Los Angeles or Pasadena, command wide and extensive views. Hotels are found on the summits of these mountains, and the climate, besides possessing the characteristics of that of Southern California, has also the peculiarities of altitude. *Edward O. Otis.*

LOSOPHAN.—(Tri-iodo-meta-cresylic acid.) An antiseptic preparation, obtained by the action of iodine upon oxytoluic acid in the presence of an alkali. Its formula is $C_6HI_3OHCH_3$, and it is said to contain eighty per cent. of iodine. It forms in white needles, insoluble in water, slightly soluble in alcohol, and readily soluble in ether, benzene, and chloroform. At 140° F. it is freely soluble in fatty oils.

It is particularly recommended in parasitic skin affections. It may be used in tinea tonsurans, scabies, pityriasis versicolor, also in prurigo, in chronic eczema, acne, and sycosis. It is contraindicated in all acute inflammatory conditions of the skin, as it is liable to increase the irritation and intensify the disease. The remedy may be applied in a solution of the strength of one per cent., or in an ointment of one to three per cent. *Beaumont Small.*

LOUISVILLE ARTESIAN WELL.—Jefferson County, Kentucky.

Location.—On the corner of Tenth and Rowan streets, Louisville.

This well is 2,086 feet deep by 3½ feet in diameter, and occupied sixteen months in boring. The temperature of the water, as it issues from the orifice of the well, is 76.5° F. A self-registering thermometer sunk to the bottom of the well indicated 86.5° F. The point of constant temperature immediately beneath the surface at Louisville is 53° F. This result shows an increase of temperature of one degree for every sixty-seven feet until the bottom is reached. The following analysis was made by Dr. J. Lawrence Smith:

One United States Gallon Contains:

Solids.	Grains.
Sodium chloride	621.52
Calcium chloride	65.72
Magnesium chloride	14.77
Potassium chloride	4.22
Aluminum chloride	1.21
Lithium chloride	.10
Sodium sulphate	72.29
Calcium sulphate	29.43
Magnesium sulphate	77.33
Aluminum sulphate	1.80
Potassium sulphate	3.22
Sodium bicarbonate	2.72
Calcium bicarbonate	5.99
Magnesium bicarbonate	2.75
Iron bicarbonate	.35
Sodium phosphate	1.54
Magnesium iodide	.35
Magnesium bromide	.46
Silica	.88
Organic matter	.70
Loss in analysis	8.12
Total	915.47
Gases.	Cu. in.
Sulphureted hydrogen	2.00
Carbonic acid	6.17
Nitrogen	1.36

The water is quite similar to that of the Kissingen Springs in Bavaria, and to the Kentucky Blue Lick Springs. It has been found very beneficial in cases of dyspepsia and constipation and in functional liver complaints. *James K. Crook.*

LOUISVILLE MINERAL SPRINGS.—Pottawatomie County, Kan.

Post-Office.—Louisville.

Accommodations in two hotels and in private families.

Access.—Viâ Union Pacific Railroad to Wamego, thence three miles to spring by stage.

This resort has recently attracted much attention in Kansas. The springs are charmingly located in a natural blue-grass park of ten acres, which has been greatly improved. It is said to be one of the finest camping places in Kansas. The surrounding country is hilly and the location of the springs is about 900 feet above the sea level. The temperature ranges from 10° F. in winter to 100° F. in summer, these figures representing the extremes. The springs are two in number, and afford an abundance of pure, crystal water, having a temperature of 60° F. A qualitative analysis, made in 1885, showed the presence of iron, sulphur, soda, magnesia, and carbonic-acid gas. The waters have been found of great efficacy in constipation, dyspepsia, general debility, and liver and kidney affections. *James K. Crook.*

LOVAGE ROOT.—Levisticum. The root of *Levisticum Levisticum* (L.) Lyons. This is a large, aromatic, yellow-flowered perennial herb, with a short, thick, fleshy rootstock, from which several large, simple roots are given off below, and three or four stout, upright, slightly branching stems above. All parts of the plant have a strong and rather agreeable fragrance, due to its peculiar essential oil, and the root contains also considerable resin. When fresh, the stem and leaves exude a yellowish latex upon being broken.

Lovage is said to be truly wild only in Southeastern Europe (Bosnia and Servia, Flückiger), but it has been cultivated for centuries in other parts of Europe, and is extensively naturalized. That of commerce comes principally from Holland, Germany, and France. It is at present cultivated upon a small scale in the United States. The "root" is most in demand, although the fruit has more oil. It consists of the rhizome split or quartered, and, more abundantly, of the roots themselves, either whole or split. The pieces are of a brown, gray-brown, or black color externally, transversely marked near the top, elsewhere deeply longitudinally wrinkled and shrivelled; section white, yellow, or reddish; resin canals visible; texture spongy and flexible. Odor and taste peculiar, aromatic, resinous, bitterish-sweet, angelica-like. It is very prone to being worm-eaten, and an article entirely free from this defect is difficult to obtain. *Essential oil, resin* (yielding umbelliferon), *malic* and *angelic acids, gum* and *sugar* are among its constituents; to the first two it owes its medicinal value, whatever that may be.

