

HUMAN
PHYSIOLOGY

BY

ROBLEY DUNGLISON, M. D., LL. D.,

PROFESSOR OF THE INSTITUTION OF MEDICINE IN JEFFERSON MEDICAL COLLEGE, PHILADELPHIA;
VICE-PRESIDENT OF THE AMERICAN PHIOLOGICAL SOCIETY, &c. &c.

"Ventilum stulti prius quam lingua streperet."—GALLIUS.

viii

FIVE HUNDRED AND THIRTY-TWO ILLUSTRATIONS

EIGHTH EDITION,

REVISED, MODIFIED, AND ENLARGED.

IN TWO VOLUMES.

VOL. I.



PHILADELPHIA:
BLANCHARD AND LEA
1856.

(3.) RESPIRATORY PHENOMENA CONCERNED IN CERTAIN FUNCTIONS.

There are certain respiratory movements, concerned in effecting other functions, that require consideration. Some of these have already been discussed. M. Adelon¹ has classed them into: *First*. Those employed in the *sense of smell*, either for the purpose of conveying the odorous molecules into the nasal fossæ; or to repel them and prevent their ingress. *Secondly*. The inspiratory actions employed in the *digestive function*, as in *sucking*. *Thirdly*. Those connected with muscular motion when forcibly exerted; and particularly with *straining* or the employment of *violent effort*. *Fourthly*. Those concerned in the various *excretions*, either voluntary,—as in *defecation* and *spitting*; or involuntary,—as in *coughing*, *sneezing*, *vomiting*, *accouchement*, &c.; and *lastly*, those that constitute phenomena of *expression*,—as *sighing*, *yawning*, *laughing*,

¹ Archiv. Génér. de Médecine, Nov. 1835.

² A Treatise on Man, Chambers's Edinb. translation, p. 71, Edinb., 1842; and Vierordt, art. Respiration, in Wagner's Handwörterbuch der Physiologie, ii. 834, Braunschweig, 1844.

³ Adelon, Physiologie de l'Homme, iii. 185.

⁴ Op. cit., p. 188.

crying, sobbing, &c. Some of these, that have already engaged attention, do not demand comment; others are topics of considerable interest, and require investigation.

1. *Straining*.—The state of respiration is much affected during the more active voluntary movements. Muscular exertion of whatever kind, when considerable, is preceded by a long and deep inspiration; the glottis is closed; the diaphragm and respiratory muscles of the chest are contracted, as well as the abdominal muscles which press upon the contents of the abdomen in all directions. Whilst the proper respiratory muscles are exerted, those of the face participate, owing to their association through the medium of particular nerves. By this series of actions, the chest is rendered capacious; and the force that can be developed is augmented, in consequence of the trunk being rendered immovable as regards its individual parts,—thus serving as a fixed point for the muscles that arise from it, so that they are enabled to employ their full effort.¹ The physiological state of muscular action, as connected with the mechanical function of respiration, is happily described by Shakspeare, when he makes the fifth Harry encourage his soldiers at the siege of Harfleur.

“Stiffen the sinews, summon up the blood;
Now set the teeth, and stretch the nostrils wide;
Hold hard the breath and bend up every spirit
To its full height.” KING HENRY V. iii. 1.

In the effort required for effecting the various excretions, a similar action of the respiratory muscles takes place. The organs, from which these excretions have to be removed, are either in the thorax or abdomen; and in all cases have to be compressed by the parietes of those cavities. A full inspiration is first made; the expiratory muscles, with those that close the glottis, are then forcibly and simultaneously contracted, and by this means the thoracic and abdominal viscera are compressed. Some difference, however, exists, according as the viscus to be emptied is seated in the abdomen or thorax. In the evacuation of the fæces, the lungs are first filled with air; and whilst the muscles of the larynx contract to close the glottis, those of the abdomen contract also; and as the lung, in consequence of the included air, resists the ascent of the diaphragm, the compression bears upon the large intestine. The same happens in the excretion of the urine, and in accouchement.

