tain point advantageous to the individual in performing his particular form of labour.

When the normal mechanical condition of the body is altered, the transmission of the body weight alone may be sufficient to produce ossification of the ligaments, which sustain an abnormal amount of weight habitually. For instance, in more than one well-marked example of dorsal excurvation acquired early in life, I have found a good-sized piece of bone in the hypertrophied ligamentum nuchæ, as well as considerable prominence of the bony attachment of that ligament to the occiput.

THE POSITION OF THE MAMMALIAN LIMB, REGARDED IN THE LIGHT OF ITS INNERVATION AND DEVELOPMENT.¹

By A. MELVILLE PATERSON, M.D.

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Introduction.—In its earliest condition the mammalian limb shows no signs of segmentation. The bones and joints, muscles, and vessels, are developed from mesoblast formed *in situ*, and are primarily distinct and separate from the segmented trunk. The nerves alone are segmental, and they moreover precede, in order of time, the development of muscle and skeleton. From a consideration of the nerves, we can form an estimate of the position of the limb and its relation to the trunk. The nerves in a sense represent segments. The limbs are outgrowths corresponding to the ventral and lateral portions of the cylindrical trunk, as seen by their innervation,—from the whole of the inferior primary divisions concerned, and not the lateral branches alone.

Position of the Fore Limb.—In mammals, the fore limb has a fairly constant position, and the exceptions are nearly all alike. The proximal end of its postaxial border corresponds to the first thoracic segment, and is innervated by the first thoracic nerve in nineteen out of twenty-five cases. In six cases the second thoracic segment is implicated. The latter cases point to a tendency on the part of the limb to shift backwards. The preaxial border varies in different cases, extending forwards more or less towards the head. This view is supported by abnormal cases in man, by cases like the manatee, with an abnormal number of cervical vertebrae, and by the condition of things met with in birds. In birds, Fürbringer shows there is a tendency towards a shifting of the fore limb in a caudal direction.

Position of the Hind Limb.—The position of the hind limb varies more in relation to the axial skeleton than that of the fore limb. The postaxial border, reckoned by the position of the last nerve entering the great sciatic nerve (*n. bigeminus* of Ihring), corresponds to one of four segments—second sacral, first sacral, last lumbar, or third sacral. In only two cases was the third sacral segment found—man and the ass. The adult position of the limb does not always correspond with the developmental position; for example, in the porcupine the last nerve to enter the sacral plexus is the last lumbar. In most cases the limb remains in direct connection with the segments with which it is developmentally connected. In these cases in which the limb girdle is articulated with segments behind those with which it is developmentally associated, the inference is that the limb has shifted backwards in process of development. In those cases in which, as in the ass, the number of sacral nerves entering the sacral plexus exceeds the number of “true” sacral vertebrae, the inference is that the limb has shifted forwards, so as to become attached to segments placed anteriorly. This view is supported by: 1. Cases of increase or diminution in the number of thoracic-lumbar vertebrae. 2. By the condition of things met with in reptiles, and birds (in which Gadow shows distinctly the tendency of the limb to shift backwards), and 3. By the cases met with of congenital scoliosis, in man and animals.

Conclusions.—1. That the segmental spinal nerves which enter and supply the limbs afford the most trustworthy guide to an estimation of the position of the limbs. 2. That from the evidence afforded by the nerves the position of the limbs is not constant. 3. That the position of the mammalian fore limb varies very slightly, but that it shows a tendency to shift backwards towards the hinder end of the body, from the point where it is developed. This conclusion is supported by Fürbringer's researches in birds. 4. That in mammals with an abnormal number of cer-

