

On vesicular emphysema of the lungs in early childhood : its origin, causes, and pathological importance, &c.; / by Graily Hewitt.

Contributors

Hewitt, Graily, 1828-1893.
Royal College of Surgeons of England

Publication/Creation

Liverpool : Printed by W. Fearnall, 1858.

Persistent URL

<https://wellcomecollection.org/works/taxd8k3s>

Provider

Royal College of Surgeons

License and attribution

This material has been provided by This material has been provided by The Royal College of Surgeons of England. The original may be consulted at The Royal College of Surgeons of England. where the originals may be consulted. This work has been identified as being free of known restrictions under copyright law, including all related and neighbouring rights and is being made available under the Creative Commons, Public Domain Mark.

You can copy, modify, distribute and perform the work, even for commercial purposes, without asking permission.



Wellcome Collection
183 Euston Road
London NW1 2BE UK
T +44 (0)20 7611 8722
E library@wellcomecollection.org
<https://wellcomecollection.org>

ON

Museum

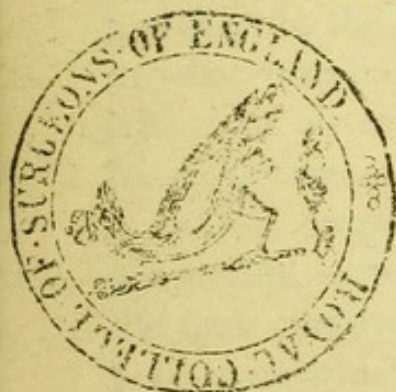
VESICULAR EMPHYSEMA
OF
THE LUNGS IN EARLY CHILDHOOD;

ITS ORIGIN, CAUSES, AND PATHOLOGICAL IMPORTANCE, &c.

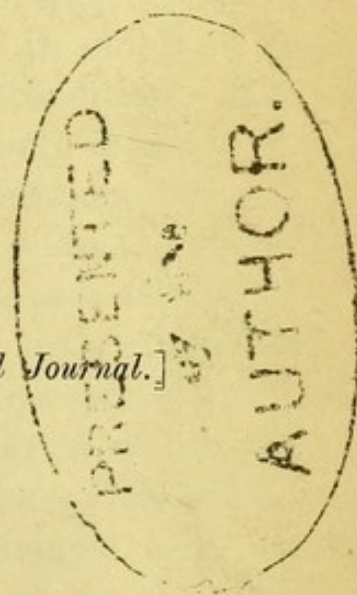
BY GRAILY HEWITT, M.D. LOND., L.R.C.P.,

PHYSICIAN TO THE SAMARITAN FREE HOSPITAL FOR WOMEN AND CHILDREN;

LECTURER ON COMPARATIVE ANATOMY AT ST. MARY'S HOSPITAL MEDICAL
SCHOOL, ETC.



[*Reprinted from the Liverpool Medico-Chirurgical Journal.*]



LIVERPOOL:

PRINTED BY W. FEARNALL & CO., 1, CHURCH LANE, CHURCH STREET.

1858.

VEGETABLE PHYSICS

THEORY OF THE PLANT
AND THE SOIL

THE PLANT IN RELATION TO THE SOIL

THE PLANT IN RELATION TO THE SOIL
AND THE SOIL IN RELATION TO THE PLANT

THE PLANT IN RELATION TO THE SOIL
AND THE SOIL IN RELATION TO THE PLANT

THE PLANT IN RELATION TO THE SOIL
AND THE SOIL IN RELATION TO THE PLANT

THE PLANT IN RELATION TO THE SOIL
AND THE SOIL IN RELATION TO THE PLANT

THE PLANT IN RELATION TO THE SOIL
AND THE SOIL IN RELATION TO THE PLANT

THE PLANT IN RELATION TO THE SOIL
AND THE SOIL IN RELATION TO THE PLANT

THE PLANT IN RELATION TO THE SOIL
AND THE SOIL IN RELATION TO THE PLANT

THE PLANT IN RELATION TO THE SOIL
AND THE SOIL IN RELATION TO THE PLANT

THE PLANT IN RELATION TO THE SOIL
AND THE SOIL IN RELATION TO THE PLANT

VESICULAR EMPHYSEMA OF THE LUNGS IN EARLY CHILDHOOD ;

ITS ORIGIN, CAUSES, AND PATHOLOGICAL IMPORTANCE, &c.

BY GRAILY HEWITT, M.D. LOND., L.R.C.P.,

PHYSICIAN TO THE SAMARITAN FREE HOSPITAL FOR WOMEN AND CHILDREN ;
LECTURER ON COMPARATIVE ANATOMY AT ST. MARY'S HOSPITAL MEDICAL
SCHOOL, ETC.

