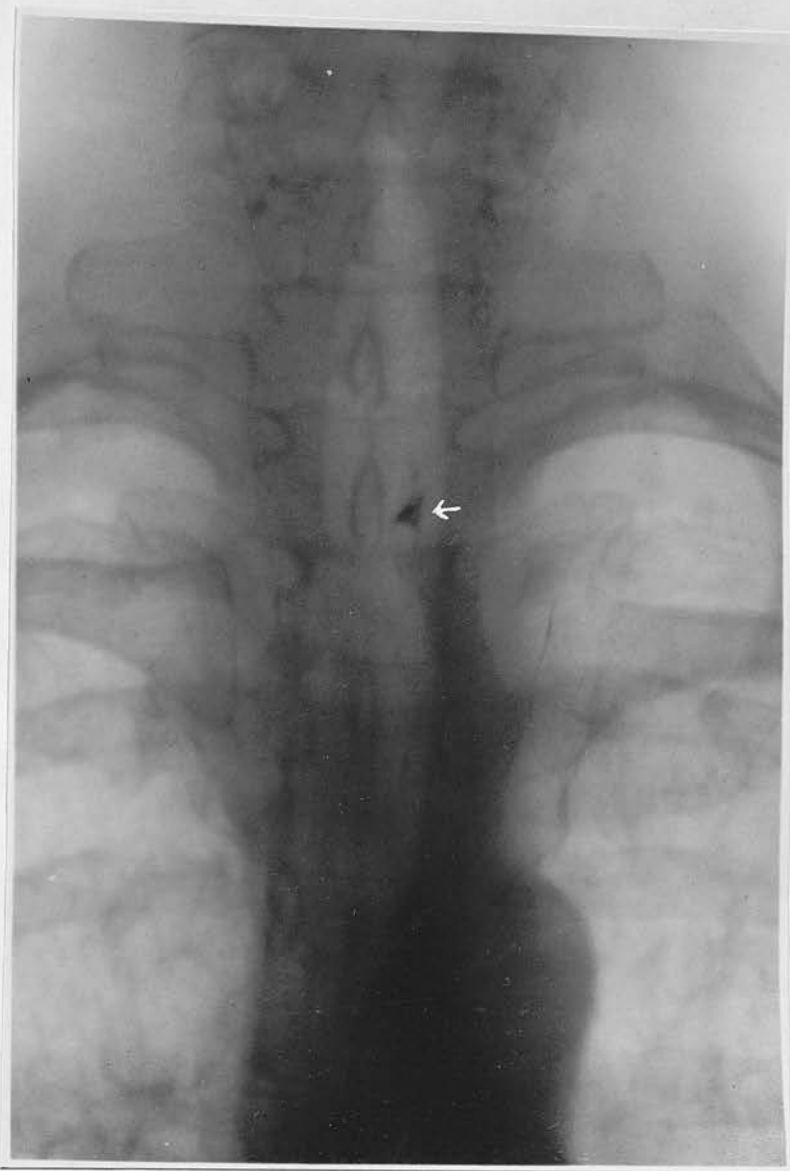
The patient gave a history of having swallowed a piece of bone. The pain was located in the pharynx on the right side at the level of the hyoid bone. On X-ray examination, no foreign body could be detected. The pharyngeal function was normal but there was a persistent flake of barium in the right epiglottic vallecula which could not be removed by drinking water. A diagnosis of mucosal tear was made, no foreign body now present. No oesophagoscopy was performed but as the patient did not return for further examination, the diagnosis was probably correct.



Case 30. R.A., female, aged 55 years.

(a) Postero-anterior film.

Piece of bone impacted in the oesophagus at the sternal notch. Barium paste, followed by a glass of water, has been given and the foreign body is shown, coated with the residual barium adhering to it. Oesophagoscopy was performed but no foreign body was found. As a foreign body was undoubtedly present at the time of the X-ray examination, it must have passed downwards in the interval between the X-ray examination and the oesophagoscopy.



(b) Postero-anterior film.