vical vertebrae, the irregularity is to be explained, not by the omission or interpolation of vertebrae, but by a shifting of the limb, and a correlated difference in the development of associated parts. In the manatee, for example, the presence of six cervical vertebrae is explained by the condition of the brachial plexus, which shows that either the fore limb is developed in this case further forwards in the neck; or it represents an archaic condition. 5. That the position of the hind limb is less constant than that of the fore limb. It may remain opposite the segments with which it is embryonically connected: but in mammals it displays in most cases a tendency to move backwards, like the fore limb. This conclusion is strengthened by the work of Gegenbaur, Gadow, and Mivart, in birds and reptiles. 6. That in consequence of this process of shifting, other correlated and concomitant changes occur in associated parts. The “sacral” vertebrae, therefore, do not necessarily, from a developmental point of view, correspond to segments concerned in the origin and growth of the limb. They are merely those bones with which the ossa innominata are articulated, and may not be strictly homologous with the corresponding bones in another individual or species. They simply serve a similar purpose in supporting the limb girdle. 7. That in certain exceptional cases, as in man, there is a tendency for the limb girdle to shift forwards in relation to the axial skeleton, along with a concomitant shortening of the vertebral column.

ON CONGENITAL DIAPHRAGMATIC HERNIA.¹

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Introduction.—Cases of diaphragmatic hernia, arising from whatever cause, are rare enough to make them objects of interest to both the anatomist and the surgeon. They are so seldom met with in practice, indeed, that our standard works on surgery either dismiss them with scant notice, or omit all mention of them. The best systematic account of the condition which I have been able to meet with is that by André Boursier.²

The forms of diaphragmatic hernia are three—traumatic, acquired (or spontaneous), and congenital. The traumatic variety, caused by wounds or lacerations, is generally fatal, either immediately from strangulation, or subsequently from inflammation of one of the serous membranes. The acquired or spontaneous form is due to the same causes as give rise to other ruptures, and may produce no symptoms, as it very frequently interferes in no way with the vital functions. The congenital form is without doubt the most interesting to the anatomist, chiefly on account of the light it throws on the mode of development of the diaphragm—a subject which, in spite of our recent advances in embryology, yet presents much difficulty.

These ruptures may be classified in diverse ways, according to the amount of interference with the vital functions to which they give rise; according to their position; or according to the mode in which the opening of the hernial sac is formed. Adopting the last-named classification, we find there are three principal varieties met with:

1. Due to defective formation of the diaphragm.
2. Occurring through one of the natural openings.
3. Due to distension of the fibres of the diaphragm.

1. **Defective formation of the Diaphragm.**—*a.* Total absence of the diaphragm is extremely rare. Cases are recorded by Meckel,³ Bowditch,⁴ Duguet,⁵ and Diemerbroeck.⁶ The last case must be regarded with suspicion, as it is stated to have occurred in a boy, aged 7. *b.* Partial absence of the diaphragm is the most frequent cause of congenital hernia. The rupture is generally placed laterally, and is on one side only. A few cases are recorded in which it occurred on both sides (Bowditch,⁷ Willigh,⁸ etc.) Duguet⁹ denies that a congenital hernia can be placed mesially; one case, at least,¹⁰ points rather towards the fact that this asser-

¹ Read in the Section of Anatomy and Physiology, at the Annual Meeting of the British Medical Association, held in Glasgow, August, 1888.

² *Dict. Encyclop. des Sci. Méd.*, Tome xxix, Art. Diaphragme.

³ Meckel, *Anat.*, vol. iv.

⁴ Treatise on Diaphragm. Hernia, *Charleston Med. Journ. and Review*, May, 1855.

⁵ *De la Hernie Diaphragm. Congénitale*, Paris, 1866.

⁶ Diemerbroeck, quoted by Boursier, *loc. cit.*

⁷ *Loc. cit.*

⁸ Willigh, *Journal Trimestriel de Prague*, 1856.

⁹ *Loc. cit.*

¹⁰ Bednar, Vienna, 1852.

¹ Read in the Section of Anatomy and Physiology, at the Annual Meeting of the British Medical Association, held in Glasgow, August, 1888.

tion is too absolute, although post-xiphoid herniæ are generally acquired. It is remarked by all writers on the subject (Richter,¹¹ Cooper,¹² Lawrence,¹³ Bowditch,¹⁴ Lacher,¹⁵ Boursier,¹⁶ etc.), that the left side of the diaphragm is most frequently affected.

