

Dr. Henderson

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— 1864 —



1. Anatomy of the passages from
larynx downwards, to the anally - including
various diseases, including
as improved in health
2. Anatomy in disease - & the various
sources of the changes - see Emphysema
well executed & calls for little
attention

The Conditions
of
The Respiratory Passages.

In
Health and Disease


1.

There are several difficulties experienced by the Medical Student in the preparation of his Thesis. Chief of those that meet him at the very threshold of the undertaking are want of Experience want of time and the difficulty experienced in selecting a suitable subject

To every student of Medicine who has only studied three years professionally the feeling, that he has neither read nor thought sufficiently on any one subject in the wide field of medical research so as to enable him to write about it clearly and fully, must have made itself felt as soon the attempt was made: besides, the hurry & anxiety attendant on the acquisition of such an amount of knowledge as is necessary to enable him to pass

pass an examination on the Five Subjects, are unfavourable to the calm investigation of any particular subject. When the examination has been passed the reaction which inevitably follows the severe and long continued mental strain, entails a necessity for rest, so that Clinical Surgery, Clinical Medicine with practical Midwifery & Dispensary work fully occupy the Summer Session. During the vacation few Students leaving Edin^g have the means of consulting medical authorities on the subjects of their Thesis so that they find it impossible to do anything to it - This was my own Case - as a result the Thesis must be written during the last Winter Session while the remaining subjects of the Curriculum at the same time claim attention. Should the student attempt any original investigation he will do so at the expense of neglecting his Clinical studies which, if not attended to now, there may never be a suitable opportunity of his again becoming acquainted with, and on a proper acquaintance with which all his future usefulness, success and comfort must depend.

Another source of perplexity is the selection of a suitable theme. The field of study is so wide that it becomes a difficult matter what or where to choose.

And wide though the field be, it will be found, -
~~that~~ should the student imagine he has struck upon
 some hitherto neglected corner - that some aspirant for
 honour or some earnest seeker after truth has already
 fully explored it. I have selected the subject of
 the Conditions of respiratory passages in health & disease
 not from any hope of being able to throw more light
 the subject, not from any feeling that I am better
 fitted to deal with it, than with any other.
 I have been rather guided in my choice of this
 subject by a desire to become better acquainted with
 a part of the human body which claims more
 perhaps than any other the attention of the
 medical profession, in our changeable climate,

The Respiratory Passages may in a general
 way be described as consisting of a single tube in
 the Centre of variable width, bifurcated at the upper
 and lower extremities. At the upper extremity opening
 on the free surface of the body by the nasal pass-
 ages. At the lower extremity dividing into the Right
 and Left Bronchus each of which as it enters the
 lungs goes on subdividing dichotomously becoming
 narrower at each subdivision till at last it termi-
 nates

- Mucous in the air cells.

A brief description of the ^{Mucous Membrane of the} nasal passages will only be necessary as the subjacent tissues are not often subject to morbid change.

a more extended description of the Larynx, Trachea, Bronchi and Bronchial tubes ^{with air cells} will be necessary to help to a right understanding of those morbid changes that take place in the different diseases that affect each separate portion of the passages.

The Larynx - from the Greek λαρυγξ the upper part of the windpipe - may be briefly described as an irregularly shaped box. Cylindrical below where it is connected with the Trachea widening as it rises upwards. It presents a flattened appearance at the sides and behind, while in front it assumes the form of a blunted vertical ridge. The cartilages composing the framework of the Larynx are jointed together and connected by ligaments besides they acted on by muscles attached to them whose function it is to give to the true vocal cords that degree of tension necessary to the production of the various modifications and intonations of the voice. placed in front of the superior opening of the Larynx and projecting upwards behind the base

base of the tongue is the piece of cartilage called the Epiglottis Cordate in form and placed with its broad or free extremity uppermost. In the ordinary condition its direction is vertical. The free extremity curving forward towards the tongue, but in the act of swallowing it is carried downwards and backwards over the entrance into the larynx which it closes over and protects from the entrance of any portion of the food or foreign substances.

When looked at from above the air passage within the larynx appears to become contracted transversely the sides approximating assume the form of a fissure which runs from before backwards. This contracted portion is called the Glottis. Four well defined folds of the mucous membrane stretched in an antero-posterior direction, two on each side, bound the glottis laterally. These are the True & False Vocal Cords. The superior of these have an arched or semilunar outline and are thinner and weaker than the inferior or true vocal cords which are straight thick and strong. The fissure between the true vocal cords is called the Rima Glottidis. When slightly open it is lancet-shaped the pointed extremity looking forwards. This aperture becomes triangular when farther expanded. It is nearly an inch
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when measured in an antero-posterior direction. This is the measurement in the male, in the female about 8 or 9 lines.

The vocal cords do not stretch across the whole extent of the glottis measuring in the male not more than seven & in the female about five lines in length -

The Trachea - Greek *τραχεια* *απτηρια*
rough artery - commences at the Larynx above to which it is connected by a fibrous membrane and extends downwards as far as opposite the third dorsal vertebra almost behind the arch of the aorta where it bifurcates into the right & left Bronchus. It is about four or four and a half inches in length and from $\frac{3}{4}$ to one inch in diameter. but its length and width vary with the varying positions of the head and neck. Its form is somewhat cylindrical rounded in front and at each side but behind flattened against the pharynx. This flattening is due to the structure of the tube at this point, which consists externally of a fibrous membrane lying between which and the mucous membrane that lines the tube there is a layer of involuntary muscular fibres pale or reddish in colour. which are arranged not only transversely between the posterior extremities of the Cartilaginous rings but also stretch across ^{opposite to} ~~between~~ the intervals between the rings. On the sides and front the tube is composed of a series of Cartilaginous rings from 16 to 20
in

in number connected at their adjacent edges by an elastic fibrous membrane, which, not only connects the transverse pieces of cartilage; but is prolonged over both their outer & inner surfaces so that the pieces of cartilage look as if embedded in it. The outer layer being stronger than the inner. Outside the transverse muscular fibres are found some small fasciculi of muscular fibres which have a longitudinal direction they arise by minute tendons of elastic tissue from the inner surface of the ends of the rings partly also from the external fibrous membrane. In addition to these and places beneath the mucous membrane of the Trachea while they adhere closely to it. a great many fibres of the elastic or yellow fibrous tissue may be seen passing in a longitudinal direction all round the tube, internal to the cartilages and layer of muscular fibres just described. They are most numerous on the membranous portion of the tube behind and are there collected into distinct longitudinal bundles which produce elevations on the mucous membrane. These bundles are best marked at the bifurcation of the Trachea. The function of these elastic longitudinal fibres is to restore the Trachea to its original ^{length} should it at any time be stretched while that of the transverse involuntary muscular fibres is to approximate the ends of the cartilages thus diminishing the diameter of the ^{tube} while its walls are rendered thereby more tense.

The

From Greek *Brōnchos*. the gullet.

The Bronchi in their general structure correspond very closely to that of the Trachea the cartilaginous rings are shorter and narrower and are imperfect behind.

The right Bronchus being shorter than the left has fewer rings from 6 to 8 in different individuals while in the left there are from 9 to 12. the fibrous, muscular and elastic tissues being disposed in the same manner as in the Trachea require no further notice.

