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Session 1888-9

JOHN A. SEAVERNS

My dear friend
I have just received
your letter of the 10th
and am glad to hear
from you. I am well
and hope this finds
you the same. I have
not much news to write
at present. I am
very truly
yours
J. H. P.

LARYNGISMUS PARALYTICUS.

ROARING IN HORSES

(*LARYNGISMUS PARALYTICUS*):

Its History, Nature, Causes, Prevention,
and Treatment.

BY

GEORGE FLEMING, C.B., LL.D., F.R.C.V.S., ETC.,

PRINCIPAL VETERINARY SURGEON OF THE ARMY.

WITH A COLOURED PLATE AND WOOD ENGRAVINGS.

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Dedicated

TO

THE RIGHT HONOURABLE HIS GRACE

THE DUKE OF WESTMINSTER, K.G., P.C.

CONTENTS.

CHAPTER	PAGE
PREFACE - - - - -	ix
I. HISTORY OF ROARING - - - - -	1
II. VARIOUS CAUSES OF NOISY RESPIRATION - - - - -	15
III. PREVALENCE OF CHRONIC ROARING - - - - -	21
IV. PREDISPOSING CAUSES OF CHRONIC ROARING - - - - -	39
1. <i>Climate</i> - - - - -	39
2. <i>Heredity</i> - - - - -	41
3. <i>Breed</i> - - - - -	46
4. <i>Sex</i> - - - - -	48
5. <i>Size</i> - - - - -	50
6. <i>Age</i> - - - - -	52
7. <i>Conformation</i> - - - - -	53
8. <i>Management</i> - - - - -	55
9. <i>Accidental Causes</i> - - - - -	57
V. SYMPTOMS AND DIAGNOSIS OF CHRONIC ROARING - - - - -	59
1. Stridor - - - - -	60
2. Dyspnœa - - - - -	64
3. The Cough - - - - -	66
Diagnosis - - - - -	67
VI. ANATOMY AND PHYSIOLOGY OF THE LARYNX - - - - -	72
Anatomy of the Larynx - - - - -	73
<i>Cartilages</i> - - - - -	74

CHAPTER		PAGE
	<i>Muscles</i> - - - - -	78
	<i>Ligaments</i> - - - - -	80
	<i>Mucous Membrane</i> - - - - -	80
	<i>Nerves</i> - - - - -	81
	The Larynx as a whole - - - - -	85
	Physiology of the Larynx - - - - -	90
VII.	PATHOLOGY AND COURSE OF CHRONIC ROARING - - - - -	99
	Course of Roaring - - - - -	104
VIII.	CAUSES OF CHRONIC ROARING - - - - -	110
	<i>Mechanical Causes</i> - - - - -	110
	<i>Pathological Causes</i> - - - - -	115
IX.	PREVENTIVE AND CURATIVE TREATMENT OF CHRONIC	
	ROARING - - - - -	128
	1. Prevention, from a Sanitary Point of View - - - - -	128
	(a) <i>Exclusion of Unsound Horses for Breeding</i>	
	<i>Purposes</i> - - - - -	129
	(b) <i>Care in the Management of Young Horses</i> - - - - -	129
	(c) <i>Hygienic Management</i> - - - - -	130
	2. Medical and Surgical Treatment of Roaring - - - - -	132
	(a) <i>Medical Treatment of Roaring</i> - - - - -	133
	(b) <i>Surgical Treatment of Roaring</i> - - - - -	135
X.	THE OPERATION FOR ROARING - - - - -	146
	1. <i>Operation</i> - - - - -	146
	2. <i>After-Treatment</i> - - - - -	156

PREFACE.

THE subject of the present work has occupied my attention for more than a quarter of a century, and its increasing prevalence in recent years has, owing to my official position, impelled me to devote myself more seriously to its study. "Roaring," as it is commonly termed, is the symptom of a more or less grave defect in the horse's respiration, which is eminently damaging to the animal's value, and only too frequently to his usefulness. In the words of an eminent veterinary surgeon of three-quarters of a century ago, "It is a deteriorating scourge which too often, for the credit of our profession, consigns the counterpart of Eclipse himself to the shafts of the street cab."

The result of recent investigations into what has been hitherto considered, in several respects, an obscure disorder, and one for which there was no remedy, is offered for acceptance as a contribution towards the solution of the mystery which surrounds the morbid condition that

occasions Roaring, and the devising of measures for its prevention and cure. I earnestly hope that obscurity and incurability will no longer pertain to it, and that the investigations, as well as the surgical procedure which is here described, and which has been already fully carried into operation, may remove Roaring from the list of the *opprobria medicorum* that still discredits Veterinary Science.

The value of a simple operation which will remove this defect in horses, without disfiguring them or impairing in any way their usefulness, can scarcely be over-rated, so far as horse-owners are concerned; while, in the interests of humanity, the relief from distress in breathing in horses so affected must be no small gain.

Since first venturing on operative procedure in the horse's larynx, ten years ago, much light has been gradually thrown upon the physiology of that organ by the attempts made to remove the immediate cause of Roaring; and now its interior is as accessible to the eye, hand, and instrument of the surgeon, and can be treated with almost as much impunity, as any other part of the body. This marks a great advance in veterinary surgery, and one which, no doubt, will largely benefit horses and their owners.

The institution of this operation has also resulted in an immense improvement being effected in the mode of

producing insensibility in horses, by the administration of chloroform, which had hitherto not been so satisfactory as to warrant frequent recourse to it. This improvement chiefly consists in the much more rapid and safe production of narkosis by means of a comparatively trifling quantity of the anæsthetic, and with quicker recovery from its effects, than when several ounces are slowly inhaled; so that there is a saving in time and in the drug, and an abbreviation of the inconvenience and suffering experienced by the animal operated upon.

In carrying out the operations on the large number of horses submitted to surgical treatment for Roaring, I must not fail to acknowledge the great skill, wonderful dexterity, and unfaltering enthusiasm displayed by Mr. F. Raymond, F.R.C.V.S., Army Veterinary Department, who acted under my direction. To him the success of the operative procedure on these horses is largely due; his perseverance, judgment, and expertness deserve the highest praise, and have elicited my warm admiration.

As time elapses the operation may be still more perfected—though I think this is scarcely possible—and its remote results will be more accurately noted. The experience now gained will doubtless be added to, and Roaring will consequently become more readily removable by operation, easily and safely practised, by every veterinary surgeon; but I trust the greater advantages to be derived from the preventive

measures here enumerated will not be overlooked, and that the adage that "prevention is better than cure" will be kept in view in dealing with such a serious detriment to the usefulness of horses.

GEORGE FLEMING.

LONDON,
January, 1889.

DESCRIPTION OF THE PLATE.

POSTERIOR view of the larynx of a horse which had been seriously affected with Roaring, showing the alterations generally observed on the left side of that organ.

a. Epiglottis somewhat deviated to the left side. *b.* Summit of left arytaenoid cartilage, which, with its body, *c*, is depressed; in marked contrast to the right arytaenoid cartilage, *e* *f*, which is in its normal position. *d.* Remains of the left dilator muscle of the larynx (posterior crico-arytaenoideus); all the muscular tissue has disappeared, and in its place there is only a little fat and fibrous tissue. *g.* The right dilator muscle of the larynx in a healthy condition, as is also the right arytaenoid muscle, *f*, while the left is only represented by a few muscular fibres at *c*.

In a healthy larynx, the left side has the same appearance as the right.

LARYNGISMUS PARALYTICUS;

OR,

ROARING IN HORSES.

CHAPTER I.

HISTORY OF ROARING.

NEXT to lameness in horses, defects in respiration are perhaps of the most importance. To be "sound in wind and limb" comprises, according to the popular notion, nearly all that is required in a horse; for unless capable of moving at a certain, and perhaps rapid, pace, and probably exerting a great amount of strength while in motion, this animal would be of little value to man. Certainly it might be utilized to some extent if slightly lame, or affected only to a trifling degree in its breathing; but whenever this limit is exceeded, and the lameness becomes particularly marked, or the defective respiration is very perceptible, then the state of the animal is considered serious, so far as its utility is concerned: for then the defect may either really impair or altogether abolish its usefulness, and create an impression that the creature is suffering pain, or is in distress—an impression which is always unpleasant to the humane horseman.

To enable it to travel at a high rate of speed, and to undergo severe exertion, the respiratory organs of the horse

are greatly developed; and yet, notwithstanding this provision, a very slight cause will render them seriously imperfect, limit the employment, and gravely depreciate the value of what may be otherwise a most valuable animal. For this reason it is that horsemen have, from the earliest times, paid particular attention to respiration in horses, and though, until recently, they were but little, if at all, acquainted with the nature of the causes which produced changes in this function, and could not even distinguish between various morbid conditions, yet they appeared to have readily perceived that there was something wrong, which they designated by terms generally more expressive than intelligent or elegant. Some of these cant terms have come down to our own day, and are in common use. Nearly all of them refer to one symptom—that which is most obvious—the *noise* caused by obstructed respiration, and to the differences in the sound.

Therefore it is that, in old works on farriery, and among horse-dealers and horse-copers of nowadays, we meet with such designations as “roarers,” “pipers,” “wheezers,” “whistlers,” “grunters,” “high-blowers,” “bellowed bulls,” etc., applied to horses which make a noise in breathing: the terms being intended to mark differences in the quality and intensity of the sound. Asthma, or “broken wind,” and the noises emitted from the air-passages during movement (sometimes designated “pursiveness”) have usually been applied to the same cause or causes by those English authorities of the last and previous centuries, whose treatises on the diseases of the horse are yet accessible.

This is noticed, for instance, in Gibson’s work,¹ which appeared in the commencement of the eighteenth century, in which he remarks: “We may observe that horses that have no inward infirmity blow and wheeze, from an imperfection in the passages between the nose and mouth, which happens the more readily to horses, as they draw in and

¹ “The Farrier’s New Guide,” 4th edition, London, 1725.

expel their breath chiefly at the nose. . . . A horse will cough pretty often, but especially upon every slight cold, and at the same time is frequently troubled with a wheezing and rattling in his pipes: all which proceeds from a thick mucilaginous matter sticking in the branches of the wind-pipe." And in Bracken's treatise,¹ published so late as the middle of the last century, in pointing out the difference in symptoms between a broken-winded horse, and one which has "newly taken a cold," he observes that "upon motion there will be a hissing, whistling sound, and greater heaving of the flanks than in common colds. . . . Besides, the cough does not sound so deep in pursiveness, but on the contrary is a short tickling one, as if it were seated at the upper part of the larynx." But Wallis,² about the same period, says that "wheezing," or "blowing," in horses is quite different from "pursiveness." "For this wheezing does not proceed from any defect in the lungs, but from the narrowness of the passages between the bones and gristles of the nose. And further, these horses do not want wind; for notwithstanding they blow so excessively when exercised, yet their flanks will be but little moved, and in their natural condition. There are other horses that are thick-winded, that is, have their breathing a little more free than the former; but neither one nor the other are agreeable, or for any great service. Yet a person may be liable to a mistake in the case; for when a horse has been kept a long time in the stable without exercise, he will at the first riding be out of breath, although he be neither a blower nor thick-winded. There are some wheezers or blowers that rattle and make a noise through the nose; but this impediment goes and comes, and is only occasioned by abundance of phlegmatic stuff; for their flanks will not redouble,

¹ "Farriery Improved; or, a Compleat Treatise upon the Art of Farriery," 7th edition, London, 1752.

² "The Farrier's and Horseman's Complete Dictionary," 3rd edition, 1775.

neither will they have a cough with it, and therefore they cannot be pury."

These remarks of Wallis are chiefly based on the observations and description of Solleysel,¹ one of the celebrated French "écuyers hippiatres" of the seventeenth century, and who is the first writer who alludes to *Cornage*, as he then designated the noise, and as it is still designated in France.

Until the early part of the present century, nothing more definite with regard to this morbid condition was known in England than was published by Wallis.

In France, however, nearly a century after Solleysel had described the different kinds of sonorous respiration in the horse—though in a somewhat imperfect manner, it is true—Bourgelat, the illustrious founder of the French veterinary schools, and pioneer of modern veterinary medicine, gives a similar description in the great "Encyclopédie" (art. "Cornage"), published in Paris in 1762. Lafosse, sen., in his "Dictionnaire d'Hippiatrique" (Paris, 1775) only briefly alludes to it when giving the definition of the term "Cornard," as applied to a horse emitting a noise in breathing. Huzard, sen.,² however, compensates for this brevity in the references of his predecessors by giving a somewhat long article on *Cornage*, in a memoir addressed to the Parliament of Normandy in 1783, though he deals with the subject chiefly from a jurisprudence point of view.