The opening of the hernia is generally due to a deficiency in the formation of the diaphragm. In rare cases one-half of the diaphragm is entirely wanting. More frequently the muscle is left in a rudimentary condition as a crescentic fold attached to the ribs, and contracting the size of the opening. Sometimes one crus is wanting, or one or more costal attachments (in order of frequency from last to first). Duguet states that the most frequent seat of hernia is on one side of the vertebral column. The opening of the hernia in such cases is bounded laterally by the attachment of the diaphragm to the first lumbar vertebra and last rib, anteriorly by the muscle itself, and posteriorly by the parietes. In these cases there is no deficiency, properly speaking, in the diaphragm itself. In most other cases the opening is in the substance of the diaphragm, either in the central tendon or in the muscle behind it, either by deficiency or separation of the fibres of the septum. The last variety is not of necessity congenital.

2. *Hernia through the Natural Openings.*—This form of hernia is extremely rare. It generally occurs in the middle line. Three cases are quoted by Boursier of hernia through the cesophageal opening, and two (doubtful) cases in which the hernia took the course of the great splanchnic nerve.

3. *Hernia by Distension of the Diaphragm.*—These cases are very exceptional. Two cases are recorded¹⁷ in which the diaphragm was distended in the left side, and formed a kind of pouch, in which the abdominal viscera were contained. It is not strictly a hernia, and may not be congenital.

The hernial sac is absent as such in most congenital herniæ. When present, that is, when pleura and peritoneum are intact, the two membranes are found closely adherent to one another.

The viscera naturally tend to pass up into the thorax. All the contents of the abdominal cavity have been found in different cases lodged within the thorax. In order of frequency the viscera contained are: stomach, small intestine, spleen, colon, liver, pancreas, great omentum, cæcum, and duodenum. In exceptional cases the urinary organs and even the rectum are present.

The alterations in the thorax vary with the size and extent of the hernia. The base of the cavity is generally enlarged, the pit of the stomach is a deep depression, the abdomen is flattened, and the costal cartilages depressed. The condition of the lungs depends on whether the infant has breathed or not. If it has not lived, the lungs present fetal characters, and are squeezed up into the back and top part of the thoracic cavity. The heart and pericardium are displaced towards the opposite side.

DESCRIPTION OF THE PRESENT CASE.

1. *Clinical History.*—I am indebted to my friend Dr. Alexander Wilson for the following notes regarding the clinical history of this case:—

"The child was born at the full time, and labour was normal. After expulsion the body was bluish; the child did not breathe or cry, but the heart beat strongly, and with a heavy impulse on the right side of the chest. The cord pulsated strongly, and in compressing it the child made a few gasps, and then lay pale and quiet. Tying of the cord was delayed for some ten minutes, until the placenta was expelled. In the meantime efforts were made to excite respiration, but without success. By slapping the chest, etc., the only effect produced was a gasping and contortion of the face, along with a heaving movement of the chest as in inspiration, and some depression of the epigastrium. No air seemed to enter the lungs. After expulsion of the placenta, artificial respiration, passage of a catheter into the trachea, and faradisation of the phrenic nerves were all tried, but with no effect. The heart continued to beat vigorously for half an hour, and after that more and more feebly for another twenty minutes. For some minutes after it had apparently stopped beating it could be called into action by compression of the chest."