The Bronchia or Bronchial tubes arise from the Bronchi, just as the tubes enter the lungs each Bronchus divides into two branches an upper and a lower on the right side a third branch is given off which goes to the middle lobe of the lung on that side, as the Bronchial tubes enter the substance of the lung they go on subdividing dichotomously in some cases three branches rise together but never anastomose with each other. Sometimes lateral branches are given off at intervals from a main branch. The larger branches generally strike off at an acute angle but as they penetrate more deeply toward the periphery of the lung they are given off at a more obtuse angle. The calibre of the tube diminishes as it approaches the surface of the lung and in proportion as the size of the tube diminishes so does the structure of the tube change we have seen that there is but little difference in the

the structure of the Trachea and Bronchi but no sooner have the air tubes entered the lungs than a modification in their conformation is observable they at once become circular tubes the pieces of cartilage are not found on the front and sides only, while the posterior portion of the tube is membranous, but they are found scattered over the whole circle of the tube behind as well as on the sides and front in the form of irregularly shaped plates of different sizes and adapted as it were to each each other. These laminae or plates are seen most distinct at the angles of division, just as the broadest piece of cartilage is seen at the bifurcation of the Trachea. As the tubes ramify more deeply into the substance of the lung the pieces of cartilage become thinner narrower and shorter till at last when the tube has become about a quarter of a line in diameter the cartilage disappears and the tubes become entirely membranous. The fibrous coat reaches to the smallest tubes becoming gradually thinner and thinner at last changing into areolar tissue. The yellow or elastic tissue arranged longitudinally can be traced to the finest tubes. The muscular fibres which in the Trachea and Bronchi were confined to the back part of the tube in the smaller bronchia ~~the~~ completely surround the tubes lying inside the cartilag-
-inons

-ious plates but they are met with still nearer the periphery of the lung appearing as irregular annular bundles in the smallest tubes. here they have all the characteristics of the involuntary muscular tissue being pale and unstriped.

The following description of the termination of the smallest Bronchial tubes in the air cells and the structure of the air cells is given by Mr. Raney in the Med. Chir. Transactions Vol. XXVIII. "on tracing one of the smaller Bronchial tubes suppose for example one entering a separate lobule. the small airtube divides and subdivides from four till nine times according to the size of the lobule, its branches which diverge at more and more obtuse angles, at first diminish at each subdivision, but, afterwards continue stationary in size being about $\frac{5}{64}$ to $\frac{3}{32}$ of an inch in diameter, moreover they lose their cylindrical form, and appear more like irregular passages through the substance of the lung which are beset at first sparingly but but afterwards closely and on all sides with numerous little recesses or loculi and ultimately terminate near the surface of the lobule in a group of similar recesses. these small recesses whether seated along the course of an air passage or at its extremity are in fact the air cells". the cells themselves appear like polyhedral cavities separated from each other by

by thin and rather shallow intervening septa and of course opening into the air passages. They do not open into one another by lateral communication but freely communicate through the medium of the air passage to which they belong.

"At the point where the small bronchial tubes lose their cylindrical character and become covered on all sides with the cells their structural elements also undergo a change. The muscular fibres disappear the longitudinal elastic bundles are broken up into an interlacement of areolar & elastic tissue which surrounds the tubes and forms the basis of their walls. The mucous membrane becomes less opaque and ceases to be covered with a ciliated epithelium. On the contrary it is exceedingly delicate consisting merely of a thin transparent membrane covered by a stratum of Squamous epithelium. A similar membrane lines the air cells and by a doubling inwards of itself forms the intervening septa. The walls of the cells their orifices and margins of the septa are strengthened & supported by scattered and coiled elastic fibres."

The most important structure as bearing on the pathology of the respiratory passages has yet to be described. It is so much alike over all the different portions of the air passages that one general description will suffice.

Unlike the serous membranes which line cavities of the body having no outlet mucous membranes line internal passages

passages and Cavities of the body which communicate with its free surface.

The Mucous Membrane of the Respiratory passages is attached by one surface to the tubes which it lines by means of areolar tissue, often called submucous tissue, in some parts, for example, the nasal passages, the quantity of submucous tissue is small the Mucous membrane being almost superimposed on the bone without the intervention of any areolar tissue while in other parts of the passages. ^{e.g.} in the larynx the quantity of submucous tissue is much greater and so lax is the Mucous Membrane that it is here thrown into folds, a proof of this greater laxity of the Mucous Membrane is seen in Cases of Oedema glottidis, where the loose areolar tissue in or near the Aryteno-epiglottidean ^{fold} becomes so much enlarged through exudation into its interstices, that asphyxia is the result.

Structurally a Mucous membrane may be said to consist of a Corium and an Epithelium. The Corium is that part of the membrane which remains after detachment of the epithelium. According to Mr. Bowman the Corium may be said to consist of a fibro-vascular layer of variable thickness bordered superficially ~~by~~ or next the epithelium by an extremely fine transparent lamella called by him the basement membrane which

which by the older anatomists if not by Mr. Bowman himself was supposed to be a distinct and separate membrane but is now not considered as such but as formed by the condensation of the fibrous tissue of the fibro-vascular layer on the upper surface of which it is placed and with which it is closely and inseparably connected by its under surface. The vessels which ramify in the Fibro-vascular layer pass up to the under surface of the basement membrane but do not pass through it. It being thus entirely extra-vascular. not only blood vessels but also lymphatics and nerves are distributed in the Fibro-vascular layer & there are also found in it in different proportions, in different portions of the air passages, muscular fibres, ~~which~~ (In the Trachea and Bronchi ^{the muscular fibres} are principally confined to the back part of the tube: but ~~which~~ in the Bronchia encircle the tubes with a uniform layer of annular fibres lying between the irregular cartilaginous plates and basement membrane. These it will be seen afterwards play an important part in some of the morbid conditions of the respiratory passages. These however are external to the fibro-vascular layer. —).

The function of the involuntary muscular fibres found in the fibro-vascular layer of the Mucous Membrane is evidently to regulate the amount of blood in the vessels with which it is intermixed

interspersed.

"As to the arrangement of the vessels in the mucous membrane the branches of both arteries and veins divide in the submucous tissue send smaller branches into the outer portion of the corium and these in the fibro-vascular layer form a network of capillaries which lie in close contact with the basement membranes.

The next portion of the mucous membrane to be described is the Epithelium, which, in mucous membranes holds the same relation to the basement membrane as the Cuticle does to the Cutis vera of the skin. The basement membrane is in immediate contact with the Epithelium "which it supports in the immediate production of which it is supposed to have probably some share".

Points or marks resembling the nuclei of Epithelial cells are sometimes seen regularly disposed over the surface of the membrane and some observers look upon these as so many reproductive centres from which new Epithelial cells are generated but Mr Bowman considers them to be nuclei belonging to the undermost or as they may be termed nascent Epithelial cells which have remained adherent to the basement membrane. However produced the Epithelium cells of the mucous membrane of the respiratory passages are of the variety called ciliated. except in the air cells and part of the passages crossed by the alimentary canal and in these the epithelium is of the variety termed scaly.

The epithelium layer of the Mucous Membrane is specially deserving of attention. Columnar in form, the cells are placed at right angles to the surface of the basement-membrane on which they stand. They taper towards this membrane and are held together by intercellular tissue which fills up the spaces between their attached narrow ends. On their broad extremities or free surfaces each epithelium cell is furnished with a tuft of minute hair-like processes which - from a supposed vital contractility possessed by them - keep up a lashing or vibratile movement. This movement in the air passages being in a direction from below upwards, from the lungs towards the mouth.

Opening into the air passages along their whole course are to be seen the orifices of a great number of Glands of the variety termed "racemose" from their branched or compound appearance. These glands are placed at different depths below the surface of the Mucous membrane. Their single branched ducts passing through and opening on its free surface in fact they may be said to be portions of the Mucous membrane, their walls being in some instances, at least, formed of involutions of the basement membrane while their ducts ~~to~~ are lined with columnar epithelium their sacculated extremities are furnished with the variety of Epithelium termed

termed "Spheroidal". These glands yield a mucous secretion of a more or less viscid character. It may be of a transparent or turbid appearance being of varied consistency, according to the state of health of the membrane. When examined by the microscope Mucus is found to consist of ^{a fluid containing} the following elements. 1st Mucous corpuscles which bear a striking resemblance to the white cells of the blood. 2^d Particles of Epithelium which have become detached from the secreting tubes, and 3^d Cells containing nuclei of different sizes, seemingly in a transition state. The viscosity of Mucus depends on the liquid part which contains in solution a peculiar substance to which the name "Mucin" has been given by Chemists.