It is a rather pleasant stimulant, aromatic, and diuretic, of the angelica and musk-root kind, with no active properties. It is sometimes given as a diuretic in dropsies from heart disease, etc., also for catarrh of the bladder, and for chronic bronchitis. It is, however, little used in this country, and even abroad has degenerated mostly to the level of a household herb among the country people.

Oil of lovage is an article of commerce, existing in three forms—from the root, from the fruit, and from the fresh herb. Although differing in specific gravity and slightly in flavor, they are very similar. *W. P. Bolles.*

LOWER BLUE LICK SPRINGS.—Nicholas County, Kentucky.

Access.—Viâ Kentucky Central Railroad to Carlisle, thence nine miles by stage to springs.

We have not been able to obtain any recent information in regard to the condition of this resort. The following analysis of the main spring was made by Dr. Robert Peter, the State geologist, a number of years ago:

One United States Gallon Contains:

Solids.	Grains.
Magnesium carbonate	1.36
Calcium carbonate	23.65
Potassium chloride	1.39
Sodium chloride	512.85
Magnesium chloride	32.39
Potassium sulphate	8.93
Calcium sulphate	33.99
Magnesium iodide	.05
Magnesium bromide	.24
Alumina, lime, phosphate, iron oxide	.36
Silicic acid	1.10
Loss	17.72
Total	634.03
Gases.	Cu. in.
Carbonic acid gas	98.80
Sulphureted hydrogen	18.24

According to Walton these are exceptionally fine waters of the saline-sulphureted class, valuable in engorgements of the liver and abdominal viscera and diseases arising therefrom. They may be relied on in gastric catarrh, and in the form of warm baths they prove efficacious in diseases of the skin. Besides the main spring there are others on the opposite side of the Licking River and in its bed, which have been found on examination to be of a similar character. *James K. Crook.*

LUMBAGO.—See *Neuralgia.*

LUMBAR PUNCTURE.—See *Brain: Cerebro-Spinal Fluid*, and *Labor, Normal.*

LUNGS, ANATOMY OF THE.—Since the first edition of this Handbook was issued many advances have been made in our knowledge of the anatomy of the lung. At the present time it seems to be one of the organs to which renewed attention has been directed.

In the present article questions bearing on the comparative anatomy of the lung have been omitted, and the reader is referred to the first edition of this Handbook, Vol. IX., and to a paper, by the author of this article, in Vol. VIII. of the *Journal of Morphology*, for a discussion of this part of the subject.

Historical.—The first account we find of the structure of the lungs is the very incomplete one given by Hippocrates.[31] He compares them to a sponge interspaced with numerous small vessels. Aristotle[5] also gave to the lungs a spongy nature; the canals receiving blood from the so-called great vein. Celsus[15] also describes the lungs as being spongy. Galen[22] had only a little better idea of their structure; he describes them as being made up of lobes, liver-like in substance, and containing many vessels. Vesalius[68] describes the lungs as being divided into lobes, and says in regard to their structure that "the substance of the lung is soft, spongy, thin, light, airy flesh, as if formed of frothy blood, or bloody froth, and crowded with many branches of vessels."

We now come to the time when Harvey[25] announced his discovery of the circulation of the blood; this had its effect on all anatomical research. Malpighi,[46] profiting by this discovery, proved by means of injections that the air and blood were not contained in the same channels, but had separate systems of vessels, and that these did not communicate with each other, but did communicate among themselves. He also saw the circulation of the blood in the vessels of the lung of a living frog. He recognized the presence of air vesicles, and described them as opening into the trachea and communicating with one another. He also compares the lung to a sponge. Bartholin[7] defended the views of Malpighi. The next writer of note is Willis.[71] He is wrongly quoted by Williams,[70] who placed Willis among those who describe the air vesicles as communicating with one another. What he does say, directly opposite to the views of Malpighi, is that the bronchial tubes give off numerous small branches which bear on their distal extremity little bladders, thus giving the lung the appearance of a bunch of grapes. Helvetius[28] returned to the older idea and maintained that the lung was spongy in its nature. He denied that the spongy tissue of the lung was formed by the expansion of the bronchial tube, but asserted that the bronchus simply penetrated into the spongy tissue. His description is not very clear. Soemmering[66] describes the lungs as made up of small, irregular, polygonal cells grouped together into lobules. The individual cells of the lobule communicate, one with another, but those of one lobule do not communicate with those of adjoining lobules.

