The type of fever will depend a good deal on the individual, as well as on the circumstances under which he is attacked. In the robust and plethoric young Englishman, it will be sthenic, or, as it has been called erroneously, inflammatory; the fever high, the pulse full and strong, racking headache, nausea, great thirst, and delirium, which will probably be followed by a well marked remission. Such cases are sometimes complicated by great solar heat, or by alcohol. In less robust individuals, there may be a tendency to the adynamic condition; the exacerbations reduplicate, the nervous power becomes depressed, and the patient passes into a low tremulous typhoid state, and the fever assumes a continued form. Sudden collapse may occur in this form of remittent; whilst, in the sthenic forms, cerebral symptoms, suggestive of apoplexy or effusion, may appear; but it is well to bear in mind that such symptoms may be a result of the direct action of the poison on the nerve-centres, and that convulsions, especially in children, as pointed out by Dr. Payne, are peculiarly likely to be so caused. Inflammatory cerebral mischief does occur occasionally, but the history of the case might encourage hope that the symptoms depended on malarial disturbance. The lungs and bronchi are liable to be implicated; congestion and inflammation may occur, and natives of India during the cold season are very prone so to suffer. Jaundice, either as the result of mechanical obstruction of the ducts or of arrested function, or bilious vomiting and epigastric tenderness, are of frequent occurrence; the spleen is not much enlarged, unless there have been previous malarial poisoning, nor is there the same amount of cachexia and anæmia as in intermittent, unless the disease have continued long or recurred often. Albumen in the urine is comparatively rare in remittent fever; whilst, in the yellow fever of the West Indies, it is said to be of constant occurrence. In any form of chronic malarial poisoning, the kidneys may suffer organically, and chronic Bright's disease result. Rheumatism is a frequent complication among the natives, but it occurs also among Europeans, and I not unfrequently find it to be a troublesome symptom in those who return to England for the recovery of health. It is chronic, and affects the extremities and trunk, but not the heart, unless it have preceded and been independent of the fever; it may be of the ordinary form, complicating the fever, but it is sometimes another mode in which the effects of malaria are expressed. Dyspepsia and irritability of the stomach are not unfrequent complications of chronic cases, causing debility and cachexia. Anorexia, flatulence, irregular bowels, irritability, nausea, eructation or vomiting, coated tongue with red edges, occasionally diarrhoea and abdominal tenderness, are present.

THE GULSTONIAN LECTURES

ON

PULMONARY CAVITIES: THEIR ORIGIN, GROWTH, AND REPAIR.

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LECTURE III. PART II.

I HAVE referred at some length, in the first part of my lecture, to the external changes which promote the collapse of cavities. Concerning the forces acting from within, which conspire towards the same result, my remarks must be brief. These forces are mainly: 1. The retraction of the trabeculae; 2. The fibrous shrinking of the bronchi.

1. In respect of trabeculae, it will suffice if I remind you of a statement contained in my last lecture. Owing to their derivation from collapsed alveolar substance, inclosing not only branches of the pulmonary artery and of the pulmonary veins, but frequently also the blood-vessels special to the wall of an adjoining bronchus, which has been laid open by ulceration, elastic tissue enters largely into their composition. In virtue of their elastic nature, trabeculae, as long as they escape ulceration, must tend to approximate their points of attachment. The same observation applies to the denuded blood-vessels which stretch across the large vomicae, due to caseous pneumonia. The tension to which I allude is often demonstrable in the recoil suffered by the segments of a trabecula, when the latter is divided. In addition to this purely elastic force, trabeculae in chronic fibrotic cavities are apt to become the seat of a fibrosis, analogous to that occurring in the cavity-wall. The slow contraction peculiar to young fibrous tissue, in this case, associates itself with the elastic forces inherent to the original

tissues, and contributes in no mean degree towards the result which I have indicated.