2. *Coughing and Sneezing*.—When the organs that have to be cleared are the air-passages,—as in *coughing* to remove mucus from them,—the same action of the muscles of the abdomen is invoked; but the glottis is open to allow the exit of the mucus. In this case, the expiratory muscles contract convulsively and forcibly, so that the air is driven violently from the lungs; and, in its passage, sweeps off the irritating matter, and conveys it out of the body. To aid this, the muscular fibres, at the posterior part of the trachea and larger bronchial tubes, contract, so as to diminish the calibre of these canals; and in this way expectoration is facilitated. The action differs, however, according as the expired air is sent through the nose or mouth; in the

¹ Op. cit., p. 190; and art. Effort, in *Dict. de Méd.*, 2de édit., xi. 197, Paris, 1835.

former case, constituting *sneezing*; in the latter, *coughing*. The former is more violent than the latter, and is involuntary; whilst the latter is not necessarily so. In both cases the movement is excited by some external irritant, applied directly to the mucous membrane of the wind-pipe or nose; or by some modified action in the very tissue of the part, which acts as an irritating cause. In both cases the air is driven forcibly forwards; and both are accompanied by sounds that cannot be mistaken. In these actions, we have striking exemplifications of the extensive association of muscles, through the medium of nerves, to which we have so often alluded. The pathologist, too, has repeated opportunities for observing the extensive sympathy between distant parts of the frame, as indicated by the actions of sneezing and coughing, especially of the former. If a person be exposed for a short period to the partial and irregular application of cold, so that the organic actions of a part of the body are modified, as where we get the feet wet, or sit in a draught of air, a few minutes is frequently sufficient to exhibit sympathetic irritation in the Schneiderian membrane of the nose, and sneezing. Nor is it necessary, that the organic actions of a distant part shall be modified by the application of cold. We have had the most positive evidence, that if they be irregularly accomplished, even by the application of heat, whilst the rest of the body is receiving none, inflammation of the mucous membrane of the nasal fossæ and fauces may supervene with no less certainty.

3. *Blowing the Nose*.—The substance that has to be excreted by this operation is composed of the nasal mucus, the tears sent down the ductus ad nasum, and the particles deposited on the membrane by the air in its passage through the nasal fossæ. Commonly, these secretions are only present in quantity sufficient to keep the membrane moist, the remainder being evaporated or absorbed. Frequently, however, they exist in such quantity as to fall by their own gravity into the pharynx, where they are sent down into the stomach by deglutition, are thrown out at the mouth, or make their exit at the anterior nares. To prevent this last effect more especially, we have recourse to blowing the nose. This is accomplished by taking in air, and driving it out suddenly and forcibly, closing the mouth at the same time, so that the air may issue by the nasal fossæ and clear them; the nose being compressed so as to make the velocity of the air greater, as well as to express all the mucus that may be forced forwards.

4. *Spitting* differs somewhat according to the part in which the mucus or matter to be ejected is seated. At times, it is exclusively in the mouth; at others, in the back part of the nose, pharynx, or larynx. When the mucus or saliva of the mouth has to be excreted, the muscular parietes of the cavity, as well as the tongue, contract so as to eject it from the mouth; the lips being at times approximated, so as to render the passage narrow, and impel the sputa more strongly forward. The air of expiration may be, at the same time, driven forcibly through the mouth, so as to send the matter to a considerable distance. The practised spitter sometimes astonishes us with the accuracy and power of propulsion of which he is capable. When the matter to be evacuated is in the nose, pharynx, or larynx, it requires to be brought, first of all, into the mouth. If in the posterior nares, the mouth is closed, and the

air is drawn in forcibly through the nose, the pharynx being at the same time constricted so as to prevent the substances from passing down into the œsophagus. The pharynx now contracts from below to above, in an inverse direction to that required in deglutition; and the farther excretion from the mouth is effected in the manner just described.