As severe symptoms continued, referred to the site of the previous impaction, the patient was re-examined 24 hours later. No foreign body could be demonstrated and the oesophageal function appeared normal. A dense flake of barium persisted at the site of impaction and could not be removed by drinking water. This is clearly a mucosal tear produced by the foreign body and giving rise to symptoms identical with those caused by an impacted foreign body.



(c) Postero-anterior film.

The patient was examined again after an interval of four days. She was then symptom free and was eating normal meals. Oesophageal function appeared normal and no persistent flakes of barium could be detected. The mucosal tear has apparently healed and barium paste no longer lodges in it.



Case 31. J.S., female, aged 59 years.

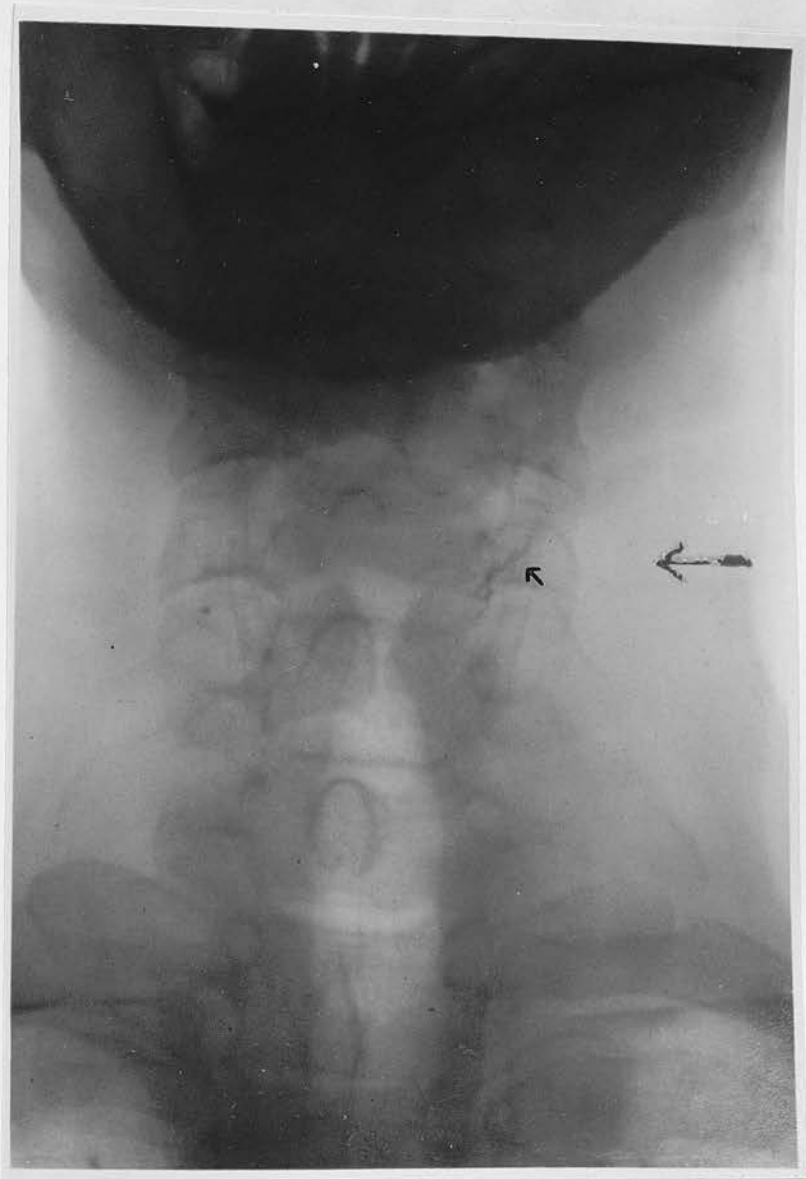
(a) Postero-anterior film.

Piece of meat bone impacted in the oesophagus at the sternal notch. It is causing marked obstruction but its upper surface can be seen causing a filling defect in the barium column.



(b) Right lateral film.

The foreign body is well seen, producing a soft-tissue swelling encroaching on the tracheal air-space and causing marked obstruction to barium. It appears as a filling defect in the small amount of barium which has collected above it. The foreign body must have passed downwards in the interval between this examination and the oesophagoscopy as no foreign body was found. A mucosal tear was discovered, however, at the site of impaction, and this is confirmation that a foreign body had been present.



