

treated on general principles. In case such radical procedures are indicated, the osseous openings, internal and external, will necessarily have to be made as large as possible. The possibility of a complicating cerebral hernia should be borne in mind, and forestalled, if possible, by suitable packing.

Irrigation, unless the absence of bony perforation is absolutely demonstrated, should never be employed after the experience gained by the consideration of this case, in which it was apparently the direct cause of death, setting up an increased tension in the old focus, with rapid spread of the infectious agents. It would seem likewise unwise, if a communication with the interior of the skull has been found, to establish a communication downward into the nose; for, on theoretical ground, certainly a communication between the two cavities should be rigidly avoided. Should the patient eventually recover, and the channel into the skull become firmly obliterated, drainage downward might be instituted at a later period if the external sinus failed to close. Likewise, after long continuance of a fistulous tract, its excision and closure by a plastic operation might be possible after establishing nasal drainage. (Botey.)

46 WEST THIRTY-THIRD STREET.

THE RELATION OF THE TRACHEA AND BRONCHI TO THE THORACIC WALLS, AS DETERMINED BY THE RÖNTGEN RAYS.¹

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THE relations of the trachea and the bronchi to the chest-wall, although of value to the diagnostician and the therapist, have been practically hypothetical, chiefly on account of the inherent difficulties in demonstrating them.

These difficulties have been largely overcome by skiagraphy, which enables us, as it were, to look through the more transparent tissues of the thorax, and, while retaining the bony landmarks in the view, see the bronchial tree accurately outlined against them. In order to render this possible the bronchial tree has to be made impervious to the rays, which is easily done by the injection of a proper substance.

Certain precautions, however, have to be taken. The opaque substance must not fill the smaller air-passages, for if it does the course of

¹ Read before the tenth annual meeting of the Association of American Anatomists, held at Ithaca, December, 1897.

the larger bronchi will be obscured. To prevent distortion or sagging from the weight of the injection mass the whole body should be hardened. The mass should be as impervious as possible to the rays.

In preparing the subjects from which the accompanying skiagraphs were taken, the following method was employed.

The bodies were first hardened by injecting the arteries with a solution of formalin, and then the bronchi were filled with a metallic alloy fusing at 155° F., forced in at a very moderate pressure. The skiagraphs were taken by Dr. Edward Leaming with the apparatus belonging to the College of Physicians and Surgeons.

In exposing the bodies to the rays they were placed as far as possible from the tube in order to obviate error in the projection of the shadow. The formalized bodies were found to offer considerable resistance to the passage of the rays, and thus several plates were spoiled by under-exposure. The plate was placed four feet from the tube when the children were skiagraphed. When skiagraphing the adult it was found impossible with a reasonable length of exposure to obtain a skiagraph when the plate was placed at a distance greater than two feet. The exposure varied from one to five hours.

When the plate is placed behind the subject and the rays are passed through from before backward, the bones of the dorsal thoracic wall only appear on the plate, and in order to obtain radiographs of the sternum it was found necessary to pass the rays in the opposite direction after the removal of the dorsal thoracic wall.

In order better to understand the relations of the bronchial tree, it is well to review the course and distribution of the bronchi in the lungs.