After Huzard, Chabert, Flandrin,³ Fromage de Feugré,⁴ and Gohier,⁵ deal in their treatises with this condition, but, like Huzard, only as it affected the soundness of horses and the law of warranty (*garantie redhibitoire*). Hurtrel

¹ "Parfait Mareschal," Paris, 1664.

² "Mémoire sur la Cornage," Paris, 1783.

³ "Instructions Vétérinaire," Paris, 1795.

⁴ "Correspondance sur la Conservation et Amélioration des Animaux Domestiques," Paris, 1810-11.

⁵ "Mémoires et Observations sur la Médecine et la Chirurgie Vétérinaire," Lyons, 1813.

d'Arboval,¹ in his remarkable dictionary, gives it a good reference. But the French veterinarians, who have studied Roaring more especially from a pathological standpoint, are Godine, jun.,² Dupuy,³ and Vatel;⁴ while articles on it in the "*Recueil de Médecine Vétérinaire*" have been furnished by very competent authorities—as Bouley, jun. (1825), Delafond (1833), Leblanc (1834), H. Bouley (1838), Riquet (1847), Goubaux (1848, 1855, 1864); and it has at times been discussed at meetings of the *Société Centrale de Médecine Vétérinaire*, of Paris.⁵

Reynal and Renault contribute a long paper on it to the "*Nouveau Dictionnaire Pratique, etc., Vétérinaires*" (Paris, 1858, art. "Cornage"); and Zundel,⁶ in his dictionary, likewise devotes much attention to it. Lafosse⁷ and Trasbot⁸ have published valuable observations, Charon, in 1886, published a monograph on it,⁹ and, in later years, other writers of less note have contributed articles, more or less important, to various French periodicals, in which, besides the older term, "Cornage," we find it designated "Siffage," "Sifflement," "Halley," "Ronflement," etc.

In Germany the subject does not seem to have attracted much attention, until Gurlt¹⁰ almost incidentally alluded to it in 1832; but Günther, the able director of the Hanover Veterinary School, dealt with it in a special monograph,¹¹

¹ "*Dictionnaire de Médecine et de Chirurgie Vétérinaires*," Paris, 1826.

² "*Eléments d'Hygiène Vétérinaire*," Paris, 1817.

³ "*Recueil Vétérinaire*," 1825; "*Fluxion Périodique*," 1826.

⁴ "*Elements de Pathologie*," Paris, 1827; "*Journal de Médecine Vétérinaire Pratique*."

⁵ "*Bulletin de la Société Imperiale et Centrale de Méd. Vétérinaire*," 1868, 1869.

⁶ "*Dictionnaire de Médecine, de Chirurgie, et d'Hygiène Vétérinaires*," Paris, 1874, art. "Cornage."

⁷ "*Journal de Vétérinaire du Midi*," 1846.

⁸ "*Archives Vétérinaires*," 1879.

⁹ "*Étude sur le Cornage Chronique*," Paris, 1886.

¹⁰ "*Lehrbuch de Pathologische Anatomy*," Berlin, 1832.

¹¹ "*Ueber Hartschnaufen*," Hanover, 1834.

the first devoted to it, after contributing an article on it to Nobel and Vix's professional journal.¹ Gerlach has described it in his classical work on "Veterinary Jurisprudence,"² quoting Fürstenberg as an observer; Günther, jun., in his "Myology of the Horse,"³ alludes to it; and in Gurlt and Hertwig's "Magazin" are to be found excellent papers by Becker (1838), Meeke (1839), Hertwig (1841), Rielzel and Swanshon (1848), and Gerlach (1862). In Hering's Stuttgart "Repertorium für Thierheilkunde," in the Vienna "Vierteljahresschrift für Thiermedizin," in the Munich "Deutsche Zeitschrift für Thiermedizin" (1887), in the "Oesterr. Monatsschrift für Thierheilkunde" (1885), and in the "Wochenschrift für Thierheilkunde und Viehzucht," have appeared papers by various writers, who designate it by the names by which it is popularly known in Germany—as "Hartschnaufen," "Kehlkopfeifen," "Pfeiferdampf," "Rohren," "Hartschnaufigkeit," "Dampf," etc. But the best treatise on the subject which has been published in Germany, is that issued in the present year by Professor Möller, of the Berlin Veterinary School.⁴

In Italy, where Roaring is known as "Corneggio," "Rantolo," "Rantolo laringeo," it has been the object of careful investigation for many years, Professor Bassi, of the Turin Veterinary School, having devoted much attention to it; while in Denmark, where it is designated "Lungpiben," Professors Bagge⁵ and Stockfleth,⁶ of the Copenhagen Veterinary School, have added to the literature of the subject.

In England, it is not until we reach the present century that we find Roaring mentioned, when the term was

¹ "Zeitschrift für Thierheilkunde und Viehzucht," Band i., 1834.

² "Gerichtliche Thierheilkunde," Band ii., p. 244, Berlin, 1862; and "Hannoverische Jahresberichte," 1869.

³ "Die Topographische Myologie des Pferdes," Hanover, 1866.

⁴ "Das Kehlkopf-Pfeifen der Pferde," Stuttgart, 1888.

⁵ "Tideskrift for Veterinarer," Band viii.

⁶ "Tideskrift for Veterinarer," Band vi. xvii.; and "Handbuch der Thierärztlichen Chirurgie," Leipzig, 1881.

probably introduced by jockeys, farriers, or horse-copers, who have given us so many of the fantastic and barbarous designations that are still retained in the vocabulary of the stable and horse-market.

Richard Lawrence, veterinary surgeon, Birmingham, is perhaps the first writer who alludes to "Roaring" by that name, in a work published at the very commencement of the century.¹ Treating of respiration and its defects, he writes: "Another imperfection, which may be included in the class of diseased respiration, is the sound which arises in breathing, with some horses, when their pace is accelerated. A horse of this description is termed a *Roarer*. From my own observation, I have not been able to discover whether its source is in the lungs, the trachea, or the nose, though it is probable its seat is in the trachea or larynx. Dealers have a method of ascertaining the existence of the disease by striking the horse under the belly with a whip, and turning him suddenly round at the same time. If he groans during this process, they say it proves that he is a 'roarer.' This is probably occasioned by the sudden contraction of the abdominal muscles forcing air from the lungs through the trachea with greater rapidity, in consequence of the pain he feels from the stroke of the whip, as well as from the bending of the ribs in the action of turning round in a small compass. This disease prevails to a different degree in different subjects; in its commencement it is generally manifested by a whistling noise, but in the confirmed state it is more sonorous, and resembles deep groaning. In either case it has hitherto remained incurable."

White is the next veterinary writer who mentions Roaring. In 1802, under this designation, he says in his "Compendium": "This disease takes its name from a peculiar sound in respiration, particularly when the horse is put into a brisk trot or gallop. It seems to rise from lymph that has

¹ "An Enquiry into the Structure and Animal Economy of the Horse," 1801.

been effused in the windpipe or its branches, which, becoming solid, obstructs, in a greater or less degree, the passage of air.”¹ And later the same writer elsewhere states: “There is another complaint of the lungs, or parts connected with them, and an incurable one, which the purchaser should be guarded against. This disease is named *Roaring*, from the wheezing noise a horse makes when rode fast, particularly when galloped up a hill: it is sometimes so considerable as to be heard at a distance of many yards; but in walking, or moderate exercise, it can seldom be perceived. The method which dealers usually employ to detect this complaint at a repository, where no other trial is allowed, is to whip the horse under the belly and make him turn suddenly, or by making him leap over the bar: if he is a roarer, this sudden exertion causes him to groan. But this criterion should never be depended upon when an opportunity offers of galloping the horse.”²

Percivall,³ in 1824, treats of Roaring in a more complete manner than any previous English writer; and again in 1840 he deals with it in another work,⁴ though more briefly and no more satisfactorily. Youatt in 1833,⁵ John Field in 1837,⁶ Ferguson in 1838,⁷ Turner and Cartwright in 1849,⁸ Owles in 1854,⁹ Reeve in 1858,¹⁰ and other writers have devoted much attention to it; while in 1882 I ventured to give the result of my somewhat lengthy experience and investigations into the pathology of Roaring.¹¹

It was not until the present century had been somewhat advanced, and veterinary surgeons were devoting more attention to anatomy and physiology, but especially to

¹ “A Compendium of the Veterinary Art,” London, 1802.

² “A Treatise on Veterinary Medicine,” vol. iii., p. 257.

³ “Elementary Lectures on the Veterinary Art,” Part Second, p. 243.

⁴ “Hippopathology,” vol. ii., p. 36.

⁵ *The Veterinarian*, vol. vi., p. 183.

⁶ *Ibid.*, vol. x.

⁷ *Ibid.*, vol. xi.

⁸ *Ibid.*, vol. xvii.

⁹ *Ibid.*, vol. xxii.

¹⁰ *Ibid.*, vol. xxvi.

¹¹ “Veterinary Journal,” 1882, pp. 1, 81, article, “Laryngismus Paralyticus.”

pathological anatomy, that the morbid conditions giving rise to Roaring began to be seriously investigated. Of course, errors were common at first, and the causes assigned were often more imaginary than real; but, nevertheless, the real sources of the obstruction causing the noise were anxiously sought for.

So long ago as 1817, Godine found deformity of the larynx to be, as he supposed, a cause of "cornage."¹ Bouley made a similar observation in 1821;² and Dupuy describes cases in which the glottis was narrowed and deformed, through depression of the left arytenoid cartilage of the larynx.

In 1825, the first marked step in elucidating the pathology of Roaring, as it is now understood, was made by a very distinguished French veterinarian, Bouley, who, in dissecting the carcase of a horse that had been seriously affected, found considerable engorgement of the lymphatic glands at the entrance to the chest (pre-pectoral); and observed that the left recurrent nerve, which passed through them on its course to supply the muscles of the larynx, was compressed by these glands and altered in its structure. He had at first imagined that the Roaring had been the result of deformity of the trachea; but as there was no deformity in this instance, the coincidence of the noise during life with this condition of the nerve found on post-mortem examination, decided his opinion as to the cause of obstructed breathing.⁴

The physiology of the nervous system was beginning to be better understood when these observations were made, and the chief functions of the great nerve of organic life—the vagus—were known, and this knowledge was applied to the elucidation of morbid processes. The very important clinical observation recorded by Bouley, led the veterinary

¹ "Eléments d'Hygiène," 1817.

² "Compte Rendu d'Alfort" for 1821.

³ "Recueil de Méd. Vétérinaire," 1825.

⁴ *Ibid.*, p. 380.

professor, Dupuy, in the same year to perform experiments on horses, in which, after dividing or compressing the vagus or recurrent nerves, he constantly produced the peculiar roaring sound; and after the death of these animals the laryngeal muscles were found wasted. The explanation he gave of the phenomenon was to the effect, that as the inferior laryngeal nerves which supply the dilator muscles of the glottis are branches of the par vagum, of course these muscles become paralyzed when the nerves are divided or compressed; but the superior laryngeal nerves, being distributed to the constrictor muscles of the larynx, and not being implicated in the experiment, these muscles retain their power, and their antagonists—the dilators—being paralyzed, the glottis is nearly closed—hence the roaring.¹

This, though not altogether a correct explanation, marked progress in the right direction.

In 1834, Professor F. Günther, then director of the Hanover Veterinary School, asserted that Roaring is due to wasting of the muscles on the left side of the larynx, owing to loss of function of the recurrent nerve of that side; as since January, 1830, he had found that division of this nerve produced the sound in breathing, as well as the before-mentioned morbid changes in the muscles of that side.²

The observers of those days, however, did not overlook the fact that various causes would give rise to noise in breathing, and these causes are mentioned.

Percivall, our highest veterinary authority in England during the first half of the century, when he published his lectures in 1824, showed that the observations of Godine and Bouley had attracted his attention. He thought, so far as the larynx is concerned, that Roaring in young horses is due to thickening, with occasional ulceration, of the laryngeal mucous membrane; he mentions bands of lymph across the larynx and windpipe, ossification or dis-

¹ "Recueil de Méd. Vétérinaire," 1826.