Case 32. M.R., female, 50 years of age.

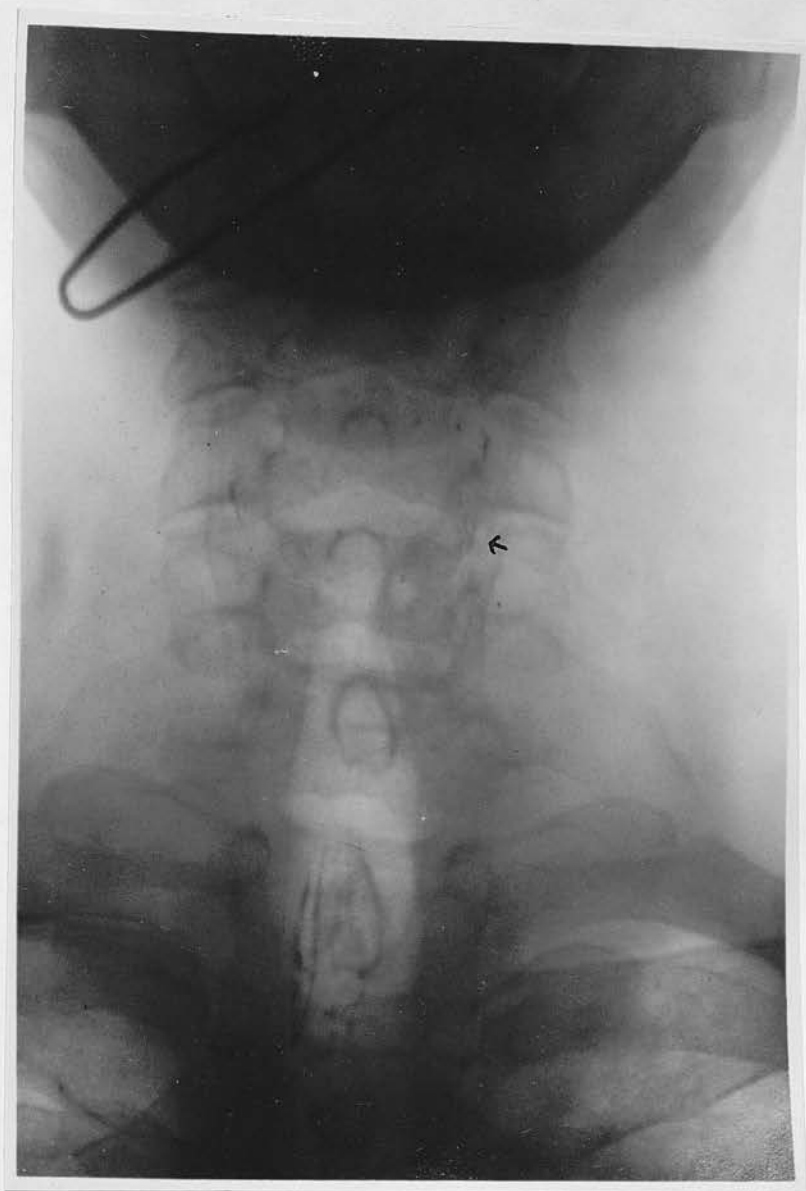
(a) Postero-anterior film.

The patient gave a history of having swallowed a small fish bone. Pain localised in the pharynx, about the level of the cricoid cartilage. The pharynx appeared to function ^{normally,} but there was a small, persistent flake of barium at the introitus to the oesophagus, on the left side. This could not be removed by drinking water. No definite foreign body could be detected.



(b) Right lateral film.

The residual flake of barium is well seen. In view of the normal function of the pharynx, a diagnosis of mucosal tear was made. The presence of the foreign body in the tear it had produced could not be definitely excluded as it was small and only very slightly radio-opaque, but the normal pharyngeal function tended to render this unlikely. No foreign body was found on esophagoscopy, but a mucosal tear was discovered at the site indicated by X-ray examination thus confirming the diagnosis.



(c) Postero-anterior film.