Mucus in ordinary health is carried along the air-passages by the action of the cilia which studding the membrane closely give its surface a brush like appearance under the microscope. The appearance of the combined movements of the cilia has been appropriately likened to the waving movements of a field of grain bending before a strong breeze. The mucous secretion as it is elaborated is passed from the glands along their ducts to the free surface of the mucous membrane and is carried upwards by the movement of the cilia, serving to lubricate the passages in its progress, at the same time protecting

protecting them from the action of the air or any irritant whatever.

Having thus briefly noticed the conditions of the Respiratory passages in health, a knowledge of which is absolutely necessary to the proper understanding of the changes of their conformation structure and functions in the state which we term disease, we now go on to consider some of those deviations from the normal state that constitute disease.

Perhaps the most frequent as well as most important of the deviations from the normal conditions of the air passages is that change produced on the mucous membrane by the inflammatory process, which when it has reached a certain stage we designate by the term Congestion. Going a step higher we call it Inflammation & still higher we term Ulceration ^{or Suppuration}. &c

We commence with a description of the inflammatory process first, because to a greater or less extent it is an accompaniment of all the morbid conditions observed in disease of the mucous membrane of the respiratory passages.

Without entering upon the subjects of the Nature and Causes of Inflammation in general we shall attempt to describe the particular phenomena which are seen in cases of Congestion and Inflammation of the

the mucous membrane of the respiratory passages and here as in other tissues of the body that are liable to be attacked by the inflammatory process the character of the phenomena observable is in some measure modified by the kind of texture involved.

The first change that follows upon the application of the exciting cause — whether that be cold & moisture applied to the external surface of the body for example to the feet, or whether the cause be a local one, for example an irritant applied to the mucous membrane itself, or whether the cause be secondary traceable to functional or organic disease in some other part of the body — is an increased flow of blood to the vessels of the membrane which becoming distended give it that red appearance which is one of the great characteristics — the first tangible one — of the inflammatory process. This stage of the diseased action going on in the membrane has been called Congestion or local Hyperaemia. I have termed it "diseased action" but this is scarcely correct. it is rather an excess of the normal healthy action which usually goes on in the part and if only temporary no bad results follow but if persistent or proceeding a step higher can no longer be said to occupy neutral ground but has passed

passed into the domain of disease. This appearance of redness is well seen in a case of Bronchitis which commencing in the mucous membrane of the Nares as a nasal Catarrh passes downwards from these into the Larynx thence to Trachea, Bronchi, Bronchial tubes at last invades the air cells. The degree of redness in such a case will correspond to the degree of inflammation, varying in ordinary cases from a uniform bright-red blush over the entire surface to dark^{red} or brownish patches which appear as isolated spots on the surface of the membrane, at other points assuming a branched or dendritic appearance, at the outset generally confined to the surface of the membrane but should the disease increase in intensity it involves the submucous tissue assuming at the same time a deeper tinge, amounting in some cases almost to a purplish hue.

Here as in all other tissues of the body attacked by inflammation the redness is caused by the distension of the capillaries by the red blood corpuscles, which from the diminished quantity of the liquor sanguinis in the inflamed part — are of more than normal amount in the vessels. The redness will also be increased by extravasation of blood from the vessels which at one period being overdistended have at last ruptured giving free exit

exit to the blood, which ^{then} fills up the interstices of the surrounding cellular tissue

The temperature of the part is also exalted, but this elevation of temperature is not so readily perceived by the patient in the mucous membrane of the air passages as in inflammation of other tissues. Dr. John Hunter proved by experiments on animals that the temperature of the blood in an inflamed part did not greatly exceed that of the blood in the heart. but that the temperature of an inflamed part is higher than in other parts of the body is quite apparent to the sense of touch. To the patient suffering from inflammation, different parts of the body have different degrees of temperature for example the degree of heat felt ^{by a patient} in a case of Erysipelas is much greater, than that felt by him, in inflammation of the Mucous Membrane of the air passages. what the Cause of increased heat in an inflamed part is, has been attributed to the increased activity in the circulation of the part, to the greater amount of blood there and to the chemical and vital changes which are going on more actively than usual in it, besides it may be supposed that the nerves of Sensation of the part suffering in the general disorder have their function more than ordinarily

ordinant

heightened and this may account for the increased feeling of heat by the patient, but this feeling of increase of heat is shown at least to some extent to be a perverted one for while there is an undoubted increase of temperature in the part the thermometer shews that it does not correspond to the sensation of heat as measured by the patient's feelings. This however applies more to inflammation in other tissues than to that of the mucous membrane of the respiratory passages, in which, the feeling of increased heat except near the external orifices is but slightly perceptible.

It may however be remarked that in inflammation of the mucous membrane of the nasal passages and fauces the increase of temperature is sufficiently well marked.

Another feature connected with inflammation of the mucous membrane of the air passages is swelling or thickening. This is best seen in parts where the subjacent cellular tissue is loose and of considerable depth. In the nasal passages where that part of the mucous membrane which lines the respiratory tract becomes inflamed, owing to the almost entire absence of submucous tissue, the membrane being as it were superimposed on the bone - little thickening occurs, whereas in the larynx in which there is a very considerable quantity of submucous tissue swelling does occur and sometimes to such

such extent that entire closure of the Rima Glottidis takes place necessitating the operation of Tracheotomy to save the patient's life.

The nature of the effused fluid varies with the different stages of the inflammatory process. In the early stage or stage of Congestion the watery part of the blood or serum is effused, as the disease advances the exudation poured out is more plastic in character. Fibrin existing in it in great abundance. Last of all the capillaries rupture & blood is extravasated into the submucous tissue. In the Bronchial tubes so great may be the amount of extravasation that the diameter of the tubes either becomes greatly diminished in Calibre. or entirely filled up, in the former case causing dyspnoea in the latter asphyxia, should the whole tubes be filled up. Should only part of the Bronchia be occluded then we have two conditions resulting. viz Collapse of the portion of tubes & air cells beyond the occluded part of the tube and a corresponding dilatation of the tubes and air cells in the portion of lung in which the tubes are still pervious. Thus constituting Emphysema of which more shall be said anon.

Not much pain is usually felt in inflammation of the mucous membrane and in this respect it differs remarkably from inflammation of serous membrane

membrane. To what is this owing? Referring to the Cause of increase of temperature in inflammation it was observed that the sensory nerves in the inflamed part have their function elevated. They are pressed upon by the enlarged vessels and by the exudation & extravasation according to their amount. If the subserous tissue be of no great extent beneath, the pressure they sustain will be all the greater. This undoubtedly is the ^{principal} cause of the Pain felt in inflammation. The vessels under the influence of Throb. being widen as well as become elongated at each impulse. In this act, the nerves that supply these vessels become pressed upon at each dilatation and pain will be the result. In this way a slight increment to the amount of pain is to be accounted for.