2. *Post-mortem Examination.*—The child was a male, fat, well-developed, and large. It presented no external lesion or abnormality to indicate the cause of death. The chest was well formed

and prominent. The abdomen was flattened, and a well-marked depression existed below the xiphoid cartilage. On opening the thorax in the usual way the greater part of the cavity was seen filled with abdominal viscera. The small intestine, colon, and great intestine were found in front; the stomach, liver, and spleen behind. On turning these viscera aside it was noted that the left half of the diaphragm was entirely wanting, and that the left pleural sac was in consequence continuous with the abdominal cavity. The only other structure present in the space was the left lung, which was in a foetal condition, solid, and attached by its stalk to the upper and back part of the chest cavity. The hernial opening was formed by the space usually occupied by the left half of the diaphragm. It was bounded on the left side by the ribs, over which a continuous membrane passed on to the deep surface of the abdominal muscles. It was bounded on the right by a strap-like band of muscle, stretching between the vertebral column behind and the sternum in front. This muscular slip represented both sternal and vertebral portions of the left half of the diaphragm. Round its left border the mediastinal pleura was continuous with the peritoneum on the under surface of the diaphragm. The pericardium was separated from the hernial cavity by the mediastinal pleura, and between the two membranes lay the left phrenic nerve, which took its usual course, and supplied the above-mentioned slip on the left side. The nerve was apparently as large as the right one. The right half of the diaphragm was developed in quite a normal manner, and consisted of muscular fibres peripherally, with a more or less circular tendon in the centre. In it lay the vena-cava opening in its usual position. Stretching between the xiphoid cartilage and vertebral column were two muscular bands (one of which has already been mentioned), representing the sternal and vertebral portions of the muscle. No tendon separated them, but between the two parts were the cesophageal opening in front, the aortic opening behind. The liver was curiously shaped; the left lobe was larger than usual, and was bent at right angles to the right lobe, so as to be lodged entirely in the thoracic cavity. The right lobe occupied its normal position. Through the substance of the liver passed the umbilical vein. The other abdominal viscera were developed in a normal manner, and no other coincident congenital deformities were present in this case.

Etiology.—As in other cases of deformity due to arrested development, we are provided in these cases of congenital diaphragmatic hernia with certain conditions which throw light on the process of development of the muscle. Putting aside those cases in which the hernia occurs through the natural openings, or behind the diaphragm proper, or by distension of the muscle, we are still left with such a variety of forms as may be regarded as representing different stages in its development. In the first place, then, the muscle, though rarely, may be entirely wanting. When only partially developed, it may be rudimentary on both sides, or (as is more usual) only on the left side. It is almost invariably deficient on one side and not in the middle line. Again, the opening varies in size. As in this case, there may be no vestige of the costal portion of the muscle; it may form a crescentic fold projecting into the cavity, or it may be more nearly complete, an interval, larger or smaller, being left either in the central tendon, or in the muscular substance behind it, or near the thoracic wall by deficiency of the posterior costal attachments.

From this, the teratological, point of view, one may infer that, as in normal conditions we describe sternal, and vertebral, and costal portions of the diaphragm, so in its development there are indications of its formation from at least three separate foci; one of these, mesially placed, may be called sterno-vertebral, and is rarely absent; the other two are costal or lateral, and by deficiency in one of these, generally the left half, a congenital hernia results.

Examining the comparative anatomy of the muscle, it is well-known that the diaphragm is only present in birds and mammals. Among birds it is best developed in struthionidæ.¹⁸ It there consists of two lateral parts, attached to the ribs and the vertebral column, but not connected together in the middle line. In most other birds it consists merely of muscular fibres arising from the deep surfaces of the ribs, and inserted into the membrane stretching over the ventral surface of the lungs.¹⁹ The mammalian diaphragm differs, then, from the highest condition of its development in birds, in having a mesial portion superadded, and thereby completely separating the body cavity into pleural, pericardial,

¹¹ *Traité des Hernies*, Cologne.

¹² Cooper, *Dict. of Surgery*.

¹³ Lawrence, *On Hernia*.

¹⁴ *Loc. cit.*

¹⁵ *Deutsch. Arch. f. Klin. Medicin*, Bd. xxvii, Heft 3 to 4, 1880, p. 268.