On re-examination, 24 hours later, oesophageal function appeared normal. When barium paste was given a very minute trace adhered to the mucosa at the same place as it did previously and where a mucosal tear was detected on oesophagoscopy. This is case of a mucosal tear which is in process of healing.



(d) Right lateral film.

The lateral film corresponding to the postero-anterior film on the previous page. The mucosal tear can be faintly seen with a minute trace of barium adhering to it.



Case 33. M.N., female, aged 14 years.

Right lateral film.

Large meat bone impacted in the oesophagus at the sternal notch. It is shown by the soft-tissue swelling encroaching on the tracheal air-space, by the total obstruction to barium and the filling defect produced in the barium column. No foreign body was found on oesophagoscopy, so it must have passed down in the interval as it was indisputably present at the time of the X-ray examination.



Case 34. E.H., female, aged 58 years.

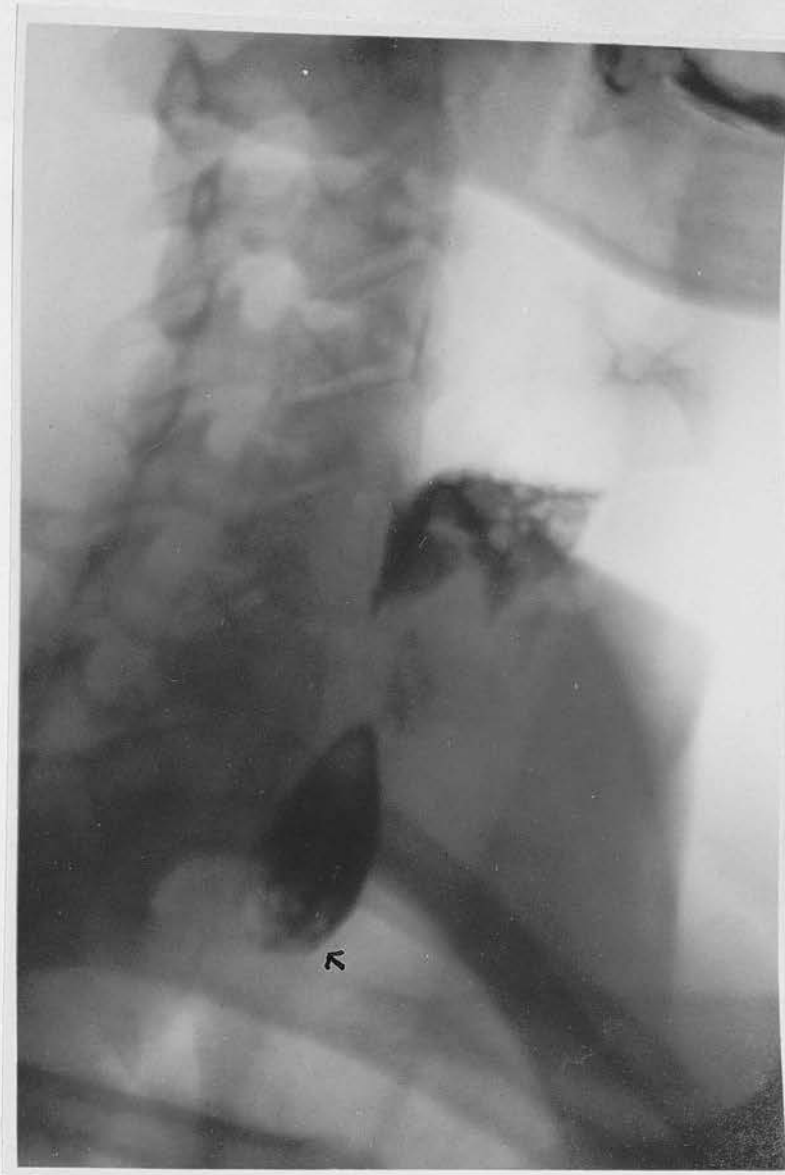
(a) Postero-anterior film.

Meat bone in the oesophagus opposite the 7th cervical vertebra. It is not sufficiently radio-opaque to cast a shadow on the film.



(b) Postero-anterior film.