Where the matters are situate in the air-passages, the action may consist in coughing; or, if higher up, simply in *hawking*. A forcible expiration, unaccompanied by cough, is, indeed, in many cases, sufficient to detach the superfluous mucous secretion from even the bronchial tubes. In hawking, the expired air is sent forcibly forwards, and the parts about the fauces are suddenly contracted so as to diminish the capacity of the tube, and propel the matter onwards. The noise is produced by their discordant vibrations. Both these modes bear the general name of *expectoration*.

When these secretions are swallowed, they are subjected to the digestive process; a part is taken up, and the remainder rejected; so that they belong to the division of *recremento-excrementitial fluids* of some physiologists.

(4.) RESPIRATORY PHENOMENA CONNECTED WITH EXPRESSION.

It remains to speak of the expiratory phenomena that strictly form part of the function of expression, and depict the moral feeling of the individual who gives them utterance.

1. *Sighing* consists of a deep inspiration, by which a large quantity of air is received slowly and gradually into the lungs, to compensate for the deficiency in the due aeration of the blood which precedes it. The most common cause of sighing is mental uneasiness; it also occurs during languor, at the approach of sleep, or immediately after waking. In all these cases, the respiratory efforts are executed more imperfectly than under ordinary circumstances; the blood, consequently, does not circulate through the lungs in due quantity, but accumulates more or less in these organs, and in the right side of the heart; and it is to restore the due balance, that a deep inspiration is now and then established.

2. *Yawning*, *oscitancy*, *oscitation* or *gaping*, is a full, deep, and protracted inspiration, accompanied by a wide separation of the jaws, and followed by a prolonged and sometimes sonorous expiration. It is excited by many of the same causes as sighing. It is not, however, the expression of a depressing passion, but is occasioned by any circumstance that impedes the necessary aeration of the blood; whether it be retardation of the action of the respiratory muscles, or the air being less rich in oxygen. Hence we yawn at the approach of sleep, and immediately after waking. The inspiratory muscles, fatigued from any cause, experience some difficulty in dilating the chest; the lungs are, consequently, not properly traversed by the blood from the right side of the heart; oxygenation is, therefore, not duly effected, and an uneasy sensation is induced; this is put an end to by the action of *yawning*, which allows the admission of a considerable quantity of air. We yawn at the approach of sleep, because the agents of respiration, becoming gradually more debilitated, require to be now and then ex-

cited to fresh activity, and the blood needs the requisite aeration. **Yawning** on waking seems to be partly for the purpose of arousing the respiratory muscles to greater activity, the respiration being always slower and deeper during sleep. It is, of course, impossible to explain why the respiratory nerves should be chiefly concerned in these respiratory movements of an expressive character. The fact, however, is certain; and it is remarkably proved by the circumstance, that yawning can be excited by even looking at another affected in this manner; nay, by simply looking at a sketch, and even thinking of the action. The same also applies to sighing and laughing, and especially to the latter.

3. *Pandiculation* or *stretching* is a frequent concomitant of **yawning**, and appears to be established instinctively to arouse the extensor muscles to a balance of power, when the action of the flexors has been predominant. In sleep, the flexor muscles exercise that preponderance which, in the waking state, is exerted by the extensors. This, in time, is productive of some uneasiness; and hence, occasionally during sleep, but still more at the moment of waking, the extensor muscles are roused to action to restore the equipoise: or, perhaps, as the muscles of the upper extremities, and those engaged directly or indirectly in respiration, are chiefly concerned in the action, it is exerted for the purpose of exciting the respiratory muscles to increased activity.

By Dr. Good,¹ **yawning** and stretching have been regarded as morbid affections and amongst the signs of debility and lassitude:—"Every one," he remarks, "who resigns himself ingloriously to a life of lassitude and indolence, will be sure to catch these motions as a part of that general idleness which he covets; and, in this manner, a natural and useful action is converted into a morbid habit; and there are loungers to be found in the world, who, though in the prime of life, spend their days as well as their nights in a perpetual routine of these convulsive movements, over which they have no power; who cannot rise from the sofa without stretching their limbs, nor open their mouths to answer a plain question without gaping in one's face. The disease is here idiopathic and chronic; it may perhaps be cured by a permanent exertion of the will, and ridicule or hard labour will generally be found the best remedies for calling the will into action."

