

**On stertor, apoplexy, and the management of the apoplectic state / Robert L. Bowles.**

**Contributors**

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Royal College of Physicians of Edinburgh

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STERTOR & APOPLEXY

ROBT L. BOWLES





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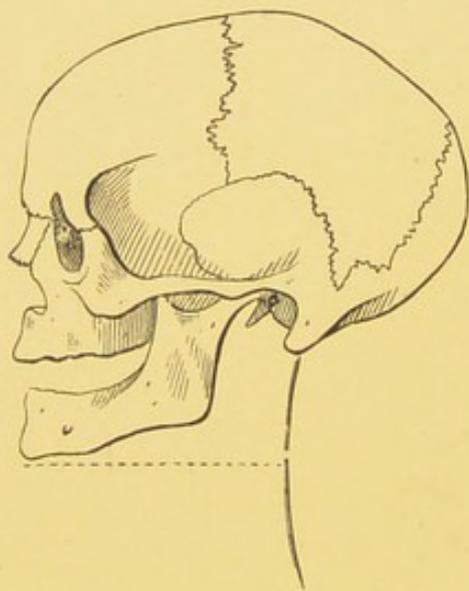


Diagram to show space between symphysis and vertebral column with mouth shut.

N. B.—The line representing the spine should, in both diagrams, have been placed more forward, *i.e.* in front of the mastoid process.

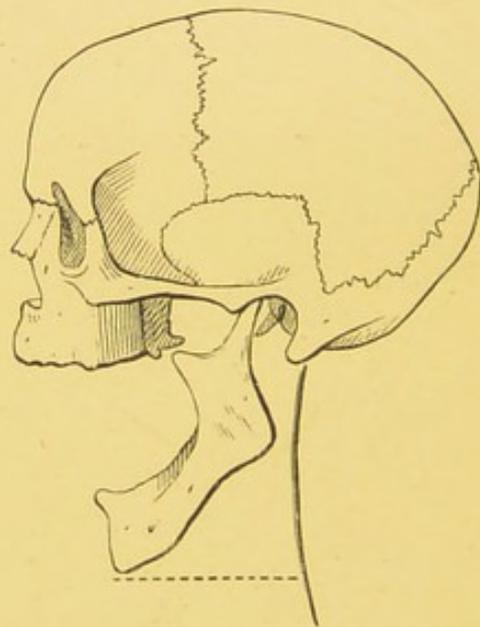


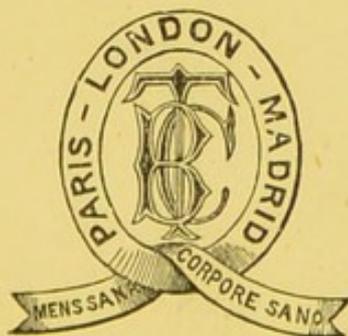
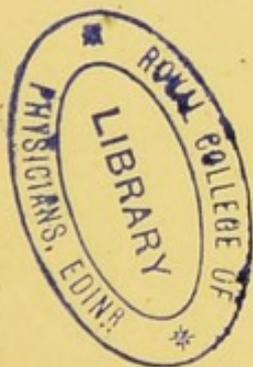
Diagram to show space between symphysis and vertebral column with mouth open.

ON  
STERTOR, APOPLEXY,  
AND  
THE MANAGEMENT OF THE  
APOPLECTIC STATE.

BY  
ROBERT L. BOWLES, M.D., F.R.C.P. LOND.,

CONSULTING PHYSICIAN TO THE VICTORIA HOSPITAL, FOLKESTONE;  
PHYSICIAN TO THE ST. ANDREW'S CONVALESCENT HOSPITAL, FOLKESTONE;  
FELLOW OF THE ROYAL MEDICAL CHIRURGICAL SOCIETY;  
MEMBER OF THE CLINICAL, MEDICAL, AND ANATOMICAL SOCIETIES;  
LATE PRESIDENT S. E. BRANCH OF BRITISH MEDICAL ASSOCIATION.

"Steritque supinus."  
HORACE.



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[PARIS AND MADRID.]

1891.



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DEDICATED

WITH KIND PERMISSION TO MY OLD AND REVERED FRIENDS,

SIR JAMES PAGET, BART.,

SIR HENRY PITMAN, M.D.,

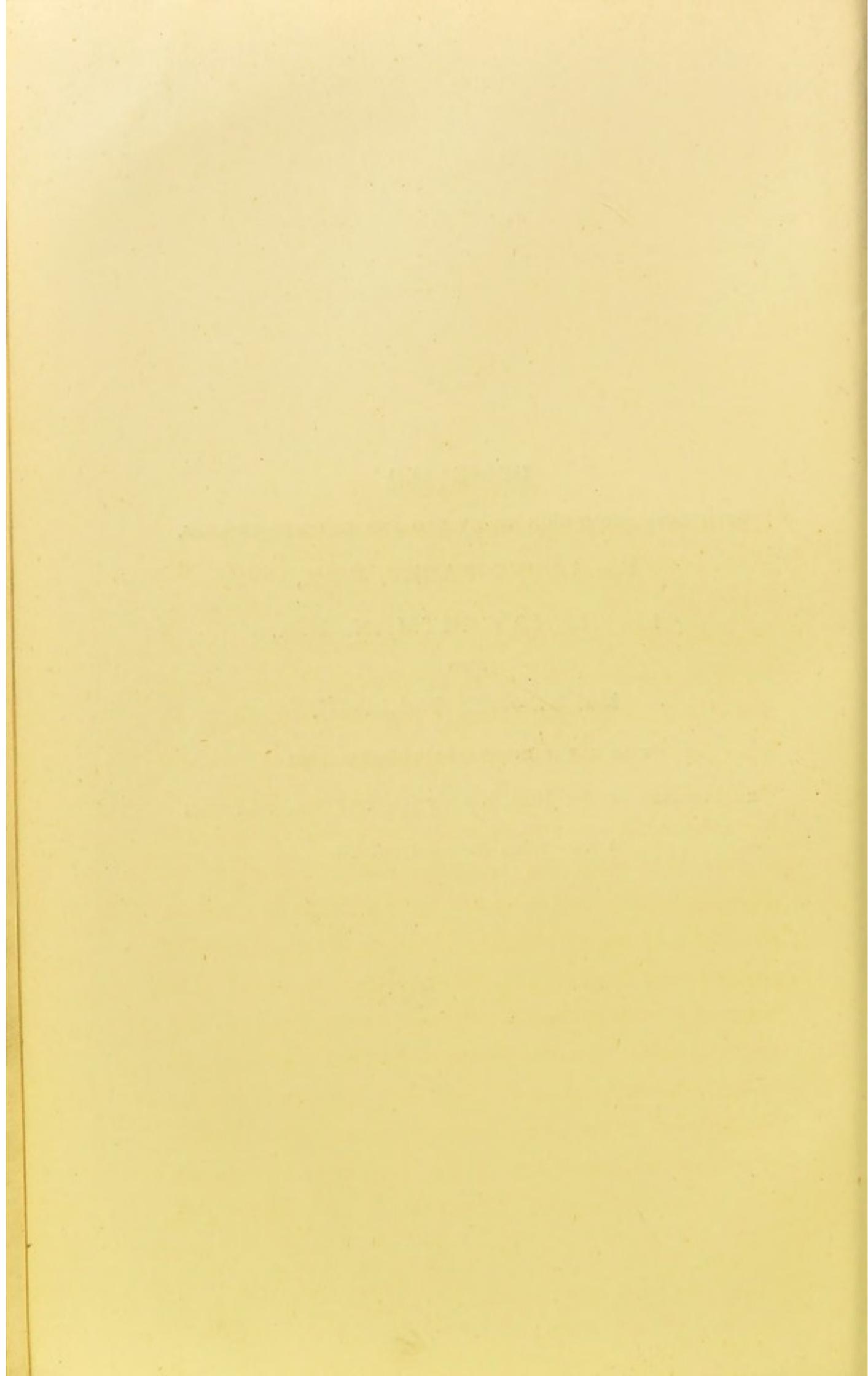
AND

MR. GEORGE POLLOCK,

WHO EARLY IN MY PROFESSIONAL LIFE

ENCOURAGED ME TO PURSUE FURTHER THE INVESTIGATIONS

I HAD THEN ALREADY BEGUN.



## PREFACE.



FOR more than thirty years in the course of my professional work, I have been observing and investigating the causes and consequences of stertor, and considering its relations with the many forms of disease and accident in which it has been found to be present. During that period I have learned, that not only may it be more or less injurious to the sufferer and interfere with the natural course towards recovery, but that it may be, and often is, immediately and supremely dangerous to life. I have also learned that stertorous breathing can at all times be promptly relieved by the judicious application of common physical laws, viz. by placing the patient in certain suitable positions and allowing gravitation to have its sway. The removal of stertor, then, in all cases, should have our first and anxious care, and be the basis of all our treatment ; for stertor, wherever and in whatever form it exists, invariably implies more or less obstruction to free and easy breathing. It is therefore obvious that in any condition of illness this must be pernicious, and at least retard recovery. In the

report of my cases, I have not attempted to select those having a successful issue, but rather, have chosen such as best illustrate the various forms of stertor and the changes which occur upon altering the positions of the body.

I have from time to time, by papers to our leading medical societies, by an article in "Quain's Dictionary of Medicine," and by communications to the medical journals, endeavoured to obtain a general recognition of the principles and practice I have now indicated ; but I find that, with the exception of my own friends and those with whom I have been associated, these principles are not as widely known as they should be. Indeed, I feel that not only should they be taught at all our medical schools, but, as well, in all nursing institutions, ambulance classes, and places for succouring the injured and the apparently drowned. The details of management are easy to understand, and may be constantly applied with advantage to the sufferers before the arrival of the doctor. I have therefore thought it well to collect my papers and cases, and, with some other original work indirectly related to stertor, put them in the form of a monograph, and thus place before the profession all that I have to say in the matter.

ROBERT L. BOWLES.

FOLKESTONE,  
May, 1891.

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CHAPTER I.

INTRODUCTION.

Definition of stertor—Varieties of stertor—Dangers of stertor—Past views of stertor—Meaning of stertor—Extracts from Strumpfel and Ziemssen—French views, showing the present state of knowledge of stertor—Arrangement of present work.

STERTOR is the term applied to sounds in the throat, mouth, or any part of the air-passages, produced by the movements of the air during respiration, and occurring in the apoplectic and like conditions.

Several varieties of stertor may be recognized, as follows:—

1. *Nasal*.—Nasal stertor arises from approximation of the alæ nasi towards the septum by the in-going air, as in the act of sniffing.

2. *Buccal*.—This form of stertor is due to vibrations of the lips, and puffings and flappings of the cheeks during inspiration or expiration.

3. *Palatine*.—Arises from vibrations of the soft palate, whether the breath passes through the mouth or the nose.

4. *Pharyngeal*.—Pharyngeal stertor is caused by the lolling back of the base of the tongue into near contact with the posterior wall of the pharynx.

5. *Laryngeal*.—This variety is referable to vibrations of the chordæ vocales.

6. *Mucous*.—Mucous stertor is a term which may be given to the bubbling of air through mucus or fluids in the trachea or larger air-tubes.

All sounds of an abnormal character, having their origin in the larynx, trachea, or bronchi, at once give rise, in the professional mind, to a sense of impending danger. It is felt that the life of the patient is in jeopardy from sudden or more commonly gradual progressive suffocation, ending in death. It is known that some physical changes, intrinsic or extrinsic, have arisen, which have narrowed or diminished the lumen of the chief air-ways, and the causes of those physical changes are anxiously and carefully sought for, and, if possible, promptly removed. The subsidence of abnormal sounds implies to the anxious physician the absence of at least immediate danger.

This has not until quite recently been our experience with abnormal sounds having their origin in the nasal, oral, and pharyngeal cavities. In those localities, it is true, they have been observed and noted, and then passed by as of trivial or secondary importance—as having, in fact, no serious bearing on the life or well-being of the patient; but in these portions of the air-ways, as in those lower down, abnormal sound implies danger, not so immediate perhaps, nor so difficult to combat, but that it is danger as real, and that it requires as much of the intelligent care and skill of the physician, will, I think, on reflection, be readily conceded.

Noise in any part of the air-way is a danger-signal ; its importance the physician must determine. The stertor of the apoplectic state may prove equal in danger to the crowing of the croupy child or the stridor arising from the pressure of a thoracic tumour.

Stertor is therefore a symptom with two meanings ; the noise expresses the mechanical interference, and the mechanical interference is an accidental concomitant of the unconsciousness. *The accident which determines whether "the stroke" be or be not accompanied by stertor, is in most cases due to the accident of the patient's happening or not happening to be on his back ; or should he exhibit stertor while upon his side, there must be some derangement of the ordinary relations of the pharynx, such as the chin being too near the sternum, the existence of a local œdema, long uvula, large tonsils, mucus in the air-tubes, pressure from without, or indeed anything which narrows the respiratory channels or vibrates in their course.*

To display and make clear the differences which exist in the views entertained by earlier and modern writers and in those advocated in the following pages, it will be well here to present shortly both sides to the reader. For that purpose I select extracts from the American translation of Dr. Adolf Strumpfel's "Text-book of Medicine," 1887 ; from Ziemssen's Cyclopædia, under the heading "Cerebral Hæmorrhage," by Nothnagel ; and from the article *Encephale* in the "Nouveau Dictionnaire de Médecine et de Chirurgie Pratique," tom. xiii. Dr. Strumpfel has laboured with great success to bring into concordance pathology and symptomatology—to arrange them as cause and effect ; and as his work is now generally accepted as fairly expressing the more modern views in Germany

and America on medicine and pathology, I think it best in this introduction, after giving the extracts, to make a general commentary upon his views on the value of the respiratory symptoms in the apoplectic state of cerebral hæmorrhage.

He says of the patient,\* "He usually sinks back in his chair or falls on the floor and becomes deeply comatose. His face is often noticeably flushed, and the pulse full and tense, but not infrequently slow because of the increased cerebral pressure. The respirations are deep, noisy, stertorous, and likewise often slow. The relaxed cheeks and lips are often drawn deeply in at every inspiration and puffed out at every expiration."

Further, on page 690, we read, "A certain number of patients never awake from the initial coma. Death may not be immediate, but they remain completely unconscious; the respiration becomes more rapid and irregular (sometimes of the Cheyne-Stokes character); and there is a rattling in the throat, because mucus and saliva run down into it; the pulse, which was at first retarded, now becomes accelerated; the face becomes paler and more and more sunken; the eyes are deep in their sockets; the cornea becomes opaque; and at last, after the coma has lasted for some hours, or even one or two days, death occurs, often attended by a considerable rise of temperature."

Again, on page 696, under the heading of "Treatment": "The treatment of the apoplectic stroke demands, first of all, rest in bed, with the head and shoulders elevated. To avoid bed-sores, it is very important to maintain clean linen, and to watch attentively that portion of the skin

\* "Text-book of Medicine," p. 689. 1887.

which is pressed against the bed by the weight of the body. An ice-bag should be put on the head, and particularly over that side on which the hæmorrhage is supposed to be. Bleeding was formerly universally practised, but of late its usefulness is doubted. It is not indicated, unless the deep congestion of the face, the violent pulsation of the carotids, and the full slow pulse show increased arterial tension. In such a case, if the patient seems otherwise robust, we may bleed at the commencement of an attack, in the hope of checking the escape of blood by lowering the intra-arterial pressure. In similar conditions, experience shows that the local abstraction of blood from the temples is sometimes advantageous. The bowels should be well emptied by enemata, and later on by drastic purgatives. If the respiration and pulse fail, we may try stimulants (ether, camphor); but very likely they will be without success."

These extracts show that practically Dr. Strumpfel's entire treatment of the apoplectic attack is directed to the relief of arterial tension, and that this tension is believed to have some relation with the deep, noisy, stertorous breathing; but what that relation is, is left to the imagination. It is clear, however, that the means suggested (bleeding) for the relief of the arterial tension is not looked upon as really trustworthy; the writer shows that he has no abiding faith in the means he advises. They are suggestions only; he evidently is not fully satisfied of their end and object. The following pages will demonstrate the fact that the arterial tension has no *direct* causal relation with the cerebral hæmorrhage; on the contrary, it is shown to be entirely *indirect*, and a consequence simply of an easily removable cause, suffocation, indicated by the

stertorous breathing, which when relieved so entirely changes the symptoms that the question of bleeding or other depleting remedies cannot even be entertained. I have never failed, during an experience of thirty-five years, to relieve arterial tension in these cases by removing the obstructions which cause the stertor, and by so doing I have at the same time found the nature of the attack to be made more clear, and the management of it more simple and effective.

The first effect of a cerebral hæmorrhage is *shock*, which produces a tendency to syncope; and this state is only changed by the supervention of stertorous, *i.e.* difficult and suffocative breathing, when the flushed and turgid countenance, pulsating carotids, and strong bounding pulse at once indicate some powerful reaction. The heart is labouring to overcome some serious obstruction, and it is now obvious enough, from the distension of the systemic capillaries, that such obstruction can only exist in the pulmonary circulation.

The dyspnœa of stertor may be as great as that of croup, but its effect on the general circulation is somewhat different. There must be some reason why in croup the face is only at first, and exceptionally, flushed, and I think the explanation must be that in croup—certainly in diphtherial croup—the left heart is already enfeebled by the constitutional disease, and has not sufficient of the "*vires vitæ*" to struggle against the difficulties that have arisen. In an apoplexy, on the other hand, the patient may have no febrile or constitutional affection to poison or enfeeble the cardiac muscles, and it is only at a later stage, when the patient becomes exhausted, that the flush gives rise to the sallow appearance generally noticed.

Ziemssen says,\* "The other features of the attack, the appearance of the face, the condition of the pupils, the respiration, the pulse, are also subject to manifold variations.

"The colour of the face is sometimes deep red, even slightly cyanotic, the latter indicating an irregular and impeded circulation; at other times it is entirely normal, and again in other cases it is found to be quite pale, resembling in every particular that of a person in a faint. This last appearance seems to occur with special frequency in cases where the hæmorrhage has taken place gradually. Sometimes in the very beginning of the attack, before consciousness is lost, the patients look pale, with sunken features, and they then, as a rule, suffer from nausea and vomiting.

"The character of the pulse also varies with the case. The so-called *pulsus cerebralis* of the older physicians, *i.e.* a slow, sometimes also an irregular, pulse is, to be sure, the variety most often observed; but sometimes, on the contrary, it is very rapid, and entirely irregular. The tension is equally subject to variation. The respiration is in many cases quiet, and as regular as that of a person in sleep. Our fathers used to describe a noisy, snoring, "stertorous" respiration as peculiar to hæmorrhagic apoplexy; but, as just stated, it is not universally present, and is, moreover, met with in *sopor* due to other causes. In cases of very deep unconsciousness, the cheeks are drawn in during inspiration and puffed out during expiration (the so-called tobacco-smokers' respiration). Traube was the first to call attention to the phenomena of the Cheyne-Stokes respiration in cerebral hæmorrhage, and we are able to confirm

\* Ziemssen's Cyclopædia, p. 101.

his statements. If the patients do not awake from their coma, the respirations become towards the end intermittent and irregular." \*

Again, on page 107: "Death takes place usually in connection with symptoms which point to paralysis by pressure of the spinal centre of the vagus nerve (irregular, faltering respiration, intermission and weakness of the pulse), or, in case the coma is of longer duration, also in consequence of œdema of the lungs, or of pneumonia. It has been practically found that recovery rarely takes place after the coma has lasted forty-eight hours."

At page 108: "After injuries of the medulla oblongata, œdema of the lungs was especially apt to occur."

At page 140, in speaking of hæmorrhage into the pons Varolii: "Finally, pronounced disturbances of the respiration are sometimes met with, such as marked stertor, cyanosis, intermittent breathing, and occasionally excessive dyspnœa."

Under Treatment we find the following (p. 162): "In case, namely, the extravasation has caused an increase of the intra-cranial pressure, and that in consequence of this, together with the cerebral hyperæmia which accompanies it, a paralysis of the respiratory or vagus centre is threatened, the rapid reduction of the quantity of the circulating blood—for it is impossible to act directly on the extravasation—may, by diminishing the pressure, have the effect of actually prolonging life; and this indication can only be fulfilled by venesection."

"The explanation of venesection, as first described, is in harmony with the observed fact that patients have sometimes been roused by its aid from a state of coma. A

\* Ziemssen's Cyclopædia, p. 102.

beneficial effect may be looked for from venesection in cases where apoplexy is accompanied by well-marked symptoms of cerebral hyperæmia, such as turgid face, with, perhaps, distended veins and increased pulsation of the carotids; where the action of the heart is powerful, the radial artery of at least normal tension, the pulse slow, or regular and of normal frequency; where the respiration is uniform, quiet, and of snorting character; when the patient is strong and of not too advanced age. Supposing these conditions to be present, we regard venesection as indicated, if cerebral pressure, already considerable, has begun to cause paralysis of the vagus centre (Cheyne-Stokes respiration). At any rate, through the use of this measure, combined with stimulant remedies, life may still be preserved in a certain fraction of these cases."

"The large percentage of deaths from apoplexy proves how fruitless is often the most careful and best-considered treatment; and when it is remembered, furthermore, how frequently patients recover spontaneously from the attack, it seems fair to raise the question whether efforts such as those described, or medical interference of any kind, are ever of value."\*

Continuing his argument, he says, "It would be difficult to convince a determined sceptic that such is the case; but the affirmative view gains a certain degree of probability through the fact mentioned above, that venesection is often immediately followed by return of consciousness. This being taken into consideration, and, in addition, the fact that the efficiency of the remedies in question, if it cannot be proved, is not to be disproved, and that without them we have no treatment left, we should in our opinion con-

\* Ziemssen's Cyclopædia, p. 165.

tinue to employ them, and that, too, not simply from a humanitarian regard for the friends of the patient."

Nothnagel, then, confirms and maintains the doctrine of our fathers, that in true apoplexy—shock, loss of consciousness, and paralysis—there are two forms, sthenic and asthenic, the former distinguished by flushed and turgid face, pulsating carotids, an excited, labouring heart, increased arterial tension, and noisy respiration, which he leaves us to imply is always an attendant on the sthenic variety; the latter, by a pale face, feeble pulse, feeble cardiac action, and, although he does not specifically say so, no noisy respiration, but a breathing in many cases as quiet and as regular as that of a person in sleep. In the former he recommends bleeding, not because he can fully explain its influence, but that "venesection is often followed by a return of consciousness." In the asthenic variety, of course he does not mention it, as there is so palpably no indication for its employment. He says that it relieves intra-cranial pressure, and when used in such cases of the sthenic variety as he describes, no doubt when blood is let freely it would do so, and one can readily conceive in what way. The respiration being obstructed, the jugulars have become gorged, the blood is prevented from leaving the intra-cranial cavity, and the oppression of the cerebral functions becomes more and more marked. To suddenly relieve this may, and probably often does, relieve the parts of the brain concerned indirectly with the causes of stertor; the stertor being silenced implies free respiration and free circulation, and therefore entire relief from that intra-cranial pressure which Nothnagel says indicates the necessity for bleeding. It is therefore the suffocative symptoms which are relieved by bleeding, the very symptoms which can so easily be relieved by simpler and more harmless means.