Vesicular Emphysema of the Lungs, as occurring in the adult, has received a large share of the attention of pathologists, and whatever may be said of our knowledge respecting the mode of its production and of its origin, we are at all events well acquainted with many of its effects, and in possession of means enabling us to recognise its presence. Not so, however, in the case of children. Emphysema is chiefly known in what may be termed its mature state, or last stage,—that in which the air cells have attained a large size. In children we have the disease presented to us in its earliest condition,—that in which, consequently, it is most advantageous to study it. No morbid lesion of the lungs is indeed more common in early life than emphysema ; a fact which, for many reasons, deserves to be more widely known than appears to be the case at present. The reason that emphysema in childhood is so little alluded to by authors, and so little practically taken into consideration by practitioners, would seem to be, that at this period of life, the enlargement presented by the air cells is, comparatively speaking, not great in degree, so far as the individual cells are concerned ; and that, unless their size be specially regarded, the slight enlargement is liable to escape observation after death.

That emphysema of the lungs most undoubtedly plays a very important part in most of the diseases of the respiratory organs in children, that it adds no little to the difficulties encountered by both patient and physician in combating and overcoming their exceedingly fatal tendency, and, that it has probably no small influence in hastening the fatal event in some diseases, in which its existence is hardly suspected,—these are circumstances to which I desire to call particular attention. In cases where recovery from these affections takes place, the lungs are often left permanently injured. The adult, tormented by chronic bronchitis and emphysema, is not rarely found, on enquiry, to have been the subject of respiratory anomalies of various kinds from an early period of life; the disease of which he was supposed to have been cured when in the nurse's arms has left behind it a malady which, slowly developing and increasing with advancing years, has by impairing, though perhaps slightly, the physical activity of the individual, exercised no slight influence on the whole tone of his life and character, and paved the way to other and serious organic diseases.

I propose, in the first place, to discuss the question of the origin, causes, and pathological importance of emphysema of the lungs in early childhood; and in the second place, to offer a few practical remarks on the diagnosis of this lesion, and the treatment called for in cases where its existence is to be presumed.

The human lung may be considered to be the most highly developed form of that kind of respiratory organ. The perfection of the human lung as a respiratory organ is evinced in the minuteness of the cavities into which the air is received, and which thus afford the greatest possible amount of surface for the respiratory change between the blood and the external atmosphere; anything, therefore, which increases the size of the air vesicles, the bulk of the whole lung remaining the same, materially diminishes the amount of surface exposed to the air. A vesicle twice the natural size, is less effective than two vesicles which have not undergone any increase in their diameters, and hence, a particular lobule, although occupying the usual space in the thorax, will, if affected by emphysema,

have its physiological action proportionately lessened. It is obvious that, if large portions of the lungs present emphysematous air cells, these cavities being only slightly increased in size, the effect is the same as if emphysema, *greater in degree*, affected the lungs to a *less extent*.

Now, the notable point with reference to emphysema of the lungs in childhood is, that this lesion is often spread over *large portions of the lungs*, the size of the individual air cells affected being only increased to a slight extent; or, to put the same fact in other words—large portions of the lungs are *slightly* emphysematous.

The essence of the change characterised as vesicular emphysema is enlargement of the air cells. In the natural state of things these little cavities undergo some little change in size during the acts of inspiration and expiration. This, however, affects the whole of the air cells equally, no obstacle to the free entry of air at all points existing. The air cells of the child's lung, are, even to the naked eye, very obvious on the surface beneath the pleura, there being less colouring matter deposited in the lung tissue than is the case in the adult, and their outlines being for that reason more distinct; and this, notwithstanding the fact, that, as most authorities agree, the air cells are actually smaller in the lung of the child than of the adult. Weber, Carpenter and Kölliker state that the air cells of the human lung have a diameter of $\frac{1}{200}$ to $\frac{1}{70}$ of an inch: Moleschott gives a less measurement— $\frac{1}{120}$ to $\frac{1}{1200}$ of an inch.

It is difficult to state what is the minimum amount of increase in the diameter of these cells, which shall be said to constitute emphysema. Air cells in the child's lungs having a diameter of $\frac{1}{50}$ of an inch are certainly morbidly enlarged, and may therefore be called emphysematous, but it may be reasonably supposed that air cells may be truly emphysematous, although having a much less diameter than that just indicated. If large portions of the lungs exhibit, however, this degree of emphysema, the effect produced in the character of the respiration will be very marked.

This degree of enlargement of the air cells ($\frac{1}{50}$ of an inch), is very frequently met with in early childhood; is, indeed, rarely absent in cases where the fatal result has been preceded

by disease of the respiratory organs. But it is not so common to meet with a degree of enlargement greatly exceeding that now mentioned. Almost the whole of a lobe may present emphysema of this degree of intensity; but those cases in which air cells are here and there found of a much larger size are very rare, and altogether exceptional.

In a large number of cases of emphysema in children, between the ages of three months and three years, and in a less number a few years older, careful post-mortem examinations have enabled me to express myself with some degree of positiveness as to the portions of the lobes most liable to be affected with emphysema—its geographical distribution, in fact.