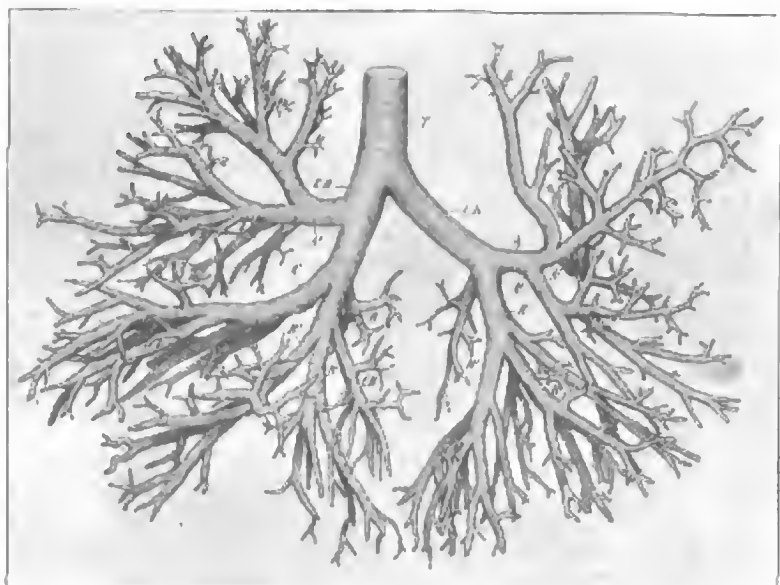
Our knowledge upon this subject was exceedingly vague and indefinite until Aeby's work was published in 1880. By making casts he was able to get a very fair idea of the ramifications of the tree. The descriptions of the bronchial tree in our anatomies have been based upon his conclusions, which may be briefly stated as follows: That the type of division of the bronchi is a monopodic and not a dichotomous one, namely, the main bronchus may be traced as a stem bronchus for some distance, and that it gives off four ventral and dorsal branches. Of these the ventral branches are the larger, as the stem bronchus is situated nearer the dorsal than the ventral aspect of the lung.

On the right side, however, beside the small cardiac or azygos bronchus, there is an additional ventral branch which passes above the right pulmonary artery and supplies the upper lobe of the right lung. This bronchus, from its relation to the artery, is known as the eparterial bronchus, and, according to Aeby and others, is not represented upon the left side. The remaining branches on both sides are known as hyparter-

¹ C. Aeby. *Der Bronchialbaum der Säugethiere und des Menschen.*

rial. It is extremely difficult to recognize Aeby's conception of a stem bronchus if a large number of corrosions of the bronchial tree are examined. If reference be had to Fig. 1 it will be seen that the stem rapidly becomes subordinated on account of the large size of the branches. In many corrosions the bronchi marked *B*, Fig. 1, break up into leashes of branches of nearly equal size. In fact, it will be found impracticable in the majority of cases to carry the stem further than this point.

FIG. 1.



Corrosion of the bronchial tree of an adult male Esquiman. *T*. Trachea. *LB*. Left bronchus. *RB*. Right bronchus. *A*. First hyperarterial bronchus on left side. Its segments, *A' A'*, correspond to *A' A'* on the right side. On the right side the upper branch, *A'*, is the eparterial bronchus, the lower *A'* the first hyperarterial bronchus. *B*. Continuation of stem bronchus, dividing into *B' B'*. *CB*. Cardiac bronchus.

As described by Huntington,¹ these difficulties are avoided and a type is given which applies to the bronchial tree of the mammalia in general and better explains its ontogenetic development.

The left bronchus, *LB*, gives off a large branch, *A*, which divides into two secondary branches, *A' A'*. It then continues on as a stem bronchus, *B*, which divides into two branches, *B' B'*. Numerous other branches are given off, but as a rule this type can be recognized.

On the right side the arrangement is somewhat different, owing to

¹ G. S. Huntington. The Eparterial Bronchial System of the Mammalia, Annals of the New York Academy of Sciences, xi. 9, 1898.

the suppression of the branch *A*, due to the migration of one of its segments, *A'*, to the main trunk above the pulmonary artery, thus forming the eparterial bronchus.

According to this hypothesis, then, the eparterial bronchus is the morphological equivalent of the upper segment of *A* on the left side, while the next ventral branch on the right side is the equivalent of the lower segment of *A* on the left side; otherwise the division of the bronchi are the same on both sides, with the exception of the cardiac bronchus on the right side. On the right side the eparterial bronchus supplies the upper lobe of the right lung, the remaining branch, *A'*, the middle; and the lower lobe is supplied by the continuation of the stem *B*.