Early in the present century, Reisseisen[55] published a very important brochure in which he advanced views quite opposite to those accepted by the anatomists of his day. His method consisted in pouring mercury into a bronchus and, by applying gentle pressure, forcing it on until it appeared beneath the pleura. He describes the bronchi as dividing into branches which in turn divide quite rapidly, becoming at the same time much smaller, until eventually each small branch ends in a single rounded extremity. This was apparently a revival of the theory of Willis. Magendie[44] wrote two important papers on the lungs. In the first he denies that the bronchi terminate in air vesicles, but affirms that the air-cells of one lobule communicate with one another, but do not communicate with those of adjoining lobules. In his second paper he states that those grape-like structures described as hanging on to the end of a bronchus do not exist in nature, but are to be found only in books. His conclusion is that the lung is made up of "spongy tissue formed by the arrangement of the vessels, which have between them small spaces into which the air penetrates freely."

In 1832 Bazin[8] wrote supporting the views of Reisseisen, and was followed a few years later by Lereboullet,[42] who, in quite a lengthy essay, also supported Reisseisen. Addison[1] failed to find "any tubes ending in culs-de-sac; on the contrary, I always saw air-cells communicating with one another in every section I made." He describes the bronchi as dividing, within the lobule, into numerous minute branches which terminate in "branched air-passages and freely communicating air-cells. Huschke,[34] however, writing about the same time, described the bronchi as ending in fine branches, which bore on their free extremity small sacs which did not communicate with one another.

Rainey[54] wrote several excellent memoirs on the lung. He says "they are made up of bronchial tubes, bronchial intercellular passages, and air-cells." These air-cells communicated with one another and with the bronchi or bronchial intercellular passages, by means of large circular openings. Moleschott[51] published an excellent brochure in which he combats strongly the opinion of those who hold to the communication of one vesicle with another. In no instance did he find the bronchi forming anastomoses; he also distinctly states that the air-vesicle contains no opening except that by which it communicates with its proper bronchial tube.

Rossignol[60] gave us a very valuable treatise on the structure of the lungs. He introduced the term "infundibulum." According to this author the bronchi give off numerous branches, which cross each other repeatedly in all directions, but do not communicate; from the ultimate division of the bronchial tube arises a dilatation in the form of a funnel, which he terms "infundibulum." The walls of each infundibulum are lined with numerous air-cells or alveoli. Rossignol compares each infundibulum with its alveoli to the lung of the Batrachians, and says: "The lung looked at from this point of view can be defined as the assemblage or concentration of innumerable small lungs, held together by means of a common bronchial tree." In an inaugural dissertation written by Adriani,[2] he adopts the nomenclature of Rossignol. He also describes alveoli as existing on the walls of the bronchial tubes just before they dilate into infundibula. He takes strong exception to Rossignol's statement that there are no communications between adjoining alveoli, declaring it to be without doubt false, and describes minute openings by which adjoining alveoli communicate.

Kölliker[39] gives quite a valuable description of the finer structure of the air-passages. He considers the term "infundibulum" introduced by Rossignol unnecessary, and says that "all the vesicles belonging to one lobule open, not into ramifications of the finest bronchial twig going to it, but into a common space from which the air-vessel is afterward developed."

The "Cyclopædia of Anatomy and Physiology"[70] contains an article on "Respiration" by Williams, in which he has embodied some of his personal investigations. He describes each lobule as being sacculated and receiving a single bronchial tube; this tube gives rise within the lobule to small branches which subdivide to the third or fourth order, and from these latter branches the air-cells arise. He discards the term "infundibulum," and uses in its place that introduced by Rainey, "intercellular passage." Mandl[47] describes the bronchial tubes as ending in terminal cavities which have numerous depressions in their walls, the "vesicles." He compares the terminal cavities and their vesicles to the lung of the frog.

In 1860 Waters[69] published a most excellent essay on "The Human Lung," in which he describes the "ultimate pulmonary tissue" as being made up of elongated air-sacs arranged in groups, called by him "lobulettes," which spring from the enlarged end of a terminal bronchial twig; the air-sacs bear on their sides and ends depressions varying in number, the alveoli. He failed to find any communication between the air-sacs. On this point he says: "I have never found, either in the lungs of man, or of the dog, or cat, or pig, or sheep, or of any other mammal I have examined, any lateral orifice of communication between the different sacs of each lobulette."

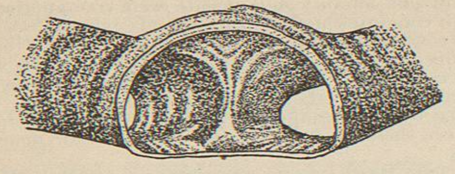

FIG. 3232.—View from above of the Division of the Trachea. The lumen of the trachea is divided by a ridge which extends sagitally somewhat to the left of the mid-line. Above is seen a broad, triangular space, the "anterior spur triangle," and below is seen the smaller "posterior spur triangle." To the right of the carina the opening of the large oblique right bronchus is seen; to the left of the carina the opening of the more horizontal left bronchus is just discernible. (After Heller and von Schrötter.[27])

Schulze[63] has given us an exceedingly interesting study of the lung which contains much that is of especial value. I shall refer more in detail to his work in another part of this article.