All parts of the lungs may present emphysematous patches, but it is far more common to meet with them at some parts than at others. The surface of the upper lobes of both lungs are very liable to be affected with emphysema, and especially the anterior portions of this surface, (excluding the languette.) In several cases I have found nearly the whole of the upper lobe (superficially at least), so affected, the surface presenting an unusually white colour, and the air cells uniformly, but slightly enlarged; but the air cells of the portion of the lobe above the first rib I do not find anywhere in my notes stated as exclusively, or even, compared with other parts, markedly affected with the enlargement. With reference to the upper lobe, it is interesting to remark (and this is especially the case on the left side), that the languette or anterior prolongation is in cases of marked emphysema of the upper lobe usually the seat of the pulmonary lesion, known as pulmonary collapse or apneumotosis.*

The surfaces of the lower lobe also frequently present patches of emphysema of variable size; the individual air cells are also unequally enlarged. The borders or margins of the lobes were rarely observed to be affected in the numerous cases which came under my notice. There is one particular spot, the centre of the diaphragmatic or under surface of the lower lobe, which is, according to my experience, remarkably subject to

* The term apneumotosis is here used to designate that affection of the lungs so common in children, formerly known as *lobular pneumonia*, an affection differing from true pneumonia in all essential particulars.

emphysematous enlargement in the lungs of children the subjects of apneumatosiis. Here, over an area of one to three inches in diameter, the lobules are seen to stand out from the surface, contrasting in a most decided manner with the collapsed lung tissue, forming the margin of this surface. The observation I regard as especially interesting, in relation to the theory of the production of emphysema at this period of life, and it will be again alluded to further on.

The chief generalisation which the facts in my possession warrant me in making is, that although no part of the lung surface seems absolutely free from the liability to be affected with emphysema, yet, that it is rare to meet with it in its primary and simplest form at the extreme borders of the lobes; at those parts, in fact, which are the most distant from the bronchi. These latter situations are, indeed, in children, the particular seat of apneumatosiis, a condition which is in its nature, the very opposite of emphysema.

The most usual form in which emphysema occurs in the lungs of children is the following:—Slightly elevated whitish patches or islets are seen scattered over the surface of the lobes, abruptly separated from the adjacent lobules, which are either healthy or affected with apneumatosiis, and the air cells themselves variously enlarged; this intermixture of emphysema and apneumatosiis gives the surface of the lung an uneven, pitted appearance—very characteristic. The emphysema is not often confined to one lobe. To the casual observer, the more evident pathological change in by far the majority of these cases of emphysema, a pathological change with which the emphysema appears to be inseparably connected, is the collapse of certain of the lobules of the lung, produced by withdrawal of the gaseous contents of the air vesicles. So intimate indeed is the connection between the two lesions,—emphysema and apneumatosiis—that a description of the one necessarily includes a reference to the other. I have never seen apneumatosiis unaccompanied by emphysema, and if large portions of the surface of the lobe present the one lesion, it is the rule that adjacent portions of the surface are affected with the other. Solidification of the lung tissue, due to the presence of tubercle or true pneumonic inflammation, appears, though in a

less degree and less constantly than is the case with apneumosis, to entail with it an emphysematous change in the vesicles of neighbouring lobules.

It has been already remarked, that the individual air cells are not found greatly enlarged in size. The average measurement observed was about $\frac{1}{50}$ of an inch in diameter, this being about twice the diameter of the healthy air cells—according, at least, to the standard I have been induced to adopt; instances were not rare, in which the enlargement reached $\frac{1}{20}$ or even $\frac{1}{10}$ of an inch; but in these cases, only two or three cells out of a series of ten or twenty presented emphysema in this degree.

I have not, in the particular class of cases forming the subject of this paper, ascertained the existence of fat globules in the walls of the emphysematous air cells, as pointed out by Mr. Rainey in the emphysema of adults; and I am very much disposed to regard the degenerative action of which, when present, they are the evidence, as secondary rather than antecedent to the emphysema in the cases in which they are observed; or, at all events, to deny that the degenerative action plays any considerable part in the production of the other lesion. In the normal state of the lungs, however, may be found a condition, which in part accounts for the liability of children to emphysema. As Dr. West remarks, “the delicate structure of the lungs in early life, seems to be the cause why the pulmonary vesicles so easily become dilated during the violent inspiratory efforts by which the child endeavours to make up for the derangement of a part of that machinery, by which the vital changes in the blood are effected.”

I proceed next to consider the *mechanism of the production of emphysema*, a question highly important in a practical point of view.

Emphysema, as already remarked, has been chiefly studied in the adult, and under circumstances somewhat different from those present in early life. The essence of Laennec's theory of the production of emphysema, was that the expiratory effort was not sufficient to overcome the resistance offered by mucous secretion in the bronchi in cases of long continued dry catarrh; that the air thus imprisoned was driven forcibly

against the walls of the air cells of the part, and that their distension was thus effected. This explanation was, in part, based on the supposition that the expiratory effort was naturally weaker than the inspiratory, a supposition which the researches of Hutchinson have disproved: the expiratory effort is, indeed, considerably more powerful than the other.

Dr. Gairdner, of Edinburgh,* first demonstrated the truth of a theory, obscurely perhaps, indicated by some previous writer, which, in contradistinction to that of Laennec's has been called the *inspiratory* theory of the production of emphysema. The theory in question, though founded chiefly on observation of the disease in adults, is abundantly borne out by examination of the disease in childhood, and under circumstances more favourable for drawing a correct conclusion. Dr. Gairdner sums up the remarks made by him in his interesting and valuable papers, in these words—"Emphysema is a secondary mechanical lesion, dependent on some condition of the respiratory organs, leading to partially diminished bulk of the pulmonary tissue, and consequently disturbing the balance of air in inspiration."