On the left side the branches *A A' A'* supply the upper lobe, and the lower lobe is supplied by *B*. The left upper lobe is thus seen to be the equivalent of the right upper and middle lobes, which differs from Aeby's conclusion, namely, that the upper lobe of the right lung is not represented on the left side. The first branches given off from the main stem are very large, nearly equalling in size the continuation of the stem. They mark an important point, for here foreign bodies may lodge or even pass into them.

Of the two primary bronchi the right is the larger, and its course is more in direct continuation of that of the trachea than the left. It has a slight curve with the concavity directed laterally. The left courses twice¹ as far as does the right before giving off its first branch. It describes a double curve—the first with its concavity directed upward and outward, over which the aorta and the left pulmonary artery pass, and the second with its concavity directed inward, conforming to the convexity of the heart. Both bronchi are nearer the dorsal than the ventral aspect of the lung. We thus have several causes determining the greater frequency of the entrance of foreign bodies into the right bronchus. First. The greater size of the right bronchus, which not only makes it capable of receiving larger bodies, but also throws the dividing spur between the bronchi to the left of the axis of the trachea. Second. The greater respiratory current. Third. The direction of the right bronchus—*i. e.*, conforming to that of the trachea.

The radiographs and diagrams demonstrate the relations of the bronchial tree to both the posterior and anterior thoracic walls, and in a manner as if one looked through the walls of the chest at the bronchi. Thus the right bronchus is on the observer's left in the anterior views and on the right in the posterior views.

Radiographs were taken of one adult, of children one and two years of age, and of one at birth. The figures are those of an adult chest.

¹ According to Luschka, the right bronchus 2.5 cm., the left 5.1 cm.

At birth the relations do not differ from those of the older children. In young children the sternum is so transparent to the rays that radiographs were obtained only after painting the cartilage with oxide of lead. The diagrams were traced directly from the radiographs, and enough of the cartilages and other structures which were indistinct added to make them recognizable. The important relations are those of the trachea, the primary or stem bronchi, and the points where they

FIG. 2.



Adult male. Relations to posterior thoracic wall.

give off their first branches. It would be superfluous to attempt the relations of the other secondary bronchi.

The trachea, which is in the median line at the lower part of the neck, lies in the right sternal line at its bifurcation, which corresponds to the right side of the centre of the vertebræ posteriorly.¹

The deviation of the trachea is caused by the aorta, which crowds it

¹ For convenience in description the following perpendicular lines are taken :

1. The median line.
2. The sternal line, along the border of the sternum.
3. The mammillary line, through the nipple.
4. The parasternal line, midway between the sternal and the mammillary line.

to the right side. It bifurcates at about the level of the intervertebral disk between the fourth and fifth thoracic vertebræ, which point corresponds nearly to the tip of the fourth thoracic spine. This point is not absolute, as it is influenced by the respiratory movements and by the position of the head and neck.¹ In the radiograph it is somewhat lower in the adult, but it is as stated in the children. This point in the adult is below the level of the scapular spine—not at that level, as given by Joessel.²

FIG. 3.

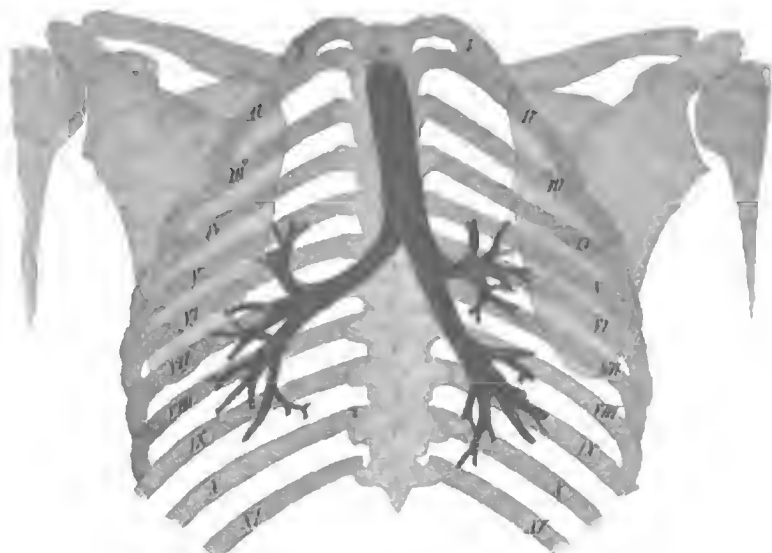


Diagram of Fig. 2.