It has been already remarked that the Mucous Membrane is a less sensitive tissue than the Serous. may not difference in Structure, to some extent at least, account for the difference of sensibility? the Mucous membrane being of a looser texture than the Serous will suffer less from compression and hence less pain will be felt. but there is something connected with the presence of pain in inflammation which no attempts at explanation by means of of any mechanical theory can account for." Do not at most the same mechanical conditions exist in Cases of Ascites

Ascites and Peritonitis:- says Professor Miller, "and yet the presence of pain in the latter and its absence in the former, show clearly that the morbid inflammatory sensation must be regarded as in great part developed according to a peculiar law," writing on the same subject Dr Watson remarks "that there is more pain felt in external inflammations & in the inflammation of investing membranes, than in inflammation of the substance of the viscera or of the lining membranes & it has been conjectured that this may be, because, in the latter cases, the parts affected have fewer nerves of common sensation" This explanation however Dr Watson does not consider satisfactory. "If" says he this statement were well founded, we should not have such exquisite pain in some of the textures already mentioned which appear to be furnished with very few nerves of common sensation, and scarcely feel at all in their healthy state, I mean tendons ligaments & cartilages. I think it will be found that most pain is felt in those parts which are least capable of yielding - in which the tendency to swell is greatest. The substance of the spleen, liver and viscera generally, is soft and yielding - the mucous membranes are spongy in their texture & often attached to the subjacent parts in loose folds, & they allow of an accumulation of blood within them without being much stretched or very tense. The investing serous membranes are more tightly applied & much less capable of yielding. & their inflammation

is

is usually attended with severe pain"

A question arises here as to whether in inflammation, the state of the blood vessels is determined by that of the nerves or the nerves by that of the blood vessels: whatever may be state of this question as to priority one thing is certain that the congested condition of the blood vessels when once established greatly increases the sensibility of the part.

I go on next to notice the effect produced by inflammation on the glands and follicles of the Mucous Membrane.

Partaking in the general excitement the glands & follicles become more vascular and enlarge while their orifices and ducts diminish in size from pressure without and swelling within as a result of ^{thick} the secretion at first diminishes then entirely stops for the first effect of inflammation on a Mucous Membrane observable is arrest of secretion, hence dryness. This however does not long continue, sooner or later it may be from 12 to 24 hours, a small quantity of thin transparent frothy Mucus of a saline taste is exuded on the surface of the Membrane. By & by this becomes altered in consistence, masses of a more viscid character and of a dark colour often, owing to the carbonaceous matters contained in them are spit up. These masses have been termed "Racrae" by Laennec. In about 36 hours the cough which had been previously very severe & painful becomes less so, expector-
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-ation becomes thick and yellowish, no longer frothy. It is in fact now altered mucus.

The different appearances of the secretion of the Mucous Membrane mark the different stages of the inflammatory process, which having once passed the stage of Exudation passes into that of Suppuration.

Pus as formed on Mucous Membranes has been long a subject of much difficulty to the Physiologist and pathologist. Two theories to account for the formation of pus on Mucous Membrane are held at the present time. The first may be termed the "Exudation Theory". The supporters of this theory hold that the formation of pus must invariably be preceded by the exudation of a modified blood-plasma. In this exudation are seen molecules & granules from $\frac{1}{1000}$ to $\frac{1}{500}$ of a line in diameter. Then there appear around these molecules, and partly independent of them, somewhat larger corpuscles which are identical with the nuclei of the pus corpuscles. These nuclei appear sometimes isolated and sometimes in groups of twos or threes, in this way forming Composite nuclei, around these the cell wall is subsequently developed, appearing at first as a pale transparent membrane afterwards becoming thickened and granular. In this way each pus corpuscle is formed and in some cases their ^{formation &} accumulation is very rapid. While

While the supporters of the theory hold that pus is a new formation in an exuded blood-plasma. The supporters of the second theory which may be called "the connective tissue Corpuscle theory" hold that pus corpuscles are only modifications of pre-existing textures, admitting the fact that molecules and granules &c are to be seen in the exudations poured out in pleurisy &c. They deny the inference drawn by the supporters of the exudation theory from such appearances. instead of regarding the molecules & granules as histogenetic elements by which the cells seen in the fluid are built up they look upon them as histolytic particles - the evidence of disintegration of textures, not as the agents of its production - They consider as a mere hypothesis based on no satisfactory observations and opposed to the whole course of embryological & histogenetic inquiry. The doctrine, that the cell forms met with in such exudations are produced in them by any precipitation or aggregation of visible molecules. Setting out as their starting point with the proposition *omnis cellula e cellula* the originators & supporters of the latter theory say they are in a position to shew that in all the textures & organs in which the formation of the corpuscles of pus, Cancer & tubercle take place pre-existing cellular & nuclear particles occur. Mr. Turner in a very able paper read by him at a Conversation of the Royal College of Surgeons Edin. 27 Feb 1863. thus describes.

+ Verchow's Archiv. vol ~~XXI~~. p. 486.

- Cribes the formation of pus on Mucous Membranes. "When a mucous membrane inflames, not only is there a discharge generally profuse, of more or less modified mucus, from its surface but at the same time a rapid production of inflammation corpuscles occurs & a great tendency to the formation of pus exists. Whence then do these Corpuscles arise? To enter properly into the consideration of this question, it will be necessary that we should briefly direct our attention to the anatomy of the membrane itself. The general Conception entertained of its structure is, that it consists of three parts.

- 1st An extremely thin, transparent, & homogeneous membrane perfectly continuous & without any aperture or appearance of structure. This membrane was particularly described by Mr Bowman and named by him "Basement membrane".
- 2^d An Epithelium varying in its shape & thickness in different localities, and consisting of one or several layers of cells situated on the superficial or free surface of the basement membrane.
- 3^d Areolar Connective tissue, intimately related to the deeper or attached surface of the basement membrane & therefore completely separated by it from the Epithelium on the free surface. In this connective tissue the nerves blood, and lymph vessels lie.

This general conception ^{of the structure} has been extended not only to the various ducts, glands, & fossae which open on the free surface of any mucous membrane, but to the serous & synovial membranes & to the skin, altho' it is admitted that whilst the epithelial & connective tissue elements

+ *Jerchow's Archiv.* 17 vol p. 90. 1859.

elements are always capable of demonstration, yet, that the basement membrane is not at all times to be isolated. But numerous careful investigations, made of late years, into the structure of the mucous & other membranes and the skin have led many anatomists to doubt the existence of any such entire continuous, homogeneous membrane, between, & separating the epithelial & connective tissue elements as Mr Bowman described, and thus it is now believed that no sharp line of demarcation between these tissues exists. They gradually pass into each other & in some localities indeed the cell elements of the one are anatomically continuous with those of the other. Burckhardt, after many observations on the tracheal mucous membrane satisfied himself that no structureless basement membrane existed between the epithelium & subjacent connective tissue. It will therefore now be more correct to consider a mucous membrane as consisting of one or more layers of epithelial cells resting on a bed of connective tissue. Various observers have now demonstrated that when a mucous membrane inflames the corpuscles of pus may take their rise either in the interior of the epithelial cells themselves or in the corpuscles of the subjacent connective tissue. Thus they have been seen within the ciliated epithelium of the ~~of the~~ bronchial tubes & as Dr Haldane has recently described, (Edin Med Journal Nov 1862) in the epithelial cells of the trachea & bronchi in variolous inflammation of those tubes, But though pus may form in

in the interior of the Epithelial cells yet it is probable that the chief seat of its production is in the corpuscles of the sub-epithelial connective tissue; and of its origin in this tissue several observations may be adduced. Thus Burchhardt (op. cit.) has described pus-cells as arising from division of the nuclei of the sub-epithelial matrix layer of the urinary mucous membrane. Kündplisch† has seen the same changes taking place in the connective tissue of the conjunctival & bronchial mucous membranes & in these cases, as in the formation of pus in the ordinary areolar connective tissue with the increase of the pus-cells the fibrous elements of the connective tissue gradually disappears." Mr. Turner in examining the mucous membrane of the pelvis of a kidney & ureter thus describes the phenomena connected with the formation of pus in the sub-epithelial tissue of this mucous membrane, he says "The free surface of the membrane was covered with a layer of granular & molecular matter, beneath which & extending for some distance into the substance of the swollen & thickened membrane, were multitudes of small closely-crowded cells like pus or the so-called leucodation corpuscles. They were so numerous that the natural texture was completely hidden by them. Still deeper the cells diminished in numbers and arranged themselves in groups which evidently corresponded to the sites of the original corpuscles of the connective tissue. & between these groups of cells, portions of the fibrous elements of the texture

texture might be seen. But in all these deeper parts of the tissue where the cells-forms were present, & evidently, from their general aspect, most capable of undergoing development & increase. The amount of granular & visible molecular matter, both free & within the cells was comparatively small. Now, if the hypothesis of the formation of Pus or leudation corpuscles, by the aggregation of granules or visible molecules were correct, we should naturally expect to have found, in those parts of the inflamed membrane, in which the process of cell formation was to all appearance most active. By going on, the molecular & granular matter in considerable quantity. But, on the contrary, it was at a minimum in these localities, & was present in greatest amount on & next the free surface of the membrane, i.e., at the part where, from various causes, as contact with the urine, & greater separation from the sources of nutritive supply, disintegration of texture would most naturally take place. Hence I cannot but conclude, that the granules & visible molecules found in such cases are products of textural disintegration, & not agents in its formation.