The following extracts express very clearly the views generally entertained by modern French physicians \* :—

Page 120 : “ The face is sometimes injected and puffy, sometimes very pale ; the aspect is expressionless ; the flabby cheeks are puffed out synchronously with each expiration. Deglutition is often difficult, the reflex of the velum palati and pharynx is enfeebled or lost ; liquids find their way more or less into the air-passages and give rise to cough ; respiration is sometimes accelerated, sometimes retarded ; hæmatisation is incompletely performed ; the face and extremities are cyanosed. The patient makes no effort to get rid of the mucus which accumulates in the trachea and bronchi, and the air inspired makes a special noise in passing it, which we call stertor. The pulse is often infrequent in consequence of irritation of the medulla ; later it becomes more frequent, smaller, and irregular.”

Page 121 : “ When the attack is fatal, the patient remains comatose, or falls again into that condition after having given some signs of consciousness ; the respiration becomes more and more laboured, the pulse small and irregular, and death supervenes, either with the phenomena of asphyxia or from syncope. Sometimes, at the moment that the coma begins to pass off, another attack occurs. The comatose condition may be prolonged for several days ere terminating in death, but the patient generally succumbs within forty-eight hours. Death is never sudden save in the case of hæmorrhage into the medulla.”

Page 129 : “ *Treatment.*—Against the lesion itself nothing is of any avail. The vessel once ruptured, the hæmorrhage necessarily follows without our being able to arrest its

\* “Nouveau Dictionnaire de Médecine et de Chirurgie Pratique,” tome xiii. Art. Encéphale.

progress. The treatment, then, ought from the commencement to be exclusively directed against functional troubles, and above all against paralysis of the encephalon. Every effort of the physician should aim at arousing the excitability of the nerve-tissue. Bleeding constitutes—when the general state of the patient permits of it—the most efficacious means. It diminishes the intra-cranial pressure, arouses circulation in the encephalon, and combats the hyperæmia which sometimes complicates hæmorrhage and tends to maintain the neurolysis. But if blood-letting is of real service in certain cases, it is in others strongly contra-indicated, and it cannot therefore be practised indifferently in all cases of apoplexy without danger.”

Page 129: “In the treatment of apoplexy, it is necessary above all to be guided by the general condition. When the patient is young, robust, the pulse full and bounding, the cardiac impulse powerful, then *la saignée générale* is strongly indicated. Bleeding from the arm is to be preferred. The vein should be opened boldly, so as to obtain a rapid depletion of the circulation. The relief is in certain cases almost immediate, and patients are even seen to regain consciousness during the operation.” (Jaccoud and Hallopean.)

The foregoing views are so similar to those extracted from the German authors that it would be needless repetition to make a further analysis of the preceding extracts; what I have already said need not here be repeated.

The following papers are so arranged as to illustrate the progressive stages of the inquiry, and cases are related to illustrate every phase of respiratory difficulty in the apoplectic and allied conditions. Cases in which the

principles seemed contradicted by experience are especially introduced, and the causes of the apparent contradictions commented on and explained. Each case was most carefully watched and noted, and its management carried out with as much scientific precision as possible. Failures are as rigidly recorded as successes, so that each case may be regarded as a scientific experiment, and, as far as it goes, perfectly trustworthy.

The conditions allied to the apoplectic state—*i.e.* those in which from any cause the mind and will are in abeyance, and the body is left in that state of physical helplessness in which the functions necessary to the maintenance of life become endangered by forces acting from within and without—are related under their respective headings, concussion and fracture of the skull, drowning, chloroform-poisoning, convulsions, epilepsy, bronchitis, and so on. Each condition is shortly illustrated by typical cases, in order to demonstrate the varied applications of the principles contended for.

The subject of drowning has been more fully dealt with in my paper read before the Medical and Chirurgical Society on May 28, 1889, and subsequently published in the "Transactions" of that Society, vol. lxxii. The paper on "Stertor in Animals," read at the Glasgow meeting of the British Medical Association in August, 1888, will be of interest, as part of the general subject, and as again illustrative of the proper management of the apoplectic condition.

The paper on the Mammalian Pharynx\* I have also included in this work, as it illustrates changes in the form and position of the epiglottis and its relations with other

\* *Journal of Anatomy and Physiology*, vol. xxiii.

parts at different ages, and thus applies in many ways to the subject under consideration, and helps to form a more or less complete study and exposition of the subject of Stertor.

As an appendix, I have thought it well to republish my original letter to Dr. Marshall Hall, which he forwarded to the *Lancet* of 1857, and subsequently published in his work on drowning, as it contains the dissections and experiments on which my principles are founded. The experiments may appear to have been somewhat roughly done, but they were conducted under many difficulties, and were honestly reported. My many years of subsequent experience have shown them to have been sufficiently exact as a helpful guide in practice, and that there was no error in principles which needed correction.

Quite early in my investigations I entertained the conviction that, by separating the suffocative symptoms from the shock of apoplexy, we should so simplify the case as to enable us to mark the position and probable extent of the cerebral mischief. As I have watched progressive steps in the localization of brain-functions, I have become more and more convinced of the practical value of removing the mystifying symptoms of suffocative stertor as an essential element of diagnosis and prognosis, quite independent of the frequent and valuable aid afforded in the final recovery of the stricken and suffering patient.

It may be asked whether in any case bleeding is justifiable in apoplexy. A wider knowledge of pathology has taught us that the short-necked, fresh-coloured, plethoric-looking man is not the individual most liable to a "stroke." It is probable that the ordinary appearance of a man in the apoplectic state, with the presence of stertor and suffocative symptoms, and therefore with a congested and turgid

countenance, may have led to the error of labelling the plethoric-looking man with the prefix "apoplectic." Of course such a man *may* have a stroke, and it is possible that under certain conditions blood-letting may become a question of treatment in the case; but my experience teaches me that even in such constitutions, if no stertor exists, and there are no impediments to the free entrance of air into the lungs, the propriety of "letting blood" has never appeared to be necessary or justifiable; the stroke has, through "shock," acted sufficiently as a sedative, and removed all traces of bounding pulse and arterial tension.

It is conceivable that the circulatory centre may be in some cases fretted by poisoned or disordered blood, and that arterial excitability and tension may result, even without obstruction in the air-way; if so, of course blood-letting may be useful and permissible; but in apoplexy, as I have before stated, I have never seen such a necessity.

## CHAPTER II.

OBSERVATIONS ON STERTOR, AND THE VARYING  
CONDITIONS ON WHICH IT IS DEPENDENT.\*

Pathology of stertor—Influence of position on the paralyzed tongue—Cases—Comments on cases—Various conditions in which stertor is found—Anatomy of the parts concerned in stertor—Diagrams—Different characters of stertor—Experiments—A case, with remarks—General reflections—New pathology of apoplexy and its treatment, with consequent more favourable prognosis—Other dangers of persistent stertor—Cases of epilepsy treated by position ; recovery.

IN order to make my subject clear, I am necessarily led to speak of obstructions about the throat in connection with stertor ; how far these obstructions are due to the position of the body, and how they may be removed by altering that position.

The cause of the loud and deep sound in the throat to which the name "stertor" has been applied, does not appear to have received the attention it deserves. From numerous experiments, I have arrived at the conclusion that in the majority of instances it arises from one of three conditions : from paralysis of the velum palati ; from the paralyzed tongue falling back in the throat ; and from the presence of mucus in the pharynx and air-passages.

\* From Volume xliii. of the "Medico-Chirurgical Transactions," published by the Royal Medical and Chirurgical Society of London. Read January 24, 1860.

In the winter of 1855 and 1856 I was engaged, in conjunction with Dr. Edward Long Fox, of Bristol, and Mr. Charles Hunter, of Wilton Place, upon some experiments for the late Dr. Marshall Hall, to determine the amount of air which could be respired in the dead subject by compression and relaxation of the chest.\* In attempting this we repeatedly found that at one time compression failed to expel any air from the chest, and at another, after air had been expelled, it would not re-enter on removing the pressure. On opening the mouth and searching for a cause, it was found that the tongue had fallen back and blocked up the cavity of the pharynx. The tongue was accordingly drawn forward and fixed between the incisor teeth, but still we found that on one body the experiment succeeded well in producing respiration, on another it failed. This time the tongue was no obstacle, but the pressure on the chest and abdomen had thrown up some of the contents of the stomach into the pharynx, which entirely prevented the current of air from passing into or out of the chest. This induced us to try to produce respiration in such positions that anything in the pharynx would fall *from* rather than *towards* its posterior wall ; the consequence was, that we obtained the most invariable and favourable results by the method of artificial respiration now known as that of Marshall Hall.

In a paper communicated to the Medical Society of St. George's Hospital in 1856, great stress was laid on the influence of the position of the body over the tongue in the half-drowned patient ; and it was pointed out how necessary it became to pay the greatest attention to a fact which at first sight appeared of little importance. Subsequent to

\* See Appendix.

the meeting I received from Mr. Harvey, one of the members of the Society, a letter on the subject, of which the following is an extract :—

“I am glad to find you lay so much stress on the tongue’s position producing apnœa in persons that have been rendered insensible. One of the first persons I ever saw on the operating-table nearly died from this cause during the operation, under the influence of chloroform. Mr. Syme, who was operating, fortunately guessed what was the cause of the sudden asphyxia, and drew the tongue forward with a pair of forceps, and the patient presently recovered.”

Mr. Harvey’s case strikingly illustrates that the tongue may be a cause of apnœa in other circumstances than those of drowning.

The following cases illustrate another phase of this subject :—

CASE I.—In November, 1857, I was called to see an old lady who had been attacked with sudden sickness whilst talking to some friends ; faintness followed, with an inability to express herself, though she was to a considerable extent conscious. She was put to bed and kept quiet ; mustard poultices were applied to the epigastrium and nape of neck, and hot bottles to the feet. In an hour or two reaction commenced, and *pari passu* coma and stertorous breathing set in, which steadily increased in intensity until my second visit, when this condition had lasted about three hours. Her pulse was now full and excited, but as she was seventy-three years of age, and had already suffered from two or three attacks of paralysis, no severe measures were adopted. The skin was hot, and covered with a pro-

fuse perspiration; the face was swollen and livid, and the mouth half open; the pupils were contracted and insensible to light, and the eyeball to touch. The stertor was very deep, and the breathing laboured. Whilst I was at the bedside of my patient she was very nearly suffocated, from the stomach ejecting a portion of its contents into the throat. I at once turned her on her side and emptied her mouth, when she not only breathed freely, but without the slightest stertor. I was somewhat surprised, but proceeded to place her in what appeared to be the most comfortable position, *on her back*. Immediately when I did so, her respiration suddenly ceased, and she convulsively struggled for breath. Supposing it to be the tongue which had choked her, I thrust my finger into the mouth, and pressed it forward, when the breathing again became easy and free from stertor. The patient was now comfortably laid on her side; and until her death, which took place two days afterwards, the stertor never recurred when she was in that position, but the respiration continued as naturally as if she slept. To convince myself that this was due to position, I several times turned her on her back for a few moments, and invariably, when I did so, the stertor was as marked as ever. The lateral position had another advantage, for it allowed the saliva and mucus to drain away instead of remaining in the bronchial tubes and giving rise to "mucous stertor," and thus offering another impediment to the respiration. Other changes occurred coincidentally with the change of position; but how far they depended upon it, future experience must decide. The pulse became calmer; the skin cooler and less bedewed with moisture; the eye sensible to the touch;

and general sensation returned to such an extent that the patient evinced signs of discomfort at the removal of a mustard poultice. Nevertheless, whenever the supine position was adopted, the stertor, difficulty of breathing, lividity of face, and other unfavourable symptoms, returned in full force. It was easy to observe that, as the position was changed, the paralyzed tongue gravitated downwards.

This case suggests many important points for consideration :—1. That the paralyzed tongue *may*, under certain circumstances, cause even death by suffocation ; for I believe this patient would have died if I had not been present when the tongue fell so suddenly back, and when the fluid was ejected from the stomach into the throat. 2. That stertor arises from the tongue falling back in the supine position of the body, thus offering a serious impediment to the respiration, since it required greater muscular force to breathe with stertor than when the respiration was noiseless. 3. The mucus (another respiratory impediment) drained away when the patient was on her side. 4. The great improvement of the general symptoms occurring upon the establishment of easy breathing in the lateral position, and *pulse, skin, sensation* all undergoing material alterations for the better.

CASE 2.—G. T——, a gentleman sixty-five years of age, became comatose from exhaustion supervening upon extensive subacute inflammation of emphysematous lungs. When I entered the room, he was lying on his back, with his mouth open, breathing stertorously, though not to a great extent. On looking into the mouth, the

soft palate appeared remarkably small and shrivelled, so that it did not come very decidedly in contact with the tongue, even though partially paralyzed. Whilst I was standing at the bedside, my patient suddenly ceased to breathe, became very livid in the face, struggled convulsively, and then became rigid. My recollection of the first case induced me to turn this patient on his side, when he instantly recovered with a long groan, and then breathed quite naturally. He was turned on his back again; stertor returned, and he became choked from a quantity of bronchial secretion. The lateral position was resumed, the sputa drained away, and he now breathed quite easily until his death, which took place about half an hour afterwards.

CASE 3.—H. J. L——, a clergyman about sixty years of age, subject to slight epileptic seizures twice a year, was seized, on May 4, 1858, at ten in the morning, with a fit of the usual character. The attack commenced with a scream, and lasted but a few minutes, though the patient was some time before he fully recovered. At eight o'clock in the evening of the same day, he was again attacked whilst walking across the hall of the hotel at which he was staying. When I arrived about ten minutes afterwards, I found him lying on his back, with a deep cut over the left eye, breathing stertorously, and with much labour. The mouth was open, the face highly congested, the skin hot and perspiring, and the pulse full and sharp, but not accelerated. He was quite insensible to external impressions. He was turned on his side sufficiently for the tongue to fall forward; the stertor instantly gave place to easy, natural breathing;

the congestion of the countenance gradually disappeared, and in *less than one minute* he began to evince signs of recovery, and almost as quickly the pulse became weak and small, and the skin cool. He went to sleep for a few minutes, and on awaking was rendered almost frantic by pain in his head. From this he slowly recovered, and in a few days was convalescent. I should mention that there was a loud bruit at the apex of the heart, and that a small pulse was common to him.

Case 2 merely gave further evidence of the danger of the supine position of the body from paralysis of the tongue and the accumulating bronchial secretion; but in Case 3 it would appear that the change of position was in some measure the cause of his speedy recovery. In this case, too, as in Case 1, the skin and pulse altered in character as the stertor ceased. It is in such a case as this that I can imagine "position" to be a curative as well as a palliative measure. Here was a delicate man, subject to epilepsy and disease of the mitral valves. Supposing the breathing to have gone on with great labour, and the lungs to have become more and more congested, and consequently the brain and heart also, one or other, or both of these vital organs, might have suffered, and death ensued.

CASE 4.—Mrs. P——, æt. 46, after suffering twelve days from continued fever, was seized on the evening of August 27, 1858, with a severe rigor, which was soon followed by what was supposed to have been a very deep sleep. I was called to see her at two in the morning of the 28th, when I found her lying upon her *side*, in a state of deep coma, with her mouth half open. There was no stertor; the skin was warm and bedewed

with moisture, and the pulse was almost imperceptible. I endeavoured to administer a little stimulant, and for that purpose turned the face upwards, when I soon perceived a harshness in the breathing, from obstruction in the back of the throat. By allowing the head to remain in this position a few minutes, the obstruction became greater at each inspiration, and *stertor* was the result. A little fluid was now introduced into the mouth with a teaspoon, which almost choked my patient; but on turning her on her side again, the fluid drained away, and the *stertor* ceased. In about an hour afterwards she sank. So prostrate was this poor woman from fever, that I believe, had much effort been required to overcome the impediment to the respiration, from the time coma first set in, she would not have survived as long as she did.

Besides the cases now related, a medical friend informs me that, on my suggestion, he adopted the lateral position in a case of *stertor* from apoplexy, and that the *stertor* immediately ceased. The man was bled, and soon recovered from the comatose condition. My friend also adopted this method with a child suffering from convulsions. When he first saw the child, it was frothing at the mouth, and the respiration seemed much impeded. He turned it on its side, and before he had time to apply other remedies, the child began to evince signs of recovery. I do not assume in these cases, or in Case 3, that change of position was the *cause* of recovery; it may have assisted to produce the happy result, or it may merely have been a coincidence. I simply state the facts as they occurred, and avoid inductions for the present.

Meanwhile, I propose roughly to consider the anatomy of the parts concerned in stertor, and to show *how* and *why* stertor is the consequence of the supine position of the body, and why it differs in character in different cases. I must also relate a few experiments undertaken with the object of further illustrating the views herein entertained.

It is well known that the cavity of the pharynx, having a fixed boundary only posteriorly, may have its capacity materially affected by the ever-varying position of its sides, of the soft palate, the tongue, and the larynx. The larynx and sides of the pharynx have, I believe, little connection with the cause of stertor. I shall therefore not further refer to them. The tongue, being attached to the lower jaw by its mucous membrane and its muscles, has its relations with surrounding parts altered as the mouth is opened or closed.

When the mouth is closed, the horizontal portion or body of the jaw forms nearly a right angle with the spinal column, from which the symphysis is then at its greatest distance. When the mouth is opened by the dropping of the jaw, the symphysis describes the arc of a circle, and approaches more nearly to the spine, where the posterior wall of the pharynx is attached (see frontispiece and Fig. 1). The tongue, having its chief attachment to the symphysis, would consequently be drawn away from the pharynx in the former case, and allowed to rest in contact with it in the latter. This, if not true in every case, is at least true in some, as the plate demonstrates (see Fig. 2).

The dissection from which the drawing was taken was made with great care, so as not to displace the parts more than was necessary to give a fair view of the base of the tongue and the epiglottis. The two sketches, with the

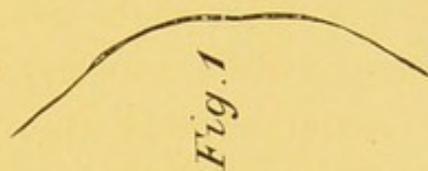
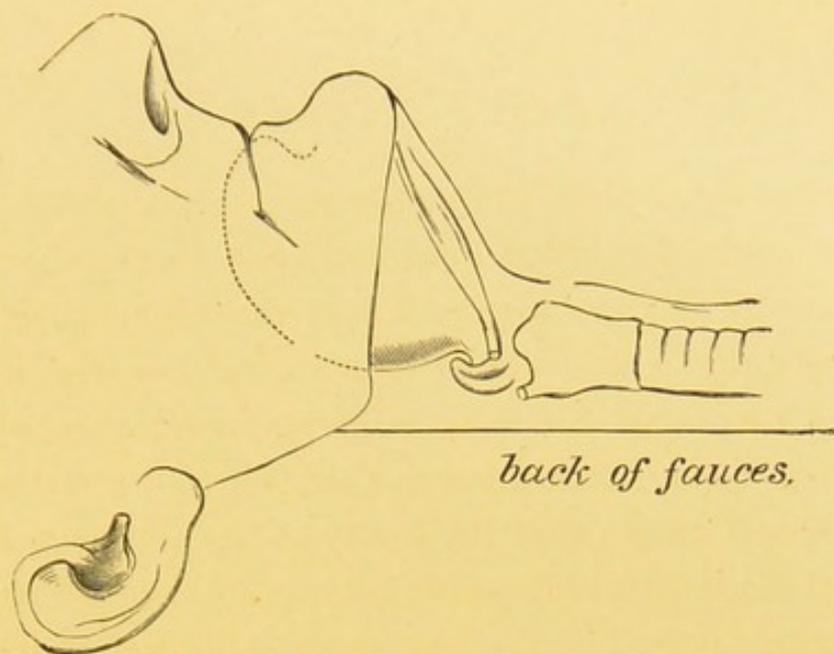


Fig. 1.—Showing the position of the tongue with the mouth closed.

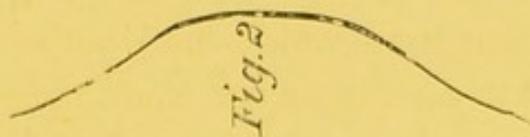
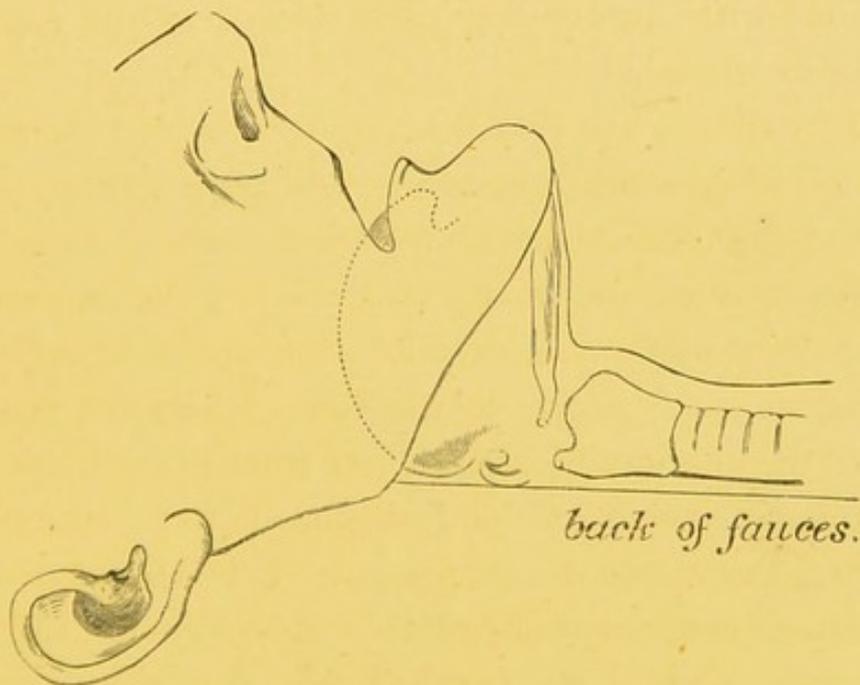
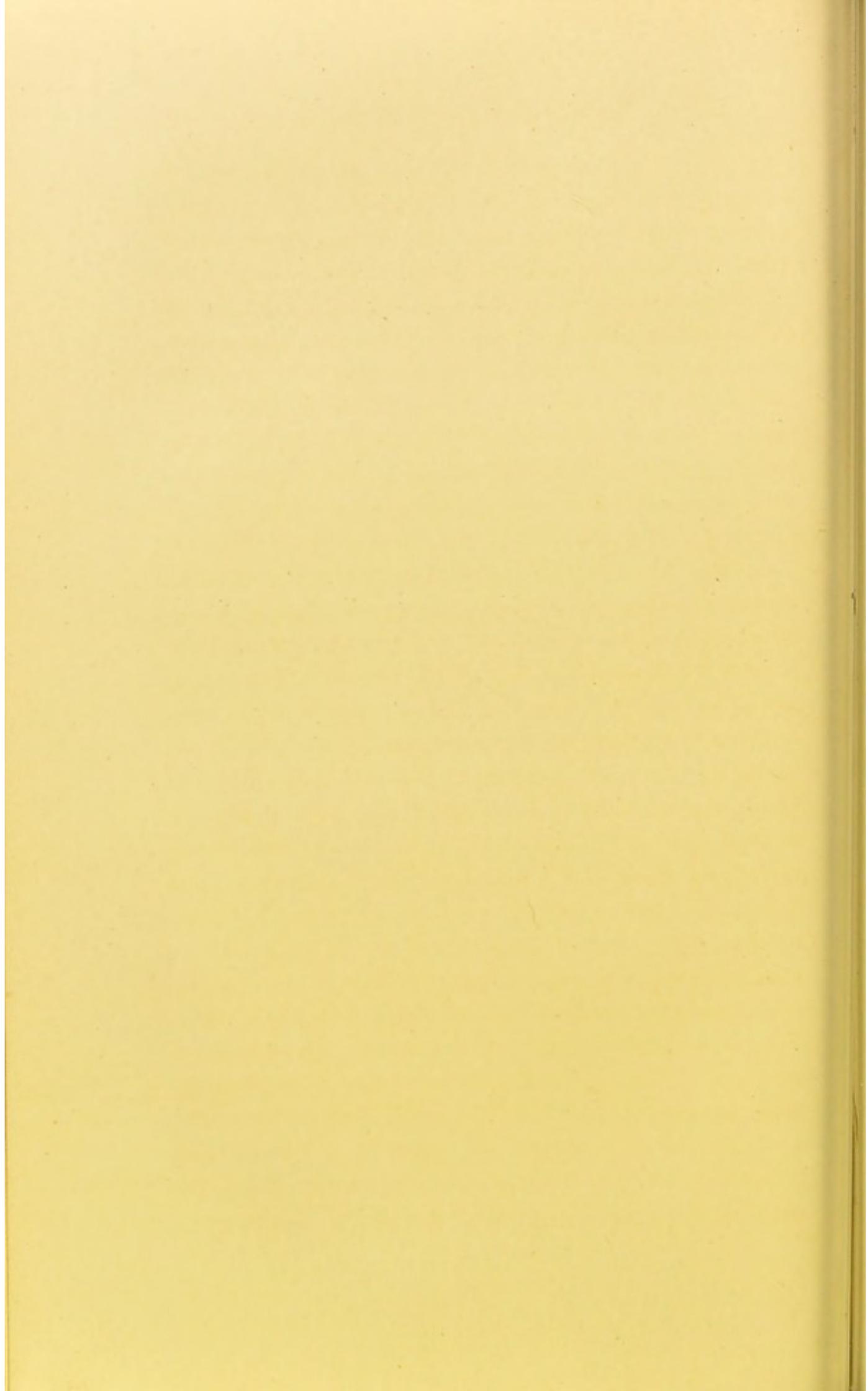


Fig. 2.—Showing the position of the tongue with the mouth open.