2. By the side of the influence exercised by trabeculae, in lessening the distance between the opposed surfaces of a vomica, another force is exerted by the thickened bronchus, tending to produce a retraction of the cavity. Bronchi, in a state of health, are stretched between the root and the periphery of the lung; and, in virtue of the elasticity which they share with other pulmonary constituents, they would retract when divided. But this original elasticity, although appreciable, is small in comparison with the fibrous retraction of a more gradual nature, induced in the ulcerated air tubes by chronic irritation. The thickness acquired by bronchi connected with the cavities of phthisis is considerable; it is mainly due to an abundant growth of fibro-cellular material within the peribronchial sheath. The blood-vessels, richly supplied to the young tissue, undoubtedly possess some degree of elasticity, which should not be omitted as an additional agent of retraction, although clearly secondary in importance to the fibrotic shrinking. The results are striking: the bronchus terminating in a vomica becomes distinctly shortened in proportion to its thickening; and, by the shrinking of the bronchus, the cavity is drawn towards the root of the lung, and additional space is given at the periphery for the expansion of the alveolar tissue.

In large and chronic vomicae, this special agency is obscured by the coincidence of many other changes; but in the case of smaller vomicae, which have undergone contraction and have retreated from the surface, it is almost impossible not to recognise the action of a definite and continuous force, the direction of which lies in the path of the bronchus. My meaning will be made clearer by a reference to Fig. 6 (See Lecture III, Part I), where the retraction of the cavities has been depicted, diagrammatically it is true, but without exaggeration. I am the first to admit that this retraction is brought about by a combination of circumstances; among the latter, I hold the collateral expansion of the surviving tissue to be one of considerable importance. Compensatory hypertrophy, however, is a very complex force, the resultant of which cannot be expressed by a line, but rather by the surface-pressure more or less evenly distributed over all points of the circumference of the vomica. On the other hand, the force to which I would call your attention is obviously linear; its direction is clearly indicated by the course of the fibres constituting the ligamentous bands figured in the diagram (Fig. 6); and, were it possible to estimate the share which must be conceded to the other factors of retraction, its strength might almost be calculated from the thickness, from the length, and from the resistance of the bands. The view which I take of the existence of a retracting force, inherent to the diseased bronchus, receives support from a comparison of the conditions of the bronchial wall before the occurrence of excavation and subsequently to it. The shortening of the diseased bronchus is obvious to the eye, and its thickness from impalpable has become excessive. Again, instead of the remarkable pliancy of the healthy air-tubes, which adapt themselves with perfect ease to the to-and-fro movements of respiration, the rigidity which we observe in their thickened walls is such as to resist the stretching involved in a normal inspiration. From these various considerations, we are warranted in concluding that the retraction of the cavities is secondary to the bronchial changes, and is in a large measure dependent upon the peribronchial fibrosis.

It may be well, at this stage, to briefly recapitulate the forces which encourage contraction and retraction. The falling in of the thorax, the over-expansion of the surrounding tissue, the hypertrophy of the opposite lung, the rise of the diaphragm, and the growth of fibrous tissue, partly within the lung and partly in the pleura around it, all exercise some amount of constricting pressure upon the cavity; whilst the trabeculae and the blood-vessels within them assist the tendency to contraction inherent to the capsule. Lastly, the remarkable displacement of cavities towards the root of the lung is the combined result of the traction, from the thickened bronchus, and of the pressure of the expanding pulmonary substance.

Contraction, which I have hitherto studied with you to-day, is but the first step towards the healing of cavities—the outcome of passive conditions, and of purely mechanical forces. Healing, I need scarcely point out, is a vital action, which presupposes not only an efficient, but an exalted state of nutrition. It implies agencies exactly opposed to those which have led to destruction of tissue. We have seen that phthisis, although originating in congestion, is ultimately productive of local anæmia. Softening or caseation is immediately preceded and is determined by a proliferation of cells within the alveolus, and, yet more important, by a cell-growth (well described by Dr. Wilson Fox) in the thickness of the alveolar wall, the combined result of which is to compress, and finally to obliterate, the capillaries. At this stage, the

vascular channels are choked by the growth of cells around them, and by the endothelial proliferation within. But, with the onset of reparative action, the balance of growth is reversed in favour of the blood-vessels. Cell-proliferation continues, it is true, but it is subservient, as in simple granulations, to the production of capillaries. Thus, in connection with the healing of cavities, we are led to inquire into the subject of their blood-supply.