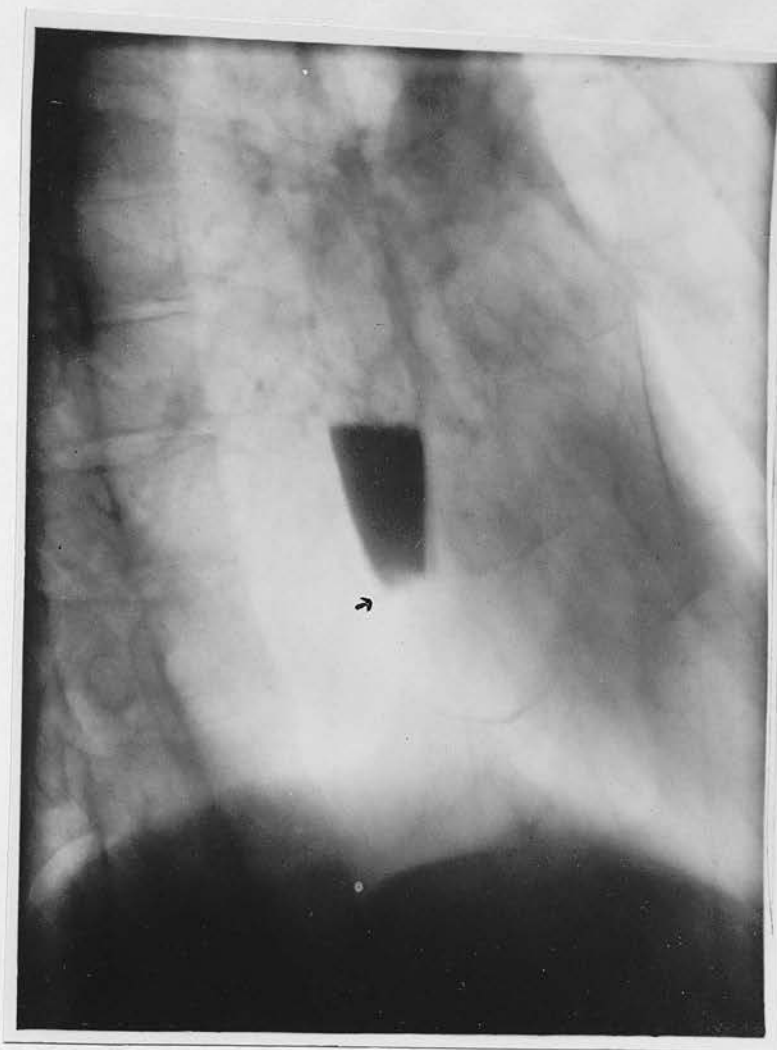
After giving barium paste and removing the excess by drinking water, the size, shape and position of the foreign body are rendered clearly visible by the residual barium adhering to it. On oesophagoscopy no foreign body was found. It was indisputably present at the time of the X-ray examination, but must have passed downwards in the interval between the examination and the oesophagoscopy.



Case 35. L.P., female aged 38 years.

Right anterior oblique film.