The dissection from which the drawings were taken was made on the body of a woman, æt. 60, who died of cancer of the uterus. Great care was taken not to displace the parts more than was necessary to give a fair view of the base of the tongue and epiglottis. The sketches were taken with the subject lying on its back on the table.



open and closed mouth, were kindly taken for me on the spot by my friend Dr. Fitzgerald, and they very accurately represent the parts as they appeared at the time. When the mouth was open and the subject on its back, the road to the larynx was completely obstructed, in consequence of the tongue resting in contact with the back of the pharynx; but the obstruction could be removed by hooking the tongue forward. When the mouth was closed, the tongue was lifted from the pharynx, leaving ample breathing space. But even with the closed mouth, if the chin were much bent on the sternum, the base of the tongue was almost in contact with the back of the pharynx.

It would seem from this dissection that the muscles of the tongue attaching it to the symphysis of the jaw, are too short to admit of the base of the tongue reaching the back of the throat when the mouth is closed. The purpose served by such an arrangement would appear to be to keep the base of the tongue away from the back of the throat during deglutition. In the act of deglutition, the mouth is firmly closed, and the genio-hyoid and genio-hyo-glossi muscles, taking their fixed point from the now immovable symphysis, draw the body of the tongue upwards and forwards, allowing sufficient room for the morsel of food to travel easily through the cavity of the pharynx. Were these muscles of greater length, the base of the tongue might become a source of inconvenience, if not of danger. The dissection, besides demonstrating the respective positions of the tongue with the open and closed mouth, suggests the necessity of caution being used in raising the head with pillows; for if the head be too much bent forward on the chest, the tongue may lie in dangerous proximity to the pharynx, even when the mouth is closed.

### The Different Characters of Stertor.

From having observed the snoring of sleep sometimes take place through the nostrils with the closed mouth, and sometimes through the open mouth, and having also observed differences in the apoplectic stertor, I endeavoured to analyze the particular cause of each of these varieties by some experiments on myself, and by clinical observation.

I placed myself as nearly as possible in the condition of an apoplectic patient, by paralyzing my tongue, or rather by allowing it to assume its own position by gravitation. After a little practice, and with some care, I succeeded in effecting this, and found—1. That it required much more voluntary effort to *snore* through the nose and breathe stertorously through the mouth in the upright and prone positions than in the recumbent and supine, and that the greatest impediment to the respiration occurs when the jaw is dropped and the mouth most widely open. 2. The deep, vibrating snore of sleep, with the closed mouth, depends upon the tongue pressing the velum palati upwards and backwards, thus narrowing the opening between the nose and pharynx, the velum vibrating as the air rushes through. Sometimes, when the mouth is partially open, the soft palate drops upon the tongue, and vibrates as the air rushes between it and the tongue. To either of these noises in which the soft palate is concerned I propose, for the sake of distinction, to apply the name of “palatine stertor.” 3. The harsh, sharp, husky noise, occurring in apoplexy, with the mouth wide open, always arises low down in the pharynx, and depends upon the narrowing of the passage between its posterior wall and the base of the tongue. By holding a looking-glass before the face whilst

producing this noise, it can readily be seen that the soft palate is in no way concerned in it. In all the cases recorded in this paper this was the nature of the stertor which existed, and as it arises solely in the pharynx, I have given it the name of "pharyngeal stertor." 4. There is a variety of stertor in apoplexy which may be named "mucous stertor," as it depends upon the presence of mucus in the bronchial tubes. So common is this, either alone or in combination with one or other of the preceding varieties, that in "Hooper's Medical Lexicon" it is stated that "apoplectic stertor appears to depend upon the presence of mucus in the air-tubes," as though it were always the cause.

Of these three different varieties of stertor, that which is named pharyngeal is far the most dangerous, for the greater the paralysis the more effectually does the tongue block up the passage, and each inspiration only adds to the distress by sucking the tongue lower down into the pharynx. Its danger is, however, not due alone to the gradual impediment it offers to the respiration, but also to the fact that at any moment this impediment may be absolute, and cause death by suffocation. This has been before referred to in the remarks upon Case 1.

We may observe a similar example in the snoring sleeper, who, after drawing several inspirations with evident effort, at last comes to a sudden check from having been gagged by the tongue falling back. This will rouse him from his stupor, and he will then sleep on quietly until the same thing recurs from his deepening sleep.

This subject gave rise in my mind to the question—Is the breathing in deep coma invariably carried on through the mouth? I once thought that such was the case. In

the four cases related it was so, as well as in some cases of apoplexy which I witnessed at a former period. But the following case is one in which the breathing was carried on through the nostrils.

CASE 5.—W. B——, æt. 41, had suffered for two years from numbness and tingling of the extremities of the right side, and was now (August 20, 1858) under treatment for a supposed commencing disease of the retina. He had been suffering much from anxiety for some time past, and was unusually drowsy in the daytime. On August 20, after eating a hearty breakfast, he was seized with paralysis of the right side. When I arrived he was able to speak indistinctly, though not to make use of the words he wished. The face was drawn to the left side, and the tongue pushed to the right when protruded; the pupils were natural. In a few minutes he ejected a large quantity of food from his stomach, and became covered with perspiration. He was conveyed to bed, but before he could be undressed he was partially sick several times. He soon commenced *snoring* with his mouth *closed*, and was now unable to answer questions; his pulse was soft and feeble, and his skin clammy. I turned him on his side, and though the snoring altered in character, it did not cease, but the impediment to the breathing was less. The mouth was firmly closed, but by means of a spoon I was able to open it slightly, and found the tongue in contact with the incisor teeth, and closely applied to the palate. By introducing the spoon further into the mouth, and pressing on the tongue, all snoring at once ceased; when, however, the mouth was allowed to close, it continued as before. Medicines

could not be swallowed, and in about half an hour he breathed his last, quietly and without a struggle.

*Remarks.*—Snoring in this case continued even in the lateral position. The spasmodic closure of the jaw had pressed the tongue upwards and backwards, carrying with it the soft palate. The snoring was, however, soft and slight, and was but a very partial impediment to the respiration.

But I am inclined to believe that the peculiar apoplectic condition giving rise to spasmodic closure of the jaw and “palatine stertor” is exceptional; and that the proposition that “it is the *rule* for persons in coma to breathe through the mouth” is a true one, and for this reason: the muscles of the jaw being paralyzed, the jaw drops and opens the mouth; whereas the dilators of the nostrils being also paralyzed, the *alæ nasi* are forcibly drawn by the in-going air towards the column of the nose, and thus close the orifice of the nares altogether. This can be illustrated by the act of “sniffing;” but the following is a case in point:—

Whilst watching the dying moments of a poor man who was comatose from hæmorrhage from an ulcer of the stomach, I observed that he breathed with evident and increasing effort, from the *alæ nasi* flapping towards the centre column during inspiration. With my fingers I kept the nares freely opened, and the breathing became so easy that I have reason to think that his life was prolonged for some little time by these means.

### General Reflections.

Having now given in detail what evidence I possess in favour of the foregoing views on "stertor" and the "influence of position in certain morbid conditions of the system," I have to add a few remarks on the cases to which this subject appears to apply, and more particularly in reference to apoplexy and its treatment.

Since the days of Abercrombie so much light has been thrown on the different causes of apoplexy, that his division of the primarily apoplectic (where no apparent change had taken place in the brain) may be broken up into several subdivisions. It is now fully acknowledged that many of these cases depend primarily on some disease of the heart or its valves, upon aneurism, upon atheroma, upon engorgement of the pulmonic circulation, and upon uræmia. Consequent upon these great advances in pathology is a total change of treatment, for it is but seldom that we now hear of that indiscriminate and enormous blood-letting which is detailed in Dr. Abercrombie's work on diseases of the brain. In his time, age, sex, or condition had little influence over treatment; so long as apoplexy existed, blood-letting was considered the chief, almost the only, remedy.

Since, then, it is admitted that apoplexy may result (and very commonly does result) from an alteration in the state of the general circulation, I conceive that anything which would mischievously affect the circulation during the apoplectic attack would militate very considerably against the chance of the patient's final recovery. Let me suppose a case. A man with disease of the heart or large vessels, on making some unusual effort falls down in a fit; he is

taken up, and laid on his back in bed. Stertor at once commences ; if it be not relieved, the respiration becomes impeded, congestion of the lungs takes place, then of the right side of the heart, then of the jugulars and of the brain.\* And now another direct source of apoplexy exists—*increased congestion of the brain*, and this, too, with un-aërated blood, itself a poison sufficient to destroy life. As long, then, as the stertor is allowed to continue, the mischief increases, and remedies will be of little avail. But suppose that, when the man is taken up in a fit of apoplexy, he is laid in such a position that his respiration cannot be impeded, that the blood may flow steadily on in its course ; that he is placed in such a position, in short, that nature will meet with no impediment in her attempt to right the temporary disturbance which a sudden effort brought about. Then, I think, we may fairly hope for a better issue, if judicious aid be afforded by means which the urgency of the case may render necessary. This especially applies to cases of congestion dependent upon, or complicated with, atheroma ; the danger would then be doubly great, for the increased congestion might be more than the diseased cerebral vessels could bear ; they might give way, and the case would become one of sanguineous apoplexy.

In the second class of cases of Dr. Abercrombie (those not primarily apoplectic), where the symptoms depend upon an effusion of blood in the brain, if there be any hope, it must at once be forfeited if the respiration be impeded, since this would increase the congestion of the cerebral vessels and cause the blood to make its way out of those which were ruptured with greater force. The same would

\* "Nothing raises blood pressure as much as suffocation."—(BRUNTON, *British Medical Journal*, January, 1889.)

apply to laceration of any of the sinuses or vessels of the brain from fracture of the skull. I remember to have seen a boy who had fallen from a bridge brought home in a state of syncope. Extensive simple fracture of the vault of the skull was detected. He was laid on his back on a table, and as reaction commenced he fell into a state of coma, with stertorous breathing. In a short time the symptoms became so urgent that trephining was performed, whereupon a large quantity of blood made its escape with considerable force. The boy was relieved, but died three weeks afterwards.

On examination after death, there was found a large quantity of clotted and fluid blood on the surface of the brain, the superior longitudinal sinus was lacerated, and the substance of the brain much injured.

In a case of this kind, to impede the onward current of blood through the jugulars must be the first step towards death, for the blood would make its way where there was least resistance, through the wound of the sinus. If, however, there were no obstruction in its natural course, we may fairly presume that it would follow that rather than turn aside through an opening in which, perhaps, a coagulum had already formed.

Such, then, are the dangers which may result from a persistence of stertor in apoplectic and similar conditions; but there remain the other and more immediate dangers of the supine position. 1. Fluids or other foreign matters may make their way into the larynx from the mouth or the stomach. This I had repeated opportunities of observing in the dead subject when engaged on experiments for the late Dr. Marshall Hall; but that it is a real danger in the living man is placed beyond doubt by a

remarkable case which is related in the *Medical Times* of April 23rd as having been under the care of Dr. Bristowe. A drunken man died from symptoms of suffocation. At the autopsy some of the contents of the stomach were found in the bronchial tubes. Further, my friend, Mr. Bateman, of Folkestone, informs me that during his attendance on a case of delirium tremens, the patient, in an attack of vomiting, became suddenly asphyxiated, and died. No post-mortem examination was made, but it seemed probable that some foreign matter had entered the larynx, and caused spasm of the glottis and death. 2. The falling back of the tongue, causing sudden and complete apnœa. This may occur in all cases of paralysis, whether from syncope, apoplexy, concussion of the brain, chloroform-poisoning, suffocation from carbonic acid, or drowning. I have seen imminent danger from this cause, but am unable to record a death arising from it, though this may be a more common occurrence than we are at present aware of; for if a disaster arise from any of the above causes, the patient is, I believe, invariably laid flat on the back.

As an appendix to this subject, and in conclusion, it will be interesting to relate the following case, which has recently been forwarded me by Dr. Lewis (Medical Superintendent of the Cheshire and Chester Lunatic Asylum), to whom I wrote many months ago on this subject:—

“Seth Yarwood, a man with a very peculiar formation of head, the subject of ambitious monomania of two and a half years' standing. He first had an epileptic fit, which was of a very severe character, on the 21st of November, 1858, and another on the 10th of December following. They did not recur until June 3rd of the present year,

(1859), when he had one ; and two more, one on the 8th and one on the 10th of July.

“On the 10th of August, at 4 p.m., he had four fits, of a very severe nature, in quick succession, three occurring in less than five minutes and the fourth in about a quarter of an hour. When seen, he was in a state of profound coma ; pupils contracted and insensible ; pulse small, weak, and irregular ; surface pale, with cold, clammy perspiration ; breathing irregular, slow, and extremely laborious ; the stertor was very marked ; very little air seemed to pass into the lungs ; the cheeks were puffed out during expiration. He was placed well over on his side, and propped up so that he remained about half-way between the lateral and prone positions. There was an immediate flow of saliva from the mouth, and this was followed by a considerable quantity of sanio-mucous fluid. The breathing instantly became more free, and in less than a minute all stertor had ceased ; the other symptoms gradually subsided, and in an hour's time, the bowels having been freely acted on by two drops of croton oil, there was a partial return of consciousness. The next morning he refused to stay in bed, and, though dull and stupid, was moving about more or less all day.”

*Remarks.*—The symptoms at the time were considered as rendering a fatal termination more than probable ; whether such was really the case is immaterial. The sudden subsidence of the symptoms on the change of posture must, I think, indisputably prove that the cerebral congestion was relieved by it ; and, further, we may conclude that the change in posture rendered a fatal termination *less probable* than if posture had not been attended to.

## CHAPTER III.

STERTOR (*continued*), WITH ILLUSTRATIVE CASES. \*

Stertor the result of a local mechanical condition—Case, with comments—Treatment necessarily resulting from the new pathology—Cases successfully treated—Remarks—The treatment applied to other conditions, as fractured skull, convulsions, hæmoptysis, and drowning—General conclusions.

SINCE the publication of the foregoing paper, if I except a paragraph in the article "Chloroform," in Holmes's "System of Surgery," I know of nothing which has been contributed to medical literature on the subject of stertor.

In my first paper only three forms of stertor are defined, palatine, pharyngeal, and mucous stertor. Professor Lister refers to a "laryngeal stertor" as occurring during a certain stage of the inhalation of chloroform, but as it has no practical connection, so far as I am aware, with the apoplectic and its allied conditions, we will at present dismiss it from further consideration.

The forms of stertor, then, which have a direct connection with the apoplectic state are—the palatine, arising from the vibrations of the soft palate; the pharyngeal, from the gravitation of the tongue into the back of the pharynx; and the mucous stertor, from the presence of mucus or other fluids in the larger air-tubes. These three

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varieties, whatever their remote cause, are the *immediate* result of a local mechanical condition—a condition which may always and at once be changed, to the great relief of the patients, and sometimes to their permanent recovery. Since adopting this method of management, many other points have developed themselves of the utmost practical importance both to the surgeon and to the physician.

CASE I.—In October, 1863, Mrs. S—— was seized with apoplexy. On my arrival, there was a partial return to consciousness, and the left side was found to be paralyzed. There was pharyngeal stertor when in the recumbent posture, and she appeared uneasy when placed on her right side, so she was placed on her left, when the stertor ceased. A blister was applied to the nape of the neck, and she remained in this position for nine days. She was now better, and spoke to me. Fearing a bed-sore, I desired the nurse to change her position by turning her from her left to her right side. Soon after this was done she was distressed for breath, and the countenance became livid. On my arrival I found the difficulty of breathing gradually increasing, the blistered surface and the ear, upon which she had lain, of a dark purple hue, and the pulse, which had before been weak and irregular, full and bounding. There were large mucous râles over the whole chest; she was quite unconscious, and death from suffocation was imminent. Finding that these symptoms supervened upon the change of position, I had her replaced upon her left side, and immediately the pulse sank, the mucous stertor ceased, the breathing was relieved, the lividity of countenance passed away, and the blistered surface,

which had been almost black, resumed a bright cherry-red colour. This additional shock, however, proved too much for her, and she died the same day, calm and conscious.

The salient points of this interesting case are : (1) That pharyngeal stertor ceased when the patient was placed on her side ; (2) that there was a slow but gradual improvement subsequent to this ; (3) that mucous stertor and imminent death supervened when she was placed on the opposite side ; (4) that relief was instant on resuming her original position ; and (5) that a return to consciousness was coincident with the cessation of stertor ; in other words, on the removal of the respiratory difficulty.

On a careful examination of the chest after she became quiet, I found all râles slowly fade away from the right side, that which was uppermost, and the natural breathing return ; but the left lung, which had been dependent throughout, was dull on percussion and deficient in respiratory murmur. The explanation now became clear—viz. that the dependent lung had become filled with some mucous fluid, and that on changing the side, the fluid, by gravitation, was finding its way across the trachea to the opposite lung, but in doing so it had been churned into foam by the in-going air, giving rise to mucous stertor, and that this foam, by filling up the larger bronchial tubes, was quickly causing suffocation with all its usual results.

As a point of management then, in a case of apoplexy, it would appear necessary to keep the patient on one side, and not to change it ; but which should this be ? Healthy people when lying on their side breathe chiefly with that which is uppermost ; for the intercostal and

other thoracic muscles of the lower one are fixed between the weight of the body and the bed, and the breathing of this side is almost entirely diaphragmatic.

CASE 2.—Dr. Fitzgerald, during his attendance on a case of cancer of the brain, finding the breathing much oppressed by mucus in the air-passages, at my suggestion placed the patient on his side, when he became suddenly so much worse that immediate death appeared inevitable. Dr. Fitzgerald repeated the experiment with exactly the same results, and he found that the difficulty arose from mucus in the trachea and larger air-tubes. It was afterwards discovered that the paralyzed side was placed upwards. Unfortunately, only the head was examined after death ; but I have reason to believe that in hemiplegia from progressive disease of the brain a low form of inflammatory action takes place in the lung of the affected side, due to disturbed innervation of the pneumogastric nerves.

In a recent case of tubercular mass in the centre of the brain, which was under my care, this was the case, and precisely the same distress as above mentioned occurred from mucus when the paralyzed side was placed upwards. It must be remembered, too, that in placing the paralyzed side downwards, the injured side of the brain is upwards, and therefore relieved from congestion, a condition always liable to occur when an injured part remains dependent.

Apoplexy, with much mucous stertor, is, I believe, always of the most grave and dangerous character, for it indicates as well as muscular paralysis, loss of function of such vital nerves as the pneumogastric ; and, I believe, the

time will soon come, now that cases can be so simplified by the removal of stertor, that by a careful consideration of the functions of the various nerves, a very accurate diagnosis and prognosis will be arrived at even in the early stage of apoplexy.

CASE 3.—Mrs. W—— was found lying on her back, breathing stertorously and with great difficulty; the trachea was filled with frothy mucus, and she was almost in a state of collapse. She was turned on her right side, when the stertor and difficulty of breathing ceased. Seventeen hours afterwards she was lying quiet and comfortable; the depending cheek was dusky and congested, the upper cheek pale. She was now turned on her left side; the difficult breathing immediately returned, and *both* sides of the face became highly congested; the breathing was shallow, and large moist râles were present in both sides of the chest; on resuming the original position all difficulty ceased. She died the next morning.

The following case would, I believe, have terminated fatally but for the careful management of position:—

CASE 4.—Mrs. S—— was seized on September '24, 1867, with left hemiplegia. She was unable to speak or to masticate, and could only swallow liquids with much difficulty; the pulse was 80, and very feeble. She was placed on her left side. On September 28 (four days after), the respiratory murmur on the left side was shallow and feeble, there were some râles, and the percussion sounds were dull. She was turned on her

right side, when immediately great distress of breathing and mucous stertor supervened; this gradually disappeared on replacing her on her left side. When turned on her back, for the use of the bed-pan, mucous stertor commenced, and it was noticed that in this position the intercostal muscles and the diaphragm acted more feebly than on the unparalyzed side. On September 29 there was a little more power, and she was less excitable. The respirations, which had been 56, were now 44. She was able to remain half an hour on the right side before the difficult breathing commenced. The following day she was still better; and the dribbling of saliva, which had been very great, ceased, but she still had no control over her bladder or rectum.—October 6: During the last week she has slowly improved. Several experiments of change of position have been made, and it was found that as her power returned she could remain longer on the right side before the difficulty of breathing commenced, and now can remain an hour and a half in this position. She speaks better, eats and sleeps better. Tongue is cleaning; bowels open, but she is still unable to retain her water. Pulse 80, respiration quiet and natural; on the right side the respiratory murmur is natural, on the left there are still a few râles, but the resonance is good, and the air enters more freely. Power is returning to the hand and face.—March, 1870: The patient is still alive and well, but has a good deal of weakness on the left side.

*Remarks.*—In its early stage this case was most critical. Had a little extra strain been put upon the patient, she must have died, and no strain could have been worse than

the persistence of a condition (stertorous breathing) which would indirectly cause obstruction in the jugulars. In the supine posture, from the paralyzed and insensible condition of the pharynx, much of the saliva which dribbled away in the lateral position would have entered the trachea and added to the trouble. Sir James Simpson, in writing of the treatment of phlegmasia dolens, says, "Position is one of the most powerful means in the treatment of many diseases; attention to this point is frequently of more importance, and affords more satisfactory results, than the use of any kind or quantity of drugs." In no case is this opinion of Sir James Simpson so aptly illustrated as in certain affections of the brain and air-passages. Dr. Bence Jones, in writing to me on this subject, says, "The case I mentioned to you was one of extreme hemiplegia of the right side, for the first few hours with perfect clearness of mind, passing in twelve hours into complete coma, with the most intense and distressing stertor, lasting for many hours. This was immediately stopped by changing the position of the patient to one side. But it had no known effect on the progress of the case. The total duration, I think, was not forty-eight hours. The gentleman was about sixty-two, pale and rather sickly, and had always feared apoplexy."