As an introduction to this subject, I would quote a remarkable passage from Louis's *Researches on Phthisis* (Sydenham Society's translation, London, 1844, pp. 28-29).

"It was, no doubt, well known fifteen years past that the ramifications of the pulmonary artery penetrate neither into tubercle, properly so called, nor into grey semi-transparent granulations; but our knowledge on this subject has since then advanced. It is, in truth, now established by the inquiries of M. Schroeder van der Kolk, and more especially those of M. Natalis Guillot, that the branches of the pulmonary artery stop at a distance, one and a half, two, or two and a half lines (three, four, or five millimètres) from tubercles or grey granulations; and the more these adventitious productions increase in size, the further do the divisions of the artery stop from their perimeter. To such a degree is this true that, when tubercles are of large size, or have given place to cavities, they may be surrounded by a sort of involucre, ten lines (two centimètres) broad, into which no ramification of the pulmonary artery makes its way. M. N. Guillot's injections (*L'Expérience*, tome i, p. 545) appear to me to render doubt upon this subject inadmissible. The injections, dissections, and microscopical examinations of this observer likewise show that, during a space of time which is always very limited, the sort of involucre in question exhibits no trace of vascularity. At the end of that period, a few red streaks with tapering extremities are perceived, the longest of them measuring half a line in diameter. These vessels, which are for a time perfectly unconnected with the rest of the vascular system, and consequently not the seat of apparent circulation, soon enter into communication with the bronchial arteries, or with those supplying the thoracic parietes. The connection with these latter vessels is effected by means of the false membranes so common on the pleural surfaces—false membranes themselves the seat of development of vessels, isolated at first, but eventually inosculating with the neighbouring arteries and the vessels of new formation. The seat of these vessels, as has been stated, is the interspace between the ultimate ramifications of the pulmonary artery and the periphery of the tubercle; but in the proportion as these multiply, enlarge, and soften, the vascular rete spreads in every spot where it has appeared, and ere long an entire lobe, oftentimes a large portion even of the lung, is the seat of this adventitious vascular system, replacing the pulmonary artery, the existence of which vessel ceases to be matter of demonstration."

I am not aware that the statements contained in this passage have since been disproved. It cannot be doubted that among the chief uses of pleural adhesions is the establishment of vascular continuity between the lung and the parietes of the chest. The probable existence of a normal vascular connection between the pulmonary artery and the bronchial system is a subject of considerable obscurity, ill suited for discussion in this lecture; but it may be stated that a case is recorded by Virchow, in which the bronchial system was found enlarged as a consequence of an impediment in the pulmonary supply; and I am in a position to adduce similar testimony in favour of a vicarious relation between the two sets of vessels. Whilst Curator of the Museum of St. George's Hospital, I exhibited before the Pathological Society a specimen which I now place before you, in which the right pulmonary artery was completely occluded by means of ancient fibro-atheromatous material. The lung, unfortunately, was not preserved. It was neither in a state of gangrene nor absolutely collapsed; but it was the seat of well-marked interstitial thickening. The blood-supply to this lung was obviously derived from some extraneous source; in a great measure, doubtless, from the bronchial artery. A similar specimen, which I have also placed on the table, had been exhibited before the Pathological Society in 1862 by Dr. Howship Dickinson. Here also the right pulmonary artery was completely occluded, owing to disease of old standing. In this case, the lung was considerably atrophied and fibrous, and the patient had suffered from severe dyspnea.