Emphysema is thus a complementary lesion; the bulk of the lung is diminished, owing to the collapse of certain lobules, or other causes, and the lobules to which air passes as usual, enlarge, to fill the vacuum in the thorax which would otherwise be created. Respiration is a mechanical act; when the distension of the thorax takes place the air rushes in, and most readily at those points offering least resistance. Bronchitis, an exceedingly common affection in young children, is characterised by the secretion of mucus, by tumefaction of the bronchial mucous membrane, and the difficulty experienced by the patient in overcoming the resistance offered by the secretion in the tubes, combined with the want of solidity of the framework of the thorax, and the weakness of the inspiratory effort, at this period of life, result in the production of collapse or apneumotosis, formerly known as lobular pneumonia. In the second stage of apneumotosis, the lobules affected with it become smaller, and the volume of

* On the pathological state of the lung connected with bronchitis and bronchial obstruction.—Ed. Month. Journ., 1850-51.

the lung is correspondingly diminished. At first, there appears to me every reason for believing that little diminution in bulk takes place, increased congestion of the vessels of the lobule occurring; but as this subsides, the conditions necessary for the production of emphysema are found present.* No other theory than that of Dr. Gairdner's, appears at all adequate to explain the appearances presented in the lungs of children dying of bronchitis, with emphysema and apneumatoses. The two lesions always appear together; they moreover bear a constant relation to one another, a relation not to be accounted for in any other way than by supposing that the emphysema is a compensating enlargement of certain air cells. In the words of Lebert,—“Qu'on en tire la conclusion théorique que l'on voudra, il n'est pas moins certain que ces faits viennent à l'appui de la coïncidence signalée par Gairdner, de la dilatation d'un certain nombre de vésicules en même temps que d'autres restent affaissées, fait que nous parait irrécusable.”†

Fauvel, in his well-known essay, “*Recherches sur la bronchite capillaire, &c., chez les enfants,*” Paris, 1840, advanced a peculiar theory of the production of emphysema, in conjunction with bronchitis, in children, to which it is necessary here to allude. Fauvel appears to take it for granted that the emphysema is chiefly observed in such cases at the borders of the lobes and the apices of the lungs. This supposed peculiarity of position, Fauvel explains in the following words:—“Mais pourquoi la dilatation s'opérait-elle seulement dans certaines parties du poulmon où l'obstruction des bronches était quelquefois moins prononcée qu'ailleurs? La raison la plus simple de ce fait me parait celle ci, savoir; que les cellules du poulmon se dilatent dans les points où elles éprouvent le moins de résistance. Ne sont-ce pas, en effet, d'abord les parties les plus superficielles de l'organe que l'on rencontre le plus communément dilatées, et ne sont-ce pas elles aussi que supportent, en définitive, l'effort de la distension? N'est ce pas au sommet du poulmon, n'est-ce pas aux bords

* This coincides with observation. Apneumatic patches, which are congested, are not surrounded by emphysema so great in degree as those in which the congestion has passed away; in the latter case, the emphysema, at first slight, becomes afterwards greatly intensified.

† *Traité d'Anatomie Pathologique, Art. Emphysème, p. 631.*

tranchants, que l'on observe le plus communément l'emphyseme? n'est-ce pas aussi précisément au sommet du thorax, et au niveau des angles rentrants où s'insinuent les bords tranchants du poumon, que les parois de la cavité offrent la résistance la moins énergique? C'est surtout au-dessus de la première côté que cela est bien remarquable; et à coup sûr le diaphragme offre un point d'appui beaucoup plus solide." (p. 65, loc. cit.) In a paragraph preceding this, he states, that the compression of the air by which the distension of the air-cells is effected, occurs during inspiration, (Laennec's view,) but still more "energetically" in attacks of coughing, and in consequence of this the pulmonary vesicles constantly distended with air, are subjected to a force which tends to rupture or to dilate them. It is evident, from these quotations, that Fauvel attached great importance to the compression of the column of air between the glottis and the pulmonary vesicles, produced by the expiratory effort in the act of coughing.

It is necessary, in the first place, to remark, in criticizing the theory in question, that I have not found emphysema in children, so confined to the parts above the first rib, or to the margin of the lobes, as it is represented by Fauvel.*

In many of the cases observed by myself, the emphysema pervaded a great part of the upper lobe of one or both lungs; and although the extreme apex, or part above the first rib, was implicated, yet it was not more affected than portions of the surface below the first rib. Here, knowledge of the true nature of the case conclusively shews the insufficiency, or at all events the non-universality, of the explanation given by Fauvel; for on that explanation, the emphysema ought not to be observed below the first rib; it should be marked off there by a distinct line from the unaltered lung surface, more properly *within* the thorax. The seat of the emphysema in the other lobes, in the cases which I have had opportunities for examining, was again, not at the margins of the lobes exclusively or even extensively; the margins of the lobes are, on the other hand, the favourite *habitat* of the opposite kind of lesion—apneumotosis.