4. *Laughing* is a convulsive action of the muscles of respiration and voice, accompanied by a facial expression, which has been explained elsewhere. It consists of a succession of short, sonorous expirations. Air is first inspired so as to fill the lungs. To this succeed short, interrupted expirations, with simultaneous contractions of the muscles of the glottis, so that the aperture is slightly contracted, and the lips assume the tension necessary for the production of sound. The interrupted character of the expirations is caused by convulsive contractions of the diaphragm, which constitute the greater part of the action. In very violent laughter, the respiratory muscles are thrown into such forcible contractions, that the hands are applied to the sides to support them. The convulsive action of the thorax likewise interferes with the circulation through the lungs; the blood, consequently, stagnates

¹ Study of Medicine, class 4, ord. 3, gen. 2, sp. 6.

in the upper part of the body; the face becomes flushed; the sweat trickles down the forehead, and the eyes are suffused with tears; but this is apparently owing in part to mechanical causes; not to the lachrymal gland being excited to unusual action, as in weeping. At times, however, we find the latter cause in operation, also.

5. *Weeping.* The action of weeping is very similar to that of laughing; although the causes are so dissimilar. It consists in an inspiration, followed by a succession of short, sonorous expirations. The facial expression, so diametrically opposite to that of laughter, has been depicted in another place.

Laughter and weeping appear to be characteristic of humanity. Animals shed tears, but the act does not seem to be accompanied by the mental emotion that characterizes crying in the sense in which we employ the term. It has, indeed, been affirmed by Steller,¹ that the *phoca ursina* or *ursine seal*; by Pallas,² that the camel; and by Von Humboldt,³ that a small American monkey, shed tears when labouring under distressing emotions. The last scientific traveller states, that "the countenance of the *titi* of the Orinoco,—*simia sciurea* of Linnæus,—is that of a child; the same expression of innocence; the same smile; the same rapidity in the transition from joy to sorrow. The Indians affirm, that it weeps like man, when it experiences chagrin; and the remark is accurate. The large eyes of the ape are suffused with tears, when it experiences fear or any acute suffering." Shakspeare's description of the weeping of the stag,—

"That from the hunter's aim had ta'en a hurt,"

is doubtless familiar to most of our readers.

"The wretched animal heaved forth such groans,
That their discharge did stretch his leathern coat
Almost to bursting; and the big, round tears
Coursed one another down his innocent nose⁴
In piteous chase; and thus the hairy fool,
Much marked of the melancholy Jaques,
Stood on th' extremest verge of the swift brook,
Augmenting it with tears."

AS YOU LIKE IT, ii. 1.

We have less evidence in favour of the laughter of animals. Le Cat,⁵ indeed, asserts, that he saw the chimpanzee both laugh and weep. The orang, carried to Great Britain from Batavia by Dr. Clarke Abel, never laughed; but he was seen occasionally to weep.⁶

6. *Sobbing* still more resembles laughing, except that, like weeping, it is usually indicative of the depressing passions; and generally ac-

¹ Nov. Comm. Acad. Scient. Petropol., ii. 353.

² Sammlungen Historisch. Nachricht. über die Mongolischen Völkerschaften, Th. i. 177.

³ Recueil d'Observations de Zoologie, &c., i. 333.

⁴ "The alleged 'big round tears,' which 'course one another down the innocent nose' of the deer, the hare, and other animals, when hotly pursued, are in fact only sebaceous matter, which, under these circumstances, flows in profusion from a collection of follicles in the hollow of the cheek."—Fletcher's Rudiments of Physiology, part ii. b. p. 50, Edinb., 1836.

⁵ Traité de l'Existence du Fluide des Nerfs, p. 35.

⁶ Lawrence, Lectures on Physiology, Zoology, and the Natural History of Man, p. 236, Lond., 1814.