The facts and arguments adduced by Mr. Turner in support of the theory that Pus on mucous membrane is formed from the preexisting textural elements, appear to me to be quite conclusive. and I am the less willing to forego this conclusion when I know, that such observers as Professor Goodsir & Nichol not only originated the theory being led to do so by

by their investigations, many years ago, into the changes which take place in diseases of the various textures of the human body, but are still its chief supporters and expounders.

It will be just as convenient here to say something of the formation of Tubercle & Cancer in Mucous Membrane for as the process of the formation of these morbid products is very similar to that of Pus, it can be very readily disposed of, and first of Tubercle which presents two principal forms viz the Miliary & foamular. & the Cheesy. between these, intermediate varieties & forms occur. of these two varieties the Miliary is the most typical. Under the microscope it presents the appearance of small, pale nucleated cells some of which are seen to have single others several nuclei. In addition to these cells-forms which are met with in the Miliary. the Cheesy form of Tubercle contains others which from their shrivelled aspect and from the fatty granules within show the commencement of degenerative changes. But how do these tubercle cells arise? It was thought at one time that they arose in an exudation or deposit from the blood poured out in the tissue, eg. the Mucous Membrane, in which they occur. but this is not now held, as the correct theory of their origin. Professor Virchow has pointed out that the connective tissue is the source from which these tubercle cells proceed & that their formation is always preceded & accompanied by changes in its corpuscles which are very similar to those

those already described in the formation of the inflammatory exudation granules or corpuscles and of Pus. By the persistence of this process in a part, a small ^{cellular} knot of Miliary tubercle is produced when formed these tubercle cells do not as a rule appear to possess much power of spontaneous growth nor do they seem capable of maintaining themselves for any length of time.

Their tendency rather is to shrivel, undergo fatty degeneration & thus produce Cheesy tubercle. In this respect they present a marked contrast to Cancer the cells of which not only grow and maintain themselves but likewise multiply by endless development. Of these let us now say a word or two.

When examined microscopically Cancer appears to consist essentially of cells & nuclei embedded in an interstitial stroma. The cells & nuclei are evidently new formations. The interstitial stroma as in Scirrhus may consist of the original texture of the part, or like the Cancer cells it may be a new formation. Now & from what source do these new formed structures arise? They arise, as in the case of pus & tubercle from changes in the textural elements - the pre-existing cells and nuclei - of the part, and do not spring up spontaneously by any process of precipitation or aggregation of granules in a structureless or granular exudation. The corpuscles of the connective tissue are actively though not exclusively engaged in the development of these new formations the cells & nuclei of other textures e.g. muscle participating also in the process

process, and this not only in one, but in the leading varieties of Cancer. Some pathologists object to the views just stated as to the mode of formation of Tubercle & Cancer, maintaining that they are the result of an inflammatory process originating in the exudation poured out in that process. but while it may be readily enough admitted that inflammation sometimes precedes the tuberculous ^{deposit}, and may even favour its formation when a predisposition exists, yet there are many cases in which not a trace of it can be detected either at the origin or in the early stage of tubercle and when it afterwards occurs there is good reason to consider it as the consequence & not the cause of the morbid product. I think a very strong argument against the inflammatory origin of Tubercle is to be found in the fact that it is least frequently found in those parts of the lungs where inflammation is most frequent viz the lower lobes or bases, whereas tubercle is almost invariably found in the upper lobes or apices of the lungs - Various opinions are put forth as to locality of the tubercular deposit in the lung Dr. Watson says "The morbid secretion is deposited principally upon the mucous surface - upon the inner lining of the air-cells & of the bronchial tubes communicating with them" Others hold that it is confined to no particular position: but is found in the vesicles, the minute bronchia, the cellular tissue between the air-cells, or in the general parenchyma of the lungs, when found on the mucous membrane of the bronchial tubes and air-cells, it may accumulate

so as to fill those cavities, or it may only line those cavities leaving a central vacant space containing mucus or other secreted fluids. and if the lung be cut across when such a state exists the divided air cells will look like rings of tubercular matter joined together and the divided bronchial tubes present the same appearance, viz that of tubercles with central depressions or soft central points. The deposit of tubercle takes place in one of two forms either that of small, isolated bodies or that of irregular infiltration into the tissues. at first hard, of a gray colour & semitransparent; by and bye a yellow spot appears at some point within the tubercular mass which gradually enlarges until the whole tubercle is converted into a yellow opaque curdy mass. The process of change continues the softness increases until at length the whole tubercle breaks down into a pus-like matter, with which are often mingled portions of the tuberculous substance in a cheesy form.

When thus mature, the tubercle excites inflammation and consequent ulceration in the surrounding tissue. The bronchial tubes are opened into and a passage^{is} thus made for the escape of its contents. The walls of the resulting cavity are sometimes lined by a kind of cyst or pyogenic membrane & sometimes not. in either case pus is secreted which is discharged by the opening into the tube and often this pus is mixed with the curdy matter. Sometimes however a healing process takes place the cavity is filled and a cicatrix only remains.

Sometimes instead of softening the tubercle undergoes another process by which the organic matter is absorbed and an earthy or chalk-like

like substance is left or deposited in its place and this may always be regarded as a favourable termination.

The mode of softening just described was supposed to be the correct one by Laennec, Louis &c. many however maintain - Andral, Sir. R. Coarswell &c - that the process of softening is produced by the infiltration of purulent or serous fluid secreted by the inflamed tissue which surrounds the tubercle. The process of softening according to these observers beginning externally and gradually proceeding toward the ^{Centre of} tubercular mass. In whatever way the softening process takes place. the result arrived at is the same viz Ulceration.

The bronchial tubes are always more or less inflamed in the advanced stages of tubercular disease and especially those which communicate with the tubercular Cavities or "omucæ" as they are termed - occasionally numerous minute ulcers may be seen in the mucous membrane of the posterior aspect of the Trachea. They are also frequently found in the larynx and here it has been observed that ulceration is found attacking the side of the larynx and ^{vocal} cord corresponding to the lung most affected by tubercle. Sometimes the epiglottis is also found attacked by ulceration. and the ulcers have been almost always found on its laryngeal surface. Dr. Watson accounts for the formation of these ulcers thus "we have strong reasons therefore for believing that their formation is influenced by the contact of the matter which is expectorated with frequent passage over the mucous membrane. Moreover, the little mucous glands wherewith the membrane is provided are

are most numerous at the posterior part of the trachea & bronchi, & these glands are especially prone to ulcerate. "When the process of ulceration commences in the mucous glands it soon spreads to the adjoining tissues. The membrane which lines the laryngeal cartilages is frequently thickened and ulcerated in Secondary Syphilis -

It may be as well to state here that the effect of inflammation on the cilia of the mucous membrane of the air passages is to arrest their movements. Purkinje & Valentin excite artificial inflammation in the mucous membrane of the nose & vagina of the rabbit. From their experiments they were led to believe that inflammation stops the movement of the cilia on mucous membranes. This will partly account for the arrest of the secretion in the tubes and the necessity for coughing to bring it up.