* It is necessary to bear in mind, that the cases from which Fauvel drew his conclusions were very few in number, (eight only,) the respective ages of the patients being two, three, four, four, eight, eleven, eleven, and eleven years.

Lastly, in reference to the supposed want of support for the apex of the lung, Dr. Sibson, who has made the anatomy of the thorax his especial study, recently declared his opinion to be against the existence of such deficiency.

I have been induced to give a degree of prominence greater than it appears to deserve to the theory enunciated by Fauvel, inasmuch as it has been recently reproduced by Dr. Jenner.

Dr. Jenner believes that the lobules affected with emphysema, are most generally found at the extreme apices of the lungs, at the anterior margins, and at the margins at the bases of the lungs. "The lung is at these situations," says Dr. Jenner, "less firmly covered than at other parts by the thoracic framework, and will thus more readily give way to the pressure of air from without than at other situations." The conditions necessary for the production of this pressure, Dr. Jenner finds in forcible acts of expiration, as in coughing with the glottis closed.†

The critical observations just made with reference to the theory of Fauvel, of course apply to the explanation offered by Dr. Jenner, the data assumed and the reasoning thereon, being remarkably identical in the two cases. Dr. Jenner does not, it must be remarked, deny that Gairdner's theory may afford a better explanation of the occurrence of emphysema in certain cases than that advocated by himself. It appears to me that the weight of evidence derived from careful observation is against the explanation offered by Fauvel, and now more recently by Dr. Jenner; and as applied to the explanation of the production of emphysema in childhood, that Gairdner's theory offers the true solution of the problem of the mechanism of the emphysematous distention of the air cells. But I am quite ready to admit, that once produced emphysema may be intensified, perpetuated, and increased, in the manner indicated by Fauvel during violent expiratory efforts. With this

* "On the determining causes of vesicular emphysema of the lungs." *Medico-Chirurgical Transactions*, Vol. xl.

† "The consequence of this want of support and of compression of the parts of the lung last enumerated, is that they like the apex and anterior margin, are the chosen seats of emphysema; the air contained in the parts of the lung most powerfully compressed during expiration with a closed glottis, being forced in undue quantities into such parts of the lung as are less compressed and less perfectly supported." *Loc. cit.* p. 31.

addition, the theory of Gairdner would seem to satisfy, more completely than any other, known conditions.

The theory here supported makes emphysema altogether a secondary lesion, dependent on certain pathological conditions of the lung substance. Whatever reduces the bulk of the lung at any one point, as a secondary consequence produces emphysema. Keeping this principle in view, it is easy to explain the appearances presented to us in the lungs of young children dying of lung affections. It will be profitable to consider in the next place the comparative frequency with which the various bronchitic and other affections incidental to young children become complicated by emphysema, and to assign to the latter condition its due importance as the pathological cause of many of the symptoms observable during life.

Amongst the first (chronologically speaking) of the affections of the lungs to which infants are liable, and which are concerned in the production of emphysema, is atelectasis, or non-aeration of certain pulmonary lobules after birth. Children in whom large portions of the lungs do not expand after birth rarely survive many days; but when a less degree of the disease is present, life may be prolonged for a variable period. In this latter class of cases when death takes place, emphysema is always found. Under these circumstances, however, the enlargement of the air cells is not so great in degree as that produced by other pathological conditions, the walls of the thorax are less resistant than at a later period of childhood, and more readily adapt themselves to the shape and size of the lung. In cases which ultimately recover, the lung often remains permanently injured; the portions of lung at first healthy, and subsequently unduly distended, owing to the presence of atelectasis do not regain their natural dimension, and the child is left to breathe habitually under disadvantageous circumstances, its *respiratory surface* having been diminished in extent. The puny child grows into the stunted adult, the developmental energy of the various organs being thus early impaired and weakened. It is a question whether nature is capable of remedying the deficiency in the extent of respiratory surface, by producing new air cells in the interstices of the old ones. A certain lobule, we will suppose, never expands, is atelectatic from birth. Pathology

teaches us that this lobule diminishes in bulk, and is probably absorbed. The surrounding lung tissue which at birth was normally expanded, takes the place in the thorax of the non-expanded lobule. It appears probable, judging from pathological data, that the space is filled up by the abnormal expansion of the air cells already existing, rather than that there is a new creation of air cells. The reason that emphysema produced by atelectasis is slight in degree is, that the shape and size of the thorax, is from the first regulated by the degree of expansion of the lung tissue.

During the first two years of infant life bronchitic affections are exceedingly frequent, and assume an importance which can hardly be exaggerated. Why do these diseases so frequently kill? How is it that the mortality from these affections is of a degree absolutely startling to those accustomed to deal with the statistics of infantile disease? These questions must be interesting to all. There are few diseases which suddenly, and by the production of one lesion alone, bring about a fatal result. The more common circumstance is, that the primary affection produces a second, the second a third, and so on.

Nature interposes, sometimes effectually, and the exaggerated functional activity of one part of an organ is made to compensate for the diminished or arrested activity of another. This compensation, successful for the moment in affording relief, has, however, often the effect of deteriorating the previously sound and healthy, and otherwise unaffected portion of the organ attacked.