¹⁶ *Dict. Encyclop. des Sci. Méd.*, *loc. cit.*

¹⁷ Mecl'el, *loc. cit.*, Zwanziger, Halle, 1819.

¹⁸ Owen, *Gegenbaur, Comp. Anat.*

¹⁹ Huxley, *Comp. Anat. of Vertebrates*.

and peritoneal parts. If, however, we look upon the lateral parts of the mammalian diaphragm as homologous with the more rudimentary diaphragm of birds, and the sterno-vertebral part as a later addition, we at once create a difficulty, in that the portion of the muscle last formed in process of evolution is the most constantly found, and is least variable; whereas one would rather expect it to present the most frequent abnormalities. It is, however, probable that the diaphragm of birds and that of mammals cannot be compared directly with one another. Each is formed for its own special purposes, and there is no definite ancestral muscle in the reptiles with which to compare them. To elucidate the development of the diaphragm, therefore, we are reduced to a consideration (1) of its teratology, and (2) of the accounts given of its embryology.

DEVELOPMENT OF THE DIAPHRAGM.

1. *Teratological Evidence.*—From the evidence derived from these cases of congenital hernia, there would appear to be two parts of the muscle, sterno-vertebral and costal. One judges from the relative frequency of the different degrees of deficiency of the diaphragm, that the mesial portion is the first formed, and that the lateral portions of the muscle develop as folds which grow from the mesial part, as well as from the costal wall, the focus or centre of development being placed anteriorly. The process of growth appears to be from the front towards the back of the body cavity, and from the periphery towards the centre—along the mesial part on the one hand, along the thoracic wall on the other. Growth occurring equally in all parts, stoppage of growth at any period will give rise to a congenital hernia. This would account for the great frequency of the form whose opening is placed posteriorly. As its growth extends, and the attachments or the muscle creep further and further back along the ribs, its breadth and length of attachment increase, and the opening gradually narrows, and finally disappears. The commonest form of congenital hernia will have its opening placed opposite the point which is ordinarily the last to be closed, that is, either in the centre of the muscle or near one of its posterior costal attachments.

While this explains the existence of the hernia, it does not account for the greater frequency of a deficiency in the left than the right side. For this various explanations have been from time to time advanced. Lockwood²⁰ has recently revived the notion of the older writers that the rarity of hernia in the right side was due to the larger size of the right lobe of the liver. He argues that the occlusion of the left omphalo-mesenteric vein causes a diminution in the growth of the left lobe of the liver; and so allows the abdominal viscera to squeeze their way up into the thorax. The left lobe of the liver has, however, as extensive relations with the primitive diaphragm during its formation as the right lobe; both are of equal size, are apparently forming at an equal rate, and the organ stretches right across the abdominal cavity, even after the diaphragm is completely formed. Pressure of the cardiac end of the stomach on the left side, weakness of the left pillar, and the presence of the openings of the œsophagus and aorta have been cited by different authors as the cause of the greater frequency of herniæ in the left side.

2. *Embryological Evidence.*—There have been two diametrically opposite theories advanced *a priori* to account for the development of the diaphragm, each of which is alone inadequate: *a.* The "centripetal" theory. This theory is advanced by Geoff. Saint Hilaire,²¹ Kölliker,²² etc.; and explains the formation of the diaphragm as two crescentic folds, which grow inwards from the costal margin, and meet in the centre. This ingrowth from the side is considered homologous with the diaphragm of birds. The absence of mesial congenital hernia has been explained by these authors as due to the presence of the heart and pericardium in the middle line. *b.* The "centrifugal" theory, advanced by Cruveilhier,²³ Duguet,²⁴ etc.

These writers maintain that the development of the diaphragm commences in the middle line, in the tissues surrounding the structures lying in the splanchnopleure, and that its further growth is due to the formation of two folds which grow out from this mesial part towards the periphery.