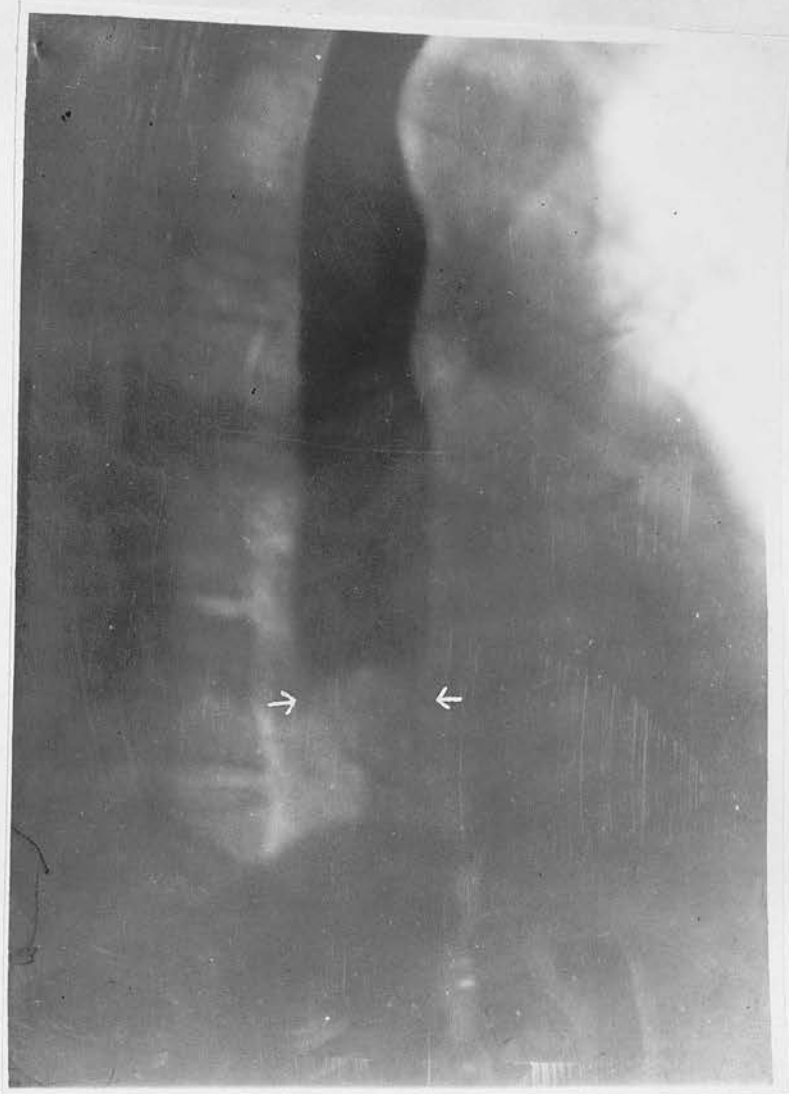
Drank "aromatic ginger" at the age of 12. Since then, pieces of food have frequently stuck in the throat but have hitherto been vomited up spontaneously, after a short interval. Now complete obstruction following impaction of a large piece of meat. The foreign body shows as a soft-tissue swelling and as a filling defect in the column of barium. Note the violent peristalsis and the comparatively large amount of barium tolerated above a high total obstruction. On these grounds, a foreign body impacted in an organic "benign" stricture was diagnosed. On oesophagoscopy, the foreign body was confirmed and removed and the stricture confirmed.



Case 36. J.N., male, aged 36 years.

Right anterior oblique film.

Lump of meat impacted in the oesophagus, about 3 inches above the diaphragm, producing complete obstruction to barium and appearing as a filling defect in the lower end of the barium column. Note the retained secretions diluting the barium and the marked tolerance of the oesophagus to dilatation. An organic stricture acutely obstructed by an impacted lump of meat, was diagnosed. On oesophagoscopy, though the field was badly obscured, an ulcerated area, probably carcinoma, was found just above the cardiac sphincter. The foreign body could not be found - either it had passed into the stomach or was missed among the retained secretions and food fragments.



Case 37. A.M., female.

Right anterior oblique film.

Large lump of meat impacted in the oesophagus, about 4 inches above the diaphragm. It is producing total obstruction and its upper surface appears as a filling defect in the lower end of the barium column. Note the marked toleration of the oesophagus to dilatation and the dilution of the barium by retained secretions. These findings justified a diagnosis of organic stricture of the oesophagus rendered acute by an impacted lump of meat. Oesophagoscopy was performed but nothing could be made out as the field was hopelessly obscured by barium, saliva, etc. During the night, the obstruction relieved itself spontaneously by slow degrees. No confirmation is possible in this case, but as the patient had attempted suicide on several occasions by inhaling coal gas, it is presumed that she had drunk corrosive material with the same end in view, though she denied ever having done so.



Case 38. H.H., male.

(a) Postero-anterior film.

This examination was not carried out by the author. The patient gave a history of rapidly increasing dysphagia. At the time of the examination only liquids could be swallowed. Barium paste showed the presence of marked oesophageal obstruction just above the sternal notch, and the cause of the obstruction appeared to be producing an irregular, more or less central, filling defect in the barium column.