I shall now proceed to notice the formation of False-membrane on the mucous surfaces of the respiratory passages. more especially as seen in Croup and Diphtheria & Plastic Bronchitis. The appearance of the false membrane is in all these diseases preceded by a greater or less degree of inflammation of the mucous membrane, not so much dependent on the intensity of the disease, as on the condition of the blood, or it may be some peculiarity in the constitution of the patient. It is met with most commonly in children and Dr Stokes thinks the predominance of the white tissues in children may explain the greater frequency of Croup and its peculiar membrane. Another theory started by.

by Dr. C. B. Williams seems to me to be if not the correct one at least very plausible viz that the inflammation involves the submucous areolar tissue which is abundant during youth and that the natural product of this phlegmonous inflammation transudes readily through the thin, simple, delicate mucous membrane peculiar to that age. The false membrane in Croup consists of Coagulable lymph. some have called it a Fibro-albuminous condensation. at first it appears in points or patches which are usually whitish or of a yellowish white colour. These patches grow and spread so that at length they coalesce so as to form complete tubes within the living ones. when formed this membrane is brittle and less organized than that formed on serous membranes which is plastic, and in which blood vessels form, often remaining during life. When inflammation has passed away the membrane in Croup which is never plastic in character. & in which no traces of blood vessels are ever seen, becomes detached from the mucous membrane and is spit up in ribbon-like shreds. or whole pieces of the tubes comes away. Sometimes these false membranes are gradually thinned till they become like delicate epidermis, sometimes they are softened and become converted into a thick puriform matter or mucus and in this form are got rid of by expectoration. The false membrane in Croup varies in site, sometimes it occurs only in the larynx or Trachea. The posterior walls of the Thyroid Cartilage are often covered by the membrane. but it may occur throughout

throughout the whole course of the tubes. It is found more frequently in the larynx than in the trachea, and in both more frequently than in the bronchial tubes. There appears to be some connection between the circumstances under which children become attacked by Croup and the extent of false membrane developed in the air passages. For Dr West has remarked "that in rural districts where the disease wears throughout a sthenic character false membrane is deposited in greater abundance & over a greater extent of surface than is usually observed in the case of the poor in the metropolis."

The character of the membrane differs in different situations. In the larynx it is usually tougher and thicker than in the trachea and bronchial tubes diminishing in consistence & firmness as it passes downwards. The older it is the more firm it is. The appearance of the mucous membrane when the false membrane is removed is that of increased vascularity or congestion generally it is red & swollen about the edges of the rima glottidis. Small aphthous ulcerations are also frequent in the larynx & trachea, and occasionally the larynx on detaching the false membrane presents a worm-eaten appearance.

In Diphtheria the false membrane is primarily found deposited on the mucous membrane of the pharynx and when it attacks the larynx & trachea it does so secondarily. At first there is redness and some swelling of the parts and perhaps a little excess of mucus on them. The inflammation as in Croup is followed by an exudation of lymph, which presents.

presents the appearance of a grey or white patch on the reddened surface. There may be only one such patch seen or many. Starting from one or many centres the exudation spreads anteriorly to the soft palate & uvula. upwards it extends into the posterior nares and downwards it invades the upper surface of the epiglottis descending thence - if not arrested - to the larynx, trachea & even bronchial tubes. I saw a case in ward 18 Royal Infirmary last summer in which the patient a girl of 19. spat up the entire false membrane which consisted of a mould of the whole bronchial tree of the right side. Sometimes too the exudation has been seen to extend into the oesophagus & stomach, unlike the fever ^{which is chronic in character} in Croup, that, in Diphtheria, is adynamic. Croup is a local disease Diphtheria a general one. though it may also be said to have a local aspect whenever there exists a tendency to inflammatory deposit. what are the distinctive features of the false membrane in Diphtheria? It sometimes presents a granular appearance and very little consistence or tenacity, sometimes the part is covered with a thinner or thicker coating of a white or grey pulpy substance, so thin soft and separated from each other may be the little particles which together form the coating of lymph. that the term membrane is hardly applicable to it, for no shred of lymph can be stripped from the surface. at other times the layer of lymph is very tough elastic and even one eighth of an inch in thickness. in one instance the lymph resembles cream in appearance. in another it resembles wash leather.

pus. granular corpuscles oloprotein granules & epithelium constitute
the

the bulk of the softer forms of the so-called lymph. Such fibres as we see in the buffy coat of blood constitute the bulk of the toughest varieties of lymph. occasionally ulceration & even sloughing of a superficial layer of mucous membrane occurs. and blood, pus & semi detached pieces of lymph may form festid shreds of some size. another character by which Diphtheria may be distinguished from Croup is a peculiar festid odour of the breath which may be felt at some distance from the patient. On examining the false membrane of Diphtheria with the microscope it is found to be a fibrinous material having no corpuscular structures resembling thus a decolorized clot of blood. In the pharynx the fibres appear to have a reticulated arrangement, in the larynx they are not reticulated but straight running parallel to each other. There may on a very rare occasion be the presence of vegetable growths in Diphtheritic exudations, but Dr. Jenner who is a most accurate observer says he has never seen them and, "Consequently," ^{he says} "I feel satisfied that epiphytes have played no essential part in the cases of Diphtheria I have seen" - possibly the observers who insist on a vegetable epiphyte as being present in Diphtheritic exudation have mistaken the exudation of aphthae on the mucous membrane of the pharynx for in these the presence of the vegetable epiphytes - the *Oidium albicans* - is invariably found. -

In Plastic Bronchitis. the false membrane does not form in the larynx trachea or bronchi but in the smaller bronchial tubes Dr Watson thinks them the result of a chronic form of inflammation.

"Concrete"

"Concrete masses" He says, "evidently moulded in parts of the hollow bronchial tree are spat up somewhat like bunches of worms or the branching roots of a small plant;". In the two cases which Watson saw the persons were of middle age, and remarkably stout & healthy men. The expulsion of the false membrane in both cases was preceded by haemoptysis which ceased after the "polypi" were coughed up. They were hollow in some cases in others solid and resembled the fibrous coagula of the blood.

I have already in passing alluded to the effect of the inflammatory process on the glands & follicles of the mucous membrane. but there is a condition in which these glands are principally affected, and this has been termed "Follicular inflammation". In this condition the distinct follicles & glands being affected the membrane has the appearance of being covered by small, rounded, more or less pointed tumours, which at an advanced stage may become phlegmonous & ulcerate.

In Chronic Bronchitis the mucous membrane of the respiratory passages is thickened and indurated. sometimes it is partially softened and ulcerated. In some cases the colour of the mucous membrane is deepened being violet, deep red or brownish in very old cases there may be but little discoloration, being greyish or of a slightly reddish tinge. generally covered by a mucous-purulent secretion or it may be well formed pus. sometimes however the secretion is mucous in its character though more copious than in the normal condition of the

The membrane, the smallest bronchial tubes are not infrequently distended with the pulmonary secretion and the bronchial glands enlarged and softened. In the Catarrhe Sec of Laennec. The mucous membrane of the minute bronchial ramifications is found reddened and so much thickened as often to obstruct the tube, and when this is not the case the passages are often found blocked up by a thick tenacious mucus.

Another change found in Chronic Bronchitis is dilatation of the air tubes. This may exist in a single ramification sometimes in a branch with all its ramifications. Sometimes only in isolated portions of the tube. In some cases of dilatation of the tubes the walls of the tubes are thickened, this being very probably the result of inflammatory hypertrophy. In cases where only an isolated portion of the tube is dilated, the walls of the tube are very generally found thinned and weakened. Possibly this thinning and distension is owing to the long continued impulse of the air driven into them in severe coughing. The part of the tube which has become dilated into a cavity is generally filled with a thick tenacious straw-coloured. Mucous-purulent fluid. The continued pressure of this mucus may also serve to produce the dilatation, the muscular tissue losing its contractility under the long continued pressure, ^{the air may beneath the pressure} ~~the pressure~~ weight of the mucus in the cavity, the nerves also suffering from the same cause.