Henle,[29] in his systematic work on anatomy, gives a very good article on the lungs. He describes communications between air-cells, but considers them anomalies. He found them in the lungs of old people, and attributed them to the result of atrophy and absorption of the lung substance. Delafield[18] advocates the theory of communication between air-cells. He says: "The air-passages seem to be made up of a succession of large vesicles which open into each other, or of an irregular larger canal made up of vesicles into which other vesicles open from all sides." He also describes anastomoses between the air-passages. Roosevelt[59] agrees with Delafield in regard to the communication of the air-cells.

Miller[49] has contributed several papers on the structure of the lung dealing with the subject from the standpoint of the comparative anatomist and also from that of the histologist.

Besides the authors mentioned above, the reader is referred to the published work of Milne-Edwards,[50] His,[32] Ewart,[21] Narath,[52] d'Hardiviller,[24] Huntington,[33] Arnold,[6] and Birch-Hirschfeld.[12] Other authors who have made special studies in the histology of the lung will be referred to under the proper heading.

TRACHEA.—For the general structure of the trachea I will refer the reader to the text-books on anatomy, mentioning especially Quain.

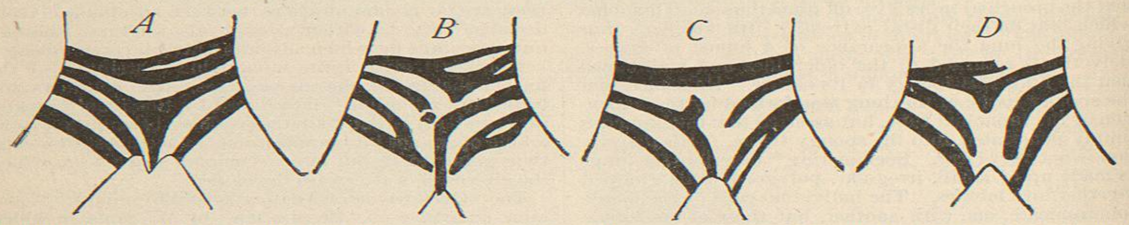

FIG. 3233.—Types of the Carina Tracheæ. View from behind. The cartilages are represented by solid black bands. *A*, Tracheal; *B*, bronchial-right; *C*, bronchial-left: *D*, membranous. (After Heller and von Schrötter.[27])

As the result of numerous studies carried on in the Anatomical Laboratory of the University of Wisconsin it has been found that the submucosa proper of the trachea contains a much larger number of elastic fibres than is usually described as being present. These fibres are quite fine and arise from the dense network of the longitudinal layer of elastic fibres and pass toward the epithelium. Their course is irregular and they form a wide-meshed network of fibres. When they reach the outer border of the submucosa, just beneath the epithelium, they change their course and run parallel to the longitudinal layer.

In 1896 Heller and von Schrötter[27] published the results of their investigations on a series of human tracheæ, together with quite a complete historical review of the work previously accomplished. The object of their research was to find if possible some general plan on which the *carina tracheæ* is formed. They were, early in their investigations, greatly impressed by the inconsistency of the anatomical conception of the carina, and it appears that the farther they went in their investigations the more variations they found, and that no definite rule could be formulated.

Their series consisted of one hundred and twenty-five human tracheæ and forty-eight taken from various mammals. In the majority of cases the entire trachea with bronchi attached was used, but in some instances only the lower part of the trachea and attached bronchi could be obtained.

Their results may be summed up as follows: If the trachea is cut off about 2 cm. above its division an exact view of the place of bifurcation is afforded. One sees (Fig. 3232), looking at such a preparation from above, a nearly sagittally arranged larger or smaller ridge dividing the lumen of the trachea. The walls of this ridge enlarge toward the anterior wall of the trachea into a more or less triangular surface which is designated as the "anterior spur triangle"; toward the posterior wall the edges of the ridge diverge less, and there thus arises a small triangular surface of more or less inclination, called the "posterior spur triangle." The middle part of the spur connects these two surfaces with each other.

In the majority of cases the *carina* possesses a cartilaginous foundation. In the ridge which projects more or less into the lumen of the trachea, and inclined abruptly or gradually toward the inner wall of the bronchi, one or more cartilaginous plates are embedded which bear at the same time the crest of the *carina*. The cartilages correspond in direction to the crest, passing from in front backward, with a greater or less downward curvature to enter the ligamentous posterior wall. In those cases in which one or more cartilaginous plates entered into the dividing line or were actually embedded in the ridge, the spur was designated as "cartilaginous spur," in contradistinction to those cases in which cartilaginous crescents, usually the first bronchial, appear near the dividing ridge but do not actually enter it. The cartilage acts in these cases as lateral supports to the *carina*, and a transsection taken through its centre shows that the part corresponding to the angle of division, as well as the ridge projecting into the lumen of the trachea, is a membranous development. In these cases the spur is designated as "membranous spur" (Fig. 3233, *D*).