Now the series of changes found in the lungs of children dying from bronchitic affections illustrate in a very forcible and apposite manner the truth of the generalisation here enunciated. The first effect of bronchitis or catarrh in an infant is obstruction to the entry of air. This obstruction increasing, certain portions of the lung become apneumatic, return to the quasi-fœtal state, as in the case of atelectasis just alluded to, but in a greater degree; the adjoining healthy lobules take on a compensating action, but by so doing, themselves become diseased, in fact, emphysematous. The act of inspiration forces the lungs to fill out the cavity of the thorax, but there being an impediment to the entry of air in the bronchi leading to the

apneumatic lobules, it naturally finds its way into those not so obstructed. The emphysema thus produced is often extreme as regards the amount of lung surface implicated, but, as before remarked, not extraordinary in degree. The peculiar character of the dyspnœa of young children suffering from bronchitis, is to be explained in great part by an attentive consideration of the altered size and relation of the air cells here alluded to. Observe an infant who has for a few days been the subject of bronchitis. The upper part of the thorax hardly moves at all during inspiration; the lower part of the thorax below the nipple, at the same time, will be seen to be actually retracted: one part of the lung receives no air at all, another (more commonly the upper lobe, or a portion of it) receives air, but a less quantity than usual, owing to the emphysematous condition there existing.

The dyspnœa presented by children labouring under bronchitis, in a very considerable portion of cases depends on three conditions, firstly, the presence of apneumatosiis; secondly, on the presence of a large amount of secretion in the air passages; and thirdly, on the existence of emphysema. How much of the dyspnœa is due to the latter condition, can, of course, be only approximately ascertained, but its amount is certainly not inconsiderable. In cases of the kind alluded to, the collapsed lung is useless; and large portions of the remainder of the lung substance are functionally less active (more active in one sense), than they should be; the distress and difficulty of respiration are thus increased. Emphysema has another effect, which I have elsewhere before alluded to; it prevents, or tends to prevent, the entry of air into lobules which have become apneumatic. The rationale of this will be readily admitted; the efforts of the patient have succeeded in filling the void in the thorax, created by collapse of certain lobules, but only at the expense of certain others—the collapse has given rise to emphysema. If emphysema were a condition easily cured and removed, there would be no difficulty in the re-admission of air into collapsed lobules—no difficulty, at least, produced by the emphysema. It is not, however, consistent with experience or pathological data (though it must be confessed that these latter are sufficiently few in number), to admit that the emphy-

sematous state of the air vesicles is one which readily passes away. On the contrary, it appears to be a condition generally perpetuated, and rarely altogether remedied. It is thus easy to see how emphysema may prevent recovery from apneumatosiis. The converse of this proposition, that apneumatosiis tends to perpetuate emphysema, may be supported on the same grounds. In those bronchitic diseases in which the inspiratory efforts are most forcible, of which whooping-cough is an instance in point, a large number of air-cells often remain affected with emphysema; and this is a disease in which, *par excellence*, apneumatosiis is observed. If space permitted, abundant evidence might be furnished from facts observed, of the relation between the two pathological conditions, emphysema and apneumatosiis, here alluded to; and of the relation of the two conditions together, to the degree and kind of dyspnœa met with during life.

Clinically speaking, the emphysema, secondary to apneumatosiis, is more important than that produced by any other cause in infants and young children. The other pathological conditions capable of giving rise to emphysema, (and there are many,) fall far short of this one in respect of the importance, which is to be attributed to them.

The effect of the act of coughing, according to Fauvel and Jenner, is to produce distension of the air-cells and emphysema; and it must be admitted that, in those cases in which the cough is most frequent and sustained, the emphysema is also frequently very marked; but it must be remembered that the cough is an index of the power with which inspiration is exercised, as well as a measure of the force of expiration. The act of coughing is never forcible, unless the act of inspiration which precedes it has been forcible also; weak inspiration, on the other hand, is followed by a weak and feeble cough, and the argument then, that the emphysema is due to the cough, and is in direct proportion to its violence, may be equally and more plausibly used to support the other theory, that the inspiratory efforts are the chief determining cause of the emphysema. That the emphysema may be increased and intensified in the former manner, I am indeed, as I have before stated, far from denying.

The relation of chronic bronchitis to emphysema in childhood, requires a few observations. Emphysema and a liability to attacks of bronchitis co-exist in childhood, as well as in adult age; it appears probable that the former condition is related to the bronchitis in two ways. The existence of emphysema increases the tendency to, and certainly aggravates the severity of attacks of bronchitis; it is also itself increased, intensified, and perpetuated by the attacks in question. The emphysema lessens the mobility of the thoracic walls; there is less power of expelling completely the contents of the air-cells and consequently a greater tendency to the accumulation of the secretions of the mucous membrane of the bronchi. Successive attacks of bronchitis increase the emphysema, and the respiratory surface is more and more encroached upon. The constant liability of the subjects of emphysema to a short dry cough, is to be considered as a sign of the difficulty experienced by the patient in getting rid of the mucous secretions of the tubes in the usual way, as well as of the presence of secretion in abnormal quantity.