Facts of this nature almost prove that the blood in the bronchial artery is capable of doing duty for the pulmonary blood, and that the substitution is facilitated by some pre-existing anastomosis between these two systems. In phthisis, the bronchial artery is not entrusted with any respiratory duties of this kind; its functions concern mainly the repair of the lung. This was admirably shown by Guillot's injections. The injections which I have attempted have not been sufficiently successful to be given as separate evidence; but their partial results were analogous to those of the French observer. The involucre and the

new vessels described by the latter I have also recognised; but I doubt whether the vessels of new formation are ever independent of the bronchial system.

A connection of the vascular network of the cavity with the bronchial artery is nothing more than might have been inferred from etiological considerations. If we bear in mind the purely functional purposes of the pulmonary distribution, we must conclude that the formation of fresh ramifications in a tissue deprived of air would be singularly inappropriate, and out of harmony with the complete obsolescence of the pre-existing set of arteries. Every probability points to their connection with the bronchial system, which has for its special office the nutrition not only of the bronchial tubes, but of the pulmonary tissue. In support of this view, we may adduce the great similarity found to exist between the inflammatory fibro-nuclear growth of the interalveolar tissue and the similar growth in the inflamed peribronchial sheath. The two structures may, indeed, be seen to merge into each other. A microscopical inspection of the tissues in phthisis not only shows that peribronchial irritation is inseparable from the disease, but that the inflammatory products in the alveolar tissues and around the bronchus are indistinguishable, and that the development of blood-vessels is identical in both.

It remains for me to apply these data to the study of the repair of cavities. If we are to trust to the results of Guillot's injections, and to the show of probability in their favour, every formative effort directed towards the limitation or healing of pulmonary lesions would originate with the bronchial vascular system. The development of capsules around cavities I conceive to take place in the following manner. The truncate extremities of the numerous bronchioles, intercepted by the vomica, become centres of inflammation and of fibro-nuclear growth, which soon overlap, and ultimately assume a continuous expansion, owing to vascular anastomosis. This continuity of the cavity-wall, and of the peribronchial tissue, is readily appreciable to the naked eye in many instances. The bright red colour of the bronchial blood-supply can be traced without any break from the air-tube into the capsule of the cavity, and the structural unity of the bronchus with the cavity-wall is equally evident. On careful inspection, this continuity is seen to be more absolute along the outer than along the inner surface. The peribronchial sheath passes entire into the capsule; but the internal surface of the tube is bevelled, and the mucous membrane thinned away at the entrance into the cavity. I have elsewhere insisted upon the danger of mistaking this condition for one of true bronchiectasis. In tubercular deposits, the comparatively limited size of the excavation, and the great regularity with which fibroid thickening and encapsulation occur within them, hand in hand with the process of destruction, render tubercular excavations specially liable to be thus mistaken.

The most characteristic feature of bronchiectasis is the continuous and unbroken mucous surface. Had I ventured, in these lectures, upon a study of bronchiectasis, I should have shown you that the last stage of a cavity of that nature is ulceration. To admit the bronchiectatic nature of the phthisical cavities provided with capsules, would be to admit the anomaly of ulceration occurring at an early date of the supposed dilatation. For with the microscope we seek in vain for any vestige of the existing membrane, or of the columnar cells, excepting within a limited radius of each of the bronchial orifices.

True bronchiectasis, when it occurs, is purely secondary, in my estimation, to the undue strain thrown upon the spongy structures which have escaped disease—its more common seat is within the upper sternal region.

We should equally guard against supposing that the capsule of the cavity is simply a distended bronchial sheath from which the other bronchial constituents have disappeared. It is in reality a new formation, continuous, but not identical, with the thickened peribronchial tissue. The nature of the relation existing between these structures is shown in one of the diagrams, which represents a cavity, invested with a fibroid layer clearly derived from a neighbouring peribronchial tract. The submucous tissue, and a few muscular fibres, in virtue of their more peripheral situation, and of their better vascular supply, are traceable a little beyond the mucous layer; but they also ultimately become merged into the fibro-vascular zone, which must now be termed, not the peribronchial, but the pericavernous sheath.