It must, however, be conceded that in many cases these distinctions are difficult to follow, since combinations can be made by means of many different cartilaginous formations, *e.g.*, the anterior part of the spur is frequently membranous while the posterior part may be formed by the coming together of two cartilaginous plates from the right and left sides, respectively.

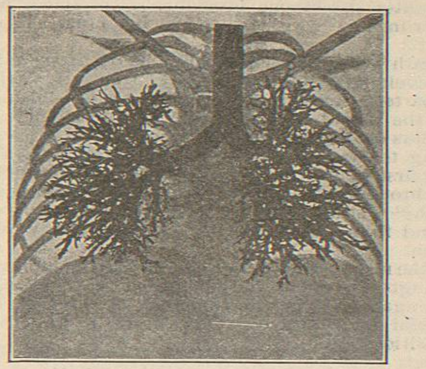

FIG. 3234.—A Röntgen-Ray Photograph of the Trachea and Bronchi Injected with Wood's Metal *in situ*. The very oblique direction of the right and the horizontal direction of the left bronchus are clearly shown. View from behind. (After Birch-Hirschfeld.[12])

In a large number of tracheæ the spur is formed in the following manner, as Luschka[43] had previously pointed out: the last tracheal ring is wider and thicker in its middle portion or is provided on its lower border with a longer or shorter process which enters into the bifurcation, while the first right and left bronchial rings converge downward and backward at an acute angle toward each other, meeting or fusing with one another. By means of this twisting, their anterior surface gradually passes from the frontal line into the sagittal line. Moreover, it may happen that the cartilage undergoes various modifications, *e.g.*, it may have thick or thin places or it may have sharp or blunt ends.

In those cases in which the dividing ridge is formed by the bronchial rings, the spur is called "bronchial spur"; and accordingly as only the first right or left bronchial rings enter into the formation of the spur it is designated "bronchial-right" (Fig. 3233, *B*) or "bronchial-left" (Fig. 3233, *C*). In some cases the first bronchial rings on both sides enter the spur; in that case it is "double bronchial."

In the majority of the tracheæ studied by Heller and von Schrötter it is the plate of cartilage corresponding to the last tracheal ring, or a cartilaginous process of the last tracheal ring, which enters into the spur. In these cases the spur was designated as "cartilaginous tracheal" (Fig. 3233, *A*).

It was often difficult to determine whether bronchial cartilages or tracheal cartilages entered into the formation of the spur. The usual distinction of a spur as bronchial or tracheal was to recognize whether the respective cartilage rings lay above or below the outer angle which corresponds to the division of the bronchi.

Out of the 125 human tracheæ investigated by Heller and von Schrötter the spur was found to be cartilaginous in 56 per cent.; membranous in 33 per cent.; partly membranous and partly cartilaginous in 11 per cent.; in 27 per cent. where the spur was cartilaginous, it was tracheal; in 21 per cent. it was bronchial, divided as follows: 15 per cent. bronchial-right, 3 per cent. bronchial-left, and 3.5 per cent. double bronchial.

In 92 cases the sex was observed. In 60 cases the spur was cartilaginous, 33 being in males and 27 in females. In 32 cases the spur was membranous, 15 being in males and 17 in females. Although, according to this, the occurrence of the cartilaginous spur appears to be slightly more frequent in males than in females, yet the formation of the carina as regards sex variation cannot be considered of any great importance compared to the size of the lumen of the trachea of the male in contrast to that of the female.

Heller and von Schrötter studied among other mammalian *carinæ* those of three cats, finding two of the three to be membranous and one cartilaginous. The number studied was entirely too inadequate, as studies in the Anatomical Laboratory of the University of Wisconsin have shown. In this investigation the *carinæ* of 50 cats were examined and the results were as follows: In 16 the spur was tracheal = 32 per cent.; in 5, bronchial-right = 10 per cent.; in 6, bronchial-left = 12 per cent.; in 10, double bronchial = 20 per cent.; in 3, membranous = 0.06 per cent.; in 10, tracheo-bronchial = 20 per cent.

An interesting fact in this connection is that if cases 12 to 16 inclusive had been the only ones studied, the result would have been three membraneous spurs and two cartilaginous. It is highly probable that if as extended a study were made in other mammals used by Heller and von Schrötter, the cartilaginous type, and not the membranous, as was found by them, would be found to be the rule.

BRONCHI.—The trachea divides into the right and left bronchus at about the level of the fourth thoracic vertebra. According to Bianchi and Cocchi[11] this division seldom takes place lower than the upper part of the fifth thoracic vertebra.

Of these two bronchi the right is the shorter and wider and is usually described as having a more horizontal direction than the left. Pansch in 1884, followed by Jössel in 1889, began to advance the opposite view, and Aeby[3] in his admirable monograph showed conclusively that the right bronchus is the more oblique. Schrötter[62] also expressed wonderment at the constantly repeated error. Fig. 3234, taken from Birch-Hirschfeld,[12] shows a Röntgen-ray photograph of an injection of Wood's metal into the trachea and bronchi *in situ*, and brings out clearly the more horizontal position of the left bronchus.