Mr. Reid, of Canterbury, and many other of my friends, have reported to me cases of apoplexy in which, on the change of position, stertor has ceased, and the patients have died peacefully and quietly, to the great relief of the distressed and sorrowing relatives. I have never in my own practice failed to put an end to stertor by position and management.

CASE 5.—At a medical meeting in May, 1862, after

urging my views on stertor, Mr. Francis, of Boughton, stated that he had just left an old lady dying from apoplexy, who had been in a state of stertor for many hours. At the November meeting in the same year he informed us that the old lady was still alive and well. On his return home he found her just as he had left her, dying as he believed. He changed her position, the stertor ceased, and she gradually but perfectly recovered.

CASE 6.—Mr. Eustace Carver, of Melbourne, a former house-surgeon at the Middlesex and Nottingham hospitals, and a careful observer, was called to Captain B——, in deep stertor and moribund. Life was evidently more a question of minutes than hours. The position was changed, the stertor ceased, and the old gentleman lived nine months.

CASE 7.—Dr. Lewis, of Folkestone, was sent for to Mrs. F——, aged sixty-seven. He found her in bed in the apoplectic condition. There was total loss of consciousness, the pupils were fixed, but there was slight reflex action on touching the eyeball, the face was turgid, the cheeks were puffed out on expiration, and there was deep pharyngeal stertor. On being placed on her side, the stertor ceased and she gradually improved. In twelve hours she had perfectly recovered consciousness, the respiration was normal, the face very pale, the pulse quick and feeble; there was no paralysis. The action of the heart was feeble, but there was no murmur.

CASE 8.—I was called in August, 1859, to a boy who had fallen on his head from a height. I found him lying

on his back, snoring, senseless, and collapsed; pulse irregular, and pupils alternately contracting and dilating. The mouth was half full of vomited matter. On turning him on his side the snoring (palatine stertor) ceased; he was sick several times with comparative ease. Presently he began snoring whilst he was on his *side*—his chin was bent upon the sternum; on straightening the neck he was quiet. The boy slowly recovered. On three different occasions in my own practice I have been summoned to cases of apoplexy with stertor, in which the patients recovered, two with, and one without paralysis.

Case 4 demonstrates that as power returns to the brain, the pneumogastric, and probably also the sympathetic nerves regain their power, and effusion into the lung ceases; and, moreover, that the lung is not injured by remaining inactive, and filled with mucus for a long period.

The consideration last mentioned induced me to adopt *position* in all conditions of the lungs in which much mucus was secreted. In April, 1866, a little child, three months old, after having suffered from a slight catarrh for a few days, was seized with difficulty of breathing at night. When I arrived in the morning, the child was livid, the eyes sunken and half closed, and the pulse remarkably slow, feeble, and irregular. The child breathed with great difficulty, and had a loose mucous cough, feeble and ineffective. The quantity of mucus in the chest was so great that the child could not inspire, and appeared dying. It was turned on the right side, ammonia applied to the nostrils, and ten drops of brandy administered every quarter of an hour. On the following day it breathed with

greater ease, the expression had improved, and the pulse, though still slow, had a little more power. The air now entered the left side freely, and the râles were few ; no breathing at the right side. The child gradually recovered, but for several days there was bronchial breathing, and bronchial voice on the right side. Before the child was turned on the right side, there was no difference on auscultation between the two sides.

In bronchitis generally, and especially in the bronchitis of the old, I endeavour to leave one lung free for breathing, and then, as vital power returns, the position is gradually changed.

In the *convulsions of children* there is often a large flow of saliva and secretion in the bronchial tubes. This becomes immediately churned into foam, and greatly impedes respiration. In the lateral position all this drains away, the breathing is freed, and I have often seen recovery commence immediately.

In *epilepsy* the fit will often cease at once by removing stertor, but here it requires a little more management than placing the patient on his side, for the spasms of the mouth, tongue, and fauces require opposing by little mechanical contrivances.

In May, 1866, I was sent for to a phthisical patient who was said to be dying from hæmorrhage. I found him lying upon his back, partially elevated by pillows, and apparently breathing his last. His face was cold and ghastly, his jaw dropped, and his eyes widely opened and staring. He made a few unsuccessful efforts to inspire, when some large mucous râles were heard in the trachea. The pulse could just be felt feebly flickering. He was immediately placed well over on the right side, and ammonia was applied to

the nostrils. A little brandy and water was introduced into the mouth, but there was no effort to swallow. A handkerchief was, however, soaked in brandy, and a portion left in the mouth. The mouth and tongue were quite cold. In a minute or two the respirations became longer, and air could be heard entering the uppermost lung, but none entered the lower. Gradually the râles diminished in the upper lung, air entered more freely, and the percussion sounds became more resonant. Consciousness, which had been utterly lost, gradually returned, and by the following morning he was perfectly himself, and could have transacted any business. He lived four days, breathing with one lung only.

On our arrival, my friend, Dr. Lewis, who was with me, was so convinced that death must take place immediately, that he thought all our efforts to prolong life would be unavailing.

On the subject of *drowning* I do not propose to consider the various modes of resuscitation, but to comment merely upon the fluid contained in the lungs of drowned persons. The Committee of this Society \* on Drowning came to the conclusion "that it was the entrance of fluid into the lungs, and the effects thereby produced, which was the cause of death in drowning." Professor Caspar, as a result of his prolonged researches on drowned persons, asserts that as a rule water exists in the lungs in the form of fine vesicular foam, even in those who have never come to the surface after once being submerged.

In 1861, a woman who had been taken out of the Serpentine and treated by the hot bath at the receiving-house, was brought to St. George's Hospital about one

\* Royal Medical Chirurgical.

hour afterwards. Mr. Jones, the resident medical officer, states that on admission "her breathing was fair, with loud rattling noise ; her lips were livid, her pulse *very good*, her surface and extremities very cold ; she was sensible and able to speak." Warmth and appropriate measures were employed, but in half an hour Mr. Jones was suddenly summoned, and only arrived to see her draw her last breath. The Marshall-Hall method was immediately employed for half an hour, without the slightest signs of recovery, *but a large quantity of frothy fluid* came from the mouth. At the *post-mortem* examination next day, it was reported that "both lungs contained an immense quantity of frothy fluid ; the bronchi were filled with fluid and injected." In this case the lungs were loaded with and paralyzed by water. There cannot be a doubt that the Marshall-Hall method used earlier would have unloaded the lungs ; but I cannot doubt, also, that had she been placed on one side, on her arrival at the hospital the upper lung would have cleared and acted quite sufficiently to sustain life. A lung containing frothy fluid does not clear immediately ; the bells of foam must gradually coalesce and ooze slowly away, and to assist this nothing is more adapted than the Marshall-Hall method.

Dr. Trollope, of St. Leonards-on-Sea, was called to a man who had been taken out of the sea. The man could speak a little, and vomited a quantity of water ; but he rapidly became worse, insensibility came on, the breathing was slow and faint, and the pulse flickering.

The Sylvester method was being used, and Dr. Trollope persisted in it for some few minutes. "Meanwhile," Dr. Trollope reports, "his respiration had ceased, beyond a slight mucous rattle in the windpipe ; his heart's action

could not be felt ; jaw clenched, and lips livid. . . . I then, finding these alarming symptoms supervening in spite of the persistence in Dr. Sylvester's method, immediately had recourse to Dr. Marshall Hall's prone and postural, or 'ready,' method, and was gratified to find fluid escape from the mouth each time the body was laid on the chest, and respiration gradually set up, commencing with long-drawn respirations, or rather gaspings, at intervals. I persevered in the prone and postural movements for three-quarters of an hour, till respiration was thoroughly and satisfactorily established. The man then again vomited between a pint and a quart of water, and was afterwards able to swallow a few tablespoonfuls of tea, and went on satisfactorily."

In March, 1862, I was called to a man who had been knocked into the sea by a heavy chain. It was calculated that he had been under water three minutes. On getting him ashore he was believed to be dead, but one of the men thought "they ought to get the water out of him," and so proceeded to roll him from side to side, and whilst this was done, a quantity of water was expelled from the mouth, and they perceived some attempt at breathing.

A few minutes after this I was on the spot, and found the man apparently dying, making occasional and feeble attempts to breathe, with a very feeble and irregular pulse. He was lying on his side with his head upon a coat, and a quantity of froth tinged with blood lying on the coat in the neighbourhood of his mouth. I observed that clear water and froth welled out of his mouth at the end of every inspiration. Active friction of the limbs, hot bottles and bricks, and ammonia to the nostrils, were carefully applied. Nearly an hour elapsed before we thought it possible he could live. He then began to moan, and in a short time

a small quantity of brandy was swallowed. He entirely recovered.

In July, 1864, a man was capsized in a boat at sea. After being in the water some time, he was picked up and rowed ashore. On arrival he was cold and livid, but breathing with great labour. He was immediately turned on his side by the coastguardsmen, and a quantity of frothy fluid came from the mouth. He was taken to an inn, where he was kept on his side, and where I saw him a quarter of an hour afterwards. He was then breathing with difficulty. A fine white froth, almost like milk, was oozing from his mouth and nose; his face was very livid, and meaningless in expression; his breath was cold; the limbs and body generally were almost stone cold; the pulse could not be felt. There were a few moist râles in the left side of the chest, the side which was uppermost, but the breathing was tolerably free; the breathing on the side upon which he lay was very feeble and obscure, and moist râles more abundant. He could not be roused. In half an hour he became a little restless, and then vomited a quantity of water. The pulse could now be felt, but not counted; this gradually improved. Attempts at vomiting supervened, and occasionally a partial restoration to consciousness. After another attack of vomiting, the pupils, which had been widely dilated, became contracted, and he went off into a sound sleep. He passed a most trying night from restlessness, and pain at the epigastrium; and the next day he was still livid, but better and easier. The following day pleuro-pneumonia of the right side (that which was downwards) supervened. From this he slowly recovered.

There are many interesting details connected with these

cases of drowning which for brevity's sake I omit ; but the cases, I hope, illustrate sufficiently that in drowning there is *some* fluid in the chest, and that all methods of resuscitation which do not provide for the removal of this fluid are utterly valueless. For my own part, my increasing experience only tends to prove that there is as yet no known method equal to that of the Marshall-Hall method.

Independently of its effect upon stertor, "position" has a direct influence in many conditions *allied* to the apoplectic, such as chloroform-poisoning, drunkenness, etc. ; and I have observed that in cases of *great exhaustion* the change from the back to the side is accompanied by immediate and great relief ; the breathing, from having been carried on with evident effort, has become at once peaceful and easy.

During sleep, when the vital powers are resting, it is not the *back*, but the *side* which is selected as Nature's position ; and I believe the explanation to be that on the back the diaphragm has to lift the liver and abdominal organs with each respiration, whereas on the side—especially the right side—the liver lies practically on the bed, and the diaphragm can do its work without oppression.

The general conclusions which may, I think, be fairly deduced from the present communication are—

1. That a "laryngeal stertor" may be added to the three forms I formerly defined.

2. That the three forms of stertor which have a most important connection with the apoplectic state are the palatine, pharyngeal, and mucous stertor.

3. That these three varieties, whatever their remote cause, are the immediate result of a local mechanical condition—a condition which may always, and at once, be changed to

the great relief of the patients, and sometimes to their permanent recovery.

4. That it is necessary to keep the patient on one side, that that side should not be changed, and that the paralyzed side should be downwards.

5. That mucus and other fluids gravitate into and fill up the lower lung ; and therefore that if the sides be reversed the mucus will find its way into the opposite lung.

6. That the fluid, crossing from the large bronchi of one lung to those of the opposite, becomes churned into foam and causes dangerous obstruction to the respiration.

7. That the lung, by remaining inactive and filled with mucus for a long period, is not injured.

8. That these principles apply to all conditions in which mucus or fluid exists in the lungs, and also to all conditions allied to the apoplectic, whether there be mucus or not.

## CHAPTER IV.

SUBSEQUENT EXPERIENCES OF STERTOROUS BREATHING  
IN THE APOPLECTIC CONDITION — VARIETIES OF  
STERTOR,

Nasal and buccal stertor, with cases—Stertor in the lateral position—Nasal and palatine stertor—Case of apoplexy, with difficulty in localization—Buccal, palatine, pharyngeal, and laryngeal stertor in the same case; treatment and remarks—Naso-palatine stertor—Mucous stertor and its dangers; cases—Croupy stertor; case—Euthanasia in apoplexy; cases—Stertor in the lateral position; case—Opium-poisoning or apoplexy—Pneumonia simulating apoplexy treated by position—Stertor in fracture of the skull.

**Illustration of Nasal Stertor.**

A LADY, sixty years of age, fell head foremost downstairs, and was taken up unconscious. She had complained much of head-discomfort in the morning, but nevertheless had been out for a short walk. The weather was thundery. On my arrival immediately after the fall, there was considerable ecchymosis at the outer angle of the left orbit; but there was no bleeding from the ears, nose, or mouth; nor was there any extravasation beneath the ocular conjunctivæ. I found her wholly unconscious, breathing stertorously, and vomiting. The right pupil was dilated and fixed; the left very sluggish. When she was turned on her side the stertor ceased; the aspect of the face became almost natural; and she moved her left arm and leg, and

remained like a person quietly asleep for twenty-four hours. At this time, *nasal* stertor commenced, and gradually increased in intensity ; and, *pari passu*, the face became congested and turgid, the veins of the temple stood out in bold relief, and in about an hour she died.

Dr. Monckton saw this case with me in consultation ; and I was able to demonstrate to him how stertor and its consequences instantly recommenced in this poor lady's case when she was placed in the supine position, and also how easily nasal stertor could be removed, either by pressing the tip of the nose upwards or by dilating the nares with the handle of a salt-spoon.

#### Buccal Stertor.

There is yet one other form—the puffing out and flapping of the cheeks and lips—which may be fairly dignified with the title of *buccal* stertor. Now, although this last does not give rise to any respiratory difficulty, it is, nevertheless, like nasal stertor, of importance in prognosis, and useful for purposes of definition. Like nasal stertor, too, it is dependent on paralysis of the portio dura, and therefore indicates the approach of the intracranial mischief towards that part of the brain which governs the functions of organic life, or (which is a very important alternative) that both it and nasal stertor may arise simply from venous engorgement at the base of the brain, in consequence of the suffocative stertor damming the jugulars.

Authors have always looked upon this symptom as an extremely dangerous one ; and so, no doubt, it is, in the combined conditions of apoplexy and suffocation ; but, as I have observed both it and nasal stertor, in a modified

degree, in the snoring sleeper, and as cases of suffocative apoplexy, in which it has been most marked, sometimes make a rapid recovery, I withhold my opinion for the present.

Indeed, it is most impossible, from the writings of the past, to arrive at any conclusion as to the value of any symptom of apoplexy. We must now observe from a new point of view (apoplexy without suffocation), and draw our conclusions in the future. The following short case, already related to clear up another point, is a happy illustration of some of these remarks.

A lady, sixty-seven years of age, was found in her bed in an apoplectic condition. There was total loss of consciousness; the pupils were of about the usual size, but fixed; there was slight reflex action on touching the eyeball, and an occasional involuntary movement of the arms. The face was turgid, and there was both *pharyngeal* and *buccal* stertor. On being placed on her side the stertor instantly ceased, and she gradually improved. In twelve hours, she had perfectly recovered consciousness; the respiration was normal; the face very pale, and the pulse quick and feeble; and there was no paralysis.

Surely no case could have looked more unpromising than this, when the age is taken into consideration.

#### **Stertor in the Lateral Position from Œdema.**

I was asked by Dr. F. Eastes to see a case of interest at the Folkestone Infirmary. On entering the ward, we found the patient fast asleep and snoring in an unusual manner. Dr. E——, who was with us, thought it tracheal breathing, but, on observing more closely, it proved to be pharyngeal stertor, and the patient was lying on his side. In a few

moments the breathing was natural; it then changed to palatine, a few moments later to pharyngeal stertor, the patient all the time remaining on his side. This was contrary to my usual experience, and needed explanation. When the patient awoke, I found him suffering from extreme œdema of the head and neck, with dilatation of the superficial veins of the chest, and a varicose condition of its venous capillaries, as well as of those down the outside of the arms. The soft palate hung low, and, with the whole of the pharynx, was œdematous, and consequently the breathing-space was remarkably contracted. It was now clear that even when the patient was on his side, and the chin only slightly bent towards the sternum, the dense and thickened cervical tissues would drive the larynx and root of the tongue up against the palate and back of the pharynx, thus still more contracting the breathing-orifices, and giving rise to the condition causing stertor.

This explanation of the case just described would entirely accord with the theoretical explanation suggested by my original dissections of the parts made prior to the year 1860.

#### **Nasal and Palatine Stertor—Apoplexy (Death).**

Mrs. T. H——, aged seventy-four, was seized with apoplexy at 9.30, whilst at supper, and died five hours afterwards. From the first she was pale and unconscious, and had tonic spasm of the right side; the jaws were closed, and there was some palatine and nasal stertor, even when she lay on her side. Both these were instantly stopped by pushing up the tip of the nose, which opened the nostrils widely, and the air rushed in freely and without

impediment. If the stertor was allowed to continue, the face became congested, which congestion passed away with the freer respiration. With the removal of stertor supervened constant vomiting, which each time made the facial vessels turgid. How palpably must these two states, vomiting and stertor, tend to cause an increased outpouring from the lacerated vessels of the brain. An apoplexy is really an accident, the result of which is very much influenced by circumstances.

#### Apoplexy (Difficulty of Localization).

Mrs. H——, aged fifty-three, was seized with sudden pain in the head, vomiting and faintness, at about 9.30 a.m., April 7, 1871. She walked up four pairs of stairs to her bedroom, and on the arrival of Dr. Lewis at 10 a.m. was drowsy, but capable of being roused, and was perfectly intelligent, with a clear memory. She said if she went upstairs she would never come down again. The condition looked more that of drunkenness than apoplexy. Pulse 80. Pupils rather contracted, conjunctivæ sensitive, no paralysis, a loose bilious action of the bowels.

April 9, 11 a.m.—I found her lying on her side, breathing easily and gently, the skin slightly moist and warm, temperature  $100.4^{\circ}$ , pulse 96, soft. She was wholly unconscious. The pupils were moderately contracted and fixed, the conjunctivæ had lost their sensitiveness; the jaw was clenched, and when I tried to open it she put up her hands, apparently to stop me. She had passed water freely in the bed, but there had been no action of the bowels, notwithstanding that croton oil had been taken, and a turpentine enema administered. Blisters had been applied. I

turned her on her back, and slight *palatine* stertor ensued, which gradually deepened, but, as the face was becoming darker, I turned her back to her side, when the stertor ceased. It was evident that she could move all her limbs, although she did so but feebly.

In the evening she was worse, and at 3 a.m. of April 10th she died. Those who watched her said that for many hours before her death the breathing was very bad, and rendered difficult by nasal stertor; there were a few râles, but no marked mucous stertor. There had been no previous head symptoms.

*Post-mortem Examination.*—The face had a livid appearance. Only the head was examined. The scalp and dura mater were somewhat unusually adherent, and the skull rather thick. On removing the dura mater a large extravasation was seen to have taken place, extending over almost the whole surface of the right hemisphere beneath the visceral arachnoid, and extending downwards beneath its base, and thence to the base of the left hemisphere and along the pons Varolii and medulla oblongata into the spinal canal, dipping between the convolutions in its course.

Above the middle third of the right hemisphere, in its substance, to the outer side, but not connected with the lateral ventricle, was a large firm clot, weighing about two ounces. The upper part of the clot communicated through a ruptured convolution with the effusion on the brain-surface; it was evident that the bleeding had commenced in the substance, and then burst its way out, but the exact origin could not be detected. The course of the hæmorrhage on the surface was just that which would result from gravitation, for the patient had been kept on her *left* side. The clot cavity was lined by softened, creamy, blood-

stained brain-substance, more than the eighth of an inch thick. The lateral ventricles were filled with clear serum, and the right was distorted by the blood-pressure. The corpus striatum of the right side was compressed and blood-stained, but there was no laceration of its substance.

*Remarks.*—It was impossible to diagnose the side of the effusion, for there was no definite paralysis; probably had she lain on her back, the increase of stertorous breathing would sooner have interfered with muscular action, and either betrayed the side affected or have earlier caused death. Was the nasal stertor caused by the advent of effused blood to the medulla? Its continuance certainly hastened death.

**Buccal, Palatine, Pharyngeal, and Laryngeal Stertor in the Same Case all relieved by Management. Pulse of Suffocation.**

On May 8, 1882, I was requested by Mr. Charles Lewis to meet him in consultation on a case of apoplexy at 11 a.m. The patient, a man aged sixty, felt ill whilst buttering his toast at 8.30, got up, leant against the door, and said his head was bad, and requested a doctor to be sent for. He was guided to a sofa, and on Mr. Lewis's arrival, a few minutes after, he was in deep stertor, with pale face, livid nose, and hard bounding pulse. Mr. Lewis found it difficult to do away with the stertor, and could only do so by straightening the neck, *i.e.* removing the chin further away from the sternum.

I found the patient lying on his side, with deep pharyngeal stertor and a strong bounding pulse, rather pale, expressionless face, and bluish cold nose. Mr. Lewis

found that his head had shifted again towards his sternum. On straightening the neck, it was found that laryngeal stertor (crowing inspiration) to some extent existed, apparently due to sticky mucus in the larynx ; but even after some attempts at vomiting, by which a large mass of mucus was expelled, it continued, but not sufficiently severe as to be much of an impediment to the breathing. By altering the position of the head, we could at will produce buccal, palatine, and pharyngeal stertor. The pupils were somewhat contracted and fixed, and the conjunctivæ completely insensible. There had been at first convulsive spasms of the limbs, and even now, after the stertor had ceased, slight occasional tremors were observed in the arms.

From the completeness of the coma it was clear that both sides of the brain, or that the parts about the medulla, were injured ; that the latter was most probable might be inferred from the complete paresis of the fifth, seventh, and ninth nerves, and probably the eighth also. An unfavourable prognosis was given. He died without change of symptoms at 3 p.m.

When Mr. Lewis first saw the patient at 8:30 a.m., *i.e.* before the full development of stertor, he had a small, slow, weak pulse (the pulse of shock or collapse) ; as the stertor continued, in about an hour it was full, and then became hard and bounding ; then, as stated above, after the stertor had been silenced, *i.e.* after the breathing had become easy, the pulse again became soft and weak.

Mr. Lewis observed that, in order to remove all impediment to the breathing, in addition to straightening the neck, it was necessary to have the elbow of the arm on which he was lying projecting behind his back ; this was

necessary in consequence of the large mass of flesh and fat of the shoulder being pressed up into the neck, or rather from the weighty head and neck pressing down on to the shoulder mass.

### Snoring Stertor.

*Naso-palatine snoring*, occurring when the air-current passes through the nose and causes the palate to vibrate, and *oro-palatine*, when the current passes through the mouth, are both caused by the larynx and base of the tongue moving slightly upwards and backwards during the inspiration, and the latter approaching the velum and narrowing the passage. This is much facilitated by the bending forward of the head, so contracting the space in the pharyngeal cavity ; and, conversely, it is rendered more difficult, almost impossible, by the head being thrown back. Sometimes, especially in old people, the snoring becomes a genuine pharyngeal stertor. The tendency of the larynx and tongue to ascend during inspiration may often be observed in the dying state, especially when the mouth is widely open.