The practical result of what I have mentioned is of the greatest importance. Under the joint influence of the bronchial and of the pleural blood-supply, the reparative energy of which greatly outstrips that of the pulmonary circuit, the cavity is placed under circumstances of nutrition not far inferior to those of the bronchi themselves. In their power of resisting ulceration, they remain far behind the latter, mainly owing to the absence of a membrana propria, and especially of an epithelial layer. But, having regard to this deficiency, we can justly wonder that the necrosis should remain so limited as we observe it to

be. This is probably due to the bronchial nature, and to the abundance of the vascular supply, which is diverted from its original purposes to the service of the cavity-wall. The enduring power of the large pulmonary vessels for a time may help to consolidate the boundaries of the cavity; but it is a source of ultimate danger, owing to the gradual exposure and to the resulting varicosity of the vascular coats. The smaller blood-vessels of new formation, constituting the special supply to the cavity wall, present no such resistance, and their destruction follows strictly the level of the general ulceration; but serious hæmorrhage does not take place from them.

Whereas, in other organs, the obliteration of abnormal spaces is effected by a free granulation arising from the bottom of the cavity, surface-granulations are practically absent from pulmonary excavations. The occurrence, in the walls of cavities, of granulations worthy of the name, where it is observed, is, I think, clearly traceable to the influence of the systemic blood-supply. I have seldom witnessed strong, healthy granulation, excepting close to the orifice of the bronchus, or in portions of the cavity wall in immediate contact with the pleura. At both these points, the systemic blood-supply is peculiarly rich. In other situations, the granulating power of cavities is extremely weak. The absence of granulations is one of the great impediments to the healing of cavities.

Although it may be doubted whether pneumonic tissue is capable of producing granulations of good quality, I cannot admit the supposition that the lung-substance originally labours under any special disability of this kind. I rather hold that the invariable decay which overtakes granulations is the outcome of the mechanical conditions of cavities, and that, if freely drained, the latter would granulate successfully, and finally adhere. The air and the fluid present, in some cases, both offer an obstacle to the perfect contact of their opposed surfaces. In small cavities, the contraction of the membrane may be so complete as to expel all fluids; whilst the air may be finally excluded, owing to the obliteration of the bronchus. The same opportunities are not enjoyed by the larger cavities. The stagnation of their contents discourages within their walls the growth of granulations, at a time when the vascular conditions are most favourable. Sooner or later the necrotic action, which I have elsewhere described, exposes the fibrous constituents of the capsule, and ultimate cicatrization is rendered improbable, unless contraction be rapidly induced, or the wall should become once more the seat of some degree of healing inflammation.

All situations do not afford like facilities for processes of healing. The upper lobe, owing to the preponderance within it of excavation, also supplies us with the largest number of instances of retrogressive cavities; but within this lobe further differences may be detected as to local facilities for reparative action. For a comparative study of these differences, clinical observation, although not always free from sources of error, supplies the necessary elements.

Most prone to heal are the cavities situated in the *inner subclavicular* district. The opportunities offered by this region are exceptionally good: the sternal lobe, when free from adhesions, as is usually the case in early phthisis, is capable of exercising by its hypertrophy effectual pressure upon the smaller cavities. Equally favourable to the limitation and ultimate repair of such cavities is the shortness of their bronchi.

Healing is more uncommon in cavities situated at the outer aspect of the apex, for there exists in this region a greater tendency to extension to the suprascapular region, and to secondary disease in the upper axilla; and, moreover, the deposition of a mass of secondary tubercle, commonly observed in this situation, generally leads to inveterate disease. More favourable by far are those cases where the pneumonic process at once involves the thickness of the outer apex. This enables the sternal region, which is supplied with independent bronchi, completely to expand, and the most brilliant instances of the virtual healing of cavities are perhaps afforded by this class.

Cavities situated in the *sternal* region do not usually occur from other causes than hæmorrhage, or as a late result of advanced phthisis. In the latter case, they are unlikely to heal; in the former, the possibility of a favourable termination is not excluded, although too often the cases in which blood is inhaled into this district present extensive disease elsewhere. The upper sternal region is probably more favourable for healing than the lower, which receives its bronchial and vascular supply from a greater distance.