² *Op. cit.*

tortion of these tubes, hepatization of the lungs, and spasm of the muscles of the glottis. But he likewise mentions wasting of the muscles on one side of the larynx as an occasional cause. He says: "Some years have now elapsed since it was first discovered that the larynges of Roarers occasionally presented us with the singular phenomenon of the muscles on one side being wasted away or absorbed, while on the other they appeared to exhibit unusual volume and redness, and strength of fibre. Since the first discovery, everyone almost has met with cases of the kind; but no person seems as yet to have given an explanation of this new piece of pathology."¹

Again he writes: "Another, and a not very uncommon cause of Roaring, is a wasting, or, in some instances, a total absorption of one or more of the small muscles of the larynx. I have lately examined a horse of Mr. —; a remarkable instance of it. In his larynx, upon the near side, the crico-arytenoideus posticus was very pale, and shrunk to half its original size; the crico-arytenoideus lateralis, the thyro-arytenoideus, and the arytenoideus, were altogether colourless and scarcely recognisable as muscles; but their antagonists, upon the other side, were unusually red and strong. Now, these muscles, contracting in pairs, are all employed in dilating the glottis; but, if one set act by themselves, this orifice is not only distorted, but actually diminished in dimension, in consequence of the arytenoid cartilage of the opposite side being drawn over it. Thus it is, then, that Roaring is here produced. How we are to account for these changes—to what original cause refer them—is as yet unknown. By some they are loosely spoken of as the ultimate consequences of paralysis, or of spasm; but though these tales may satisfy their employers, they are no more, to the profession, than the baseless conjectures of their authors, and, as such, are deserving of no comment."²

¹ "Lectures on the Veterinary Art," Part Second, p. 253.

² "Hippopathology," vol. ii., p. 44.

And in 1840 he shows that opinions were much divided as to the principal cause.

But, previous to this period, Youatt, in his lectures on horses, when treating of Roaring and its causes, remarks: "In the far greater number of cases there is distortion, rendering the muscles on one side useless, and therefore causing them to waste away. . . . The wasting of the muscles is, therefore, the *effect*, and not the *cause*, of that which produces Roaring."¹

About this time Field observed that a frequent cause of Roaring, in cases of ulceration of the rima glottidis, was spasm of the glottis. "While the horse is suffering great pain from the passage of the air over these denuded surfaces, the instinctive action of the muscles, more powerful than the will of the animal itself, partially closes the air-tube, and thus lessens the irritation. I have seen many cases of this kind, and by opening the trachea have obtained immediate relief."

This hypothesis, however, presumably did not satisfy Mr. Field, for we find him repeating one of Dupuy's experiments, by producing Roaring in a horse, and demonstrating the cause of laryngeal muscular atrophy. "Having ascertained that the organs of respiration of a horse used for farm work were sound, I cast him, and laid bare the recurrent nerve of the off-side, and passed a ligature loosely around 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 out by the ligature, and one inch and a half excised; and immediately on 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 though his breathing became much better, he continued a sad roarer. At the end of that time I destroyed him for the larynx, which exhibited the

¹ "The Veterinarian," vol. vi., p. 183.

usual condition of wasted muscles on the side deprived of the influence of the recurrent nerve."¹

In the following year (1838), Ferguson found, on making the autopsy of a horse which had been a Roarer for a long time, one of the recurrent nerves (left) enveloped and compressed by a voluminous mass of indurated bronchial lymphatic glands, and the portion of nerve between these and the larynx was quite different to that on the opposite side, being greatly wasted and its fibres scarcely distinguishable. All the laryngeal muscles which received filaments from this nerve were so completely atrophied that it was difficult to recognise their structure, while the glottal opening he described as twisted, the borders of the arytenoid cartilage partly obstructing it.²

In 1846, Lafosse relates that a horse which, at first, only manifested Roaring at intervals, was at last continuously affected; dyspnœa became progressively more marked until, during a violent attack, the animal died asphyxiated. At the autopsy, the bronchial lymphatic glands were found extremely enlarged, brownish in colour, adherent to each other and to the lungs, and containing pus at various points; while the pneumogastric nerves were compressed in them, and almost confounded in their mass.³

Goubaux, a recent director of the Alfort Veterinary School, in 1848 gave a brief account of the alterations he had observed in the larynges of horses which had been Roarers;⁴ and in a communication to the Société de Biologie in 1853, seemingly unconscious of what had already been accomplished in this direction by other investigators, he alludes to these observations, and dwells on the fact that in "chronic Roaring" muscular atrophy on the left side of the larynx was nearly a constant feature. In 1864, in another communication to the Société Vétérinaire of Paris, he further confirms the fact, and even

¹ "Veterinarian," 1837, "Proceedings of Veterinary Association."

² "Veterinarian," 1838. ³ "Journal de Vétérinaires du Midi," 1846.

⁴ "Recueil de Médecine Vétérinaires," 1848.

asserts that he never witnessed an exception to the rule; he always found the muscles on the left side of the larynx and the left recurrent nerve in an advanced stage of atrophy. Professor Trasbot, of the same school, stated in 1879 that from the time his colleague, Goubaux, had drawn attention to the subject, up to that date, whenever the opportunity occurred he had examined, post-mortem, the larynx of every horse brought to the school and known to have been a Roarer during life, and always with the same result—the discovery of wasting of the muscles on the left side of that organ.¹

In a work on the muscles of the horse, published by Professor Günther in 1866, it is mentioned that ninety-six per cent. of horses affected with “chronic Roaring” have wasting of the left laryngeal muscles, and that it is extremely rare to find those on the right side involved.² Bruckmüller, in his Text-Book of Pathological Zootomy, published in 1869, alludes to Roaring being due, among other causes, to atrophy of the dilator muscle of one side of the larynx: and though he agreed with Günther that an alteration (degeneration) in the nerve supplying it would produce such wasting, yet his observations led him to believe that degeneration of the nerve was not always the cause, but that the muscle weakness might result from induration after inflammation of its texture, induced by mechanical action.³

Other writers have confirmed these observations, though opinions have been far from unanimous as to the pathology of the morbid conditions which occasion the impeded respiration; and even the immediate cause of the noise itself has been much discussed, and is not yet definitely decided upon.

¹ “Archives Vétérinaire,” 1879.

² “Die Topographische Myologie des Pferdes,” Hanover, 1886.

³ “Lehrbuch der Pathologischen Zootomie der Hausthiere,” Vienna, 1869.

CHAPTER II.

VARIOUS CAUSES OF NOISY RESPIRATION.

NOISY respiration may be due to a variety of causes, as any obstacle situated in the air-passages, and which interferes with the free movement of the air to and fro in them, is likely to give rise to an abnormal sound ; and there can be no doubt that such sound, from whatever cause arising, may be designated "Roaring," whether it is heard during inspiration or expiration, or during both of these acts. In order to understand the pathology of the condition which we are specially considering, and to distinguish it from the other sources of noise-production, we will briefly notice some of these.

Every horseman is, of course, familiar with the more or less noisy breathing of horses out of training when they are subjected to severe exertion ; the muscles of respiration, and especially those of the upper air-passages, not being in a state to dilate these sufficiently, or to maintain them for any length of time in a condition which will allow the increased volume of air to pass freely to and fro. Fatigue of these muscles invariably leads to this result.

Very often, also, excitable horses will make a noise for a short time when made to gallop, and particularly when the head is held in a cramped position. Some horses, also, which are not Roarers, are in the habit of making a noise when pulling at the bridle in galloping, owing to their opening the mouth and retracting the tongue so as to force back the soft palate to such an extent that it interferes with the passage of air between the nasal passages and the larynx. So annoying is this noise sometimes to the rider,

that to get rid of it the tongue is tied down to the floor of the mouth by a piece of wide tape.

Paralysis of the wings of one or both nostrils will cause noisy breathing, the noise being loudest, of course, during inspiration; the muscle which raises the false nostril at this period being incapable of doing so, the part hangs pendulous against the nasal opening and diminishes the volume of air required. This leads to difficult and sonorous breathing.

Thickening of the membrane lining the nasal passages, the presence of fleshy or bony tumours, polypi, or diseased or fractured nasal, frontal, ethmoid, palatine, or maxillary bones, or any other obstruction, as accumulated discharges, or abscesses, will give rise to noisy breathing; the sound, however, being generally as loud in expiration as in inspiration. Collections of pus in the guttural pouches, which are very largely developed on each side of the pharynx in the horse, may hinder the admission of air to the larynx, as may also tumours in that organ or in its neighbourhood. Inflammation of the membrane lining the larynx, and the results of that process—whether specific or otherwise—frequently produce thickened or stridulous breathing; as does likewise deformity of the cartilages entering into its formation. Spasm of its constrictor muscles will produce most distressing breathing, accompanied by sounds more or less shrill, emitted most loudly during respiration. Percivall mentions bands of lymph extending across the interior of the larynx as a cause of Roaring, but these I have never met with.

Angina, Strangles, and inflammation of the parotid gland and of the textures in proximity to the larynx, frequently cause sonorous breathing, sometimes of a very distressing character; as will also foreign bodies lodged in that organ or in any other part of the air-conduits. External pressure on these, either by harness, tumours, inflammation of the jugular vein, or any other cause, will often provoke the emission of abnormal sounds; and fracture or injury to the cartilaginous rings of the trachea, or malformation of that tube, as well

as the effects of tracheotomy, are far from being a rare cause of noise production.

Pressure on, or inflammation or destruction of, the recurrent nerves, which supply nearly all the muscles of the larynx, will certainly quickly induce that kind of roaring which is so common among horses, and which will receive most notice in this treatise. Of course, the same result occurs if the main trunks—the pneumogastrics—which give off these nerves are involved in disease or injury, whether at their point of origin in the medulla oblongata, or at any part of their course from the cranium to the cavity of the chest. This will be noticed hereafter.

Certain kinds of food will produce Roaring, and perhaps the most notorious for causing difficult and stridulous breathing, which may terminate in asphyxia if relief be not promptly afforded by the operation of tracheotomy, is the Indian vetch or pea commonly known in this country as Indian “mutters,” obtained from the *Lathyrus sativus*. Several remarkable instances of poisoning with this legumen are recorded.¹ In France another kind of vetch known as “Gessee-chiche,” “Jarat, Jarosse” (the flat-podded latyrus—*Lathyrus cicera*) is reported to have caused a similar accident, the noise and distress being most evident when the horses were put to even slight exercise.²

According to Grogner,³ such accidents are somewhat frequent, this plant being grown in the South of France for the food of sheep while they are housed in winter. Delafond and Renault, as well as Verrier,⁴ give interesting notices of cases of this kind. One is to the effect that a farmer in the neighbourhood of Paris kept his horses on winter tares, chopped and mixed with a small quantity of

¹ See the “Veterinary Journal” for April, 1885 (p. 233), and July, 1886 (p. 337).

² “Recueil de Méd. Vétérinaire,” 1883; “Nouveau Dictionnaire Pratique de Méd., etc., Vétérinaires,” tome iv., p. 352.

³ “Cours d’Hygiène,” p. 174.

⁴ “Etude sur la Gessee-chiche,” Rouen, 1869.

treacle. Soon they were attacked with stertorous breathing of a peculiar kind. The slightest exercise, continued for only one or two minutes, would cause loud Roaring, and the respiration became so disturbed that suffocation appeared impending. One of them, indeed, fell, and continued in a state of semi-asphyxiation for nearly half an hour; but the roaring generally ceased after a few minutes' rest. In the interval between these attacks the horses were perfectly tranquil, respiration natural, and appetite unimpaired. One horse was killed when the Roaring was most violent, but nothing was found to account for the disturbance on examination of the body. The other was medically treated for two months, but did not recover, and was destroyed during an access of Roaring. The result of an autopsy was no more satisfactory than in the other case.

Verrier reports that of fifty-four omnibus horses in Rouen, which had been fed for some time on this pea mixed with oats, twenty-nine were affected. Of these, nine died from asphyxia, after exhibiting symptoms of most violent inspiratory dyspnoea, and twenty remained Roarers. The majority of the latter, however, manifested, in addition, weakness and paralysis in other parts, and some of them paraplegia. In those that died from asphyxia, acute inflammation of the larynx was observed. Cöster,¹ Kopp,² and others in Germany, have recorded similar accidents with the chick-pea, lucerne, and vetch (*Kichererbse*, *Luzerne*, *Wicken*), especially when given green and in seed; but the most interesting cases of all are those described by McCall³ and Leather,⁴ as occurring in Glasgow and Liverpool. In these, on a post-mortem examination of the horses which died, degeneration of the laryngeal muscles and nerves was found.

It may be noted that paralysis and other serious

¹ "Berlin Archiv," 1885.

² "Bulletin de la Société Vétérinaire d'Alsace," 1868.

³ "Veterinary Journal," 1886, pp. 337, 412.