The secondary effects of emphysema, as dilatation of the heart, dropsies, &c., are rarely observable in childhood, the disease with which it is accompanied destroying the patient before there has been time for these effects to develop themselves. There are other effects, however, produced by emphysema, which only require to be looked for to be at once recognised. Emphysema, if at all considerable in amount, interferes very materially with the passage of the blood through the lungs and heart. Ecchymoses beneath the pleural surface of the lung, are frequently witnessed in cases where the lungs are affected with emphysema and apneumatoxis, both of which lesions have a like tendency to produce congestion of the respiratory organs. The congestion at first confined to the pulmonary circulation, extends soon to the vessels of the brain, vessels peculiarly liable in childhood to become distended with blood. Now, it is a remarkable circumstance, that, while in whooping-cough, congestion in the brain, and its effects, convulsions, are exceedingly frequent, the emphysema of the lungs is also found to exist with a corresponding frequency, and there seems to be good reason for concluding

that the emphysema plays a most important part in giving rise to the convulsions observed under these circumstances. The congestion of the cerebral vessels is brought about by the condition of the lung substance, large portions of which are partly emphysematous and partly apneumatic. In the other respiratory affections in childhood, convulsions frequently occur at the last stage of the disease, and are in many cases, in my opinion, dependent as much on the emphysematous condition of the lungs, as on the other conditions in combination with which this lesion is usually found.

Considerable difficulty has always been experienced, in accounting for the presence of the large emphysematous cavities at the margins of the lobes of the lungs, which so often present themselves in the adult; but the origin of this pathological condition is, I believe, to be traced back to an early period in the history of the individual; it is a very common circumstance to find in the lungs of children who have been for any considerable period the subjects of bronchitis, the following condition of certain portions of the lungs. Certain of the collapsed lobules, in which no trace of air is visible in the vesicles on the surface, present little spots of a yellowish white colour, varying in size from a pin's head upwards; when these are pricked with a needle, a small quantity of mucopurulent fluid exudes. These little spots are most commonly found at the margins of the lobes; and the languette of the upper left lobe is especially their favourite seat. Fauvel described them very accurately* as "*granulations purulentes*," and he attributed their origin to the accumulation in the bronchi of the products of secretion, the purulent secretion passing into a small group of *dilated* pulmonary cells. He says, "*par un effort expirateur il peut arriver qu'une ou plusieurs cellules se débarrassent de l'air que les distendait; mais si une inspiration vigoureuse survient, alors la matiere bronchique refoulée par la colonne de l'air, qui ne peut la traverser facilement, avance vers la périphérie, et peut envahir les cellules du poumon.*"† I have met with a large number of

* Dr. West describes this appearance under the name *vesicular pneumonia* or *vesicular bronchitis*. Dr. West considers the secretions found in these little cavities to be produced by inflammatory actions at the spot where they are discovered.

† Fauvel, loc. cit., p. 57.

such cases, but do not adopt the explanation given by Fauvel in its entirety. These purulent dépôts, or "bronchial abscesses," as they have been called, occur, according to my experience, chiefly in parts of the lung which have become collapsed; the collapse itself is enough to interfere with the due excretion of the mucous secretion, which, consequently, remains distending the bronchi in the lobes so affected. The presence of air in the distal portion of the lobe is a necessary condition to the expulsion of the mucus; here this condition is wanting. The process of secretion goes on, but not the process of removal; inspiration occurs, as Fauvel observes, and the "bronchial matter," driven back by the column of air which cannot easily pass through it, advances towards the periphery, and may thus invade the cells of the lung. This latter explanation is obviously correct, but Fauvel supposes the cells to have been *previously* emphysematous, and *afterwards* filled by bronchial secretion in the manner thus indicated; the facts appear to me to warrant the conclusion, which is in substance almost identical with that of Dr. West's, that enlarged air cells, or, speaking perhaps more correctly, the little cavities communicating with the bronchi, which constitute the "granulations purulentes," result directly from distension of a group of cells by the bronchial secretion. The formation of bronchial abscesses may go on to such a degree and extent, as to invade the whole of a lobe or lobes, as in a case which came under my observation three years ago, in which, cavities (non-tubercular), the size of small nuts were found occupying the whole of two lobes of the lungs. The explanation I have here to offer then, of the origin of those large emphysematous projections which are found in adults, is connected with the presence of these bronchial abscesses in the lungs at an early period of life. The emphysematous bladders in the adult are bronchial abscesses, the contents of which have become evacuated, and in which the puriform fluid has been replaced by air. The walls of these cavities have not collapsed or come into apposition, owing to the semi-solidified state of the lung tissue in the neighbourhood, at the period when the fluid was replaced by air; and the state of distension consequently persisted. Many clinical facts are in favour of this view of the question, and I am unacquainted with any which invalidate or interfere materially with it.