On the anterior wall of the chest this point in the adult is just internal to the junction of the lower border of the second costal cartilage with the sternum.³

In the child, on account of the horizontal direction of the ribs and the consequent greater height of the sternum relative to the vertebræ, the point of bifurcation is under the right border of the sternum at the level of the third costal cartilage.

The stem bronchi, beginning at the bifurcation, end or become so small as to be negligible opposite a point on the posterior thoracic wall at the eighth rib situated in the adult on the left side three inches, and on the right side two inches, from the vertebral spine; in the child one and

¹ Joessel gives it as opposite the fourth or fifth thoracic vertebra. Joessel. *Topographisch-Chirurgische Anatomie*, zweit. Theil, erste Abtheil.

² *Ibid.*

³ The projection of the point of bifurcation in the adult on the anterior chest-wall was confirmed by section on four additional subjects previously formalized.

one-half inches and one inch, respectively. On the anterior thoracic wall these points are situated on the left side at the fifth rib just in-

FIG. 4.



Adult male. Relations to anterior thoracic wall.

ternal to the mammillary line, on the right side at the fifth rib in the parasternal line.

These data enable us to plot out the course of the stem bronchi on the posterior and anterior thoracic walls. On the posterior wall in the adult the course of the left bronchus is from a point to the right of the fourth thoracic spine to a point on the eighth rib three inches to the left of the spine. The course of the right bronchus is from the same point above to a point on the eighth rib two inches to the right of the spine. On the anterior wall in the adult the course of the left bronchus is from the lower part of the second right chondro-sternal articulation to

FIG 5



Diagram of Fig. 4.

a point on the fifth rib just internal to the mammillary, and of the right bronchus from the same point above to the intersection of the fifth rib with the parasternal line.

In children the point of commencement of the bronchi, as before stated, is opposite the third chondro-sternal articulation; otherwise the course is the same as in the adult, due allowance being made in the distance of their termination from the vertebral spines posteriorly. In

comparing the direction of the two bronchial trunks the right is seen to correspond very closely with that of the trachea, while the left diverges markedly.

The relations of the first branches of the stem bronchi are approximately as follows, their position in regard to the chest-wall being influenced by the same factors which affect the position of the tracheal bifurcation.

The eparterial bronchus is given off at the level of the lower part of the second interspace or the third cartilage anteriorly, and at the level of the fifth space or sixth rib posteriorly. The first branch from the left bronchus is given off at the level of the third space or fourth cartilage anteriorly, and at the level of the sixth interspace or seventh rib posteriorly.

On account of the double course of the left bronchus the point of origin of the first branch is slightly lateral to the line of general direction of the stem bronchus as given, but on the right side the origin of the eparterial branch may be designated by the intersection of the line of general direction of the stem bronchus with the level given. These points may also be determined by measurements, the eparterial bronchus arising one inch, the first branch from the left bronchus two inches, from the tracheal bifurcation.

The points of origin of the first branches on the two sides differ greatly as to their distance from the median line, being anteriorly on the left side in the parasternal line, on the right midway between the sternal and parasternal lines; while posteriorly the point of origin of the eparterial bronchus is at the right border of the vertebral column, that of the first branch from the left bronchus being two and a half inches from the spines of the vertebræ.

HEMIATROPHY OF THE BRAIN WITHOUT DISTURBANCES OF INTELLIGENCE OR PERSONALITY.¹

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THE following case has been deemed worthy of record on account of its unique character and because it has important bearings upon the localization of psychic functions.

The patient, a carpenter, aged fifty-seven years at the time of his death, was, according to his own statement, strong and well up to the

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