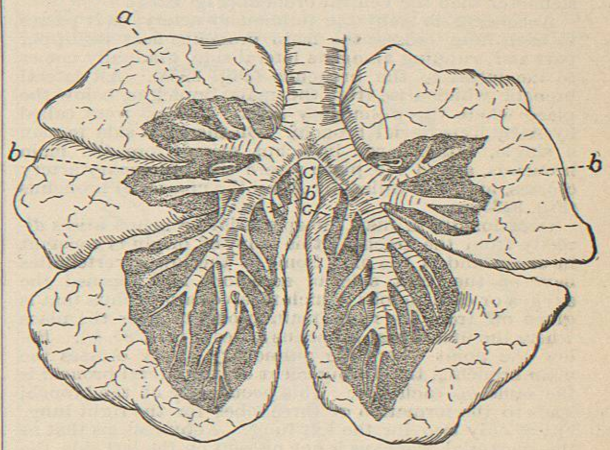

FIG. 3235.—Lung and Bronchial Tree of Man. *a*, Eparterial bronchus; *b*, first ventral hyparterial bronchus; *b'*, cardiac bronchus; *c*, first dorsal hyparterial bronchus. The cut ends of the pulmonary artery can be seen just above the first ventral hyparterial bronchi. (After Aeby.[3])

If the fact be taken into account that the *carina* is situated to the left of the centre of the lumen of the trachea (Fig. 3232), and that the right bronchus is the larger[14] and the more oblique,[37] it is easily seen (Fig. 3234) why foreign bodies pass so readily into the right bronchus and lung.

Aeby[3] demonstrated that there is a main bronchus (Stammbronchus), gradually diminishing in size, which extends through each lung. These main bronchi are direct continuations of the two bronchi into which the

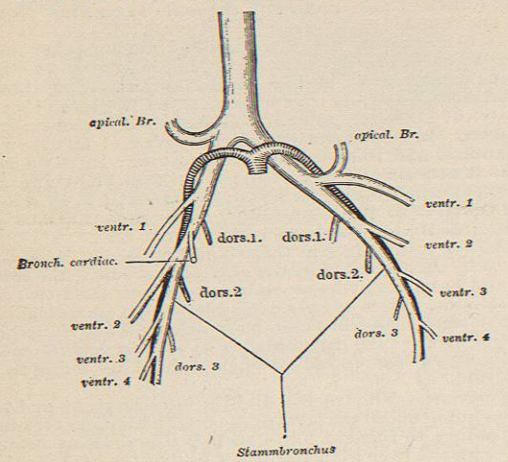

FIG. 3236.—Scheme of the Bronchial Tree. *apical. Br.*, Apical bronchus = eparterial bronchus of Aeby; *ventr. 1, 2, 3, 4*, ventral branches; *dors. 1, 2, 3, 4*, dorsal branches of the main bronchus (Stammbronchus); *Bronch. cardiac.* cardiac bronchus. The pulmonary artery is indicated by the shaded vessel. (From Merkel, after Narath.[52])

trachea divides. From each main bronchus lateral branches are given off in a monopodial manner; these lateral branches were named by Aeby dorsal and ventral bronchi. The dorsal bronchi are usually shorter and slenderer than the ventral bronchi (Fig. 3235).

According to Aeby the pulmonary artery, as it passes to each lung, crosses the main bronchus near its upper part and, running along its lateral side, gradually comes to lie dorsal to the bronchus (Fig. 3235). All lateral bronchi which arise from the main bronchus, below the place where the pulmonary artery crosses, were called by Aeby hyparterial bronchi. On the right side in man a single, rather large bronchus arises from the main bronchus, above the place where the pulmonary artery crosses, and was called by Aeby the eparterial bronchus (Fig. 3235, *a*).

Occasionally in man the eparterial bronchus arises directly from the trachea; this point of origin is constant in sheep and in the ox. Some of the lower vertebrates have on the right side an accessory lobe, termed the azygos or cardiac lobe, which receives a bronchus that is given off from the right main bronchus near the place where the first dorsal bronchus arises (Fig. 3235, *b'*). Below the point where the pulmonary artery crosses the main bronchus the arrangement of the lateral bronchi is the same on each side. This peculiarity of the bronchi leads to the formation of three lobes for the right lung, but of only two for the left lung. Aeby reasons that as the eparterial bronchus is not present on the left side, the lobe to which it is distributed is absent, and that the upper lobe of the left lung and the middle lobe of the right lung are homologous.

This conception of Aeby, which he evolved from his studies of the comparative anatomy of the lungs, received confirmation from His, who studied the development of the lungs in human embryos of various ages. His[32] showed that from the first there was an unsymmetrical arrangement of the lung buds, there being three on the right side but only two on the left. His agreed with Aeby that the mode of branching for the main bronchus was monopodial, but disagreed as to the lateral bronchi, which he claimed were dichotomous in their mode of branching.