Von Baer²⁵ and His²⁶ have described certain points in the de-

velopment of the diaphragm of the fowl; and Kölliker²⁷ has described the mesocardium laterale, which is concerned in the formation of the muscle, in the rabbit; but the most valuable researches on the subject are those of Cadiat,²⁸ Uskow,²⁹ and Lockwood,³⁰ as these authors have worked at it in a systematic manner, and with the most recent methods.

Cadiat's work has not received the attention from English authors which it deserves, owing partly perhaps to the scant consideration afforded to it by Balfour. He describes the development of the diaphragm as occurring in two parts—a pericardial and a pleural part. The pericardial portion is mesial, and at first placed vertically, extending from the ventral side of the trunk to the vertebral column. It is soon subdivided into a ventral and a dorsal part. The ventral part is gradually made horizontal, being pushed downwards by the increase in size of the heart and its passage into the thorax. The dorsal part remains vertical. The pleural parts of the diaphragm he associates with the formation of the liver, the mesoblastic tissue which surrounds the latter forming the lateral portions (as well as the capsule of Glisson, pleura, and peritoneum), and by the growth of the liver contracting adhesions with the side of the thorax.

Uskow's researches were made on the rabbit. He gives a careful and intelligible account of the development of the diaphragm, and his paper is particularly useful as a complement to Cadiat's work. He describes more clearly the development of the lateral portions of the muscle. After describing the formation of the mesial part, and its dorsal and ventral portions, he gives an account of the development of the lateral parts, which, like Cadiat, he closely associates with the mesoblastic tissue of the liver; in fact he calls the formative tissue of the diaphragm and the primitive liver mass by the one name, *massa transversa*. From this the lateral portions of the diaphragm are developed in the following way. Each forms a crescentic fold, with the horns of the crescent projecting backwards, and growing from the front and mesial part. The body cavity is thus gradually, from before backwards, and from the periphery towards the centre, divided by this growing crescent into thoracic and abdominal parts. While this is forming, the diaphragmatic tissue is gradually becoming separated from the hepatic portion of the *massa transversa*, so that before the partition is completely formed it is possible to distinguish the serous membranes in its surfaces. At the sixteenth day the separation of the body cavity into its several parts is complete.

Lockwood's account in his Hunterian lectures does not differ markedly from Cadiat's and Uskow's. He associates the development of the diaphragm especially with the growth of the large veins, heart, and liver. He describes the mesocardium laterale (Kölliker), and the septum transversum (His), and shows how the mesial part of the muscle is the first to be formed. The lateral parts he describes as formed by crescentic folds projecting inwards from the fore part of the somatopleure towards the mesentery.

These researches give us a much clearer notion of the development of the diaphragm, and of the separation of the body cavity into its component parts. We see that in mammals the mesial part is the most primitive, that it is at first vertical, and that the lateral portions are developed secondarily as outgrowths spreading towards the parietal wall of the body cavity from the front of this mesial septum.

There are still, however, important points in connection with the development and morphology of the muscle which require elucidation. For example, is the diaphragm as a whole to be regarded as a special development for a special purpose, or does it belong to other more elementary muscular strata? The dorsal part of the muscle, for example, may possibly belong morphologically to the hyposkeletal system of muscles, and it may not be the wildest notion to hint that the anterior (and lateral) parts of the muscle considered developmentally may be parts of muscular strata which form also the infra-hyoid muscles. This idea is strengthened by a consideration of the innervation of the muscle. Von Baer showed long ago that the phrenic nerve is developed at a very early date, at the same time as the nerves of the upper limb. It thus acquires connection with the primitive diaphragm, but long before the development of muscular fibres. At this time

²⁰ JOURNAL, April 7th, 1888, p. 731.

²¹ St. Hilaire.

²² *Entwicklungsgeschichte des Menschen und der Thiere*, 1879.

²³ *Bull. de la Soc. d'Anat. de Paris*, T. xxii, p. 169.

²⁴ *Loc. cit.*

²⁵ *Über die Entwicklungsgeschichte der Thiere*, I. Theil, 1828.