⁴ *Ibid.*, 1885, p. 233.

symptoms (*Lathyrismus*) have been produced in mankind by the *Lathyrus sativus*.

One of the most marked symptoms of lead-poisoning in horses, is the noise emitted in respiration when the animals are moved at all quickly. Not long ago, in the neighbourhood of Bath, I saw a mare and her foal, which was only a few weeks old, so seriously affected in this way, that a little excitement or rapid movement caused them great distress, the inspiratory sound being loud and shrill. On the farm where these animals were, and which was in close proximity to lead-works, fowls, pigs, horses, and an ass had died from lead-poisoning. Such instances are not at all rare, and the paralysis of the larynx may be due to the action of the lead upon the peripheral nerves of that organ (*neurotic cause*), and perhaps also upon the muscles (*myopathic cause*).

From these remarks it will be observed that noisy respiration may be due to many causes, some of them of a temporary nature, others more or less permanent. The "Roaring" may therefore be considered as "temporary," or "chronic" or "permanent," according as it is ephemeral and depending upon transitory causes, or continuous when the causes persist.

"Temporary Roaring" may be developed during the course of an acute disease of the larynx or the parts around it, or it may arise from any casual obstacle to the entrance of air to the lungs; the kind and amount of noise varying with the nature and intensity of the disease, or the character of the obstacle which occasions it. It is generally readily recognised, for not only is there usually a history of the case to be referred to, but the sound itself often affords valuable indications. This is in most cases of a rattling or whistling kind, heard chiefly during inspiration, perceptible at rest or in motion, and noticed not only at the nostrils and on auscultation at the larynx, but also at some distance from the animal. In extreme cases the respiration is laborious and distressing; the nostrils are widely dilated,

and the flanks convulsively heaving; the head is extended and lowered, the face anxious, the eyes prominent and lustrous.

In other cases the noise will only be heard during active exercise, and then only during inspiration, or during inspiration and expiration; sometimes it varies in intensity, or is altogether intermittent. Some horses, though the instances are very rare, make a noise in their respiration when they are at rest, and not during movement. Others emit a noise during feeding and at no other time; while those affected with swelling of the lining membrane of the air-passages, or in which there is any obstacle to the entrance and exit of the air from these tubes, make a noise during inspiration and expiration.

All these differences, and the causes to which they are due, need close investigation in the majority of instances; for upon the result will depend the probability of remedial measures being successful in restoring the affected animals to efficacy.

“Chronic Roaring,” due to the wasting of the laryngeal muscles, is that which is by far the most frequently met with; indeed, it is not, perhaps, verging on temerity to assert that ninety-six or ninety-eight per cent. of the cases of chronic Roaring have atrophy of these muscles as the chief post-mortem appearance on examination; and it might also be affirmed that of these, ninety-nine per cent. show only the muscles on the left side of the organ involved in atrophy, those on the right side being usually increased in size, as if to compensate for the loss of their fellows. The reason for this peculiarity we will notice hereafter, when treating of the pathology of this cause of chronic Roaring—the only form we are now concerned with, as it is very prevalent, and of all forms is the most serious.

CHAPTER III.

PREVALENCE OF ROARING.

ROARING is much more prevalent in western and northern, than in eastern and southern countries. In the latter, indeed, it is rarely observed among the native horses. In India, for instance, the indigenous horses are extremely seldom affected in this way, those imported from Australia being much more liable; though there appears to be a tendency to disappearance of the hereditary predisposition which may be present in these exotics. Hayes says: "In India, Roaring is almost unknown among horses bred there, although many of their imported sires have been confirmed Roarers. I have known instances of imported horses—and one case of a colt bred in India, whose dam, an Australian mare, was a Roarer—which appeared to be confirmed Roarers, become, after a time, perfectly sound in their wind. The disease appears to be nearly as rare among Arabs as it is among Indian stock."¹

Mr. Oliphant, Principal Veterinary Surgeon in India, but whose experience has been chiefly gained in Bengal, in reply to my inquiries, writes: "The two classes of horses I have had most to do with in India are stud-breds (including country-breds, as used in the Government service) and Australian horses. In the studs Strangles was very rife, but the stud-bred horses were, in my experience, peculiarly free from Roaring, and I do not think that the country-breds of the present day, got by Government sires, are any more liable to it. I have seen a few cases among Australian remounts,

¹ 'Veterinary Notes for Horse Owners,' third edition, p. 257.

but not many ; in fact, the disease is not common in the Service—indeed, it is very uncommon. Amongst race-horses of all breeds, the affection is, I believe, much more prevalent, but I have very little experience of this class of horse. Acute diseases of the respiratory organs do not prevail in India, owing, probably, to horses being kept in open stables. I except, of course, Strangles in young horses ; and this disease, one would think, would be the most likely to end in Roaring. It does not, however, do so ; and the fact that the race-horses form the class mostly affected, would seem to point to excessive exertion as the main cause.”

Inspecting Veterinary Surgeon J. J. Meyrick, C.B., also supplies the following information with regard to India : “I believe that in eastern countries, as a rule, Roaring is very uncommon. During twelve years’ Indian service, I met with only one case that I can remember, but it was a very bad one. The animal, a remarkably well-shaped Australian horse, had been imported only a short time, and was found to be a Roarer immediately after joining a battery of which I was in charge. Whilst looking after various batteries of artillery, regiments of cavalry, and Government studs, as well as while superintending the horse-breeding operations of the Punjab, I had to inspect stud-bred and country-bred horses in tens of thousands, Australians, and a few scores of horses from Cabul and Central Asia, besides many hundreds of Arabs and Persians. Among all these, as before remarked, I never met with a Roarer except the Australian. It is, of course, just possible that some might have been affected, but so slightly as not to attract the attention of the officer in charge of them. . . . I never met with a case of hereditary Roaring in India, there being no Roarers among either the stallions or brood mares of the studs to which I was attached. I should add that I have only served in the Bengal Presidency, but I have been in every part of it, from Calcutta to Peshawar. Mr. Steel

served in Bombay, and I understood him to say that he had met with a few cases of Roaring in that Presidency; but he quite agrees as to the general exemption of Eastern horses from it. It is certainly remarkable that I did not meet with any Roaring among the stud-breds, because Strangles is said to be one cause in England, and that disease used to prevail in a severe form in the Government studs of Bengal (owing to the large number of young stock collected in them), in spite of most ample ventilation and other sanitary measures. Veterinary Surgeon Glover, of the Army Veterinary Department, tells me he knew a few instances of Roaring among the Australian racers in India, but he had never met with Roaring among stud-breds or country-breds."

Mr. Hart, however, states that "Roaring is very common in Calcutta, and is most often observed in the coarse-bred horses which can least withstand the heat, and seem to be constantly in a state of fever."¹ These were, in all probability, imported horses.

With regard to Bombay, Inspecting Veterinary Surgeon J. Anderson, who has served in India for about a quarter of a century, has forwarded me the following interesting notes:

"Roaring is comparatively rare in India, and chiefly affects Australian horses, less frequently Arabs, and very rarely country-breds. In this country it is more usually found among race-horses, and is comparatively rare amongst troop, hack, and harness horses. The latter are more subject to it than the hacks and troopers, they being frequently over-sized, under-bred, big-headed, and short thick-necked horses.

"The stamp of Australian thorough-bred that usually becomes a Roarer, is also a large horse with his head badly 'put on,' with a thick, fleshy, coarse throat, and often more or less 'ewe-neck.'

"Large, coarse Arabs are also subject to this defect,

¹ "Veterinary Journal," vol. xxv., p. 4.

which is hardly ever seen among high-caste, middle-sized, or small Arabs and ponies. I have only met one Arab a Roarer in all my experience, viz., the chestnut Arab pony Impulse. The disease made its appearance after an attack of Strangles, and the animal, although an inveterate Roarer, ran and won many races in good time for years. The weather affected this animal more markedly than I have ever noticed in any other instance. On a clear, dry day he made less noise, and could gallop his half-mile in three or four seconds better time than he could do on a dull, cloudy day, especially if there was any dampness in the atmosphere. I have noticed this in various degrees in all Roarers in this country.

“Some of the thorough-bred Australian Roarers are bought cheap in Australia, and brought here for sale. I have known a few of these animals entirely recover in Oude and the North-West Provinces, the climate being dry and well suited to such complaints.

“Roaring is sometimes contracted on board ship, as a result of disease of the respiratory organs, etc., but I attribute the majority of cases in Australians to bad stable management and feeding while in the dealers’ stables in Calcutta, where they are chiefly fed on a crushed food which is largely composed of chopped straw and coarse ergotized grasses. They are also bedded down on rice straw, which horses like, and eat greedily. To allow horses to eat rice straw for any length of time is sure to cause Roaring. I had a very clear-winded Australian, Yanathon who met with an accident, while running in a hurdle-race in Calcutta, some years ago. I had to leave him there; he got the usual fare, and ate largely of rice straw for about six weeks or two months, and came back to me an inveterate Roarer, which he is to this day. I have often split open the rice straw, and found the inside mouldy, ergotized, and full of parasites—in fact, this is the case in nearly all badly-preserved coarse grasses, as the natives do not understand the principles of hay-making.

“Roaring has become more frequent of late years among Arabs. This I attribute to the great number of two- and three-year-olds now imported. Formerly there were not so many young ones imported, and they came in small batches in native boats called buggalows; now they are brought over in steamers from Bussorah, are crowded together under the most insanitary conditions in large batches of one hundred and fifty to two hundred—the voyage generally lasting from three weeks to a month, from Bussorah to Bombay. During the voyage Strangles invariably breaks out, and generally assumes a most virulent form, and from the absence of all treatment, the consequence is that a number of the affected animals become Roarers. Among the Arabs I have also noticed that the larger and coarser the horse the more likely he is to become a Roarer. This I attribute to the fact that most of these very large horses, from 14.3½ to 15.2 hands high, are not pure-bred Arabs, they having an admixture of foreign blood, which gives them size at the expense of quality, the pure desert-born horse being an exceedingly clear-winded animal.

“Strangles is not so frequent a cause of Roaring in Australians as it is in the Arab in this country, because the former are seldom imported under four years old, and have generally had the disease before shipment.

“I have observed two distinct kinds of Roaring in this country: one, which is permanent, and becomes gradually worse with fast work, and the other, which diminishes as the horse gets into condition, disappearing altogether while the animal is kept in racing condition; on the other hand, however, such a horse, when turned out of work at the end of the racing season, will again begin to Roar, and continue to do so while out of work and gross.

“The late Colonel Robarts, a well-known Indian sportsman, was a great advocate for *ghee* (clarified butter) in Roaring. He used to give the Australian chestnut thoroughbred mare Music (an inveterate Roarer), ¼ lb. of warm

glee half an hour before starting for a race. This material greatly diminishes the noise, and seems to afford much relief, enabling the animal to gallop without so much distress. Of late years I have prescribed glycerine in such cases— $\frac{3}{4}$ iv. to be administered half an hour before running, or taking violent exercise—and I am certain it is highly beneficial.”

In the Madras Presidency, Inspecting Veterinary Surgeon Shaw reports lung and air-passage diseases as being rare, and Roaring, therefore, very seldom noted. Veterinary surgeons there state that the cases coming under their notice are few, and some have never met with one. In the 3rd Madras Light Cavalry there was not a horse so affected in June this year. He had remarked it among horses from Northern Asia—*i.e.*, Karnbaghees, Mushids, Cabulees, Toorkomancees, etc., horses which are reared in a climate more severe than that of England, and which, therefore, exposes them to diseases likely to produce Roaring.

With regard to Australia, I am informed that Roaring is somewhat common, and the evidence just quoted with reference to India would go to corroborate this.

In South Africa the native-bred horses are, according to all the information I can obtain, particularly exempt from this defect. An officer of the Army Veterinary Department, Mr. Nunn, has recently travelled over the greater portion of the horse-breeding districts of the Cape and Natal Colonies, as well as those of some of the Boer States, inquiring into the horse-supply; and during the whole of his journeys and residence in the country, he has only met with two horses so affected. Mr. Rowe, senior military veterinary surgeon in Natal, where he has been serving for several years, writes: ‘I have examined a great number of horses since I arrived, and have only rejected one Colonial and two Free State horses because of Roaring. Imported horses that were Roarers when they arrived in the country, are still so;

but in no case have I found the stock from such animals give the slightest sign of such an affection.' And yet Strangles is common, and frequently prevails in a widespread and severe form.