A third form of dilatation is that in which the same tube expands

expands at intervals giving a beaded appearance to the tube. Dr. Wm. J. Quindner thus accounts for these Sacculated expansions "After Bronchitis pur is sometimes found imprisoned in the central air-branches of a collapsed lobule. The coats of these tubes injured & softened by disease gradually give way and ulcerate, and the pus which accumulates is at length surrounded by a false membrane exactly similar to that of an abscess in any other part. The continuity of this membrane with that of the ministering bronchus may either exist from its first formation or be established subsequently. These bronchial abscesses at length, communicating freely with the tubes leading to them may afterwards be expanded beyond their former dimensions by the inspiratory force." As to the cause of the first kind of dilatation with Hypertrophy, in which a tube the size of a crow quill becomes expanded to a size as large as the finger of a fore. Dr. Corrigan pointed out that the tissue around the tube was in a state of atrophy ^{or collapse} and that from some previous inflammatory attack, the ^{tube} becoming thickened from the same cause. The tube being no longer supported from without expanded to the extent of the atrophied tissue around it, "by the expansive forces of inspiration", acting on the tube from within. may it not rather be supposed that the filling up of the vacuum around the tube caused by the atrophy or collapse of the lung would necessitate dilatation without any additional inspiratory force. Such a state of matters may also exist in a case of pleuro-pneumonia the air cells pressed by the effusion are sometimes unable to.

to expand sufficiently to fill the vacancy caused by the absorption of the liquid, and the deficiency is supplied by the dilatation of the bronchial tubes, those of the middle size being usually most affected.

The opposite condition to dilatation of the Bronchial tubes viz Constriction is frequently met with, and when it exists to a considerable extent gives rise to another interesting pathological condition - dilatation of the air-cells - termed Emphysema (vesicular).

Constriction of the air tubes, or narrowing of them may take place in at least four different ways

- 1st By a plug of tenacious mucus closing in part the passage
- 2^d. By congestive or inflammatory thickening of the mucous membrane
- 3^d. By plastic exudation thrown out in the sub-mucous areolar tissue and undergoing subsequent slow contraction - just as we see in stricture of the Oesophagus or Urethra.
- 4th By contraction of the involuntary muscular tissue which is disposed in a circular manner around the bronchial tubes. The first of these is mechanical. The second & third inflammatory and the last spasmodic stricture, narrowing of the tubes may also take place from pressure from without. ^{e.g.} from a tumour or enlarged bronchial gland pressing on a portion of tube, and this may partly be ^{mech-} anical.

aural and partly an inflammatory form of constriction of the tube,
 the difference between these various kinds of stricture of the
 air-tubes, can readily be made out by the stethoscope. to this
 I shall not allude at greater length because my object in this
 paper has been not to treat of physical signs, but briefly to
 describe the pathological appearances as seen in Health and
disease and shortly attempt to account for these appear-
 ances. I will however give one or two reasons to show that such
 a condition as spasmodic stricture of the air tubes exists in the
 disease termed asthma. and First the auscultatory phenomena
 differ in asthma from those observable in the air tubes constricted
 from mechanical or inflammatory causes. in all, the air tube
 may be said to be converted into a musical - wind instrument
 which at the seat of the sound will give forth a ~~loud~~ note of a high
 or low pitch according to the diameter of the tube. now the sound
 in each of these cases is much the same viz sibilus. how then
 can the sibilus occasioned by a plug of tenacious mucus be dis-
 tinguished from that occasioned by spasmodic stricture. In the
 former case the tube is relieved generally - always ultimately - by
 coughing, in the latter the sibilus is never affected by coughing.
 again, we can never dissociate inflammatory tumidity of the mu-
 cous membrane from the symptoms of existing Bronchitis & the sibilus
 arising from it is not of transient appearance & disappearance. The
 sibilus of asthma however is continually changing present at one
 moment

moment and absent the next. & in it the signs of Bronchitis are absent. The sibilus arising from the contraction of plastic exudation thrown around a tube is unvarying and inextinguishable. That from Asthma ceases with the paroxysm. What then is the cause of the phenomena seen in Asthma? I think spasmodic contraction of the annular muscular fibres explains them all. The sudden access & departure of dyspnoea & sibilus are states that may be instantaneously induced & as suddenly vanish. Independently of this evidence we have the anatomical & physiological support that dissection & experiment supply. "for we find," ^{say Dr. Carter -} "in the muscular furniture of the wall of the bronchial tubes & the nervous arrangement of the whole bronchial system. a valuable confirmation of these views both negatively & positively. for while their absence would be a sad stumbling block in the way of our conclusions from other evidence their presence supplies exactly the required machinery".

but is it not more than this? Is it not the most positive proof that could possibly be adduced. that muscular contraction of the fibre that surrounds the bronchial tubes does take place? For what is the purpose of circularly disposed if it be not to alter the diameter of the tube it invests? then the distribution of the nerves which supply the tubes. arranged in the form of a network they invest the tubes to their minutest ramifications. Besides the anatomical evidence we have the evidence obtained from experiment. ^{Dr. Williams & Dr. Williams} have clearly shewn that the bronchial tubes undergo contraction in some cases

Cases so great as to amount to complete occlusion, from the application of various stimuli both to the tubes themselves and to the trunks of the Pneumogastric nerves, this leaves nothing further to be desired in the way of evidence for the existence of bronchial spasm in asthma.

Dr. Hyde Salter & Professor Cairdner have both suggested that the circular bronchial muscles may have for their function the clearing out of the mucus from the smaller tubes by a kind of peristaltic motion, and Dr. Cairdner from this imaginary office of theirs has termed them the "scavenger muscles" of the bronchial tubes. I am not inclined to admit that the bronchial muscular fibres have any such function, and for the following reasons. No true peristaltic action can take place in a tube which has not both circular and longitudinal fibres in its structure. that has not in short such an anatomical arrangement as that seen in the stomach and intestines. longitudinal fibres are necessary to shorten the tube and thus facilitate the passage of ^{fluid or any substance} mucus along it. but no such fibres are found in the bronchial tubes, and consequently there can be no shortening of them and no true peristaltic action. the fact that they contract and narrow the tube has already been proved, but will simple contraction of a tube on its contents force those contents along much well depends on their character. ^{it} Such contraction I should think is just as likely if ~~the contents~~ ^{it} takes place simultaneously along the whole tube, to force the contents toward the air cells as toward the larger tubes, and more likely to compress

- press

-press the contents so far as they can be compressed, in situ. Should the
 action begun at the air cells & proceed inwards, it might have the ef-
 fect of forcing the mucus, ^{if normal in character & consistence} along the tube, that is, always supposing
 the first contracting fibres to remain firmly contracted till the whole
 ramification has become firmly closed. but did such contraction take
 place when mucus formed in a tube we should have dyspnoea when-
 ever a tube contracted to expel mucus. and when this process was going
 on at many points of the lungs at once. dyspnoea would always
 be great. and would it not also be constant? as the process of secretion
 is constant. and in addition to dyspnoea ought we not as a consequence
 to have ^{if not} pulmonary collapse at least vesicular emphysema as Dr. G. him-
 self has so well pointed out. Another objection to this office of the
 bronchial muscle is the nature of the contraction. ^{is} involuntary,
 or organic muscular fibre. it is slow gradual and persistent
 now I would beg to suggest that this is not the kind of action
 that would be likely to effect the expulsion of mucus even
 suppose it were not followed by the results just stated. viz
 dyspnoea followed by pulmonary collapse and vesicular
 emphysema. I am inclined to think that the office of this
 muscle is to regulate the diameter of the tube in connection with
 the admission of air to the air cells. the action of the cilia ~~and~~
^{and elasticity of the lung} the expiratory efforts in cough, being in ordinary circumstances suffi-
 cient for the removal of the mucus from the smaller bronchial
 tubes

The last subject I shall advert to is ~~the~~ Emphysema. The term given to that condition of the lung in which the air cells become dilated the partitions which separate them become broken down and several may unite to form cells of a magnitude equal to that of a hazel nut and even much larger. while the general size will be about that of millet seed. These are probably merely dilated vesicles.