²⁶ *Die Entwicklung des Hühnchens im Ei*, 1868.

²⁷ *Loc. cit.*

²⁸ Du Développement de la Portion Cephalo-thoracique de l'Embryon de la Formation du Diaphragme des Plèvres, etc., *Journ. d'Anat. et de Phys.*, vol. xiv, 1878, p. 630.

²⁹ Über die Entwicklung der Zwerchfells des Pericardiums und des Coeloms, *Arch. f. Mikroskop. Anat.*, Bd. xxii, Hft. 16, 1883.

³⁰ *Loc. cit.*

the diaphragm is adherent to the somatic wall just opposite the brachial plexus and developing limbs, and the backward course of the nerve is caused by the increased size of the heart and lungs, and the consequent pushing backwards of the diaphragm. It appears to me that from the nerve-supply of the muscle we are supplied with a hint that ontogenetically the diaphragm is related to the same muscular stratum as the infra-hyoid muscles.

ON THE MECHANISM OF THE NOSE AS REGARDS RESPIRATION, TASTE, AND SMELL.¹

By GREVILLE MACDONALD, M.D.LOND.,
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CERTAIN experiments I have lately been making on the functions of the nose as regards the raising of temperature and hygrometric condition of the inspired air, as well as certain deductions from clinical observation, have appeared to me of sufficient importance to bring under your notice and criticism.

By the simple device of connecting a tracheotomy cannula with one nostril, I have proved it possible for a tracheotomy patient to breathe through the nose, the inspired air passing in at one nostril and out at the other. By a valvular arrangement attached to the tracheal end of the connecting tube, the expired air is prevented from passing into the nose; while in the nasal termination a sensitive thermometer is placed which will indicate the temperature of the inspired air after traversing the nasal cavities.

Next it occurred to me that it would be a perfectly simple matter to connect the tracheal end with the mouth instead of to the trachea, and that so experiments might be made upon ordinary individuals. And it is in this manner that my experiments have been conducted. I find that the effort at drawing the air through the tube attached to the mouth is sufficient to close the post-nasal space completely, and so cut off the nasal from the buccal cavities. And this contraction of the soft palate is quite involuntary, or at least unconscious. But, to prevent all source of error, I have employed a valvular arrangement similar to that used on the tracheotomy patient.

The same method of passing the air through the nose was adopted in estimating the hygrometric condition. A measured bell jar was held over water by an assistant who allowed it to sink as the air was exhausted by the lungs. Connected with the upper opening of this was a vessel containing chloride of calcium, which in its turn carried tubing fastened in one nostril. Thus, a measured quantity of dry air would pass through the nose. The connection between the other nostril and the mouth contained in its course three chloride of calcium tubes, which abstracted the moisture contained in the air after passing through the nose. The whole of this circuit was weighed before and after the passage of a known quantity of dry air through the nose, the difference giving the hygrometric condition.

First, let me give you some results of my observations on temperature:

At - 7° C.,	the air was raised to 28.8° C.
At 1.7° C.	" " 35° C.
At 7° C.	" " 34° C.
At 12° C.	" " 35.6° C.
At 45° C.	it was reduced to 33.6° C.

These are but a few of a great number of experiments on different individuals. *Cæteris paribus* the robust raise the temperature two or three degrees higher than the anæmic. A noteworthy fact is that cocaine, by inducing collapse of the inferior turbinated bodies, will lessen the acquired temperature by two or three degrees. Doubtless this throws some light on the functions of these structures, although it would appear that they are not directly of much importance in imparting caloric.