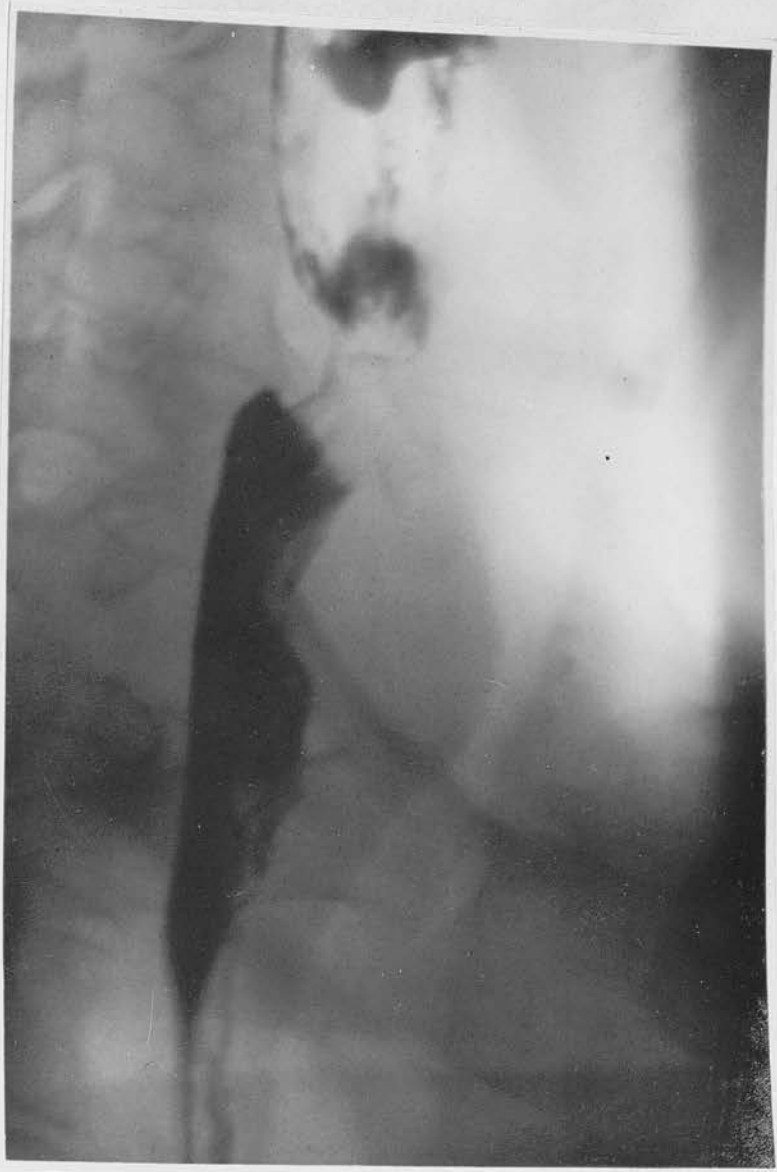
(b) Left anterior oblique film.

This examination was not carried out by the author. The oblique film also shows the irregular, central filling defect, producing marked obstruction. A diagnosis of intra-oesophageal tumour, or a large, impacted foreign body, was made. Oesophagoscopy was performed but was absolutely negative. As the symptoms persisted, the patient was sent back for further examination after an interval of four months.



(c) Postero-anterior film.

Re-examination was carried out by the author. There was still marked obstruction to barium just above the sternal notch. The central filling defect in the apparently dilated oesophagus above the obstruction, was still present and had increased in size.



(d) Right lateral film.

This shows the lesion causing the symptoms. It appears as a spindle-shaped soft tissue swelling lying between the oesophagus and the trachea, and apparently arising from the septum between them. It is producing marked narrowing of the trachea and is compressing the oesophagus from before backwards. In the postero-anterior film this appeared as a dilated oesophagus with a central filling defect. A diagnosis of a relatively benign extrinsic tumour, growing in the septum between the oesophagus and the trachea, and compressing both, was made. A second oesophagoscopy showed no intrinsic lesion of the oesophagus, but its lumen was found to be flattened from before backwards at the site of the tumour.