Emphysema of the lungs in childhood, as revealed to us by examination after death, has now sufficiently, for the present, occupied our attention. Its recognition during life, by means of the physical signs and symptoms presented to us, is clinically an object of interest. Emphysema is probably a lesion which is not directly susceptible of removal; we cannot cure it as we would an inflammation. It is not on that account, however, the less important to recognise its presence, and to assign to it its proper share in the causation of the symptoms observed in that class of cases in which it may occur; the treatment which must be adopted, should, in this, as in other cases, be influenced by a correct appreciation of the relation of the symptoms to the pathological conditions of which they are the manifestation.

The movements of the chest are markedly influenced by the presence of emphysema. Emphysema, of what may be called *acute* form, developing itself in the lungs of infants or young children during an attack of bronchitis, most commonly attacks the upper lobes of the lungs. Here the want of expansion beneath the clavicles, the greater resonance on percussion, and the feeble respiratory murmur are diagnostic of the presence of the lesion. Dr. Jenner states that he has observed a falling in or subsidence of the supra-clavicular region during inspiration, in cases where the apices are affected, and my own observations enable me to confirm this statement. Below the clavicles the emphysema may most surely be recognised; for in this situation the lung is most liable to be *extensively* affected. At other situations the mixture of emphysema with apneumotosis renders the diagnosis more difficult, the results offered by percussion are less valuable, and the auscultatory signs are less significative.

An intensification of the natural respiratory murmur is not heard over parts of the lung which are truly emphysematous; rather coarse rhonchi may be heard masking more or less completely the natural respiratory sound; but these rhonchi themselves are not of much value as tests of the presence or absence of emphysema. The presence, at any situation, of signs indicative of apneumotosis, such as dulness, finish rhonchus or complete absence of respiratory murmur, is almost, or quite sufficient to warrant the conclusion that emphysema is also

present, and in such cases the signs of emphysema have only to be looked for, to be at once made out.

Inasmuch as emphysema is rarely unaccompanied by apneumotosis, it is a matter of difficulty, as before remarked, to define precisely the share of each in the production of the various *symptoms* observed. The dyspnœa present in bronchitis, in young children is peculiar, the expiratory act occurring first, and the interval following the inspiratory act. When emphysema is present to a considerable degree, the "expiratory" type of respiration is intensified; the respirations are eminently *shallow* in character, the cough is short, stifled and weak; and coincidently with these, the physical signs of emphysema at the apices, and of collapse at the lower portions of the lungs, may be satisfactorily made out. What of the symptoms and of the distress which the patient is labouring under, cannot be set down to the airless state of certain parts of the lungs, and to the obstructed condition of the air tubes, must then be attributed to the emphysema, the emphysema affecting, let it be remembered, not limited portions of the lung's surface, but often spread over entire lobes. Orthopnœa and great distress are, in young children, generally due rather to the presence of extensive emphysema than to those other conditions which produce difficulty of respiration in bronchitis. As the child grows older, the lungs less readily become collapsed, and less readily, for this reason does this acute form of emphysema occur. In weakly children the sternum often projects at the same time that the chest is laterally retracted, one diameter of the chest being increased to make up for the diminution of another.

Of the symptoms of chronic emphysema in childhood there is little to be said, the characters of the disease differing in few essential particulars from those observed at a later period of life. As in the adult, the patient is liable to frequent attacks of bronchitis, evidently dependent on the existence of the emphysematous condition of the lungs. The rapidity with which severe dyspnœa supervenes, on an apparently slight attack of bronchitis is, in ordinary cases a good test of the presence of emphysema.

Much more might here be said in reference to other symptoms which are produced in part or altogether, by the existence

of emphysema, but the general indication thus given of the part emphysema ordinarily plays in giving rise to symptoms usually referred to other conditions, has been thought sufficient for the present purpose.

In conclusion, I would refer briefly to the kind of treatment which may be advantageously adopted in that form of emphysema most commonly witnessed during childhood, and which may be designated acute emphysema. The primary indication in such cases is to remove the cause of the emphysema,—viz., collapse of the pulmonary lobules. For this purpose counter-irritants possess a remarkable efficacy, inasmuch as the existing congestion of the lungs, especially localized in the collapsed lobules, tends to prevent both the ejection of the mucous secretion from the bronchi and the re-admission of air. The mustard bath or repeated application of mustard cataplasms to the thorax are to be preferred; frictions of the chest, with an oleaginous, slightly stimulant material, will be found of great service also. Internally, ipecacuanha wine, in slightly nauseant doses, promotes evacuation of the obstructing mucous secretion. I have rarely used tartar emetic, and am strongly opposed to its use in the bronchitic affections of young children, except in cases where the patient is very robust and over the age of two years.

In cases of hooping-cough, in which it is desirable to mitigate the frequency of the violent expiratory efforts, I have found the hydrocyanic acid more useful than any other medicine. The diet should consist of milk, or milk and water and sugar, according to the age of the patient; and the state of the bowels must receive its due share of attention. It is impossible to lay down a treatment for every case, but the simple principles here indicated, it will rarely be found necessary to depart from. Depletion is hardly ever admissible in the case of patients belonging to the town population and of the lower classes. Under other circumstances it may be necessary, but I have not hitherto had occasion to find it so. The inspiratory act in the young child is, in cases of bronchitis, weakened by so many causes, that we should be careful how we add to the difficulties present, by depletory, which are depressing, measures.