The snoring of children with enlarged tonsils is orotonsillar and oro-pharyngeal: the mouth in these cases is open, and the tongue in the morning dry and brownish from the continued removal of its moisture by evaporation.

### Mucous Stertor and its Dangers.

This has already been referred to in Cases 1 and 4 in Chapter II., pp. 26 and 30, in which the dangers that may arise from mucus in the air-passages are very fully set

forth; but the subject is so important that I may add another case or two in further illustration.

On January 15th a gentleman, whilst signing his name to a document, became faint and vomited; he was conveyed home. On my arrival soon after, I found him conscious, but very faint and sick, and slightly paralyzed on his *left* side.

On the 16th he was much better in every way, but his pulse was only 38.

On the 17th, whilst taking his breakfast, he became suddenly aphasic, and was paralyzed on the *right* side, but his consciousness was unaffected.

On the 18th, at 4 a.m., he became completely unconscious, his pulse (40 to 60) and respiration were irregular, and his power of deglutition was lost. At 10 a.m., I found him lying on his back, breathing stertorously, his face bloated and of a deep purple-red colour. He was turned on his side, when the stertor ceased, the face cleared and became natural, and the pulse quiet and less thumping.

On the 19th, whilst lying in a quiet, unconscious state, he was turned on his back, when stertor recommenced, and he was nearly suffocated, until his position was changed to his side. His pulse and respiration now increased in frequency, and on the evening of the 20th he died quietly, and without suffering.

I watched the condition of the chest, and found the side which had been lowermost dull on percussion, and that very little air entered the lung of that side; mucus, and perhaps œdema, had contracted the air-space. On changing his position, râles appeared on the sound side, accompanied by the urgent danger above related.

Dr. Elin, of Hertford, in writing to me in 1881, says, "I

was much interested in your pamphlet; it brought to my mind a case that I was attending some ten years ago—a patient about sixty, with a sharp attack of bronchitis; chest full of râles, worse on the left than on the right side. He breathed easiest while lying on the left side. I left directions to keep him on that side, and on no account to turn him on the right; but they let him do it, suffocation set in, and he was dead before I got to him.”

**Croupy Stertor from Mucus in the Glottis, simulating Spasm of the Glottis.**

A child about six weeks old, in the last stage of exhaustion from malnutrition, was seized with spasm of the facial muscles of the nature of trismus; there was also divergent squint.

These symptoms subsided in about twenty-four hours, but were followed by what the nurse, a trained and intelligent woman, called spasmodic croup; she declared the child had died many deaths during the night. Fortunately, I had the opportunity of being present at one of these attacks, and I observed that the spasm was followed by large loose râles in the throat. The child was turned on its side, when a quantity of clear saliva drained away from its mouth, the attacks ceased from that moment, and the râles were no more heard. It was evident, from the child's weakness, that it was unable to expel the saliva from the glottis, and was much in the condition of a child who had got its food the wrong way. It should be added that the child was the subject of cleft palate, and this may have contributed to its difficulties.

**Apoplexy, Stertor, Euthanasia.**

A stout, healthy-looking lady of fifty-four years of age, and liable to intermittent attacks of neuralgia in the head and face, complained of headache, and took an aperient pill for its relief. The next morning (November 24, 1887), at daybreak, she was found sitting at the washstand, feeling faint and sick, and making occasional attempts to vomit. She appeared dazed, and her sensibilities were all dulled. Her maid induced her to get to bed, which she was able to do with assistance. At eleven o'clock, as she did not improve, Mr. C. Lewis was sent for, and he found her in the condition above named, but worse. He elicited that the aperient had acted freely, but, perceiving that the brain was oppressed, he administered four grains of calomel. At three p.m., he found her completely comatose. On placing her on her back, after a time, stertor commenced, and gradually increased in intensity; she was then placed on her side, and a blister was applied to the nape of the neck. The pupils at this time were moderately contracted and fixed, but conjunctival sensibility was not lost. She was perfectly indifferent to any attempts to rouse her, but it was evident that there was no special paralysis at that time of any limb, nor was the face distorted. The pulse was soft and feeble, and the countenance calm and free from flushing. In the evening I saw her in consultation, and found her in the condition just mentioned. The urine was passed involuntarily; there was no fever, and no indication for any special treatment. It was quite impossible to administer medicine by the mouth, as she was unable to swallow even a drop of water. The bowels had

not acted, but, as they had been freely relieved in the early morning, this was considered unimportant. An "injection rutæ" was administered, but it was not retained; mustard plasters were applied to the calves of the legs, and ice to the head. On the following day (November 25), there was still no change, except that the pulse had risen in frequency and was a little fuller. Another injection was ordered, and leeches were applied to the temple. November 26.—She appeared just as we had left her, in a deep sleep; no pain, apparently not even a discomfort. The injection produced no effect, the face was a little more flushed; the pulse had risen to 100, and the temperature ranged about 100°. November 27.—She was more flushed, and during the day she quietly passed away. The temperature rose to 106° just before her death. The bladder had emptied itself involuntarily during the whole time; shortly before death two ounces of urine were obtained; it contained albumen, but no casts or blood.

*Remarks.*—Could anything more have been done in this case? When first seen, she was nearly in a state of syncope, and the bowels had been freely opened, so that blood-letting or drastic aperients were contra-indicated. At my visit in the evening, although the condition was clearly apoplectic, we made the most searching inquiries into the possibilities of poisoning. The aspect was not that of opium-poisoning, nor were the pupils as contracted as they would have been if such a profound condition of coma had been produced by opium. Moreover, there was no opium or morphine to be found after a strict scrutiny of the rooms and drawers. We found a box of cocaine lozenges, from which some had been taken, but we had reason to believe that few, if any, had been taken the

preceding night. We had, therefore, no doubt that hæmorrhage had taken place in an important part of the brain, and that we could only wait and watch events; and, as I hold the promotion of euthanasia to be an important part of a physician's duty in cases which appear irremediable, we determined not to harm our patient by what the late Sir Thomas Watson would have called "senseless routine formalities." It is certain that the stertorous breathing and its distressful accompaniment, gradual suffocation, were avoided by the management of the position of the patient, and thus the family and friends were at least spared the harrowing appearances of that condition, as well as the persistent and painful sounds of stertorous respiration. The patient literally, from beginning to end, slept her life away. When one remembers the remarkable accounts of recoveries after severe and repeated blood-lettings reported by the celebrated Dr. Abercrombie in times past, and at the same time feels acutely the utter helplessness of one's position when face to face with a case like this, I confess it is, to my mind, an open question whether one ought not to yield our present prejudices against blood-letting to the convictions of its utility handed down to us by the great ones of the past, even if the general symptoms do not appear to justify its employment. It would be consistent with pathology to attempt to check an oozing from small vessels in one part by freer blood-letting elsewhere, which tends, amongst other things, to the more rapid formation of fibrinous coagulation in the vessels.

**Apoplexy—Sertor in the Lateral Position; Apparent  
Contravention of Ordinary Law.**

Colonel B——, æt. 55, the subject of albuminuria, and a man much addicted to sherry, found himself (on October 28, 1889) unable to use his fork at dinner. He had not long returned from the club, where he had been playing billiards, and had appeared quite cheery and well. I saw him about an hour later in consultation with Mr. Charles Lewis; he was partially undressed and on his knees, constantly passing small quantities of limpid urine, partly into a vessel and partly on the floor, for he had already drifted into a half-stupid, helpless condition, with left hemiplegia. The right pupil was extremely small, but this was said to have existed for years; the left was contracted and sluggish; the tongue was pushed over to the left, and there was left facial paralysis. The pulse was excited, but soft and small. There was constant restlessness and irregular movement of the right side, and some moanings, but no complaint of specific suffering of any kind.

Five grains of calomel were placed on the tongue, a blister to the back of the neck, and mustard poultices to the calves of the legs. On the following morning, he was quiet, quite unconscious, and breathing stertorously. On careful observation it was seen that the stertor was of the palatine and mucous varieties, and that there was but little real obstruction to the entrance of air.

In this respect a great change for the better had taken place since Mr. Lewis had altered the patient's position earlier in the morning. We now changed his position slightly, more towards pronation, and supported the back

with pillows; the stertor then ceased altogether, and a quantity of very viscid mucus was expelled from the mouth. A second five grains of calomel had been administered in the night, and croton oil in glycerine early in the morning, but there had been no action of the bowels, and the urine was passed unconsciously. Swallowing was now impossible; it was even doubtful if any of the croton oil which had been administered had entered the stomach. From the nurse's account, it was more likely to have found its way into the windpipe.

An aperient enema was administered, and another blister applied. In the evening, at the request of Mr. Manley Sims (who, as his own doctor, now came to see him), ice was applied to his head. He was now in a state of profound apoplectic coma, but there was no stertor, and his pulse was soft and small.

On the following morning (October 30), he was exactly as we had placed him the preceding evening, but there was now some stertor. On investigation it was noted that it was *expiratory* stertor, and arose entirely from loose viscid mucus in the fauces; this was removed by the nurse, and the stertor ceased. He sank quietly about two hours afterwards.

*Remarks.*—His wife told us that for some months previously he had suffered from sudden startings and movements during sleep, and cramps in his legs, and on suddenly awaking would burst into a profuse warm perspiration. He was gouty, and very careless in his mode of life. It will have been seen, from the report of the case, that stertor was present on two occasions, even when the patient was *on his side*, but that the physical causes were slight and immediately removable, and that the obstruction to the

respiration was not sufficient to cause suffocative breathing of importance to the patient's life. Noise alone must not be trusted as a symptom, but its amount, nature, and cause must at all times be scrupulously investigated; treatment then becomes both simple and effective.

#### Opium-poisoning or Apoplexy? Euthanasia.

On Friday, February 17, 1888, Mrs. W——, æt. 57, was seized with violent, agonizing headache. She took two moderate doses of chloral, but soon after rejected them. Later on she took twenty grains of bromide of potassium, and, finding herself no better, in the evening, at seven o'clock, she insisted upon having administered a hypodermic injection of morphia. Her doctor objected strongly to this, as he knew her to be suffering from albuminuria. She protested that she had repeatedly had it done before under similar circumstances, and that it had suited her well. She vomited within two minutes of the injection, and then quietly fell asleep.

The following morning, February 18, the doctor was sent for in haste, as her husband was alarmed at her condition. She had been breathing stertorously all night, and was then very seriously exhausted, in a profound state of coma, with stertorous respiration and a cold clammy skin. She was turned on her side, and the stertor ceased. There was no conjunctival reflex; the pupils were contracted and fixed, the breathing was quick and shallow, and the pulse extremely feeble. She was unable to swallow.

At 9 a.m. I was summoned in consultation, and found her in the condition just described, except that her face was now warm. Her pulse was now 108, and her respira-

tions 48. It was quite impossible to rouse her, or to attract her attention in any way. The pulse was so feeble, and the condition generally so grave, that we had reason to fear her life would have ebbed away in the course of half an hour. All attempts at rousing only made the pulse flicker, and cause us to fear that immediate death was impending.

The question which presented itself for solution was, What was the direct cause of such grave symptoms? Was it opium-poisoning, was it uræmic poisoning, or was it ingravescent apoplexy? I was inclined to believe that it was apoplexy, but we felt it right to act as far as we dare as if it were the result of the hypodermic injection. Caffeine was twice injected into the arm, and a rue-injection administered per anum, and ammonia was kept constantly over the widely opened mouth. At 1 p.m. she was rather improved; her respirations were 38, and her pulse was slightly firmer, but there was still no conjunctival reflex. At 6 p.m. she was still a little better, and her respirations remained the same. A blister was applied to the nape of the neck, and, as she could now swallow a little, a teacupful of milk was ordered to be given every three hours.

On February 19, at 9 a.m., she looked much more natural in expression; she smiled when spoken to, but evidently was without understanding. The left pupil was more dilated than the right, but both were fixed; the pulse was 100, and more resistant, and the respirations 48. At 7 p.m. she was less well. The temperature had risen to 99.5, and her pulse to 120. Four grains of calomel were given, and the milk continued as before.

February 20, 9 a.m.—She was in all respects worse. Both

pupils were now dilated and unaffected by light. The bowels had been relieved by castor-oil injection. From this time until her death in the afternoon she slept quietly. There had never been any stertor from the moment she was first turned on her side; nor had there been the slightest sign of suffering from the beginning to the end of the illness.

#### The Onset of Pneumonia Simulating Apoplexy.

Mr. L——, æt. 84, was taken suddenly ill on November 18, 1887, at 8.30 a.m. Mr. Lewis saw him, and found him so far unconscious as to be unable to answer questions; he could be aroused sufficiently to put out his tongue, which, when protruded, was directed to the right side, and his face was drawn to the right side also; the pupils were small and regular, and acted to light; the right arm and right leg were apparently completely paralyzed; the pulse was intermittent, soft, and not more than 30 to the minute. He looked like a dying man. Half an ounce of brandy in milk was administered with difficulty, when the pulse immediately improved.

Soon after nine I saw him. He was expressionless and pale, and his mouth was partly open. In a minute his pulse fell to 27, when his jaw dropped, his eyes turned up, a ghastly expression came over his face, and a slight epileptiform convulsion supervened.

I thought him dying, but more brandy was administered, his pulse rose to 30, and he rallied.

After taking more brandy he became more conscious, and it was then seen that the tongue was put straight out, and that the facial paralysis had disappeared; moreover,

it was now the *left* side of the body which was paralyzed, and he could now move his right arm and leg; his urine passed unconsciously. Brandy and milk were administered at short intervals, and during the day he gradually rallied. On the following morning (November 19) his pulse was 56 and somewhat full, his temperature elevated, and his respiration seemed irregular and quickened.

November 20.—Pneumonia of the right base was detected, and the general symptoms now pointed in this direction. From this time he slowly recovered.

*Remarks.*—It appears that Mr. L—— had taken an ordinary aperient pill the day before his attack, and had been much prostrated by its action.

The sudden onset of the symptoms and the accompanying paralysis made it almost certain that the attack was apoplectic, but the further course of the malady appeared to indicate that the grave nerve-symptoms only substituted the rigor which usually inaugurates the onset of pneumonia, and that the extreme inhibitive action of the pneumogastric so lowered the heart's action as to cause almost fatal anæmia of the brain, giving rise to those epileptiform attacks which frequently accompany death from hæmorrhage. In this, the case is similar to that of a gentleman of my acquaintance whose pulse was delayed, at times, to 17 in the minute, and invariably, when it arrived at that number, convulsions occurred. Dr. Tyson, who attended him, informs me that he could tell with absolute certainty when an attack of convulsions would occur, and he had, during the long illness from which this gentleman suffered, many opportunities of confirming this observation.

I introduce this case in the series of Apoplexy as an illustration of the difficulties of diagnosis in the early stage

of a sudden attack. There is, however, one other point in connection with this convulsive attack to be entertained, and that is the irritative and depressing effect of an aperient. We have all of us seen, from time to time, especially in children, convulsions of a very violent kind supervene on the action of an aperient administered for a supposed bilious or febrile attack, and we have often had to wonder whether those convulsions were caused by the aperient or by the onset of one of the eruptive fevers, and we have as often doubted the treatment we ought to pursue.

#### **Stertor in Fractures of the Skull.**

“Cambridge, September 14, 1889.

“MY DEAR BOWLES,

“About a fortnight ago I was called in consultation to see a gentleman in the country who a few days before had been thrown out of his dog-cart on to his head; he had been seen by Professor Humphry a few days previously, and in his absence the local doctor sent for me. I found the patient lying on his back, and making such a noise during breathing that one might have heard him half-way down the stairs. I looked at my patient, and immediately realized the danger he was in; his throat was full of mucus, which was oscillating between his velum and trachea or some higher point. He was quite insensible, and every now and then, in the midst of irregular and shallow breathing, associated with a tremendous rattle, he seemed as if he were going to choke instanter. Your aphorism, ‘Turn him on his side,’ immediately occurred to me, and, in less time than it takes me to write this, the

noisy breathing had almost disappeared. I had him turned at first somewhat on his face, to let a quantity of mucus run out of his mouth, and then left him, with strict injunctions to his attendants that he should on no account be allowed to lie on his back. When I first saw him I was exceedingly alarmed, and thought that he had but a short time to live, for he had deep stertor, a bluish face, and swollen, turgid veins. Had I not been sent for, I believe the patient would have been dead before many hours had elapsed; instead of this, on visiting him the next day, his wife said that he had been sleeping 'beautifully and quietly.' He gradually regained consciousness, and is now convalescent.

"Ever yours sincerely,

"E. CARVER."

A case of death from fracture of the skull attended with stertor has already been related,\* and, as well, an account of the *post-mortem* examination. Reasons are also given how lives may be saved in these cases by the effectual relief of the patient from stertorous respiration. The above case related by Mr. Carver effectively illustrates the truth of the views then expressed.

\* *Vide* p. 40.

## CHAPTER V.

ON CERTAIN DANGERS AND RESPIRATORY DIFFICULTIES  
ARISING DURING THE ADMINISTRATION OF ANÆS-  
THETICS, AND IN OTHER CONDITIONS.

Similarity between the anæsthetics and apoplectic conditions—Pulling on the tongue not always successful—Dr. Hewett's paper—Treatment of chloroform asphyxia, with illustrative cases—Reported deaths, with remarks—Suffocation from poisonous gases and poisons—Syncope—Drowning—Bleeding in apoplexy ; comments—Extracts from Copland and Niemeyer.

It will readily be conceded that a person under the full influence of an anæsthetic is in a condition physically equivalent to a person in the apoplectic state, and subject, therefore, to the same physical laws. The tongue will gravitate to the lowest point ; the vomit may enter the larynx ; the mucus, which under some circumstances is largely secreted, froths up and collects about the aditus laryngis ; and the chin, if bent on the sternum, contracts the pharyngeal cavity and narrows the air-way ; so that respiratory impediments of various kinds are ever at hand to add to the anxieties of the administrator.

These difficulties were well known to me in 1856, when I made my first dissections for the purpose of investigating their causes ; and I indicated their applications to chloroform dangers in a paper read at that time at the St. George's Hospital Medical Society, and subsequently

published in the Transactions of that year. In the debate, Mr. Harvey stated that Professor Syme was in the habit of seizing the tongue with a pair of forceps, and drawing it away from the back of the pharynx when respiratory embarrassment occurred from this cause. I had reason to doubt the efficacy of Professor Syme's proceeding; and subsequently, I was enabled to prove its untrustworthiness from experiments performed on myself, and from subsequent dissections. Pulling at the tongue's tip will not always raise its base, nor the epiglottis; neither will it clear away mucus or vomited matter.

For some years past \* Dr. Frederick Hewett has made a careful study of the causes of the dangers connected with the administration of anæsthetics. He has shown that, even very slight impediments to the respiratory function give rise to immediate and grave danger, and that the beginning of stertor ought to be the beginning of anxiety to the administrator, as the heart is then liable to almost instant failure. He says, in his conclusion, that "the slightest impediment to respiration should be corrected as soon as possible, in order to prevent an apnœa of a more abiding character from becoming established."

As to the causes of the impediment, he is entirely in accord with the views I have so frequently enforced, and he further draws attention to the fact that "the tongue and parts constituting the boundaries of the upper air-passages may, by vascular engorgement, become swollen, and thus obstruct respiration. The more plethoric, bloated, and flabby the patient, the greater will be the tendency to the latter form of embarrassment."

\* Paper read at Royal Medical and Chirurgical Society, December 9, 1890.

In the large number of reports of accidents from anæsthetics published in the journals, illustrations of the causes above referred to may be detected ; and although there may be a feeling in the minds of the administrators that impeded respiration may be a source of mischief, the exact cause is not usually made out with sufficient certainty to enforce complete removal of the, perhaps, one and only impediment. In the haste and anxiety to do something, many measures are only half executed, thoroughness is overlooked, and some little thing is left undone, which might make all the difference to the life of the patient.

Of the following illustrative cases the first occurred in my own experience :—

CASE 1.—In the year 1863 I was present at the reduction of a dislocation of the shoulder in a County Infirmary. The patient was sitting on a chair fastened to a post, whilst the pulleys were on the arm. After chloroform had been administered for some time, the man suddenly ceased breathing and became deadly pale, the jaw dropped, and the tongue touched the incisor teeth. The gentleman who had charge of the chloroform immediately procured water and dashed it on the face and back. Seeing the man did not recover, I at once, though a stranger, introduced my finger into his mouth and hooked up the *base* of the tongue, when the patient instantly inspired, and rallied without further difficulty.

CASE 2.—In March, 1891, Dr. Percy Lewis was administering chloroform to a very fat woman of sixty years, for the removal of a urethral caruncle. At the

operator's request, the patient was anæsthetized on her back. She became unconscious in about three minutes, when she suddenly ceased breathing, and became of an ashy grey colour. Pulling on the tongue had no effect; but when, with the help of the operator, she was turned on her side, the tongue and parts at the base of it falling forwards, as they must do in that position, she gave a gasp, respiration recommenced, and her normal colour returned.

Dr. P. Lewis has several times seen this accident occur in hospital practice, when patients have been chloroformed on their backs, and has, as often, seen the patients revive when effectively turned on their side.

CASE 3.—In the *Lancet* of 1874 a case is recorded as follows: "Geo. W——, aged forty-eight, a strong, healthy-looking man, occupation a joiner, described as a drunkard and a passionate man, was admitted into the General Infirmary at Leeds on July 15, 1874, suffering from destructive inflammation of the middle joint of the long finger of the right hand, which was caused by his striking a comrade in a quarrel. On Thursday, July 16th, he was brought into the operating-theatre for the purpose of having the finger amputated, and at his own request chloroform was administered by the house-physician in the usual way, on a square piece of lint, and from a bottle with a drop-cork. He took it rather badly, struggled more than is usual, and was just fully under the influence of the chloroform, not having taken more than two drachms, and the operation barely begun, when he gave two or three snorts, suddenly

becoming livid in the face, his respiration stopped, and his pulse became very faint at the wrist. Artificial respiration by the Silvester method was at once commenced and continued for an hour, together with cold affusion to face and chest, galvanism to heart and diaphragm, and ammonia to the nostrils. The heart was heard to beat faintly at the end of about twenty minutes; after that no sound could be detected, and no voluntary attempt at respiration was at any time made by the patient. The autopsy was made twenty-two hours after death. The brain was found healthy, the lungs were slightly congested. The heart was flabby, slightly enlarged, weighing  $12\frac{1}{2}$  oz. Both ventricles contained a little fluid; blood-valves healthy. The abdominal organs generally were congested, but otherwise healthy. The stomach was perfectly empty.

In answer to my inquiries for further particulars relating to the above, the house-physician, Dr. Pickles, wrote: "1. There was no stertorous breathing. 2. We kept the tongue forwards by means of artery-forceps during the whole time artificial respiration was being performed. 3. We did not listen for any respiratory murmur, but we could hear the air enter and leave the chest very distinctly."

CASE 4.—In the *British Medical Journal* of October 19, 1889, "A death from the inhalation of chloroform occurred at the Richmond (Ireland) Hospital. The patient was a woman about to undergo amputation of the thumb. She had taken a very few inspirations, when her *face* was observed to *become deeply congested*. The administration of the anæsthetic was at once

stopped, artificial respiration was set up, and the external jugular vein opened, but she never rallied. At the *post-mortem* examination the heart was found to be infiltrated with fat, and the brain congested."