Ewart[21] in quite an extended brochure opposed the views of Aeby and attempted to establish a complicated nomenclature for the various divisions of the bronchi and blood-vessels. Ewart came to the conclusion "that all bronchi are dichotomous; and that in any bronchial pair the greater size of one bronchus is correlated with the greater mass of lung tissues which it must supply with air."

Narath[52] denies that the pulmonary artery influences the development of the bronchial tree. He claims that the eparterial bronchus on the right side is homologous with the dorsal branch arising from the first ventral bronchus on the left side. The eparterial bronchus, according to Narath, is therefore a dorsal lateral branch of the first ventral bronchus which has migrated up the main bronchus (Fig. 3236). In a later communication Narath[52,a] studied the problem from the embryological side and found confirmation of his previously expressed opinion.

As the result of a series of comparative anatomy studies Huntington[33] reaches the conclusion that "the right and left lungs agree, morphologically, in the type of their bronchial distribution." This leads to the following proposition:

Right side.		Left side.
Upper + middle lobe	=	Upper lobe.
Lower + cardiac lobe	=	Lower lobe.

Huntington agrees with Narath that migration and not the pulmonary artery is the active principle in modifying the architecture of the lung, but disagrees with Narath in the derivation of the apical bronchus. The type of bronchial division is given by Huntington as being "practically dichotomous."

In a number of contributions, of which only the first and last are given in the bibliography, d'Hardiviller[24] opposes the theory of dichotomy, supporting Aeby in this respect, but strongly opposes him in the manner in which the bronchi arise from the main stem. The lungs are at first symmetrical and have on each side an eparterial bronchus. Deviations from this type are to be referred to the result of atrophy. The eparterial bronchus is not a lateral branch of a hyparterial bronchus as described by Narath, but is a special bronchus.

Birch-Hirschfeld[12] has investigated the bronchial tree of adults and agrees with Narath that the upper part of the left lobe corresponds to that part of the right lung which is supplied by the "eparterial bronchus." From a pathological standpoint Birch-Hirschfeld thinks that only such branches should be designated "apical" as are exclusively distributed to the upper portion of each lung.

A recent study by Justesen[35] of the division of the bronchi leads him to the conclusion that the mode of division is a modified dichotomy in which one branch becomes much more highly developed than the other. This

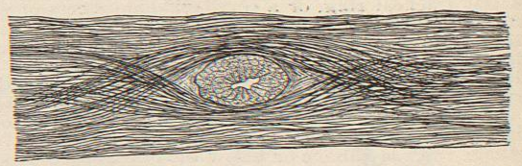

FIG. 3237.—Arrangement of Elastic Fibres in a Medium-sized Bronchiolus at the Place where the Duct of a Gland Opens into the Lumen of the Bronchiolus. Weigert's staining. (Miller.)

type of division is designated by Justesen "sympodial," a name applied by botanists to a similar mode of branching in plants.

At the hilus of the lung we find the artery, vein, and bronchus lying in quite close apposition. The arrangement differs on the two sides; on the right side the bronchus lies behind, the artery in the centre and the vein on

the outside, the bronchus occupying a higher level than the other two vessels. On the left side the vessels have the same order, but the artery occupies the higher place.

The bronchi, in their finer structure, have the same arrangement as the trachea up to their entrance into the lung. With the division of the bronchi within the lung we find changes in the structure. The cartilage which has been in the form of incomplete rings is now found in the form of angular plates, which are placed at longer and longer intervals, until at last it is found only as a small plate at the fork of the smaller branches. Bronchi which have a diameter of 1 mm. and under rarely have cartilaginous plates. At the same time that the cartilage begins to disappear, the smooth muscle which has been in the form of rings gradually spreads out into a uniform layer, which diminishes in thickness with the diminution in the calibre of the bronchus. Distal to the terminal bronchus smooth muscle is not found. In the larger bronchi the mucosa is arranged in longitudinal folds and consists of at least two layers, the innermost of which is made up of ciliated epithelium and goblet cells. In the smaller bronchi the ciliated epithelium is replaced by a single layer of non-ciliated columnar epithelium; in the terminal bronchi the epithelium gradually becomes cubical and finally passes over into the thin, flat "respiratory epithelium."

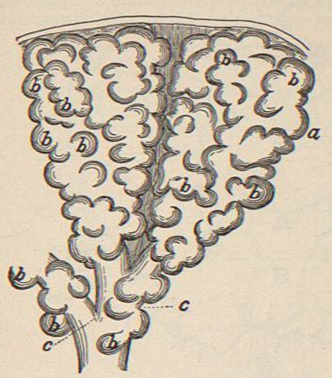

FIG. 3238.—Two Small Pulmonary Lobules. *a*, With the air-cells; *b*, *b*, and the finest bronchial twigs; *c*, *c*, which also possess air-cells. From a newborn child. Half schematic. (From Kölliker.[39])

The elastic fibres of the bronchi are arranged in a single layer in which the fibres run parallel. Where this layer is pierced by the ducts of the glands the fibres take a crossed arrangement, which gives additional strength to the otherwise weakened layer (Fig. 3237).