But if the native horses are rarely affected with Roaring in South Africa, it would appear that newly-imported ones are sometimes very liable to it — especially those from England. A striking instance of this was afforded in 1879, during and subsequent to the Zulu War, among the army horses sent from England. Inspecting Veterinary Surgeon Lambert, who was then attached to the 17th Lancers during the campaign, gives me the following particulars :

That regiment left England in February, and arrived in Durban in April, 1879, with more than three hundred Irish mares, and some scores of geldings. At the conclusion of the war, when the regiment returned from Zululand to Natal, towards the end of the year, the horses were sold by auction, and eagerly bought by the Boer and other farmers; the mares especially were in great demand for breeding purposes, as the South African horse has much degenerated in size and general physique during the last thirty years, and the 17th Lancers' mares were large and good of their kind. Mr. Lambert went again to Natal in 1881, in the capacity of Principal Veterinary Surgeon of the Expeditionary Force sent against the Boers, and there he made many inquiries as to how the 17th Lancers' mares had turned out. The answer always was, that they had proved barren and become Roarers. Mr. Lambert himself took out a fine horse as a charger, and within three months after landing in Natal the animal was a bad Roarer. An excellent hunting and steeplechase mare, which an officer of the 17th Lancers took out in 1879, and sold in Natal, Mr. Lambert saw in a cab at Pietermaritzburg in 1881, she having become a Roarer, besides proving barren. Colonel Gore, commanding the Inniskilling Dragoons, took out to Natal, in 1881, two excellent young horses bred by himself,

and though perfectly sound on landing, yet were bad Roarers a few months afterwards. Mr. Lambert observes that these instances are only a few out of many, and are somewhat remarkable, because Roaring in South African-bred horses is very uncommon; but he notes that size may have something to do with this, as they are not more than 14.3 or 15 hands high, and in England Roaring is not common in ponies. However this may be, it would appear that, at least on arrival in Natal, the climate is not favourable to the respiratory organs of imported English horses.

Mr. Hutcheon, Colonial Veterinary Surgeon, Cape of Good Hope, has furnished me with further evidence as to the immunity of horses from this ailment in South Africa. Mr. Robertson, a horse-breeder, in the Hantam district of Colesberg division, writes: "I would not mind breeding from the rankest Roarer you could give me. I do not believe that Roaring is transmitted from the parents in this part of the country, and I do not know of a single instance of a Roarer having been bred here. I believe Brian Boru, a horse imported in 1863, was a very bad Roarer; after he was here some time he could run two-mile races, and beat anything in the country. I saw a good many of his stock, but not one of them was affected in his wind. In our district, Agar (imported) was as bad a Roarer as you could get; he could not win a hat in England. Six months after he arrived he won a mile race at Cradock, in a large field of horses, and got stock as sound as possible. I believe Woldman has gone wrong in his wind, probably the effect of a dose of Strangles; he is by Catalpa, out of a common mare, and was a very sound horse when Van Zyl had him. . . . Esther Stockwell makes a noise, but I am not in the least afraid of her stock being unsound. With the exception of Woldman, I don't know of a single case of a colonial-bred thoroughbred Roarer, and he was very bad with Strangles when I last saw him in Cape Town. Guiderius (imported)

is a Roarer, but his stock which I have seen are sound. I am quite sure that Roarers improve in this country, and that this is owing to the dry climate."

The Commissioner of Police, from inquiries among his inspectors, who had experience of horses for many years in the eastern provinces of the colony, the Transkei, Basutoland, etc., as well as his own long experience among all classes of horses under a variety of circumstances, concludes that "Roaring is a disease to which colonial-bred horses are not liable." The officer commanding the Cape Mounted Rifles for ten years had not found more than three Roarers during that period. Mr. Hutcheon's experience is to the same effect. He writes: "I have also inquired of the various jockeys, and their united testimony is that Roaring is very rare out here, Woldman being the only colonial-bred racer known to have become a Roarer. I remember an imported horse (*Excelsior*) becoming a Roarer in the early part of 1883. I attended him for Strangles when a colt in 1881. Buxton, an imported horse, ran from 1880 to 1883, sound, with an unbeaten record. I saw him the morning before he ran his last race in 1883; he was ill—suffering from a catarrhal condition of the whole mucous membranes, with a tinge of jaundice. His jockey landed him a winner, but the horse could scarcely stand when he came into the paddock. In less than a fortnight after he was a rank Roarer, and never ran again. Paul, brother of Peter, came out here in 1885 a Roarer. He ran at one meeting, won the trial stakes, but ruptured a small blood-vessel when running a second race. He was then put to the stud, and, notwithstanding his services there, I saw him at the Cape meeting recently; he ran well for five furlongs, but could do no more, so that I do not think he has improved. On the other hand, taking into consideration that he has been serving at the stud for three seasons, he is not any worse, so far as Roaring is concerned. Amongst ordinary-bred horses out here, I have never met with one

Roarer, and only one Broken-winded. All breeders are agreed that Roaring is not hereditary in this climate."

For Egypt the evidence is somewhat conflicting. By some observers, Roaring is reported as almost enzoötic, no breed of horses enjoying immunity. According to Mr. Meyrick, it is far more prevalent than in England: "In the streets of Cairo, Arab or Syrian horses can be heard to Roar while drawing the carriages of the gentry. Shortly after our army reached Cairo at the latter end of 1882, a severe form of Fever, resembling Anthrax in many respects, broke out amongst the horses, many hundreds of them being attacked. Within two or three months after this outbreak subsided, it was found that an extraordinary number of the horses had become Roarers. All except a few had been treated for the Fever, and I am inclined to think that these few had also been affected, but in so slight a form as to escape notice. In some cases the only symptoms observable were a quickened pulse and breathing, with a yellow tinge of the mucous membranes and loss of appetite. As more than half of the private soldiers, and likewise the veterinary surgeons, were in hospital, those left had so many animals to attend that slight cases of illness might easily have been overlooked. On making post-mortem examinations of some of those which died, I found infiltrations of lymph in various parts of the body. Possibly the Roaring may have been caused by the pressure of some of these deposits upon the nerves supplying the larynx. I afterwards found that a similar Fever is present nearly or quite every year in Egypt, and it may perhaps be the cause of the Syrian and Arab horses there so frequently becoming Roarers. The cause of the Fever I believe to be malarious, depending upon the annual overflow of the Nile, and aggravated by the absence of sanitary arrangements throughout the country. After several months, many of the Roarers completely recovered, while others remained in the same condition, or became worse, and had to be cast

from the army. I found many instances of horses being cast for Roaring more than two years after they returned to England, so gradually did they deteriorate. Small horses are, according to my experience, less frequently affected with Roaring than large ones. In Egypt, it may be said that, practically, all horses are imported, the country being so ill-adapted to them, that few are bred in the cultivated parts. In the desert the Bedouins breed some, but the desert can hardly be called Egypt proper."

Mr. Case, Senior Army Veterinary Surgeon in Egypt, informs me that Roaring is rare, the horses most affected being imported—chiefly English; after them come, with regard to liability, Australian horses, then French, Russian, and, lastly, Hungarian horses. He had heard of only one case in a native horse, and one case of recovery; the affection generally came on without any appreciable cause. From extensive inquiries he learned that it was very seldom observed in indigenous horses, and the Egyptians did not consider it objectionable when it did occur. When he wrote (August, 1888), he thought about eight per cent. of the English army horses were Roarers; they were large, tolerably well-bred animals, which had been affected for years—probably soon after landing in 1882. The coarser-bred horses were much less affected. He had never heard of mules or donkeys becoming Roarers in Egypt.

Mr. Beech, of the Army Veterinary Department, and attached to the Egyptian Army, mentions that of 470 Arab horses in that force there are only five affected. He has never seen a case in an Egyptian country-bred horse. The Arab horses from Bagdad, those of large size and probably town-bred, are more liable to it than those from the desert; those from Mesopotamia are seldom affected, and it is all but unknown in Syrian desert-bred horses. He had never seen a case among the horses of the Romella and other Anazeh tribes of Arabs, nor yet among those of the Shammiar Arabs. When Arab horses are affected, the Roaring is

never so severe in them as in European horses. Natives think little of it, and will buy a Roarer as readily as a sound horse.

Mr. Littlewood, Civil Veterinary Surgeon to the Egyptian Sanitary Department, remarks that the large white donkeys used by the better class of Egyptians, and which frequently cost as much as £70 in the market, are often Roarers; but this does not depreciate their value. The native veterinary surgeons say that recovery is doubtful. He has known Russian horses to be affected.

In the United States of America, Roaring is prevalent, and probably a considerable number of the horses unsound in their respiratory organs are so because of this defect; though I am unable to give anything like an approximate idea as to the extent to which it prevails. But it doubtless is much more common in the North and West than in the South—indeed, I am assured that in South America it is very seldom noticed, especially in the drier regions, and it is asserted that in Buenos Ayres it is quite unknown, and that Roarers sometimes recover when sent there. In North America it affects a certain proportion of horses, though I cannot ascertain what this is.

On the European Continent it is only too well known; indeed, as the historical sketch in this treatise shows, it was first described in French veterinary literature, and for nearly a century it has been receiving the serious attention of all the most distinguished veterinary authorities in France, Germany, Italy, Belgium, Holland, Denmark, and Sweden, as well as Russia. It appears to be less common in the East and South than in the West and North.

Reynal¹ says that in France it is frequent, though when he wrote (1858) he thought it was less prevalent than before-times—a result he attributed to the greater care of horse-breeders in the selection of breeding-stock, better

¹ "Nouveau Dictionnaire Pratique, etc., Vétérinaires," vol. iv., art. "Cornage."

crossing, and improved hygiene, rearing, and training. He remarks that in that country certain breeds were more predisposed to it than others, the old Norman carriage breed, chiefly raised in the Cotentin, Bessin, etc., being notorious for this unsoundness; and he states that, speaking generally, Roaring is more frequently observed affecting heavy draught-horses (*chevaux de gros trait*) than those bred for riding, and in entire horses than geldings, and males than females. He asserts that it is often observed in France in certain breeds of horses obtained from Hanover and Holstein, resembling the Norman horses of Cotentin. Riquet estimated, in 1847, that in Holstein the number of carriage-horses affected with Roaring was about eight per cent., while it was four per cent. among those of medium size.¹

Professor Goubaux stated at a meeting of the Société Centrale de Médecine Vétérinaire of Paris, in 1868, that he had examined the larynges of 250 horses, and found that one-fifth of the number had the characteristic wasted muscles on the left side, indicating that the horses had been Roarers.

In the Veterinary Statistical Report of the French Army for 1883,² the latest published, I find the number of horses cast and sold in France because of Roaring is 0·86 per 1,000, and in Africa 0·10 per 1,000. The greater number were in cavalry, and it appears that horses aged eight and nine years, and sixteen years and above, furnished the largest proportion. Charon, veterinary surgeon of the Remount Dépôt, Caen, shows that the defect is seriously prevalent among French troop-horses.³ Of the horses purchased at his dépôt during ten years, an average of 1·62 per cent. of the geldings and 1·35 per cent. of the mares were Roarers; this did not include the stallions, among which the defect

¹ "Recueil de Médecine Vétérinaire," 1847.

² "Recueil de Mémoires et Observations sur l'Hygiène et la Médecine Vétérinaires Militaires," Paris, 1887.

³ "Etude sur le Cornage Chronique," Paris, 1886.

is more frequent. Among horses of the Reserve, 3·87; heavy cavalry, 2·19; light cavalry, 1·19; and artillery horses, 0·97 per cent., purchased during four years, were Roarers. As evidence that the defect is on the increase, he notes that among the horses purchased at his dépôt in 1880 there were thrice the number of Roarers than there were in 1871. His remarks with regard to Algeria corroborate the observations of our own army veterinary officers with regard to India. He asserts that, practically, the disease does not exist in that country, for since the establishment of remount dépôts there not a case has been reported. In a total of 1,515 stallions, purchased by the dépôts at Blidah, Constantine, and Mostaganem, since 1845, not a single horse had been cast and sold because of Roaring. Since 1878 these dépôts had also purchased 16,721 troop-horses, and the defect had not been observed in any of them.

In the Veterinary Reports of the German Army accessible to me, there is no mention of Roaring, though the diseases which it often follows appear to be quite as prevalent among the troop-horses as among our own; and if we are to judge by the frequent allusions to it in veterinary literature, it might be concluded that in Germany it is as common as in England.

In Spain and Italy it is very infrequent.