CASE 5.—In the *British Medical Journal* of November 8, 1890, a case of death under chloroform is recorded at St. Mary's Hospital as follows: "J. T—, a labourer, aged thirty-six, a well-nourished man with a florid complexion, was admitted on October 11, having a recent fracture of his left patella. It was decided to wash out the distended knee-joint, and to approximate the fragments with pins (Mayo Robson's method).

"On October 15th the patient was taken to the theatre for this purpose. Auscultation of the heart showed no murmurs and good heart-sounds, though the first was somewhat too clear. The patient appeared very nervous. Chloroform was given by me in a flannel inhaler, with plenty of air. During the early minutes he struggled a good deal, called out, and two or three times he held his breath momentarily. The pulse was at this time frequent and irregular in force, but the patient's colour was good, and there was no suspicion of danger. Suddenly, and just after a very short *spasm of glottis and masseters*,\* his temporal pulse ceased. Artificial respiration was immediately begun, injections of ether and strychnine were given, and faradism tried; and a superficial vein in the neck was opened. During the first half-minute of the artificial respiration there were three inspiratory gasps, but no other evidence of reaction. The heart ceased to act at about four or five

\* The italics are mine.

minutes from the time of commencing the anæsthetic, and half a minute before death the conjunctival reflex was present. The pupils remained somewhat contracted during the whole period, and after death.

“The *post-mortem* examination showed that the lungs were engorged, and that there was much fat under the epicardium. The *right\* heart was distended with liquid blood, and the left heart empty.* The substance was pale and friable, and the muscle-fibres showed under the microscope advanced fatty degeneration. There was some early atheroma of the root of the aorta. The liver was very soft, but not markedly fatty. The kidneys were of normal size, the capsules adherent in part. There was some increase of intertubular tissue, and numerous fat globules were seen in the tubal epithelium.”

*Note by Mr. Page.*—“I had not at the time, nor have I now, the least doubt that the death in this case was due to sudden heart-failure. Waiting to begin the operation, my eyes were upon him at the moment the first sign of danger was seen, and instantly, without the shortest delay, I myself began artificial respiration. The three deep inspiratory gasps which followed were like the inspirations of the dying, and bore no likeness to the breathing which comes in response to artificial respiration. I felt sure, and then remarked, that the man was dead, and there never was the trace even of a response to the various efforts at restoration which were kept up for half an hour. That danger under anæsthetics is much more frequent on the respiratory than on the cardiac side I feel little or no doubt, from my own

\* Italics are mine.

experience and observation. I have long made it a practice at once to begin artificial respiration, and I am confident that in several instances—some of them most alarming—life has been saved in this way. I am convinced, however, that, as in this case, death may in rare instances be the result of heart-failure."

The above case, so carefully reported by Mr. H. Collyer, the resident obstetric officer, and afterwards commented on by Mr. Page, no doubt was, as Mr. Page insists, due to cardiac failure. But there are a few points in the relation of the case which may raise some question in the mind of the reader. In the first place, there was "spasm of the glottis," and therefore obstruction primarily to respiration; secondly, the method of the artificial respiration is not described; thirdly, "a vein in the neck was opened" to relieve engorgement, one presumes, of the right side of the heart.

At the *post-mortem* examination, "the right side was distended with liquid blood, and the left heart empty," the admitted pathological condition of obstructed respiration.

Personally, I am always so suspicious, in all these cases, of possible existing mechanical obstruction, that I should be disposed to believe, even in this carefully managed case, if the patient were treated on his back, that a block in the pharynx might still have been overlooked.

CASE 6.—When in Berlin in November, 1890, seeking information on Professor Koch's system of inoculation, I had the opportunity of being present at some operations performed under the supervision of Professor Von Bergmann. In one case, during the administration of

chloroform, I observed the patient suddenly cease to breathe, and the administrator's face to flush up and become anxious. He at once stopped the chloroform, and tried to rouse the patient, but with no good result, until he turned the patient's head sideways, placed his fingers behind the ramus of the jaw, and pressed it forcibly forwards and upwards. The respiration instantly recommenced, and the operation was completed without further incident.

I do not, of course, pretend to say that in all cases death arises only from the falling back of the tongue ; but it must be admitted that the cases, as reported, are often open to such an interpretation. As the Sylvester method of artificial respiration is the one now in common use, it is fair to infer, unless otherwise stated, that such was the method employed when no special one is mentioned ; and as this is employed when the patient is lying on his back, we may assume, with much certainty, the constant presence of a possible and probable cause of mischievous obstruction in the helpless and depending tongue.

SUFFOCATION from *poison* or *poisonous gases* does not produce the same series of phenomena as suffocation from mechanical causes, or rather not in the same sequence. In the former cases, the blood and the heart are primarily acted upon ; the circulation is first interfered with, and then the respiration.

In SYNCOPE, too, the respiratory disturbances are secondary to the cardiac failure ; but in these cases, as in every other form of unconsciousness, the air-ways must be jealously watched, and every possible obstacle to the free and easy entrance of air must be removed. In all these

states, the tongue and its attached muscles become in effect paralyzed, and, therefore, subject to the ordinary laws of gravitation.

In DROWNING or SUBMERSION the conditions are even more complex. It is true that danger arises primarily from deprivation of air—*apnœa*; but the entrance of water into the lungs produces rapid and serious changes in the blood and circulation, and shock, syncope, and spasm, more or less combined, become additional causes of danger, requiring the fullest consideration in our management of the case. It is not proposed now to discuss this subject in all its bearings; but sufficient has already been said in these pages to show that, with regard to the position of the body and to the removal of the mechanical obstruction, the same rule holds as in every state of general paralysis or unconsciousness; but in drowning it is, in addition, necessary to evacuate the water from the lungs, and to provide for the introduction of fresh air by artificial respiration. The proper system or method of the artificial respiration has for years been much under discussion; but it will have been seen by the reader that, from my point of view, all reason is overwhelmingly in favour of the Marshall-Hall method, for no other known system fulfils so entirely the requirements of readiness and facility of application and completeness of result.

The removal of the cause of stertor so immediately changes the aspect of a case, that the question of blood-letting is at once solved in the clearest and surest manner. The truth is, as already stated, two separate conditions of the apoplectic state have been jumbled together and

treated as one : the cerebral affection, and the condition of suffocation consequent upon it. As a respiratory impediment, pharyngeal stertor may be regarded as equivalent to croup in laryngitis ; the former is apoplexy plus suffocation, the latter laryngitis plus suffocation. We feel it necessary to relieve croup by a serious operation ; whereas stertor is left to itself, although it may be relieved by merely changing the position of the body.

On referring to the literature of the subject, I have been astonished to find how difficult it is to draw any conclusions from the descriptions of the disease, or the treatment to be adopted. Authors are not agreed ; and one of our most distinguished neurologists, in an article on apoplexy in a recent important work on medicine, appears to arrive at the conclusion that in apoplexy we can know nothing, we can foretell nothing, and we can do nothing. This confusion arises in a great measure from the stertorous breathing, converting all cases in which it is present into cases of apoplexy plus suffocation.

It is agreed that there are cases of apoplexy in which the face is pale and the pulse small, and in which bleeding is not to be thought of, and also that there are cases in which stertor is not present ; but I cannot, with all my diligence, find out for certain, from any works that have been open to me, whether these two conditions—that is, the pale face and absence of stertor—were coexistent. There are no observations, as far as I know, made by any author as to the position of the patient in non-stertorous cases.

Suffocation, added to grave mischief in the brain, must of necessity affect not merely the symptoms and progress of cases, but also their mortality. Those only

who have observed the extraordinary change on the removal of suffocative stertorous breathing, can judge how the diagnosis and prognosis are affected by it, and, not less so, the treatment and morbid anatomy.

Most modern writers on apoplexy adopt the general views of Dr. Abercrombie, and naturally, from the broad division of cases into sthenic and asthenic, are disposed to bleed in the former, and to avoid it in the latter ; whereas, if we look upon the hard, slow pulse as the result of the heart labouring to overcome an obstruction in the lungs (suffocation), we shall at once see that our first duty is to remove this obstruction, and thus simplify the case.

Heberden and Fothergill were opposed to bleeding in any case, and the latter has made some curious suggestions which pertain to the subject of this paper. He says that "even the hard, full, and irregular pulse, which seems imperatively to call for a very free use of the lancet, is often an insufficient guide, since it may be that struggle which arises from an exertion of the *vires vitæ* to restore health." From what has already been said, it will readily be guessed that *I* should say, "This strong pulse arises from an exertion of the *vires vitæ* to overcome vascular obstruction from gradually increasing suffocation."

Dr. Copland, in his "Monograph on Palsy and Apoplexy," presents to us the generally accepted views of apoplexy and its management up to the date of its publication in 1849, and the following extracts from that work will show how accurately symptoms had been observed, notwithstanding the absolute ignorance at that time of the exact part played by the physical states which give rise to stertor in the production of those symptoms. Throughout these extracts it is constantly seen how the weak, small pulse

had been observed to be coincident with the *absence* of stertor ; and the converse, that the full, strong, slow pulse was associated with the *presence* of stertor. He says :—

“The patient is more or less suddenly seized with profound stupor, the eyes being either open or closed ; the breathing is deep, slow, sonorous, or stertorous, and the pulse slow, full, hard, or strong—sometimes irregular or unequal. In this state of the disease, the above are often the chief symptoms, no signs of paralysis being observed.”\*

“In this variety of the disease, the patient falls down deprived of sense, consciousness, and voluntary motion ; is like a person in a very deep sleep, with his face much flushed, tumid, or occasionally livid ; his breathing slow, deep, and stertorous ; his pulse full, natural in frequency, or slower than usual.”†

“He had been blooded largely when I saw him. His breathing was *not* stertorous ; his pulse was weak, small, and quick, and his countenance sunk. The brain, on a careful examination, presented no change in colour or consistence, and was even less vascular than usual.”‡

“There are certain symptoms occasionally met with both in simple apoplexy and in apoplexy associated with palsy, to which I shall briefly refer. The pulse is often full, strong, and slow, or of natural frequency in the first form of simple apoplexy, and in apoplexy associated with hemiplegia, and occasionally in palsy passing into apoplexy. In other cases, and especially in those which are intense, and particularly in the second form of simple apoplexy, and in palsy which has passed into apoplexy, it is often small, feeble, and unequal or irregular. The

\* “Monograph on Palsy and Apoplexy,” par. 184, p. 108.

† Ibid., par. 187, p. 110.

‡ Ibid., par. 191, p. 112.

respiration, both as to strength and frequency, generally presents similar characters with the pulse ; when the latter is slow and strong, the former (is) deep, slow, and stertorous ; and when the pulse is weak and frequent, respiration is quick, less laboured, and much less sonorous. Deep sighs are occasionally observed in all the forms of the disease." \*

Niemeyer, more than others among recent authors, has attempted to be systematic, and to clear away the confusion attached to apoplexy ; but, like others, he fails, from not discriminating between the apoplexy and the suffocation. He believes that the shock and oppression of the apoplectic state arise from the anæmia of the brain-substance, from sudden compression of the cerebral capillaries. This anæmia is always seen after death, and is shown during life by the very symptom which has always had a contrary interpretation—"a remarkable pulsation of the carotids." This, instead of being a sign of increased pressure of blood to the head, really indicates that the flow of blood into the skull is obstructed "by the space," he says, "in the skull being affected, so as to prevent the escape of blood from the afferent vessels"—throwing the blood back, as it were, into the carotids.

As a consequence of this view, under the head of treatment, he says, "It is evident that, under some circumstances, venesection is a very useful remedy ; under others it is very injurious, and the indications for it may be very exactly given. In order that as much arterial blood as possible may enter the brain, we must try to facilitate the escape of venous blood, without, however, diminishing the propelling power too much." (What a plea is this for

\* "Monograph on Palsy and Apoplexy," par. 233, p. 139.

removing suffocation !) Then he continues, "If the impulse of the heart be strong, and its sounds loud—if the pulse be regular, and no signs of commencing œdema of the lungs exist, we should bleed without delay. If, on the contrary, the heart's impulse be weak, the pulse irregular, and the rattling in the trachea has already begun, we may be almost certain that bleeding would only do harm, since the action of the heart, which is always weakened, would be still more impaired, and the amount of arterial blood going to the brain would thus be still more decreased."

## CHAPTER VI.

## STERTOR IN ANIMALS.

General considerations—Comparative anatomy of the parts concerned in stertor, in the horse, pig, sheep, ox, and man, and at different periods of life—“Cast” sheep—“Cast” horses—“Roaring” horses—Experiments.

WITH the growth of physiology and our increasing experience, the “practice of physic” \* appears, in a sense rapidly becoming the “practice of physics.” Pill and potion are steadily giving place to the judicious administration of air, exercise, hill-climbing, gymnastics, massage, kinesipathy, zanderism, *et hoc genus omne*—rest, position, surgical and medical appliances, hot and cold bathing, Turkish baths, the compressed-air cure, climate, with its different atmospheric pressures, from the cold and elevated regions of the snowy Alps in winter, to the warmer and more genial regions of the Mediterranean littoral and the Canary Isles.

What are these methods of treatment—in addition to the uses of heat, light, and electricity in their various forms and in varying degrees—but the practical application of the principles of physics to the disordered and diseased conditions of the animal body? Especially does this apply to the management of the apoplectic condition ;

\* Paper read at British Medical Association meeting at Glasgow, August, 1888.

for here most surely, as vital force diminishes, so do the laws of physics assert their sway. The paralytic limb, no longer amenable to the subtle forces of the patient's will, becomes the sport of forces from without, forces that will only yield to the return of what the ancients called the *vires vitæ*. As in man, so in animals, the same law obtains.

The following record of observations and dissections, undertaken to inquire into the subject of stertor in animals, will, I think, assist, with what I have already stated in reference to man, in demonstrating instances of the reality of some of the changes above referred to.\* "Fat as a pig," "sleeping like a pig," and "snoring like a pig," are expressions commonly used by the vulgar to illustrate conditions of a similar character in the human being. The aptness of these expressions was much impressed upon my mind by a visit to the Smithfield Cattle Show. On entering the piggery I was greeted by a chorus of snoring swine; the air was full of stertor. There I saw before me, in perfection, fatted pigs, sleeping pigs, and snoring pigs. My mind, always on stertor bent, was at once exercised as to the cause of the great difference of sounds in the piggery and in the central hall. In the hall, as in the piggery, were animals as fat, and sleeping as profoundly; but not a sound of stertor was to be heard. I concluded that the difference depended upon a natural conformation of the soft palate and back part of the throat. It seemed, from what I saw and heard around, that snorers were omnivorous, non-snorers herbivorous. It was observable that the attitudes of the sleepers were somewhat different.

\* *Royal Medical and Chirurgical Transactions*, 1860; Quain's "Dictionary of Medicine," article on "Stertor;" *Lancet*, 1880; *British Medical Journal*, 1881.

The cattle and sheep were more prone in their sleep; the pigs lay more commonly on their sides. But this alone could not account for the great difference between noise and no noise. I noted that the two forms of stertor observable in pigs were, apparently, the palatine and the nasal; the palatine occurring in expiration as well as inspiration, the nasal only in inspiration. This was only what might have been expected, for the soft palate would vibrate with either current of air, whereas nasal stertor would only occur with insufflation and approximation of the *alæ nasi*. A very experienced herdsman told me that he had very occasionally heard a "beast," *i.e.* an ox or cow, snore, and this I hear from an old shepherd is *his* experience with sheep. I have never heard a horse snore, but snoring dogs we all have heard, more in some breeds than in others.

The anatomy of the *velum palati* in horses and other domestic animals differs in some respects from that of man. In the horse, as stated by Professor Youatt, "the *velum* forms a perfect division between the mouth and the pharynx, so that, although it yields and permits the food to pass under it in order to enter the pharynx, it prevents the return of the food; and the horse, except in the convulsive spasms of death, breathes and vomits only through the nose." The pig, like the horse, breathes ordinarily only through its nose, and, from dissections which I have made, I find the anatomy is very similar in the two animals, the base of the *epiglottis* being situated posterior to the *velum*; and as there is no, or only a very rudimentary, *uvula*, the *velum* lies flat upon and, with its yellow elastic and muscular structures, firmly clasps the upper surface of the tongue, just at the root of the

epiglottis, entirely cutting off all communication between the mouth and the pharynx, except during the act of deglutition. The epiglottis almost entirely surrounds the opening of the larynx, and reaches around and outside the arytaenoid cartilages. It stands high above that opening, and its upper edge is curled downwards and outwards; the tip projects also, forwards and downwards. This arrangement would tend to prevent the liquid food upon which an animal of this age (six months) almost entirely lives, from either regurgitating into the nostrils or overflowing into the larynx; and would of necessity direct it, on its way to the œsophagus, into two channels, one on either side, between the sides of the pharynx and the sides of the epiglottis. The soft palate or velum is firm and strong, and, running backwards from the uvula, meets the fibres of the opposite side, completely encircling the epiglottis and larynx, and forming at the upper opening of the œsophagus a strong sphincter-like band. Behind this is a pouch of considerable size, the utility of which is not at present to me very clear. Chauveau speaks of it as "a pouch immediately above the glottis, between the thyro- and crico-pharyngeal muscles." In front of the palate, the mucous membrane of the base of the tongue lies in large loose folds, permitting great expansion of this part of the buccal cavity during the passage of food.

In sheep, on the contrary, the soft palate does not reach to the tongue, and the epiglottis is situated slightly anterior to, and (when the animal is prone) at a lower level than, the velum, thus enabling the animals to breathe through the mouth; and the food which is returned from the stomach by vomit or for rumination passes by the sides of the epiglottis and below the velum into the mouth.

Chauveau says that in sheep there is no arytæno-epiglottidean ligament, but I find very remarkable loose and free folds of mucous membrane running from the lateral edges of the epiglottis, on the outer sides of the arytænoid cartilages to their bases, and it occurs to me that they must form some protection to the larynx on the regurgitation of food during rumination. The posterior bands of the soft palate, instead of surrounding the epiglottis as in the pig, and forming a strong sphincter to the entrance of the œsophagus, become much thinner, and appear to lose themselves in the sides of the walls of the pharynx; but doubtless the fibres of the palato-pharyngei muscles contained within these pillars follow much the same course as in man.

The narial and post-narial cavities are relatively much smaller in the pig than in the sheep, and it is the small size of those cavities and the fact of the epiglottis being confined in the pig to the contracted post-narial cavity that causes the animal to snore so profoundly during sleep, and of course, as fat accumulates in large quantities in the cellular tissue about the neck and pharynx, the post-narial cavity becomes more encroached upon and narrowed, and the unseemly noises are therefore more pronounced.

In oxen I find anatomical conditions very similar to those of the sheep, and I was fortunate enough to find, in an animal just slaughtered, some macerated food enclosed in a sort of gutter or tunnel between the arytæno-epiglottidean folds and the posterior pillars of the palate, showing the course the food was taking during the regurgitation of rumination.

The epiglottis of the ox is more curled downwards and forwards than that of the sheep.

In man the mouth, the tongue, the velum, and the muscles are not only used for the mastication and passage of food, but as part of the organs of voice and respiration, modulating the sounds in phonation and articulation. The velum does not reach the tongue, but hangs in mid-air, ready for the most delicate vibrations and movements of all kinds.

During my anatomical investigations of the relative positions of the various parts concerned in the production of stertorous breathing, I was struck by the differing forms of the epiglottis in many of my cases; eventually I found that the epiglottis differed in shape and position according to the age of the child or animal under investigation. In the sucking infant it is curled laterally upon itself backwards, very convex in front, and concave behind; the chink of the glottis is relatively higher up and closer behind the epiglottis than in later life; and on either side, formed by the glosso-epiglottidean folds, is a little valley at a lower level than the glottis, so that the liquid food of the suckling is directed by the convex-fronted epiglottis into this valley, and thus prevented from going astray into the larynx.\* The uvula, in the few cases I have examined, exactly fits into the tip of the epiglottis, thus adding to the child's safety. As the child increases in age, the epiglottis expands laterally, and presents almost a plane surface towards the base of the tongue, and the chink of the glottis is, relatively to the epiglottis, lower down. As confirmatory of this, in marsupials the mothers have a provision for forcing their milk into the mouths of their young whilst they are in the abdominal pouches, as they are then too feeble to suck, and, to prevent the milk

\* See Plates at p. 115.

getting into the trachea, the larynx is drawn up to the back of the nostrils, whilst the fluid passes beside it into the œsophagus, so that the animal can continue breathing whilst being fed. I have reason to believe (from less extended observations) that in all mammals important developmental changes take place after birth. Independently of these changes being of scientific interest, they become, when understood, of real practical value ; for I think it will generally be conceded that stertorous breathing, and the ill consequences of unnatural positions in health and disease, are much less likely to happen to the young and active than to the plethoric and those who are more advanced in life.

If sheep get, as they sometimes do, on their backs in a rut or ditch ("cast" or "mislaïd," as it is called), they quickly die ; and frequently, during the operation of shearing, sheep die suddenly, and no satisfactory explanation of this disaster has as yet been given. A friend of mine one year lost ten or twelve, and this year two or three, in this way ; and he tells me that a friend of his lost forty at one shearing.

On December 14, 1887, I took a sheep that had just been killed, placed it on its back precisely in the position it would rest in when "cast" or "mislaïd," or when, if improperly managed, its belly was being shorn. After removing the side of the jaw, I carefully dissected out and displayed the exact positions of the tongue, soft palate, epiglottis, and larynx. I found the tongue on the roof of the mouth, and the epiglottis flat upon the velum palati, and the velum close on the posterior wall of the pharynx—as close as if it had been glued there ; not a breath of air could have passed into or out of the larynx. It was

quite curious to see how easily and completely the tongue and larynx, with their appendages, would render breathing in this position impossible. The animal, too, in its struggles to rise, would bring its chin towards the sternum contracting the space in the pharyngeal cavity, and pressing the base of the tongue and the epiglottis more closely against its posterior wall, thus hastening its own death in its efforts to live.

In the horse, the cow, and the sheep (graminivorous) the tongue, pharynx, larynx, and windpipe, with their surroundings, though presenting marked anatomical differences, as I have already shown, are large and heavy, and very loosely connected with their fixed points. This gives freedom of movement to the head and neck for feeding purposes, and at the same time allows the afore-mentioned parts, when the animal is in its natural position, to fall easily away from the posterior wall of the pharynx, giving ample room for deglutition and respiration. On the other hand, when the animal is in a position exactly the reverse of natural, these anatomical conditions would necessarily permit the loose and heavy structures to gravitate towards the spine, and thus to act as impediments to those two functions (deglutition and respiration) in this class of animal more than others differently constituted.

Since writing this I have again, by introducing my hand into the throats, and by dissections on sheep and oxen, been able to verify my statement in every detail ; so that what I had upheld on theoretical grounds must now be accepted as established fact.

From farmers, from shepherds, and from a great sportsman and acute observer, I learn that sheep "cast" or "mis-laid," when found before death, make gasping, catch-

ing noises in their throats, as one of my informants expressed it, "choking-like;" the animals also froth at the mouth. After death the abdomen is immensely distended, and the flesh is black from venous engorgement; sometimes the ream (rumen) is found to be ruptured from the great distension. They die so quickly when *quite* on their backs, that noises in the throat are seldom heard; but when lying more on the sides of the back, the choking noises are always heard, if the animals are noticed in time. It is generally thought that the manner in which sheep are held is the cause of death in shearing; and quick, clever shearers manage to avoid this accident by having a care to the position. Keeping the animal fasting beforehand has not been found a sufficient precaution in preventing this form of death.