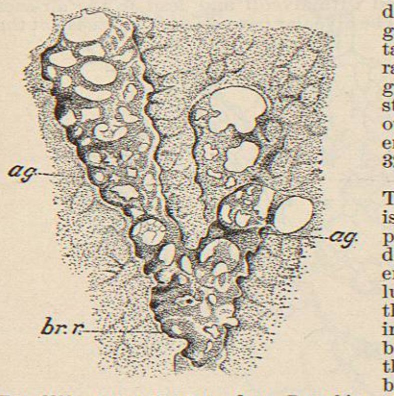

FIG. 3239.—Lung of a Dog. *br.r.*, Bronchiolus respiratorius; *ag*, two alveolar passages, one of which is continued into an infundibulum. (From Kölliker.[39,a]). This practically represents Fig. 3238 in section.

THE LOBULE.—The term lobule is used at the present time to describe two different areas in the lung. Following the majority of investigators, and because the author of this article believes it to be the correct usage of the term, the lobule of the lung may be defined as being composed of a terminal bronchus, the air spaces connected with it, and their blood-vessels, lymphatics, and nerves. This must be considered the unit of the lung.

Laguesse and d'Hardiviller[41] call those large areas, faintly marked out on the surface of the human lung, distinctly marked out on the lung of the ox, the lobules, and give the name acinus to the structures connected with a ductulus alveolaris (terminal bronchus). Councilman[16] thinks the unit should be called an acinus.

The author cannot agree with these statements. The acinus of a gland does not correspond to the lobule as here described; it might have been applied with some degree of justice to the conception of the lobule as described by Kölliker.[39] If any part of the lobule of the lung is to be compared to an acinus it is an atrium with its air sacs; but until "acinus" is used to describe a more definite portion of a gland than its present usage does, no intelligent comparison can be made.

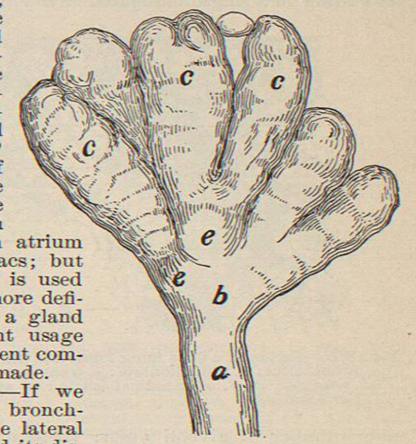

FIG. 3240.—An Ultimate Bronchial Tube with a Group of Air-Sacs, or Lobulette, connected with it (human). *a*, Ultimate bronchial tube; *b*, the dilated end of the same; *c*, *c*, *c*, single air-sacs; *e*, *e*, openings of other sacs which lie beneath those drawn; six air-sacs are seen which converge to a common centre. (After Waters.[69])

AIR SPACES.—If we follow the main bronchus or one of the lateral branches toward its distal extremity, we finally reach a point where the smooth tubular character of the bronchus disappears and we find small projections appearing on all portions of the bronchus. These projections (alveoli) were first described by Rossignol[60] and shortly afterward confirmed by Kölliker.[39] Alveoli are also present on the succeeding and final division of the bronchus (Fig. 3251).

Up to this point there is a general agreement of investigators, but they disagree in regard to the structure distal to the terminal bronchus. That this should be the case is not surprising, in view of the difficulties which attend the study of this part of the lung.

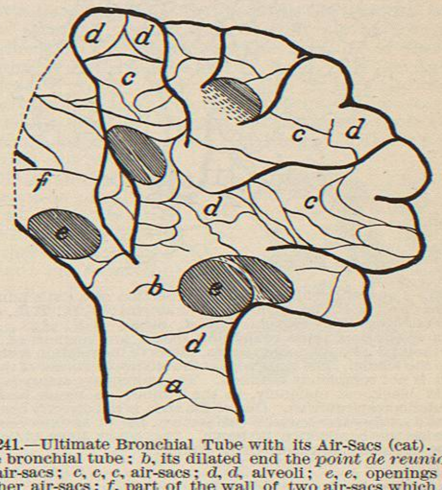

FIG. 3241.—Ultimate Bronchial Tube with its Air-Sacs (cat). *a*, Ultimate bronchial tube; *b*, its dilated end the *point de reunion* of all the air-sacs; *c*, *c*, *c*, air-sacs; *d*, *d*, alveoli; *e*, *e*, openings leading to other air-sacs; *f*, part of the wall of two air-sacs which are cut off. (After Waters.[69])

The most familiar description and diagram of the ending of the bronchi in the parenchyma of the lung is that