In estimating the quantity of aqueous vapour absorbed, I find that it varies considerably according to the barometric pressure in the nose. For instance, I found that any alteration in the arrangement of the tubes causing respiration to be more difficult increased the amount of water, and *vice versa*. Hence any degree of stenosis in the nose would result in an additional degree of saturation in the inspired air. In most of my experiments there has

been more or less obstruction to easy respiration, and in some the weight of aqueous vapour has almost doubled that of saturated air at the temperature of the nose and the external barometric pressure. One may consequently assume that the air on passing through the nose is always saturated with water as well as raised to the temperature of the blood, and that the usual statements in the textbooks as to the quantity of moisture exhaled by the lungs are incorrect. Ordinarily, there must always be a *minus* pressure in the nose during inspiration and a *plus* during expiration, and one may even suppose a slight deposit of dew in the respiratory passages during expiration, this excess of moisture being reabsorbed by the next inspired air. Cocaine applied to the nasal mucous membrane has the effect of slightly lessening the amount of moisture absorbed.

Remembering the latent heat of aqueous vapour, and that it is when the external temperature is lowest that the most water is vapourised in the nose, one realises the enormous quantity of heat given up by the nose.

A consideration of the course pursued by the inspired current of air will bring me to these points in connection with the senses of smell and taste which I am venturing to bring under your notice. The orifice of the nostrils lies for the most part a quarter of an inch or so below the floor of the nasal fosse. This arrangement obviously tends to give some of the indrawn current an upward as well as a backward direction, so that the middle as well as the inferior meatus is used for respiratory purposes. That such is the case we can readily satisfy ourselves by considering the changes in position of the *alæ* during olfaction. In the presence of an unpleasant smell, we instinctively "turn up the nose," in common parlance, or, in other words, contract the *levator labii superioris alæque nasi*, and so bring the external opening of the nose on a level with the floor of the inferior meatus. Contrarily, when we wish to enjoy an agreeable odour, we sniff it up, or, in other words, depress the upper lip and with it the *alæ*, thus directing the inspired air more towards the olfactory region. The influence of these movements on the perception of smell can be submitted to very simple experiment.

I have frequently noticed in cases of obstruction in the middle meatus from the presence of nasal polypi, etc., a deepening in the furrow running from the angle of the nose to that of the mouth, and for a time I was much puzzled to account for it; but as it is obviously caused by a constant contraction of the *levator labii superioris alæque nasi*, we may consider it as a result of the effort to facilitate respiration through the inferior meatus. One might even classify the muscle as one of those accessory to inspiration.

The olfactory nerve is divided into two main divisions, an anterior and a posterior, the former being distributed over the middle turbinated body and septum, while the latter is consigned to the superior spongy body. This latter again is almost, if not quite, sheltered from the inspired air by the overshadowing middle turbinated, so that it can hardly take part in what is commonly designated as smell. With expiration, however, its position and importance is reversed. The expired air is driven vertically upwards, and odoriferous particles from the mouth, such as flavours, would take the same course. In each case the superior turbinated bone would lie exposed to their influence; so that I am venturing to ask the question, Mr. President, whether we might not aptly pay some consideration to the subjective distinction between smell and taste, that is, the perception of flavour, and assign to the superior spongy body the latter sense, reserving the middle spongy for simple olfaction?

Certain clinical observations have considerable weight in my argument. In inflammatory and other affections of the nose it is very frequently observed that smell is abolished without taste being deteriorated. Moreover, I have frequently heard such patients aver that, although they have altogether lost their sense of smell, they can sometimes *taste*, as they say, bad odours when forcibly inhaled through the nose. This last observation further suggests to me that on the superior spongy being reached either by inspiratory or expiratory efforts, in either case the nerve-stimulation is interpreted subjectively as taste rather than smell.

PRESENTATION.—Mr. Cecil G. Westropp, L.R.C.P., M.R.C.S.I., on resigning the post of medical officer of the Derrylin Dispensary District to practise at Monkstown, has received several farewell addresses from local bodies, together with a handsome timepiece and salver.

PROFESSOR SCHÄFER'S textbook of histology has been translated into German by Professor W. Krause.

¹ Read in the Section of Anatomy and Physiology, at the Annual Meeting of the British Medical Association, held in Glasgow, August, 1888.