I have heard also of horses dying quickly when cast on their backs, as sometimes happens when they roll in the stables, and get their legs fixed under the manger or otherwise. Only lately one of my own horses was caught in this way, but happily my coachman was at hand. He found the animal in the greatest distress, profusely sweating, and making noises in its throat; and he had no doubt it would soon have died had it not been extricated from its difficulties. He told me that he had known a horse which had acquired a trick of getting cast so frequently that it had to be watched at night, until at last they strapped wooden blocks on each side of its body, which effectually prevented the animal from rolling. On the other hand, horses in the hunting-field at times get fixed on their backs in narrow ditches, and have remained so for some time without dying; so that the point requires in horses further investigation. Possibly, as a horse breathes only through

its nostrils, the anatomical relations would explain the apparent contradictions.

Pathologically, animals as well as man are liable to stertorous breathing ; but since the vocal organs are by no means so highly developed in animals, it naturally follows that the derangements are fewer, and sounds of an abnormal character do not so readily arise. Still, animals, like man, are liable to the various forms of stertor—buccal, nasal, pharyngeal, laryngeal, and mucus—either from temporary causes (such as catarrhs, strangles, diseased bones, abscesses, and their consequences), or from permanent causes, such as growths and tumours. But in the horse there are two special and notorious forms, "high-blowing" and "roaring." The former was once considered as a form of unsoundness, as it was supposed to be a respiratory impediment ; but it was gradually found to be an *expiratory* sound, caused by the vibration of a large and loose nostril, and to be more or less trick and playfulness on the part of the animal, usually denoting spirit, courage, and powers of endurance.

"Roaring," on the contrary, is true laryngeal stertor, and is a much more serious matter. With the public all forms of throat-noises have been called roaring ; but, although it is apparent that there are various forms and causes of stertor in the horse, it is stated, on the authority of the late Professor Spooner of the Royal Veterinary College, that ninety-five per cent. of the cases of "roaring" have their origin in paralysis of the laryngeal muscles on the left side—those muscles, in fact, which are supplied by the left recurrent laryngeal nerve. It has not, to my knowledge, ever been satisfactorily demonstrated why paralysis should be so exclusively confined to this particular nerve.

A centric origin is not probable, and as the only difference in the two corresponding laryngeal nerves is that the left takes its course round the aorta, it seems probable that that fact alone accounts for the paralysis usually being confined to the left side. We should not be surprised at this, for we have a familiar example in man of such paralysis arising from aneurism and dilatation of the aorta, and from cancer and other growths in the chest altering the structure or interfering with the functions of the left recurrent laryngeal nerve. Moreover, when we consider the sudden and straining efforts during violent exertion and high speed to which horses are liable, and which are often enforced upon them when fatigued or out of health, we should naturally expect sudden alterations of size in the aorta, and therefore frequent stretchings of the fibres of the nerve, even if *permanent* dilatation of the vessel were not found to be present. I am bound to admit, however, that no pathological changes in the recurrent nerve or in the aorta itself have, so far as I have been able to find out, been observed by veterinarians in the common run of roarers. Dr. John Ogle, in a paper communicated to the Pathological Society on May 17, 1859,\* dealt somewhat fully with the subject of "roaring" in the horse, in reference to the alteration of the human voice, and the peculiar noise attendant upon the breathing in certain morbid states, wherein the pneumogastric nerve, or its recurrent laryngeal branch, were materially involved. He showed, as a specimen, a horse's larynx, from the museum of Mr. Field, the veterinary surgeon, in which (says Dr. Ogle) "the posterior crico-arytæ-noid muscle on the left side was seen to be in a very pale and completely dwindled state." The specimen was

\* *Path. Soc. Trans.*, vol. x. p. 339.

believed to be the one referred to in the following quotation from the *Veterinarian* for 1837 (vol. x. p. 77), and reproduced in Dr. Ogle's paper.

"Having ascertained that the organs of respiration of a horse used for farm purposes were sound, I cast him, laid bare the recurrent nerve of the off side, and passed a ligature loosely round it. He was then allowed to get up, and after a few minutes galloped severely without evincing the slightest defect in his breathing. The nerve was then drawn forward by the ligature, and one inch and a half of it excised; and immediately on only trotting the horse a short distance, such a degree of roaring was occasioned that, had the exertion been continued, he would soon have fallen. I kept this horse four years, and although his breathing became better, he always continued a sad roarer. At the end of that time I destroyed him for the larynx, which exhibited the usual condition of wasted muscles on the side deprived of the influence of the recurrent nerve." Dr. Ogle also gave numbers of quotations from Ruffus of Ephesus, Galen, Vesalius, Mundinus, down to modern writers, showing what various experiments had been undertaken for the purpose of proving the influence of the pneumogastric nerve and its recurrent laryngeal branch upon the voice and the breathing.

As before stated, in animals stertorous breathing is a prominent symptom of the apoplectic state: the paralyzed muscles have become amenable to physical rather than to vital laws. The pathology too of apoplexy, according to Professor Williams in his "Veterinary Medicine," in the horse at least, is identical, betraying, as in man, brittle vessels and disorganized brain-structure as the causes of the bloody effusion and broken brain-substance.

In cattle the only form referred to is the so-called "parturient apoplexy," a very grave and dangerous disease. In this, it is a curious fact that if the animals get on their sides, stertorous breathing supervenes, and death most surely follows in a short time. It is the practice, therefore, to prop them up with bags of straw, so that they rest in their more natural position on their breast-bones. On their sides, in this condition, food constantly finds its way into the larynx, and either quickly kills or gives rise to a form of destructive pneumonia and slower death with mucous stertor—a sequel more common to the dead-drunkness and the apoplectic state of man than is commonly supposed.

## CHAPTER VII.

OBSERVATIONS ON THE MAMMALIAN PHARYNX, WITH  
ESPECIAL REFERENCE TO THE EPIGLOTTIS.\*

Comparative anatomy of the epiglottis—Epiglottis of the suckling infant—  
Important changes occurring with age—Epiglottis of sucking pig—  
Points in physiology of the horse, pig, and lion—General conclusions as  
to the use of the epiglottis.

THE following communication embodies some notes and experimental observations incident upon my investigations upon stertor in animals. The figures which I give will be found to illustrate, in part, facts long recorded; but, as no good drawings of so familiar an object as the pig's epiglottis have hitherto been published, I supply the want, in the hope that the figures proffered may be of service to workers in general.

Comparative anatomists have long ago shown that the characters and relationships of the velum palatinum and epiglottis are, in many quadrupedal mammals, widely different from those of the human subject. Youatt, writing of the horse, says † the velum forms a perfect division between the mouth and nose, so that, although it yields and permits the food to pass under it, in order to enter the

\* Read before the Anatomical Society of Great Britain and Ireland, March, 1889.

† "The Horse," p. 213, London (Gabriel's revision): 1863.

pharynx, it prevents the return of the food, and the horse, except in the convulsive spasms of death, breathes and vomits only through the nose. The epiglottis of the adult pig is well known to lie, like that of the horse, above the velum (*e*, Figs. 1 and 2), and observation upon the living animal shows that normal respiration is carried on exclusively

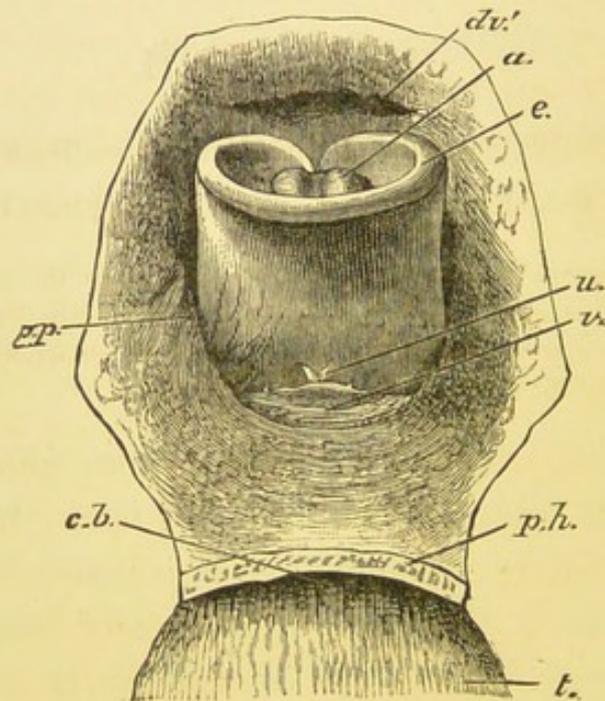


FIG. 1.—Narial pharynx of eighteen-months' pig, with epiglottis *in situ*; front view, nat. size. *a.*, Arytaenoid; *c.b.*, buccal cavity; *d.v.*, orifice of diverticulum retro-pharyngeum; *e.*, epiglottis; *p.h.*, cut edge of junction between hard and soft palates; *p.p.*, posterior pillar of soft palate; *t.*, tongue; *u.*, uvula; *v.*, velum.

through the nose. On dissection of the pharynxes of the adult horse and pig a fundamental similarity in disposition of the parts is to be observed.\* The free border of the velum (which, in the last-named animal, bears an insig-

\* Most of the dissections upon which my observations are based were made as follows: The head was separated from the trunk by cutting through the occipito-atlantal joint, care being taken that the parts about the pharynx were undisturbed, raphé being then divided along the middle line. In pigs it was found desirable to saw away the occiput before dividing the raphé.

nificant and vestigial uvula, *u*, Fig. 4) lies flat upon the tongue, and embraces the upper surface of the same at the root of the epiglottis, in such a manner as to cut off all communication between the mouth and pharynx except during deglutition. The enormous epiglottis is backwardly extended so as to almost surround the aditus laryngis. It stands high up above the level of the arytænoids, and its free border is curled over antero-laterally, whereby its actual apex comes to look downwards and forwards (*cf.* fig.).

An essentially similar condition of the parts is seen in

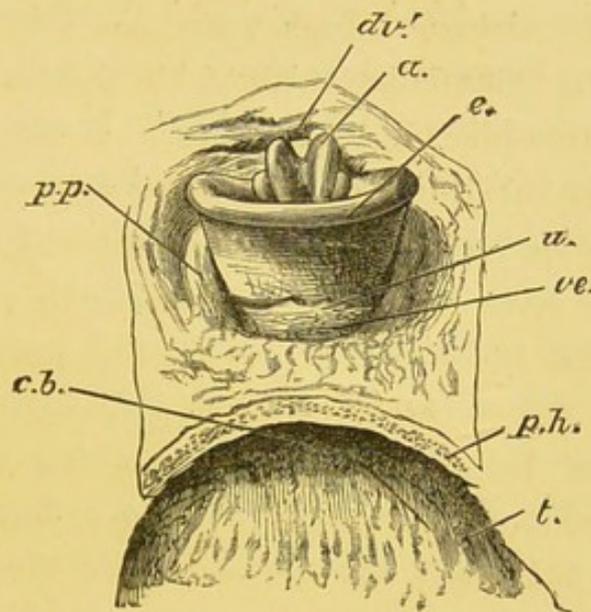


FIG. 2.—Narial pharynx of six-months' pig, with epiglottis *in situ*; front view, nat. size. References as for Fig. 1.

the six-months' pig (Fig. 2), except that the epiglottis is, in it, relatively shorter than in the adult, whereby the arytænoids, *a*, are more fully exposed. The arrangement of the parts is such as would tend to prevent the liquid food, upon which the animal, up to this period, almost entirely lives, from either regurgitating into the nostrils or welling over into the larynx. In front of the palate the mucous membrane at the base of the tongue lies in large

loose folds, such as would permit of a great distension of that portion of the buccal cavity during the passage of food; and the parts generally are, in fact, so disposed and modified as to ensure the transmission of the food along the sinus pyriformis, round the epiglottis, into the œsophagus.

The velum palatinum is powerfully developed, and it completely encircles the epiglottis and larynx, forming, at the upper extremity of the œsophagus, a strong sphincter-like band. Immediately behind this there opens a pouch of considerable size (*d.v.*, Figs. 1 and 9). Chauveau speaks of it\* as lying "immediately above the glottis, between the thyro- and crico-pharyngeal muscles." It extends back for some distance (*dv'*, Fig. 6), and would appear to represent the *diverticulum retropharyngeum* of authors.† Concerning its function I have nothing to communicate.

Rückert has recorded the intra-narial condition of the epiglottis in the sheep (*cf.* Howes, this volume). I find, however, that the same varies in position with animals resting in different positions, and that ordinarily the soft palate does not reach the tongue, while the epiglottis is situated anteriorly to, and (when the animal is prone) at a lower level than, the velum.

Chauveau asserts ‡ that in ruminants there is no arytæno-epiglottidean ligament. I find, however, in an analogous position, a couple of free folds of mucous membrane (*f*, Figs. 3 and 4). These structures are, in life, remarkably

\* "Comp. Anat. of Domestic Animals," Fleming's translation, 1873, p. 376.

† Albrecht has suggested that it may be a vestigial homologue of the piscine urine-bladder. *Cf.* Wiedersheim, "Bau des Menschen," p. 85. Freiburg: 1887.

‡ *Loc. cit.*, p. 462.

loose and elastic; they run from the lateral edges of the epiglottis along the outer sides of the arytænoids to the bases of the same, and I conceive of them as functional in protecting the larynx during the regurgitation of food in rumination.

Turning now to the human subject, we find that, in the adult, the velum does not reach the tongue. In addition

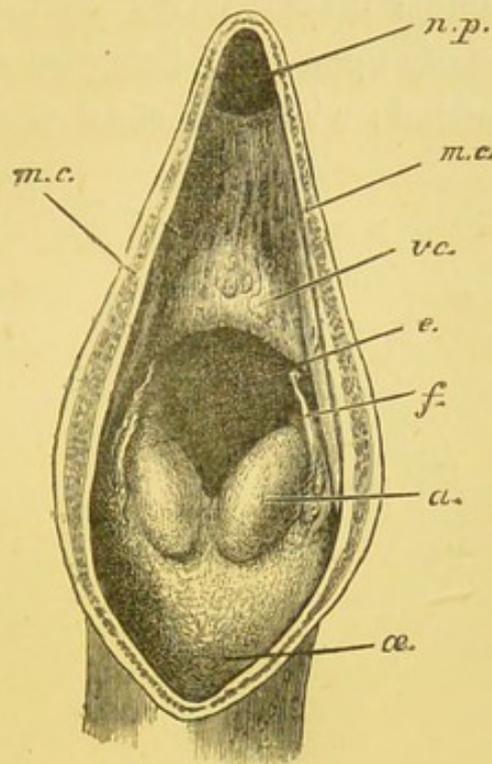


FIG. 3.—The larynx and nasal pharynx in the adult sheep, seen from behind; the constrictors of the pharynx having been divided down the raphé. References as for Figs. 1 and 2. *f.*, Mucous fold; *m.c.* constrictor pharyngei muscles, cut edges of; *n.p.*, posterior nares; *œ.*, œsophagus.

to its function in alimentation, the former is here an important accessory to respiration and vocalization; and it hangs, as it were, in mid-air, ready to respond to the most delicate vibrations and other movements.

I have been struck, in the course of my work, with the fact that, while much has been done with the comparative anatomy of the adult mammalian larynx, but little attention

appears to have been paid to variations and differences due to age in any one case. In the course of my researches into the relative positions of the various parts concerned in the production of stertorous breathing, I was early struck by the different forms of the epiglottis in many of my subjects, and I ultimately found that this organ differs in shape and position in accordance with the age of the child or quadruped under investigation. In the sucking infant it is curled laterally upon itself, being very convex in front and concave behind; while the rima glottidis is situated

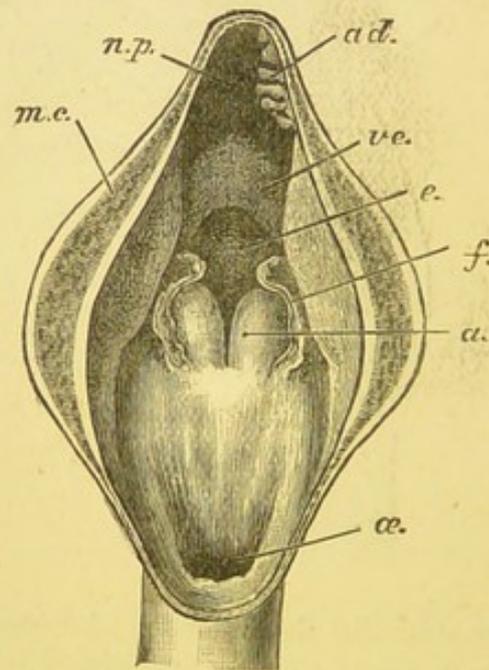


FIG. 4.—The larynx and nasal pharynx of an old lamb, seen from behind; nat. size. References as before. *a.d.*, adenoid growth.

relatively higher and closer behind the epiglottis than in later life. The glosso-epiglottidean folds are so disposed as to enclose, on either side, a valley, which lies at a lower level than the glottis; by virtue of the convexity of the front face of the epiglottis, the liquid food of the suckling is directed into the same, being thus prevented from entering the larynx. The uvula, in the few cases which I have

examined, fits exactly into the excavated summit of the epiglottis, and the whole condition of the parts suggests an approximation towards that so well known to be realized in the developing marsupial while within the pouch.

As the child ages, the epiglottis expands laterally, and presents an almost plane surface towards the base of the tongue. At the same time the rima glottidis comes to lie, relatively to the free border of the epiglottis, lower down.

I have, from dissections, long been familiar with the fact that at birth, before the child has breathed, not only is there no air-cavity in the chest, but there are no such cavities in the pharynx, mouth, or nares. The various walls and adjacent surfaces are all in close apposition; the base of the tongue lies against the posterior wall of the pharynx, and its upper surface against the palate; the uvula

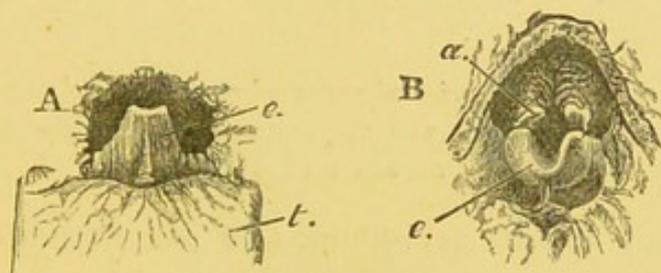
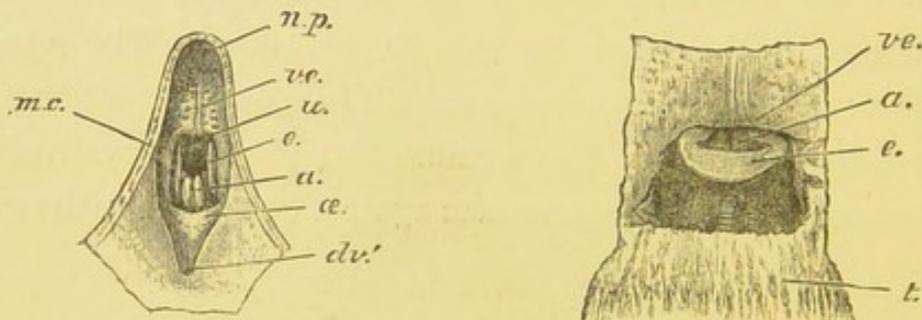


FIG. 5.—The human epiglottis and larynx at twelve months. A, front view; B, top view. References as for previous figures.

lies behind and against the epiglottis; and the soft walls of the nares, lined with mucus, are all in close contact, and impermeable to air. The first reflex action has for its object the dilatation and opening up of these cavities by forcible separation of their respective walls; but for some months afterwards the palate lies near the upper surface of the tongue, and the uvula is capable of being brought into apposition with the epiglottis.

On passing from the human subject to the quadrupedal

mammal (pig), some important and unexpected differences are to be noted, in the correlation of growth and the relationships of the maturing epiglottis and velum palatinum. In the sucking pig, soon after birth, the epiglottis is to be found in the mouth, below and considerably anterior to the soft palate, while it does not so far encircle the laryngeal orifice as in later life. The soft palate is less elongated than in the older animal, and the uvula is bifid. The conditions appear to be identical in the fourteen-days' animal (Fig. 6) and at this stage the



FIGS. 6 and 7.—6. The narial pharynx of a two-weeks' pig dissected from behind. 7. The velum and epiglottis of a six-weeks' pig, front view. Both nat. size. References as for Figs. 1-4.

diverticulum retropharyngeum (*d.v.*) is well developed and proportionately as extensive as in the older pig.

I have already shown (p. 111, Fig. 2) that at six months the epiglottis lies, in this animal, wholly within the narial pharynx, the relationship between the two being exactly in accord with those of the adult. My assistant, Mr. Stainer, has introduced his hand into the pharynx of many pigs of six months and upwards, and has always found the velum to lie anteriorly to (below) the epiglottis and firmly clasping its root. This being so, I was not a little surprised to find that in one animal (said to be five months old) the epiglottis (*e.*, Fig. 8) lay much more within the buccal cavity than I should have anticipated.

In the six-weeks' specimen (Fig. 7) the soft palate is seen to have curled in the sides of the epiglottis in such a

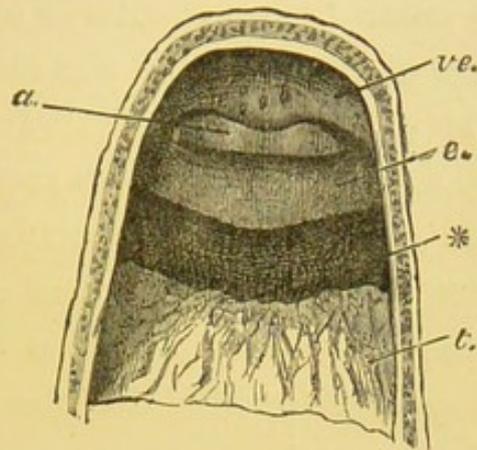


FIG. 8.—The velum and epiglottis of a five-months' pig ; front view, nat. size. References as before.

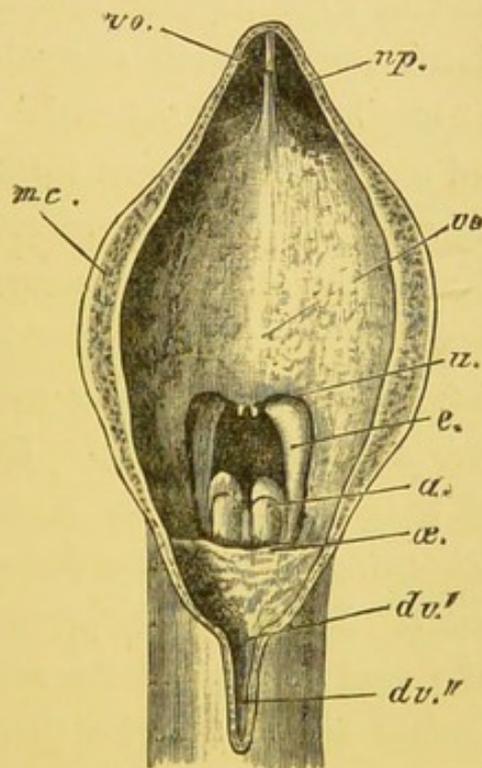


FIG. 9.—The narial pharynx, larynx, and posterior nares of a fourteen-weeks' pig, seen from behind. The diverticulum retropharyngeum (*dv.\\'*) has been opened up for its whole length. Nat. size. References as for other figures. *vo.*, vomer (posterior edge of nasal septum).

manner that half of that organ lay in the mouth and half in the narial passage. In the fourteen-weeks' specimen

(Fig. 9) (the relationships of the parts of which have become somewhat disturbed by repeated manipulation) the relations were much the same, except that a considerably greater portion of the epiglottis was seen to lie in the narial passage. It will be observed that the two last-named animals would appear to be, with respect to general relationships of the parts concerned (as in age), transitional between the earlier and later stages here dealt with, and the facts suggest the probability that it is within the fifth to sixth month of extra-uterine life that the pig's epiglottis finally becomes intra-narial. Further inquiry is requisite for the settlement of the question ; but it is clear, from the facts delineated in Figs. 1 and 2, that after the sixth month the epiglottis continues to elongate, whereby it ascends the more completely into the narial pharynx.