It is impossible now to ascertain to what extent Roaring prevailed among horses in the United Kingdom previous to the present century. When such veterinary authorities as Coleman, Percivall, Youatt, White, and others, began to describe it more than half a century ago, though little was known as to its pathology, it was evidently a common affection (if we may speak of a symptom as such), and was the cause of much speculation and discussion. There are grounds for believing that it has become much more prevalent in recent years, and especially among light, well-bred horses; and if current reports, as well as one's own personal experience, are taken into account, Roaring must be very common

indeed. Thoroughbred horses appear to be most predisposed to become Roarers, and three-parts or half-bred hunters and carriage-horses come next. Among saddle and light harness horses, Roarers are to be found in considerable proportion, and draught-horses, heavy and light, are by no means exempt; but among small-sized horses and ponies the defect may be said to be somewhat rare. Certain breeds of horses, and even certain strains, would appear to have a tendency to become affected when exposed to exciting causes.

But to what extent the morbid state which produces the noise prevails generally, there is no positive evidence to show, except that to be obtained by examining the statistical records of British army horses. These may afford an approximate notion of the prevalence of Roaring among the lighter horses in the United Kingdom, though only to a certain extent; for many troop-horses which make a noise in respiration, if not much distressed during severe exertion, are not reported, and are retained in the army until cast and sold because of age, or for some other reason—they consequently do not appear in the Casting Returns as Roarers. I find that the number of troop-horses cast from the Service owing to this defect was, in

1881—20 with an average service of 7 years.

1882—27	„	„	$5\frac{5}{9}$	„
1883—35	„	„	$4\frac{1}{7}$	„ ¹
1884—92	„	„	$5\frac{7}{12}$	„
1885—55	„	„	$5\frac{9}{12}$	„
1886—83	„	„	$4\frac{1}{12}$	„
1887—61	„	„	$5\frac{7}{12}$	„

showing a total of 373 horses during the seven years, the annual strength of the army in horses being about 12,000. Taking four cavalry regiments stationed at Aldershot in

¹ During this year many horses returned from Egypt affected with Roaring, contracted in that country, and the worst cases were cast and sold.

July of this year, I find that the average number of their horses which are affected with Roaring, though doing duty, is 6·14 per cent.

The following table shows the ages of these horses, their regiments, and average service :

TABLE 1.

REGIMENT.	AGE.													TOTAL.	AVERAGE AGE.	STRENGTH OF REGIMENT.	PER CENT. OF ROARERS.
	4 years.	5 years.	6 years.	7 years.	8 years.	9 years.	10 years.	11 years.	12 years.	13 years.	14 years.	15 years.	16 years.				
1st Dragoons		4	5	5	5	8	2	1	3	4	1	3	1	42	9 $\frac{1}{2}$	421	10·0
5th Lancers	1		3	1	1	3	2	2	1	1	1			16	9	422	3·8
14th Hussars		2	5	2		2	2	2	2					17	8	280	6·08
18th Hussars		5	2	4	2	2		4			1			20	8	423	4·72
Total...	1	11	15	12	8	15	6	9	6	5	3	3	1	95	8 $\frac{9}{12}$	1546	6·14

The second table has been compiled from special returns, and shows as exactly as possible the number of army horses affected with Roaring, by corps ; it also exhibits the proportion according to age, sex, size, and total number.

From this table it would appear that the percentage of army horses affected is 5·42, and of course the Roaring is present in all stages and degrees of intensity.

TABLE II.

AGE.	HOUSEHOLD CAVALRY.		HEAVY CAVALRY.		MEDIUM CAVALRY.		LIGHT CAVALRY.		ROYAL ENGINEERS.		COMT. & TPT. CORPS.		ROYAL HORSE ARTILLERY.		FIELD ARTILLERY.		TOTAL.		PER CENT.	
	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.
1st May, 1888.																				
4 years	...	...	1	1	2	2	3	2	...	...	3	...	1	...	2	1	19	6	4.05	2.72
5 "	1	...	4	4	19	1	18	3	1	1	1	2	...	...	1	1	45	15	9.60	6.79
6 "	2	1	6	1	14	3	25	5	...	...	5	4	3	...	3	3	58	20	12.37	9.05
7 "	5	1	5	3	9	2	12	1	...	...	...	1	4	...	4	4	39	16	8.32	7.24
8 "	4	2	6	2	16	5	17	...	1	...	2	1	...	...	8	2	56	12	11.73	5.43
9 "	1	2	7	2	15	6	13	4	...	...	...	1	...	...	7	...	44	16	9.48	7.24
10 "	3	5	2	1	7	4	16	4	...	...	...	2	1	...	10	9	42	30	8.97	13.57
11 "	4	8	2	1	8	4	16	5	...	...	1	4	3	...	11	10	46	32	9.83	14.48
12 "	3	2	3	1	9	3	7	3	...	...	2	1	2	...	6	8	32	18	6.83	8.15
13 "	1	2	3	1	14	3	5	3	...	2	...	2	1	...	2	2	26	15	5.55	6.79
14 "	8	7	1	...	5	4	4	2	...	...	1	2	...	...	7	7	26	22	5.55	9.95
15 "	5	3	6	1	1	1	5	1	...	...	...	...	1	...	4	3	22	9	4.73	4.07
16 "	6	...	1	...	2	2	2	...	...	...	...	...	...	...	1	4	12	6	2.55	2.72
17 "	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	.22	...
18 "	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
19 "	1	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	2	.22	.9
20 "	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Over 20 "	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...
TOTAL	45	38	47	18	128	40	143	33	2	3	16	20	19	15	69	54	469	221	...	...
STRENGTH	419	409	579	241	1592	472	2611	715	199	167	644	498	668	499	1703	1309	8415	4310		
AVERAGE AGE, YEARS.	11 $\frac{1}{2}$	12 $\frac{1}{2}$	9 $\frac{5}{8}$	8 $\frac{1}{2}$	8 $\frac{1}{2}$	10	8 $\frac{1}{2}$	9	6 $\frac{1}{2}$	10 $\frac{1}{2}$	7 $\frac{1}{2}$	9 $\frac{1}{2}$	9 $\frac{1}{2}$	7 $\frac{1}{2}$	10 $\frac{1}{2}$	11 $\frac{1}{2}$	9 $\frac{3}{4}$	10 $\frac{1}{2}$		
PER CENT.	10.74	9.29	8.12	7.47	8.47	5.47	4.61	1.0	1.8	2.48	4.02	2.81	3.0	4.05	4.13	5.57	5.12	5.42 of Total Strength.		

Taking these figures as an index of the prevalence of Roaring among horses generally, throughout the United Kingdom, we might hazard the opinion that at least 6 per cent. have this infirmity, though they may be more or less serviceable, according to the stage it has reached.

It is possible that it may be very much higher among the lighter horses—saddle and harness—of the public: as army horses, nearly 6 per cent. of which we may admit are Roarers, are purchased when young, and are carefully attended to, medically and hygienically, during the whole of their service; they are therefore less exposed to the exciting causes which give rise to Roaring.

CHAPTER IV.

PREDISPOSING CAUSES OF ROARING.

IN the production of what I have termed, following the example of French Veterinarians, "Chronic Roaring," we must not overlook the existence and the influence of predisposing causes, as it is only by recognising and endeavouring to neutralize them that we can hope to prevent its occurrence. These causes are numerous and various, and some of them are more potent and obvious in their influence than others; they may be considered in their relation to: 1. Climate; 2. Heredity; 3. Breed; 4. Sex; 5. Size; 6. Age; 7. Conformation; 8. Management; 9. Accidental Causes.

1. *Climate.*

In treating of the prevalence of Roaring, in the preceding chapter, there was much and strong evidence given in favour of the influence of climate as a predisposing cause, and it was remarked that horses in Western and Northern countries are much more liable to it than those of Eastern and Southern regions. Even in Europe this is evident, the horses of Italy and Spain being very much less affected than those of England, or Northern Germany and France. Cold and damp climates appear to favour its production, not only because they are inimical to the natural vigour of horses, but also because the artificial conditions in which they have to be maintained in order to protect them from the deteriorating influences of climate, or to improve them, are predisposing agencies in themselves, tending as they do,

and as we shall presently show, to develop those maladies which so frequently lead to Roaring.

According to Charon,¹ Roaring is frequent in the West of France, and more especially in the Norman Departments of La Manche, Orne, and Calvados; while it is less frequent in La Vendée, is almost unknown to the south of the Loire, and is still more rare from the banks of the Garonne to the Pyrenees. Normandy has always been considered the country in France in which the defect is most common and has been longest known. Indeed, there is a Norman tradition that the name by which it is known in France—"Cornage"—originated there, and was carried, along with the horses of La Manche and adjoining departments, into the interior; it was derived from the similarity of the sound emitted by the affected horse to that given out by the horn of the cowherd assembling his cattle.

Ireland is a moist country, more so than England, and the affection is more common in Irish than English horses, so far as my experience goes.

Change of climate may also act as a predisposing, or even exciting cause, as witness the case of English troop-horses in Egypt and South Africa, and Irish horses brought to England. An Arab recently imported from India to this country has become badly affected with Roaring.

Climates which predispose to diseases of the respiratory organs are those in which Roaring is most prevalent; such are cold, moist climates; and those in which it is least known are warm and dry climates—maladies of the air-passages being rare in them, and horses living much in the open air. Under the influence of acclimatization in moist, cold climates, horses bred in warm, dry climates become predisposed, through the diseases common to such inhospitable regions attacking them and rendering them liable to this defect.

¹ Op. cit., p. 77.

2. *Heredity.*

The question of heredity of predisposition is a very important one for consideration, as, if it really exists, unlike climate, it can be controlled.

Of its existence I think there can scarcely remain a doubt. We do not know when Roaring first began to be observed in England, but it would not appear to have been much noticed until within the last century or two. Was the tendency to it imported into this country by foreign horses of large size? Godine, jun., long ago asserted that the defect was introduced into Normandy, in 1764, by Danish stallions which were Roarers.¹ May we not have got it among our horses from a similar source, and about the same time?

It has been stated that the famous race-horse, Eclipse, was affected in his breathing. Youatt says: "Eclipse was a 'high-blower.' He drew his breath hard and with apparent difficulty. The upper air-passages, perhaps those of the head, did not correspond with his unusually capacious chest; yet he never was beaten. It is said that he never met with an antagonist fairly to put him to the top of his speed, and that the actual effect of this disproportion in the two extremities of the respiratory apparatus was not thoroughly tested."² Whether this "high-blowing" was the defect we are now studying, there is no other evidence to show. Certain it is, however, that Roaring began to receive attention about this time, and towards the beginning of this century suspicions of an hereditary tendency to it were being entertained. Soon strong proofs of the reality of such a tendency were accumulated and published, and some of them were sufficiently convincing.

K. Günther, in Germany, and Stockfleth, in Denmark, maintained that Roaring is hereditary, and gave evidence in support of their opinion.

¹ "Traité d'Hygiène."

² "The Veterinarian," 1833.

In France, Dupuy, early in this century, insisted, from his observations, upon Roaring being hereditary; and Girard, jun., cited the case of the stallion Misanthrope, in the plain of Caen, whose produce were superb, but one-half, and often even two-thirds of them, became affected with Roaring. Reynal refers to many instances of a similar kind, and particularly alludes to that of a great horse-breeder of Livonia, who had a fine English stallion which, when about ten years of age, became a Roarer without any appreciable cause. From this time nearly all his produce were affected, more or less, with Roaring, and among them eight mares which he kept for breeding purposes. The curious feature in this instance was that the descendants showed the defect when ten years old, the age at which the sire was discovered to be unsound from this cause.

And the evidence obtained in the French Government studs is further confirmation of this hereditary predisposition. Charon, from inquiry and observation, states that 60 per cent. of the produce of horses affected with Roaring become Roarers when exposed to exciting causes, and he gives a long list of stallions which, themselves undoubtedly unsound in this way, were the sires of generations of similarly unsound stock. He refers especially to a thoroughbred stallion, which by his name—Eastham—should be English; this animal was a Roarer when comparatively young, but, owing to his fine appearance, he was a great favourite in Normandy, and much sought after. He unfortunately left a long line of half-bred Roaring descendants, and Charon declares that there is not a breeder in the Valley of the Auge who does not retain an unpleasant reminiscence of the animal's presence in the country, through the serious respiratory defect in the stallions and mares he produced. To this day these breeders, in referring to this horse, say "*Il a du Béranger dans le gosier*," a phrase as significant as imaginative. Charon gives a list of the stallions descended from Eastham which were

Roarers, and some of which were rather celebrated. One of his produce, Chasseur, and his grandson, Carnassier, became Roarers; the latter was the sire of the celebrated Ganymede, out of a mare by Chasseur; and Ganymede in turn produced a Roarer bearing the parent's name. Among the descendents of the latter, Quebec and Troarn are particularly distinguished as hereditary Roarers; among the sons of Quebec nine, and of those of Troarn seven, were affected.