In the *axillary* region, secondary excavation is, for obvious reasons, ill suited for recovery. The disease, constitutionally speaking, is invariably advanced, and the tendency to deterioration is progressive. The tissue immediately above is usually rigid, from the presence of active or ancient disease. Thus spongy elasticity, and the power of compensatory growth, are completely absent from the upper boundaries

of the cavity, and the chances of its contraction are proportionately reduced.

Primary cavities in the axilla are placed under very different circumstances. They are surrounded by spongy material, capable of vigorous reparative action. I have frequently noticed, in the mid-dorsal or axillary region, small spherical scars, obviously the remains of small cavities; and I shall presently exhibit to you a specimen in which cicatrization of a larger cavity, although uncompleted, had proceeded to a considerable extent.

Basic cavities are so uncommon, that the healing of vomicae in this situation must be of very rare occurrence. The basic excavations, which belong to the last stages of the disease, are clearly unfitted for recovery, and to them I will not further allude. Probably many of the instances of healed basic vomicae hitherto alleged, were really cases of mid-dorsal disease, in which the cavernous sounds were conveyed to the base by some transient consolidation. This is a mistake which it is sometimes difficult to avoid. Echo may have a share in the production of cavernous sounds at the base, when the original excavation situated in the opposite side of the chest is not in immediate contact with the spinal column. Dr. Mitchell Bruce, who alludes to this subject in his lectures on basic cavities (see *Practitioner*, March and April 1882) refers the causation of the phenomenon to a reflexion of the sounds along the bronchial tubes. It is sufficiently obvious that the disappearance of these phantom-caverns does not of necessity imply the healing of the original vomicae. Again, in the large class of bronchiectasis, to which many basic cavities belong, the cavernous sounds are apt to disappear periodically, owing to the filling of the bronchial sacs, and an impression may be produced that a phthisical cavity has become obliterated.

Bearing in mind these sources of error, we shall feel the necessity of increased caution in resting upon mere clinical data a diagnosis of healed basic excavation; but, when due allowance has been made for these possible fallacies, it must be admitted that primary cavities may originate at the base in various manners, and that they are not incapable of recovery. I have already alluded to the accidental causes, such as injury, inhalation of foreign bodies, gangrene, empyema, and hydatid disease, and I have briefly mentioned the occasional presence of cavities due to syphilis; but, in the softening of hæmorrhagic nodules, we possess a cause for the localisation of disease at the base, which more specially belongs to the district of phthisis, and to which are probably to be referred most of those basic cavities in phthisis which are capable of healing.

If we review basic vomicae independently of their origin and of their complications, it must be owned that they enjoy some unusual facilities for healing. One great disadvantage they all possess in common; I refer to the difficulty of drainage. Adhesions to the diaphragm also constitute, where they exist, a most serious complication; but, when we consider the amount of spongy tissue by which they are surrounded, the powerful cough-pressure which can be utilised for their voidance and for their contraction, we must conclude that they are, in these important particulars, singularly favoured; and we are led to surmise that cavities at the base may occasionally run through their stages unobserved, and ultimately heal more frequently than we suspect.

Closely allied to the subject of healing of vomicae is that of encapsulated residues. Although there is much that opposes the view that vomicae could ever assume the aspect of a solid mass surrounded by a capsule, the derivation of the products in question is so uncertain, that we cannot refuse to discuss any of the possibilities of the case. It may be safely asserted that these deposits are the outcome of some antecedent disease which has become arrested or cured. Of this I see no better proof than in the nature of their contents. The pulaceous masses I have found invariably rich in elastic fibres; and the size and abundance of the latter have suggested to my mind that the deposits were smaller than the area originally covered by the disease. This contraction could clearly have been induced either by excavation followed by closure, or by the mere shrinkage of a pneumonic consolidation. In deciding the question between these two origins, we should be guided by the presence or absence of a good-sized bronchus in the immediate neighbourhood of, or in contact with, the deposit. If in contact with the capsule and occluded, it is probable that the bronchus at some time or other was in open communication with the deposit, and that the latter was excavated, or at least ulcerated. From the character of the contents, we derive but little assistance. Cells may be recognised within them, both of the epithelial and of the exudative type. This demonstrates clearly enough that excavation, if it existed, had not proceeded to a complete removal of the inflammatory products. For the remains of extravasated blood, I have in vain examined the pulaceous deposits; but I am ready to admit that this