The dilatation may affect only a very few cells or may occupy isolated spots as single lobules, for example, while others adjoining may remain unchanged. It may extend over a considerable portion of the anterior ^{part} of one or of both lungs. being generally found in the anterior and upper border, on opening into a chest, the lung if affected by Emphysema does not collapse, but more frequently expands more extensively if the ribs and diaphragm have been compressing it. Some have ascribed this expansion or maintenance of the expanded condition to the inelastic or rigid condition of the membrane which forms the cells, this condition being supposed to be a consequence of a kind of hypertrophy which frequently thickens the walls of distended cavities.

In consequence of the distension of the cells, the whole amount of surface over which the blood vessels can ramify is lessened, and these therefore undergo absorption. There is as a consequence of this a diminished supply of blood, and the
portions

portion of lung so affected have a whitish or pale appearance which sometimes presents a marked contrast to the ^{colour of} healthy parts. It sometimes the surface of the lung presents a pearly appearance patches of it looking as if it had been bleached. The lung when in this condition is drier than in normal state and when a piece of it is cut off and thrown into water it floats on the water not in it.

There is another form of Emphysema termed Interlobular in which the areolar tissue in and around the lung is infiltrated with air which is in reality true Emphysema but as this has no connection with the respiratory passages except in that it may receive the inflating medium from them. I shall say nothing farther about it.

Numerous theories have been advanced to account for Vesicular Emphysema. Laennec supposed that the fine bronchial tubes became rigid and more or less impervious from swelling of their lining or mucous membrane and impaction of mucus. He supposed that inspiration was more powerful than expiration so that while air might be drawn through the narrowed and obstructed tubes, it could not again be breathed out. The result of this was that the air accumulated in the ultimate pulmonary lobules & air cells. The stagnant air obeying the law of rarefaction expanded and so acted mechanically as a dilator distending the air cells. & in proportion to the length of the disease

disease, and strength of the respiratory efforts in this way establishing Emphysema.

Dr Wm J. Garver, in a paper published in the Monthly Journal 1850. 1, shewed that Expiration was a more powerful act than Inspiration, for he observed that in all cases of Bronchitisⁱⁿ which the breathing became embarrassed, the effort of inspiration was a much more laborious one than expiration, & that there is never much difficulty in expelling the air in such cases. It is the act of Inspiration therefore that is laborious in all cases of Bronchitis &c., and when the tubes are obstructed the air-cells instead of being dilated are in fact obstructed & collapsed. Dr G. shewed that Emphysema was not to be found where the bronchial tubes were obstructed, but in those parts of the lungs where the air tubes are healthy and patent, and adjoin those that are obstructed, when the lungs are in their normal healthy state the column of air distends all the tubes and air-cells equally, but when one portion of lung connected with an obstructed tube, is collapsed or diminished in size in any way then the adjoining patent portion is enlarged to an extent corresponding to the diminution of the bulk of the lung caused by the occlusion of the tube, and occupies the vacant space. It will be seen from this that anything that ~~tends to~~ occludes a tube will produce Emphysema. Therefore Emphysema is the result of Chronic Bronchitis Asthma & any other disease that causes the obliteration or occlusion of a bronchial tube. Still later another theory for the production of Emphysema has been advanced by Dr Wm Jenner of London, which may be termed the Respiratory theory. The

The following is a short resumé of the arguments adduced by him in support of the theory that Emphysema is caused by the expiratory force.

That the lung at different parts during expiration is compressed with different degrees of force. That in consequence of their anatomical constitution the parietes of the Thorax yield to the same force at different points with a degree of facility proportioned to their elasticity at that point.

That Emphysema is found at those points of the lungs which are least compressed during expiration and least affected by inspiration, viz the anterior margins, these being seated under those portions of the Thoracic parietes that give way the most readily before pressure.

That the power possessed by man of dilating the apex of the lung by the inspiratory effort is insufficient to distend the air-cells to the degree to which they are often found distended in Emphysema of the apex. Besides it can be proved acurately that the air cells at the apex are distended and that very considerably too during expiration. For in the violent expiratory efforts in Coughing the Supra clavicular region corresponding to the apex of the lung is found to be elevated & resonant on percussion. The upper part of the sternum advances the intercostal spaces bulge out with each expiratory succussion.

When an impediment exists to the entrance of air into the lungs. eg. as in Croup, Hooping Cough &c the parietes of the chest which overlie the parts of the lung found emphysematous after death recede during inspiration & advance during expiration. & this recession & advance is proportioned to the violence of the inspiratory & expiratory efforts.

When the air cells of the apex are partly obliterated by the deposit of Calcified
or.

"obsolescent tubercle, lymph being effused around and into all the tissues of the apex it is found that the dilatation of the unobliterated cells attains its maximum when the air is driven into them by violent expiration & that under the same conditions & in the same situation the inspiratory force is quite insufficient to cause dilatation of the air cells.

The air moved by the inspiratory effort can exercise but little pressure on the inner surface of the air-cells situated at the extreme margin of the base, the root of the lower lobe - i.e. that part immediately next the spine & below the primary bronchus - or at the part of the apex situated in the furrow posterior to the trachea on the right side. While violent expiration being chiefly performed or greatly aided by the abdominal muscles forcing upwards the liver &c drives the air (in consequence of the highly arched form of the diaphragm in violent expiration) from the central part of the lung, not only thro' the bronchi towards the larynx, but also towards the circumference of the lungs i.e. towards those parts which are least compressed during expiration.

In the parts just named dilatation of the air cells is very common and the dilated cells are of large size - while complete obstruction of a bronchial tube is followed by collapse of the lung on the distal side of that tube: partial closure of a tube has as its consequence dilatation of some of the air-cells of the part of the lung from which it leads, provided that part be unequally supported and compressed during expiration - and finally Vesicular Emphysema is the invariable and necessary consequence of whatever impedes the free exit of air from the lungs
and

and at the same time excites powerful expiratory efforts: because by such efforts the air is driven from the more powerfully compressed parts of the lungs into those parts which are less powerfully compressed and the walls over which yield more or less readily to pressure.

Dr. Bennett who is disposed to adopt Dr. Jenner's view mentioned the case of a foreigner, De Groux who exhibited his chest in the various medical schools of this country a few years ago. A vacancy existed ~~on~~ ^{by this man} the thoracic parietes, near the lower part of the sternum, and it was remarked that when this man made any violent expiratory efforts for example in coughing the lung projected through the space alluded to, shewing that the expiratory effort in coughing has a more powerful influence in expanding the air cells at the periphery of the lung than the act of inspiration however violent can have. I am inclined to believe that Emphysema may have its origin both in the way described by Dr. Gaillardet and in that propounded by Dr. Jenner.

There are one or two other ^{discuss} conditions of the respiratory passages of which I might have said a few things e.g. Polypi growing from the mucous membrane of the posterior nares and upper turbinated bones. and warts which are sometimes found in the larynx and attached to the vocal cords. The former when simple are hypertrophies of the mucous membrane

brane. the latter, excrescences or outgrowths from the parts
 to which they are found attached, ^{e.g. vocal cords} just last week Professor
 Syme removed from the upper part of the larynx a pedun-
 culated tumour of malignant character. the patient a
 man about 60 feeling greatly relieved by the operation.
 This was a ~~primary~~ case of primary Cancer invading the
the respiratory passages which is a very rare lesion.