In England, the instances that might be quoted in support of hereditary predisposition are very numerous and convincing. Youatt, in his *Veterinary Lectures*,¹ delivered in 1833, gives a rather notable case, occurring in Norfolk, which is somewhat similar to that of Eastham in France. He says:

“There was a valuable stallion in Norfolk, belonging to Major Wilson, of Diddlington. He was a great favourite, and seemed to be getting some excellent stock; but he was a Roarer, and some of the breeders took alarm at this. They had occasionally too painful experience of the communication of the defects of the parent to his progeny, and they feared that Roaring might possibly be among these hereditary evils. Sir Charles Bunbury was requested to obtain Mr. Cline's opinion on the subject. Mr. Cline was a deservedly eminent surgeon of mankind; he had exerted himself in the establishment of the Veterinary College; he was an examiner of veterinary pupils, and therefore it was supposed that he must be competent to give an opinion. He gave one, and at considerable length: ‘The disorder in the horse,’ said he, ‘which constitutes a Roarer, is caused by a membranous projection in a part of the windpipe, and is the consequence of that part having been inflamed from a cold, and injudiciously treated. A Roarer, therefore, is not a diseased horse, for his lungs and every other part may be perfectly sound. The existence of Roaring in a stallion

¹ “*The Veterinarian*,” 1833, p. 66.

cannot be of any consequence. It cannot be propagated any more than a broken bone, or any other accident.' . . . Sir Charles returned full of glee ; the good people of Norfolk and Suffolk were satisfied ; Major Wilson's horse was in high request ; and in a few years a great part of the two counties was overrun with Roarers, and many a breeder half ruined."

Among thoroughbred or pedigree horses, the influence of heredity in leading to the development of this defect is notorious, and instances will occur to those who have even only casually studied the subject. Bal Gal, for example, was a confirmed bad Roarer, and her dam, Cantinière, was even worse. Blair Athol's progeny are distinguished for developing their sire's respiratory disability, and the case of Prince Charlie is well known. Lady Agnes is the dam of Ormonde, and both suffer from Roaring.

Goodwin, late veterinary surgeon to the Hampton Court stud, in *Bell's Life* for January 15th, 1855, alludes to the heredity of Roaring, and remarks: "We have before us such a remarkable case—one which, in this instance, so distinctly proves that it is hereditary, and this is so well known to all turf-men, that I feel no delicacy in giving the names of Bowstring, Iris, and Longbow, all the produce of one mare, Miss Bowe, yet not by one sire ; for Bowstring was got by Amuratti, the other two by Ithuriel—first-class race-horses, and whose infirmity as Roarers is conclusive upon this point. At the same time I am aware that many instances exist of stallions either being or supposed to be Roarers, whose stock are wholly free from any symptom of their sire's disorder ; but I believe that a great deal of misapprehension exists, which has often been the cause of imparting to stallions the character of their being Roarers when such was not the case."

Elsewhere,¹ the same writer and Mr. Apperley (Nimrod) allude to the celebrated mare Marry, by Precipitate, and

¹ "The Veterinarian," 1840.

her dam, who were both Roarers; the first had a filly by Sorcerer, which in time exhibited the same defect, and transmitted it to her son, Black Jack. Marry produced three Roarers by three different horses. Markham¹ gives an instance in which, of eight descendants from a Roarer, six became affected.

Pedigree horses of the heavier breeds, such as shire and Clydesdale cart-horses, have sometimes this hereditary weakness.

The transmission of predisposition is, of course, more certain when both parents are affected than when only one is a Roarer; in the latter case the chances are more in favour of the progeny escaping, especially if circumstances are otherwise propitious. Besides, the hereditary influence is not equally manifested in all the produce from the same stock, as there are often many exemptions, only one-half or one-third becoming affected when exposed to exciting causes.

It has also been remarked that age appears to influence the potency of hereditary predisposition in such a manner, that a stallion affected with Roaring will beget fewer foals with the tendency to that weakness when young than when old. A remarkable example is given by Charon, of the Haras stallion, Pater, which was a Roarer. Very few of the produce of his earlier years became affected, but nearly all those he begot in his old age were Roarers when young.

But in considering this question of heredity, it must be confessed that a satisfactory conclusion cannot always or easily be arrived at. The predisposition may exist, but the immediate exciting cause may never arise; while certain diseases occurring in horses which may not have the predisposition are often followed by Roaring. When the defect appears at a very early age, and without any marked exciting cause, then predisposition may be suspected.

Goodwin, quoted by Percivall, gives the case of the cele-

¹ "The Veterinarian," 1839.

brated race-horse Taurus, which was a Roarer, and yet, though he sired a number of foals and fillies from several mares, none of them inherited his defect, and they won many races. He came from a stock noted for this disability.

3. *Breed.*

All breeds are not equally predisposed to become Roarers.

In France, Reynal asserted that the affection was more frequently observed in heavy-draught horses than in those used for light draught or riding; though he mentions the old Norman race, reared in the Cotentin, and recognised by the great development of its bony frame, its large convex face, narrow space between the lower jaw, which is voluminous and projects much backwards, as being especially predisposed.

In Germany, though the heavier breeds of horses are not exempt, yet the lighter furnish by far the largest percentage of Roarers. The Hostein and Hanoverian horses, which somewhat resemble those of Normandy, have been considered as greatly predisposed to Roaring.

In England, more than half a century ago, Youatt said: "There can be no doubt of the fact that the majority of Roarers are draught-horses and horses of quick draught; they are not only subject to the usual predisposing causes of this obstruction, but there is something superadded—the bearing-rein." At the present day, there can be no doubt that the lighter breeds of horses are most predisposed. A recent writer¹ states that "Cleveland-bay, coaching-like horses, Shire and Clydesdale cart-horses, hunters and van-horses, appear to be most disposed to the affection," and that "a fruitful source of transmission to our half-bred stock has been the use of thoroughbred horses, cast as Roarers, becoming country stallions."

In my experience, the breed of saddle-horses is more predisposed than any other—a circumstance which I attribute

¹ T. Hopkin, "Veterinary Journal," May, 1888, p. 317.

to the fact that many thoroughbred race-horses are affected with Roaring, which eventually, wholly or partially, incapacitates them from further performance on the turf, and causes their relegation to service as travelling stallions.

Tables II. (p. 37), III., and IV. (p. 48), show that, so far at least as army horses are concerned, those used for saddle purposes are affected in larger proportion than harness and heavier draught horses.

TABLE III.

Return of Horses sold for Roaring, from 1st January, 1881, to 31st December, 1887, in the Cavalry Regiments serving at Home.

AGE.	1881.		1882.		1883.		1884.		1885.		1886.		1887.		TOTAL.		Per Cent.	
	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.
4 years ...	...	...	...	...	1	...	3	...	2	...	5	1	4	...	15	1	8.15	1.61
5 " ...	...	...	...	...	2	...	2	...	...	...	4	1	5	2	13	3	7.06	4.84
6 " ...	...	...	...	...	4	...	3	2	...	...	5	...	1	...	18	2	9.78	3.23
7 " ...	2	2	...	3	1	...	8	3	1	...	1	1	5	1	18	10	9.78	16.13
8 " ...	...	...	...	1	1	...	7	7	3	1	5	2	4	...	20	11	10.87	17.74
9 " ...	...	...	1	...	2	...	11	4	5	1	4	...	6	...	29	5	15.76	8.07
10 " ...	...	1	1	...	3	...	2	2	2	2	6	2	3	2	17	9	9.24	14.51
11 " ...	2	...	...	...	1	2	4	1	3	2	6	3	2	1	18	9	9.78	14.51
12 " ...	...	1	...	...	2	...	2	1	4	1	...	2	2	2	10	7	5.43	11.29
13 " ...	1	...	...	...	2	...	2	...	2	2	3	...	2	1	12	3	6.52	4.84
14 " ...	3	...	...	...	2	...	2	1	1	...	5	1	1	...	14	2	7.61	3.23
TOTAL	8	4	4	4	21	2	46	21	26	9	44	13	35	9	184	62		
Average } Strength }	4889	1630	4525	1509	4649	1549	4766	1539	4630	1543	4913	1638	5171	1724	4792	1597		
Average } Age, yrs. }	11 $\frac{3}{4}$	9	7 $\frac{3}{4}$	7 $\frac{3}{4}$	9	11	8 $\frac{1}{2}$	9	9 $\frac{1}{3}$	10 $\frac{2}{3}$	8 $\frac{9}{11}$	9 $\frac{1}{2}$	8 $\frac{1}{2}$	9 $\frac{1}{4}$	8 $\frac{5}{8}$	9 $\frac{1}{4}$		
Per Cent...	.18	.24	.09	.26	.45	.13	.06	1.32	.56	.58	.89	.79	.63	.52			3.84	3.88

TABLE IV.

Return of Horses sold for Roaring, from 1st January, 1881, to 31st December, 1887, in the Royal Artillery, Royal Engineers, and Commissariat and Transport Corps.

AGE.	1881.		1882.		1883.		1884.		1885.		1886.		1887.		TOTAL.		Per Cent.	
	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.	Mares.	Geldings.
4 years ...	...	...	...	...	1	1	...	3	...	...	1	...	...	...	2	4	2'44	8'9
5 " ...	...	...	...	...	1	...	...	...	1	...	1	...	...	1	3	1	3'65	2'22
6 " ...	1	...	1	...	1	...	1	1	1	1	3	...	1	1	9	3	10'98	6'66
7 " ...	...	...	2	...	1	3	...	1	1	1	2	2	1	...	9	4	10'98	8'9
8 " ...	1	1	1	1	2	...	1	1	3	...	2	...	...	2	10	5	12'19	11'11
9 " ...	...	...	...	...	2	1	1	...	1	5	...	...	4	...	8	6	9'76	13'33
10 " ...	1	...	1	3	...	...	1	...	...	1	2	2	1	...	6	6	7'32	13'33
11 " ...	...	...	...	...	1	...	4	1	...	1	...	1	...	...	5	3	6'1	6'66
12 " ...	1	...	2	...	...	...	2	2	2	2	2	1	1	1	10	6	12'19	13'33
13 " ...	...	...	5	1	...	...	1	1	3	2	3	...	...	1	12	5	14'63	11'11
14 " ...	3	...	1	1	1	...	1	...	1	...	...	...	1	1	8	2	9'76	4'44
TOTAL	7	1	13	6	9	3	16	9	12	8	20	6	5	12	82	45		
Average } Strength }	3256	2456	3106	2343	3262	2461	3238	2443	3161	2384	3257	2457	3394	2560	3239	2443		
Average } Age, yrs. }	11½	8	10½	10½	8½	6½	9½	8½	9½	10½	8½	9½	10½	9½	9½	9½		
Per Cent...	·21	·04	·41	·26	·27	·12	·49	·37	·38	·33	·61	·24	·15	·47			2'53	1'84

4. Sex.

It has often been asserted that sex has influence as a pre-disposing cause, and that horses are more liable to the defect than mares. This notion was started by Girard, jun., and is alluded to by Percivall, who writes: "Mares seldom become Roarers, at least in comparison with horses. This is a fact, I believe, too notorious among men of horse experience to admit of doubt, though it is one for which it appears difficult, if not impossible, to assign any satisfactory reason. However, as I am informed, so stands the fact."

It cannot be well founded, for the evidence I have collected does not in any way corroborate it, neither does that of Charon. That authority gives statistics of troop-horses purchased in France during a period of ten years (from 1871 to 1880); these were 12,538 geldings, of which 206 were Roarers, and 9,282 mares, 126 of which were similarly affected—being 1·62 per cent. of the first, and 1·35 per cent. of the second. These proportions only refer to geldings and mares, for according to Charon (and the same remark has been made by Reynal and others), Roaring is more frequent among entire horses. He states that the Administration of the Haras always purchases more stallions than are required to complete the establishment, because of rejections due to unsoundness; and it is estimated that there is an average proportion of 10 per cent. which are Roarers among the purchases. The same writer adds, in concluding his remarks with regard to this point of sexes, that it is remarkable that it is among the best-bred and best-looking animals that most Roarers are found.¹

Moeller,² for Berlin, states that, in his experience, he finds twice as many horses as mares affected with Roaring; and Williams,³ following Percivall,⁴ asserts for England that horses and geldings are more liable to become affected than mares, which are seldom Roarers.