failure cannot be used as a conclusive argument against the hæmorrhagic origin which probably belongs to some of them.

I have imperfectly described to you some of the methods by which nature endeavours to heal pulmonary excavation. Although this great object is seldom fulfilled, we possess a clear proof of the energy with which the attempt is made, in the extent and the importance of the collateral results of a contraction of cavities. So much practical interest attaches to some of these results, that I shall venture to devote to their consideration the remainder of this lecture. The contraction of cavities is capable of exerting an influence in four chief directions: 1. upon the outline of the chest; 2. upon the shape of the cavities themselves; 3. upon the shape of the lung; 4. upon the position of the neighbouring viscera. Let us consider first the changes which are commonly induced in the outline of the chest. In estimating these alterations, we must not lose sight of pre-existing peculiarities of chest-formation, among which I need only remind you of the large thorax in chronic fibroid tuberculosis, and of the flattened thorax with drooping ribs, characteristic of catarrhal pneumonia. In accordance with these types, the changes referable to healed excavations may be slightly modified, but they are never completely veiled. Most constant is the occurrence of a local flattening over the site of excavation; in this, we possess one of the safest as well as one of the most obvious guides to a diagnosis of the latter. I have elsewhere sufficiently described the mechanism of this collapse. The local falling in of the ribs inevitably leads to a corresponding increase in the convexity of the costal arch. This secondary bulging of the outline of the chest is usually seen in the axilla: it supplies an important confirmation of the occurrence of excavation. A similar falling in may affect the whole side on which excavation has taken place; this is usually the combined result of excavating disease and of pleurisy. In these cases, the opposite lung is often of considerable size, and encroaches beyond the sternum. The clavicle is usually rendered more prominent, owing to the depression of the supraclavicular space, to the recession of the ribs, and to the atrophy of the upper part of the pectoral muscle. Extreme instances of this unilateral contraction closely resemble the deformity produced by pleurisy with lung-collapse, of which Laënnec has depicted so striking an illustration. Curvature of the spine, often of considerable extent, has repeatedly been observed by me; in youth, it is undoubtedly one of the active means of adaptation to altered thoracic conditions. In a striking case, this curvature was accompanied by a tilting of the pelvis.

As an instance of the varieties, too numerous for description, of the alterations in the thoracic outline, I have selected the remarkable case of a man aged 42, of whom I submit a photograph and cyrtometric tracing. You will not fail to notice that the left side of the chest,

Fig. 8. Cyrtometric Tracing of Chest.

Cyrtometric measurements: (6) = $17\frac{1}{4}$ inches; (7) = $14\frac{1}{16}$ inches; (8) = $16\frac{1}{4}$ inches; (9) = $15\frac{1}{2}$ inches.

Lines: (1) = $11\frac{1}{8}$ inches; (2) = $7\frac{3}{4}$ inches; (4) = $10\frac{1}{8}$ inches; (5) = $5\frac{1}{4}$ inches.

M = middle line of body, passing through sternal notch. X = line drawn through xiphoid cartilage, parallel to M. Distance between M and X = $7\frac{1}{2}$ inches.