I have examined a series of different forms, with a view of ascertaining how far the facts above recorded for the pig might be typical of the leading mammalian orders. I am unable to detect between either the lamb and full-grown sheep, or the calf and ox, any such remarkable differences as those noted for the pigs. It might reasonably be expected that in each order a definite type of structure and relationship of the parts under consideration would be discernible. So far as my investigation carries me, this is not the case ; for while the arrangement and relations of the palate are, in a series (horse, pig, rabbit, guinea-pig, and others), similar, the shapes of the epiglottides vary considerably in each member of the same at corresponding ages.

I am able to confirm Howes' observation concerning the intra-narial condition of the rabbit's epiglottis. When the head is dissected from behind, in the manner which I

have adopted, this becomes very striking. It has occurred to me to put the matter to the test of experiment in its bearing upon respiration, and I accordingly stopped up the nostrils of this animal for a short period during life. I found that the creature was, for the time being, quite unable to breathe through its mouth. I have repeated this experiment upon full-grown pigs with a similar result,\* and I am inclined to believe that the condition of the epiglottis described by Howes is the normal one for the rabbit.

In addition to the foregoing, I append some notes of a more general nature, in the hope that they may be of service in the further study of the co-ordinate functions of the great cavities and organs related to the mammalian pharynx.

A horse, as we have seen, cannot breathe or vomit through the mouth, but does it neigh through the mouth or nostrils? A pig snores or grunts ordinarily through the nose, but who has not heard this animal squeal through its mouth? A lion ought not (if the anatomy of the pharynx in a six-weeks' specimen in Professor Cleland's series at Glasgow is typical)† to breathe, vomit, or emit noises by the mouth; and yet a friend of mine, probably

\* I saw this experiment performed, for purposes of safety, upon a violent horse while in Paris during the slippery weather of last year. A large chestnut brougham horse had got his legs entangled between the broken shafts and harness of another horse; in his terror he plunged and kicked most violently, and nothing appeared to be possible to save both animals from destruction, until the coachman got down from his box and grasped the chestnut's nostrils. The animal was at once subdued, and he gradually fell senseless to the ground, remaining there while the harness was cut, and all danger removed. The knowledge of the fact that pressure on the nares will stop the breath in horses is practically utilized in an invention for stopping "bolters" by an arrangement of pads to the nostrils, which can be closed at the will of the rider.

† The arch of the palate clipped the root of the epiglottis in front, like that of the horse or full-grown pig.

one of the greatest lion-hunters of the age, assures me that lions open their mouths with their heads low down, and appear to roar through the former. When they attack, however, they throw up their heads and emit sudden yelps like a dog. Dogs appear to breathe in ordinary through the nose; they can, however, by volition, breathe as efficiently through the mouth.

Since writing the above, I have elicited the information that horses when much excited neigh through the mouth. I have, moreover, experimented again on the full-grown pig by stopping up its nostrils for a short time, and have found that, although it does not appear to be capable of inspiring by the mouth, it can yell and shriek through it most terribly—shrieking being, of course, the result of an expiratory effort. The same explanation may perhaps apply to the horse and lion.

I believe that physiologists have experienced difficulties in conducting certain investigations upon the rabbit while supine. I have dissected two rabbits in this position, and find that they would probably have died from the cause alluded to above had they been fixed in supination. I have already dealt with the cause of stertor in man, and with the fact of its being so common in swine. I submit, finally, that the great development of the epiglottis in many of the "dumb" animals is opposed to the view which now tends to prevail, that the epiglottis is not primarily protective of the opening of the larynx.

## APPENDIX.

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### EXPERIMENTS ON POSTURAL RESPIRATION.

COMMUNICATED BY MARSHALL HALL, M.D., F.R.S.

*To the Editor of THE LANCET.*

SIR,

I am indebted for the following able and careful experiments to Mr. R. L. Bowles, of St. George's Hospital. I think they render any further repetition of them unnecessary, fully confirming as they do the first very accurate investigations of Mr. Fox.

I am, Sir, your obedient servant,

London, October, 1856.

MARSHALL HALL.

DEAR DR. MARSHALL HALL,

The enclosed experiments, to each of which I have appended a few remarks, were made by Mr. Hunter and myself, the object being to confirm or correct those previously made for you by Mr. Fox and ourselves, feeling that, from our former experience, we could now guard against several fallacies likely to arise during the experiments. The mode of procedure was the following:—

An indiarubber tube was inserted into one nostril, the opposite one, with the mouth, being closed, and rendered air-tight by plasters, bandages, etc.; the free end of the tube was now attached to a glass syphon, containing a small quantity of water in its bend, and to the opposite end of this syphon was fastened an oiled silk bag, made in the form of an intestine, to which it was similar in appearance and calibre when inflated. This bag, when full, contained forty cubic inches. The water in the syphon acted as an index of the direction of the air in its passage to or from the bag, or, as we have called it in the experiments, one oiled-silk tube. It was the amount of air expired into this tube on pronation, etc., which enabled us to compare it with the natural expiration of thirty inches; for when the tube was half filled, which was easily proved by pressing the air towards its closed extremity, we inferred that we had twenty cubic inches in the tube, and so on. We did not pretend to perfect

accuracy as to the amount, but it must be an exceedingly near approximation to the truth.

I think you will also see in these experiments, proof that though the supine position does not in every case prevent the passage of air, it does so in a *large proportion* of cases; and if it do so in one case only, that appears to me quite reason enough why that position should be avoided.

Believe me, faithfully yours,

Eaton Place South, Eaton Square, 1856.

ROBERT L. BOWLES.

#### SUBJECT I.

A male, much emaciated, about fifty years of age, and six feet in height. The body was not quite cold, and cadaveric rigidity had but partially come on. He had been dead ten hours. The apex of the tongue reached the incisors, and the body of the tongue was at the floor of the mouth, so that a considerable space existed between its surface and the roof of the mouth. Some fluid was seen at the back of the fauces, and on laying the body on its face, a large quantity of fluids and solids from the stomach made their escape.

*Experiment 1.*—Semirotaion, prone and lateral. In the former position, the tube was quite half filled, and in the latter it was instantly emptied.

*Experiment 2.*—By the alternate pressure and relaxation on the thorax (the subject supine), the same result was obtained as in Experiment 1.

*Experiment 3.*—Semirotaion, prone and lateral, was again had recourse to, and with the same result as before.

*Experiment 4.*—Alternate pressure and relaxation on the thorax in the supine position. This time, not the slightest inspiration or expiration could be obtained.

On removing the coverings of the mouth, the tongue was seen to be in the same position as when we commenced, but there was again fluid in the pharynx.

*Remarks.*—This case demonstrates how (in the supine position) fluids in the stomach might interfere with respiration, for, in Experiment 2, a good result was obtained, no fluid being in the pharynx, but after the further movements of Experiments 3, more fluid, etc., had been ejected from the stomach, thereby filling up the pharynx, and totally preventing the passage of air into or out of the trachea. This case also shows that the epiglottis does not in all cases cover the glottis in the supine position, though in a large majority it would appear to do so.

#### SUBJECT II.

A middle-aged man, very much emaciated, having suffered for a long time from abscess of the brain. Rigor mortis still present. The brain had been removed.

*Experiment 1.*—Alternate pressure and relaxation on the thorax (body supine); no effect.

*Experiment 2.*—On pronation, about one-third of the tube, on applying pressure, nearly the whole tube was filled; on removing the pressure, the tube was emptied to one-third, and on resuming the lateral position it was quite

emptied. These movements were several times repeated, and invariably with the like series of results.

*Experiment 3.*—Experiment 1 was repeated. No effect was at first produced; but on pressure being applied by a sudden jerk, some obstacle seemed to be removed, and expiration was the result to such a degree that the tube was nearly filled, as in Experiment 2; and on removing the pressure, the corresponding amount was inspired. After this, alternate pressure and relaxation, in the supine position, produced inspiration and expiration with ease. On removing the tube, no obstacle was to be seen in the pharynx.

*Remarks.*—Experiment 1 proves that in the supine position *something* does at times prevent respiration in the dead subject; and although in Experiment 3 respiration was produced in this position, it could not be done at the commencement; some obstacle had first to be overcome, probably adhesion of the epiglottis to the back of the pharynx by viscid mucus, as the following observation would tend to prove. On cutting down and removing the right side of the pharynx, with the corresponding halves of the hyoid bone and thyroid cartilage, in another subject, a tolerable view of the position of the parts was obtained. The epiglottis was in direct apposition, by its laryngeal surface, with the posterior wall of the pharynx, so as quite to preclude the possibility of the passage of air; when, however, the head was allowed to hang backwards over the edge of the table, the bending of the cervical vertebræ caused the posterior wall of the pharynx to recede from the epiglottis, so allowing free passage of air. If the tongue had been drawn forwards, would the epiglottis have been removed from the pharynx? or would the prone position cause it to fall forwards? Experiment 3 differs from any we have yet had, in so small an amount being expired in this prone position without pressure. The only reason we could see for this was, the removal of the brain; for in all previous experiments we had allowed the head to hang over the edge of the table in the prone position, so that the weight of the head, dragging on the thorax, must have had considerable power in expelling air from the lungs; whereas, in the case before us, the weight of the head was lost (the brain having been removed). As a further proof of this, when weight was added to the head, the amount of expiration on pronation, without pressure, was very considerably increased.

### SUBJECT III.

A middle-aged man, very short and emaciated; had suffered from extravasation of urine. There was some dulness on percussion on the left side of the chest; rigor mortis present; tongue very stiff, and moved about with difficulty. Whilst the body was being shifted, we could distinctly hear the rushing in and out of the air.

*Experiment 1.*—Very good result (more than half the tube) from pressure in the supine position.

*Experiment 2.*—The arms were folded beneath the forehead and fastened there by bandage. On pronating the body, nearly one-third the tube was filled; and, on applying pressure, a little more than one-third.

*Experiment 3.*—As a considerable portion of the chest was (by the arms being folded beneath the head) raised from the table, a block was so placed that, on pronation, the thorax should rest upon it. No better result, however, followed this than in Experiment 2, except that by pressure the tube was now nearly half filled. On resuming the lateral position, the tube was of course emptied as usual.

*Experiment 4.*—The head was allowed to hang over the edge of the table, as in all our previous experiments; and now the tube was more than half filled (as in Experiment 1) on pronation with the addition of a little pressure.

*Experiment 5.*—Pressure in the supine position produced the same result as in Experiment 1. On removing the tube, the fauces were quite clear, and free from fluid.

*Remarks.*—As in Case I. and II. of the present series, Experiments 1 and 5 were exceptions to the general rule. Even though the tongue had been moved about, so as to relax it as much as possible, it did *not* drop back into the fauces, on account of its excessive stiffness. The reason of the but partial success in Experiment 2 was clearly from the large portion of the chest which was prevented from coming in contact with the table; and the result of Experiment 3 being no better, even though a block was placed beneath the chest, would doubtless depend upon the weight of the upper part of the body, which is necessary for the proper expulsion of the air, being conducted away through the medium of the spine to the lumbar region. In Experiment 4, when the chest came well in contact with the table, the result was as usual.

#### SUBJECT IV.

A middle-aged man, had suffered some time from a purulent discharge from the side of the chest, with which cavity the opening was supposed to communicate; and there was considerable dulness on percussion over the same side of the chest. Rigor mortis less marked than usual; the tongue had dropped back into the pharynx, but it could not be accurately ascertained whether it quite stopped the way or not.

*Experiment 1.*—Pressure on thorax (supine); no result whatever.

*Experiment 2.*—Prono-lateral movements, with the head on the table; a little more than one-third the tube, but increased by pressure to nearly one-half.

*Experiment 3.*—Prono-lateral movements, with head hanging over the edge of the table; nearly half the tube full, which took place very readily at first, but afterwards more slowly. On taking out the tube, grumous fluid from the stomach was found in it. After this was emptied out, the experiment was repeated, and the air now passed in and out as easily as at first; so that the tube was nearly half filled.

*Experiment 4.*—Pressure on the thorax (the body supine); no result, after repeated trials. It being observed that the abdomen was very lax, and so interfering with the amount expired from allowing the diaphragm to descend, a binder was applied, but a large quantity of the same fluid as before was ejected from the stomach into the tube. The subject was pronated, and the fluid allowed to run out from the tube and pharynx.

*Experiment 5.*—The arms were folded beneath the chest, and the pronolateral movements employed, but with very little result.

*Experiment 6.*—Pressure in supine position ; no result. On removing the tube, the body of the tongue was far back in the fauces, but no fluid could be seen.

*Remarks.*—It was difficult to say whether it was the tongue or fluid in the pharynx that prevented the passage of air when the subject was supine ; but the tongue was much more movable than in previous cases, and therefore farther back. It was evident in Experiment 3 that the fluid was the cause of the difficulty. Experiments 2 and 5 were much inferior to Experiment 3. The amount of air expired was in all these experiments less than usual, probably from the disease of the chest.

#### CONGENITAL MALFORMATION CAUSING STERTOR AND DEATH.

The following case occurred while this book was passing through the press.

On May 6th, 1891, Dr. Fredrick Eastes was kind enough to bring to my notice an infant, two days old, with a singular malformation of the lower jaw, entailing such changes in the relations of the soft parts as caused the death of the child from suffocation on the day following my visit.

The case was typical of the dangers arising from the shortening of the distance between the symphysis of the jaw and the posterior wall of the pharynx,\* as will be seen from the following notes kindly supplied to me by Dr. F. Eastes.

“The soft palate was almost entirely wanting. The lower jaw was one inch behind the upper, in consequence of the body of the bone running transversely from one ramus to the other, without any forward projection. The tongue was directed upwards, so that only its under surface could be seen. The tip fitted exactly into the cleft of the soft palate, and would come no further forward. There was no proper existing pharyngeal cavity ; as it was entirely filled up by the body of the tongue, so that inspiration was almost impossible. Occasional stertorous inspirations occurred which would be repeated many times, and then respiration would entirely cease for several seconds. The cry was faint and feeble, mainly in consequence of the deficiency of the pharyngeal cavity. It could not take the breast, and it was doubtful if it swallowed anything at all ; attempts at swallowing always brought on suffocative symptoms. Change of position did not alter its difficulties, the tongue could not fall forwards as it was fixed by the abnormal jaw.

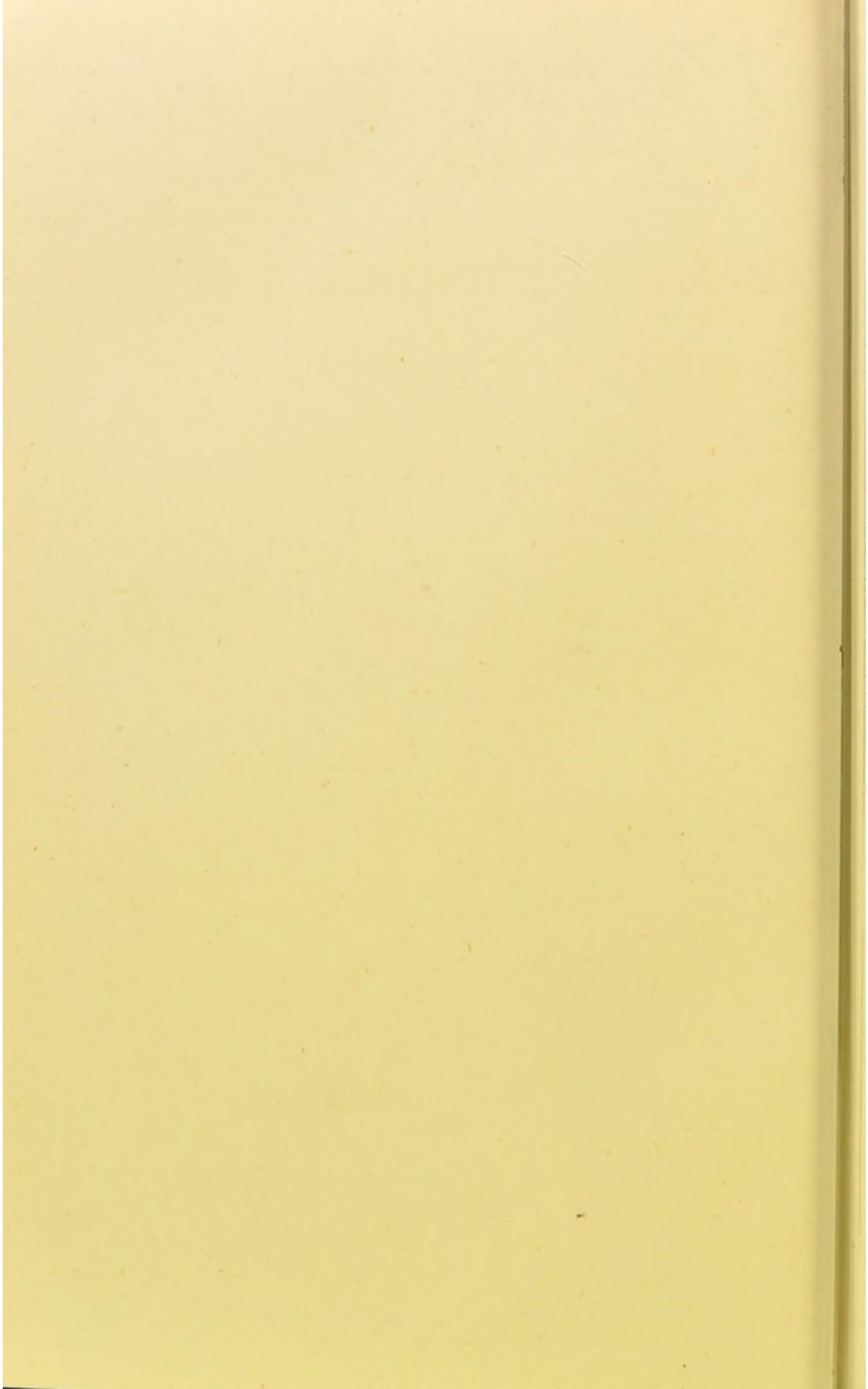
“*Post-mortem Examination.*—The inferior maxilla was natural as to the ramus and as to its breadth, but the horizontal portion or body of the bone came almost directly across from one ramus to the other, so that the anterior surface of the symphysis was only a quarter of an inch in front of the anterior border of the ramus. The hyoid bone, and hyoid and cricoid cartilages were all lower than usual, the cricoid being on a level with the top of the sternum.”

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\* *Vide* Frontispiece, and figure and description on p. 32.

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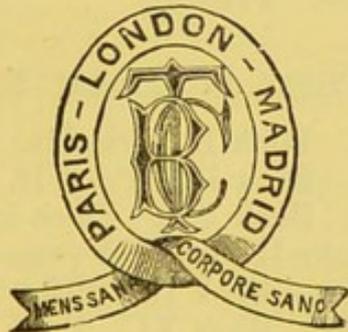




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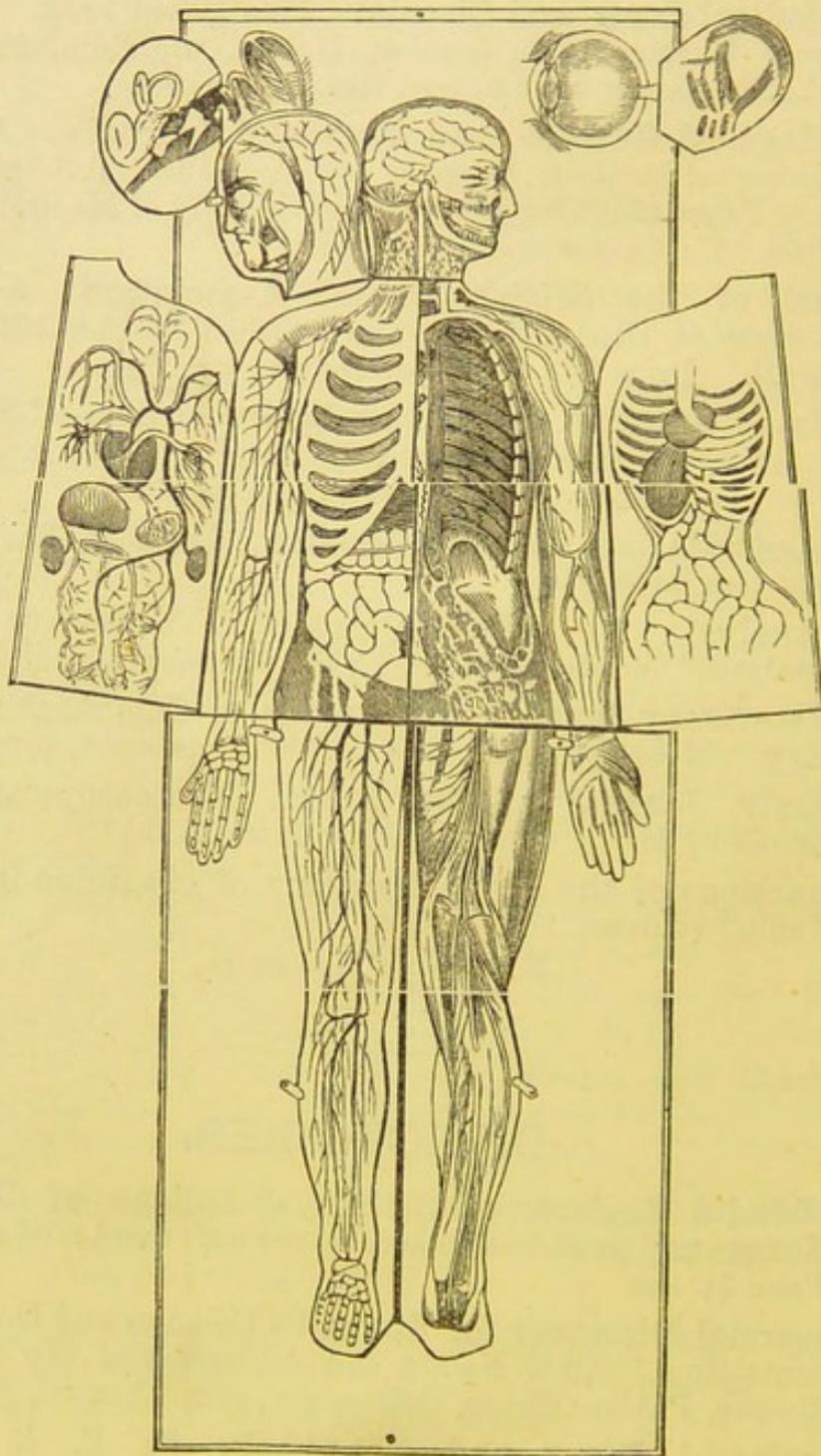
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