Right half of line (3) = $6\frac{1}{2}$ inches; left half = $5\frac{1}{2}$ inches.

viewed from the front, appears broader than the right, whilst posteriorly it is decidedly narrower. It appears probable that the drooping of the ribs, usually coupled with a recession of the sternum, was hindered in this case by the rigidity of the costo-sternal joints and the flattening of the costal arch, instead of leading to the usual bulging in the axilla, occasioned a displacement of the lower part of the sternum towards the right. The measure of this lateral displacement is indicated in the photograph by two lines, one being the middle line of the body bisecting the sternal notch, the other line, parallel to the first, passing

through the centre of the xiphoid cartilage. The cavity which had induced these changes was of larger size, audible close to the spine from the upper scapular region to beneath the angle of the scapula; and the remainder of the left side was the seat of complete fibrosis. No history of antecedent pleurisy could be obtained from the patient, and the origin of the deformity appeared clearly traceable to excavation.

(To be continued.)

ABSTRACT OF LECTURES ON THE MORPHOLOGY OF THE MAMMALIAN SKULL.

Delivered at the Royal College of Surgeons of England.

By W. K. PARKER, F.R.S.,
Hunterian Professor of Anatomy in the College.

LECTURE VII.—THE VISCERAL ARCHES AND CRANIAL NERVES OF THE BRANCHIATA.

THE visceral arches are the ventral parts of the cranial skeleton, and form the framework of the mouth and branchial apparatus. This region extends backwards further than the upper or cerebral part of the head. The lamprey, although not the lowest of the suctorial fishes, is most easily understood; and therefore may serve as a starting-point, especially as there is a close relationship between this type and the tadpole.

The proper cranial cavity in the lamprey lies entirely in front of the functional branchial pouches, which are seven in number. There are no intrabranchial cartilages, but the pouches are protected by a complex basketwork of extrabranchials, which also enclose the pericardium behind, and send a bar outside the hyoid region. There is no developed hyomandibular cleft. In this type, there are prolongations downwards from the basis cranii, which correspond to the suspensorium of the mandible and to the hyoid arch. There is no free mandible, and these first and second postoral arches are not differentiated from the basis cranii. There is a large lingual cartilage, which apparently corresponds to a basi-hyo-branchial in a very generalised condition. These rudimentary arches are supplied by the fifth and seventh nerves, which arise in front of the ear; but the nerve-supply of the seven branchial pouches emerges from behind the auditory capsule; the foremost branch of this forks over the first (hyo-branchial) cleft, and corresponds to the glosso-pharyngeal; the other six branches fork over the clefts behind, and all belong to the vagus. But the vagus is a cranial nerve, arising by several roots; and, in such forms as *Notidanus* amongst the Selachians, it passes out of the skull by several foramina. Hence it would appear that the cranium of the early extinct forms of vertebrates must have been of great length: for, leaving out the two first pairs of cranial nerves, as not corresponding in origin to the rest, we have to account for five pairs of pre-auditory and seven pairs of postauditory nerves, counting the vagus as six.

In the proper myxinoids (*Myxine* and *Bdellostoma*), the branchial pouches have retreated so far back, that the forepart of the heart and the hinder part of the last pouch lie under the twenty-fifth pair of spinal nerves, which is as far back relatively as the heart of the swan. In *Myxine*, the branchial pouches of one side all open by a common aperture; *Bdellostoma* more nearly resembling the lamprey, in that it has a separate opening for each. These pouches have no superficial basketwork protecting them, but in the head there is a considerable outgrowth of non-segmented visceral arches—the archaic ends of the proper intrabranchials of the higher fishes; but these are in a very generalised condition. There is no free mandible, but the hyoid region is well developed, and is continuous below with an enormous and complex lingual cartilage, behind which there is another basi-branchial piece.

The next higher form of visceral arches is seen in the tadpole. Here, again, the suspensorial part of the lower jaw is a large arched outgrowth from the skull, with which it is continuous both before and behind. In the larval state of the mouth, each ramus of the rudimentary lower jaw, now free as a Meckel's cartilage, is in the front of the face, the suctorial disc being placed between the two. For some time, the only part of the hyoid arch which is developed is its lower region—the cerato-hyal; and each of these is continuous with its fellow below