My own inquiries have had a similar result to that obtained by Charon, as the preceding tables will show. In Table III. (p. 47), giving the number and sex of cavalry horses sold because of Roaring during seven years, from the British Army at home, the sexes are nearly equal; while in the heavy corps—Table IV. (p. 48)—the mares are largely in excess. Table II. (p. 37) also shows that, among army horses generally, there is very little difference in the sexes, with regard to predisposition.

¹ *Op. cit.*, p. 31.

² "Das Kehlkopf-Pfeifen der Pferde," p. 42.

³ "Principles and Practice of Veterinary Medicine," 1872, p. 509.

⁴ "Hippopathology," vol. ii., p. 40.

5. *Size.*

Size is supposed to have some influence in the genesis of Roaring, and it appears to be a fact that ponies and small horses are less frequently affected in this way. Not only in England is this recognised; Continental horsemen have accepted it as undeniable. The Baron Curnieu, for instance, a great authority in France on horses and horsemanship, says, in speaking of Roaring: "*Le Cornage est une maladie du grand cheval;*" and again, "*Comme le Cornage est la maladie du grand et gros cheval, il est probable que l'on continuera de risquer l'emploi des étalons corneurs, d'autant plus qu'ils ne manquent pas.*"¹

Of the horses in Holstein, Riquet estimated in 1847 that eight per cent. of the carriage-horses were Roarers, and of the smaller-sized horses only four per cent.²

For England, Mr. Hopkin writes: "In breeding, as we improve the size and conformation, we also increase the tendency to unsoundness of wind. Taking 15-2 hands as a medium height of the horse, we rarely find one under that affected with *Laryngismus paralyticus*, whilst (with age) when over that height a heavy percentage are unsound. This has been established by investigations undertaken for me.

"Little horses are very rarely affected, and in offspring from the same parents, if one be small and the other big, the Roaring will be developed in the latter and not the former; but I believe if the small one be bred from and should breed a big one, even if the mate be sound, the tendency to Roaring will return. I have a striking instance in a bay mare, 15-1½ hands high, and which I have hunted for the last eight or nine seasons; her half brother and sister, 16 hands high, were both Roarers, whilst their dam was sound; and Spoonstealer, the sire of all, was also a good-winded horse."³

¹ "*Leçons de Science Hippique Générale.*"

² "*Recueil de Méd. Vétérinaire,*" 1847.

³ *Op. cit.*, p. 315.

With regard to the latter remark, as to sire and dam being sound in their wind and their progeny Roarers, this might admit of another explanation than that of size, and inquiry would probably elicit the fact that a progenitor of one or other parent was a Roarer. Atavism is not at all a rare occurrence in the equine species, and there are instances, to my knowledge, which would go to prove that a predisposition to Roaring may be transmitted indirectly and collaterally.

Some years ago, it was asserted that heavy cart-horses in England and Scotland were almost as liable to become Roarers as thoroughbreds, while roadsters and hackneys seemed to suffer least; and in Paris it was stated to be the same. So far as I can ascertain, this is not the case nowadays.

Though it is a fact that large horses are more predisposed to become affected than small ones or ponies, yet size cannot be looked upon as nearly so important a factor as the other influences we have been considering. Eastern and Southern horses, natives of warm, dry climates, are small when compared with those of the West and North, which are reared in a cold and damp atmosphere, and kept generally in hot, close dwellings, which engender diseases of the respiratory organs. But even among the large horses there are such notable exceptions to this predisposition, as to show that height and weight are not so important as some authorities would lead us to believe.

Among army horses, the largest are to be found in the Artillery and Transport, the smallest and lightest in the Cavalry; and yet it is in the latter that most Roarers are reported. Table II. (p. 37) shows this; but it likewise affords evidence that the larger horses of Heavy Cavalry are more affected than those of Light Cavalry.

Charon carefully noted the sizes of horses purchased for the French army during four years, and found that the percentage of Roarers among those of the Artillery was only 0.97,

while in the Light Cavalry it was 1·91, in Cavalry of the Line 2·19, and in the Reserve horses (Heavy Cavalry) 3·87. Though there were more horses unsound from Roaring in the Heavy than the Light Cavalry, which fact might be adduced in favour of the influence of size; and though the Artillery horses were taller and heavier than those of the Cuirassiers and Dragoons, yet there were far fewer Roarers among them, showing that the defect is much less frequent among common-bred than well-bred horses.

In a tramcar company in London, with an establishment of about 3,000 horses, which are chiefly light agricultural animals from Wales, Roaring is unknown.

Therefore size cannot be considered as of great moment, in predisposing to the morbid condition which gives rise to the defect.

6. *Age.*

Age would appear to exercise a certain amount of influence in the manifestation of Roaring. Apart from toxical production, it is extremely rare in foals, though it has been observed in those of six months old. Reynal, speaking of this defect in French horses, says that with those which do not leave the country in which they are foaled, it appears more frequently between two and four years of age; and with those which are exported to the great industrial centres, it is not unusual to see it manifest itself at from five to seven years old.

From two to seven years of age, horses appear to be most predisposed to become Roarers in this country, and the majority probably become unsound from this cause between three and five years. This is more especially the case with well-bred, and particularly racing horses. It has been justly remarked that "not a season passes but some promising animal, having accomplished wonders at two years of age, is good for nothing, or for nothing but short spins, at three, because it has begun to make a noise, and goes on from bad to worse."

Our army statistics do not assist us very much in arriving at a conclusion as to age in predisposing to Roaring. Horses rarely receive medical or surgical treatment when they first become affected, and are consequently not reported; the morbid change commencing in many cases very obscurely and gradually increasing, does not, except in severe cases, prevent the horses performing their duty until they are cast, either because of it or of age, or some other disability. Tables III. and IV., therefore, only show horses sold because of Roaring, which in the older ones was no doubt present for many years; and Table II. gives the ages of those already affected, but serviceable.

The influence of age must be considered in relation with the circumstance that young horses are most predisposed to those diseases which are followed by Roaring, adult horses being much less liable to them, and therefore seldom becoming subjects of laryngeal disturbance; though they suffer far more frequently than young animals from the affections collectively and popularly designated "Broken-wind."

7. *Conformation.*

Certain conformations have been always more or less associated, in the minds of horsemen, with a tendency in horses to become affected with Roaring.

In this country, horses with long thin necks—"Ewe-necked"—are supposed to be more likely victims than those with better-formed and proportioned necks. Martin¹ has supposed that the processes of development of the body in young horses predisposes them anatomically: the heart being pushed farther back and the neck growing correspondingly long, causes the left recurrent nerve to be exposed to extensions and pressure at the aorta, which, he imagines, may impair its conductivity. And Møller² is of the opinion that the frequent appearance of Roaring at from three

¹ Martin, "Oesterreich. Monatsschrift für Thierheilkunde," 1885.

² Op. cit., p. 34.

to six years of age, when the processes of development are accompanied by great alterations in form, when the formation of the neck in particular makes considerable progress, and the fact that long necks indicate a special predisposition to this affection, show that a cause for its appearance must be sought for in these processes. He thought that Roaring, often increasing slowly at this period, substantiated this view. Fürstenberg and others in Germany have also considered the long thin neck as a predisposing conformation. But my observation leads me to the conclusion that horses with all kinds of necks may become Roarers, and that the neck in question no more predisposes than a short thick neck. If the neck develops in length during youth, so will the organs and tissues in relation or direct connection with it—nerves, muscles, trachea, œsophagus, blood-vessels, etc. The same processes of development take place in horses in countries where Roaring is scarcely known; and if long thin necks predisposed to it, we could scarcely expect camels, giraffes, and creatures of similar conformation to be at all exempt from this affection.

Horses with flat sides, narrow chests, and elbows inclined inwards, have also been supposed to possess a strong tendency to Roaring, but I cannot find any reliable evidence to support the supposition. I have seen as many well-shaped, among them perfect-shaped, horses suffering from this defect in respiration, as I have of those with the faulty conformation just described.

A notion of the same kind has largely prevailed in France with regard to the shape of the head, horses with the forehead and face convex (*tête busquée*) being regarded by veterinary surgeons and horsemen as much predisposed to Roaring. The idea, in all probability, was due to the fact that the old breed of Norman horses, which was notorious for this respiratory defect, had this unsightly-shaped head; but though the conformation has, by crossing the race, almost disappeared, the Roaring has not. Besides, the

majority of Italian and Spanish horses have this kind of head, and yet they are nearly exempt from the noise in respiration. And Charon has shown how little such a formation has to do with the defect in question; as, among 297 horses which were Roarers, only nineteen had this shape of head to a marked degree, thirty-three had it but slightly, and 245 had heads of the ordinary shape.

Another supposed predisposing cause is narrowness between the branches of the lower jaw, which does not admit of sufficient space for the larynx, and which is therefore compressed. This supposition has also been prevalent in France, but in reality it has no foundation; as the space, which is rather variable in dimensions, has been found as wide in Roarers as in sound horses—demonstrating that the conformation has no influence in the causation of Roaring. It is to be observed, however, that horses with their heads “badly set-on” and diminished space between the branches of the lower jaw, will, when ridden or driven with the nose pulled in or to one side, sometimes make a noise in breathing, but this is different to that of Roaring.

Möller remarks that horses with a thick fleshy neck and narrow lower jaw, are worse Roarers than those of the opposite conformation.

So far, then, as certain conformations are concerned, I am of opinion that they have very little, if any, influence on the production of Roaring, the existence of this defect in an animal of a certain shape being, in my experience, a mere coincidence.

8. *Management.*

There can be little doubt that the management, or rather mismanagement, of horses often predisposes them to Roaring. The artificial conditions in which they are bred, reared, and worked, necessitated by climate and the demands of civilization, and also those measures resorted to for improving them, certainly have a tendency to develop altered

and more delicate states of tissues and organs, which place horses at a disadvantage when compared with those which live in more favourable climates, and are kept in a more natural way.

What can be more unnatural, for instance, than the training and racing of horses at two years of age, when they should be running at large and developing their bodies gradually and solidly? The housing, feeding, grooming, and training lead to abnormal precocity, while the severe exertions required from such immature creatures must be a severe tax upon their constitutions. The evidence of this is seen in training-stables, as well as on race-courses where horses run in five and six furlong races, and are fit for nothing else, and at the sales of "cast-offs" and racing "weeds."

We are told that the late Mr. Thomas Parr, "in whose hands Fisherman won countless Queen's Plates, and Weathergage, who cost his late owner and trainer no more than £35, won the Cesarewitch, used to maintain that half the Roarers in England picked up that distressing malady in the hot stables of trainers. It was Tom Parr's custom to have Fisherman, Rataplan, Saucebox, Weathergage, Mortimer, and all the many good horses which passed through his hands, standing in rough-boarded loose-boxes, through the open chinks of which the wind whistled with cutting fierceness in mid-winter, while a single rug was thrown over the loins of his horses. Moreover, he rode these habitually as hacks along the roads, and occasionally with the hounds, as had been done many years before by Mr. Fergusson, who is said to have been asked in the hunting-field what he would take for his horse, and to have replied, 'Seven thousand guineas.' The horse in question was Harkaway, who would have been cheap at that price."

Hot stables, and especially if they are badly ventilated, by predisposing to catarrh, bronchitis, pneumonia, and pleurisy, likewise predispose to Roaring. Improper food may also do so, though of this I have no clear evidence, except in those cases in which it acted as a poison.

The bearing-rein has long been considered a powerful agent in injuring the larynx, and so leading to impaired respiration. Percivall, fifty years ago, said of Roaring horses: "A large proportion of these subjects are harness-horses, whose necks have been rainbowed by the bearing-rein for hours together, and whose larynges have been compressed and tracheæ distorted by this unnatural and constrained position of the head and neck." And subsequent writers have insisted as strongly upon the injury done by the injudicious use of this article of harness. But though it may, and does, cause much pain and discomfort to horses, yet it is very questionable if it does distort the larynx or trachea, or produce Roaring. Saddle-horses are more liable to become Roarers than carriage-horses, so far as my experience leads me to judge, and they do not wear bearing-reins.

9. Accidental Causes.

What may be considered as the accidental predisposing causes of Chronic Roaring may also be regarded as the most frequent, if not the almost constant exciting, causes of the imperfection. The occasional causes I have already alluded to, and among them are some which I believe are in operation in a very great majority of the cases of Roaring, and especially of horses predisposed by heredity or other tendencies to become Roarers. I refer to the contagious and infectious suppurative fever of early age—Strangles, which is followed so very often by Roaring; also inflammation of the air-passages, or fevers affecting these or the membrane lining the chest (pleura).

Among our army horses, Strangles certainly holds the first place in predisposing or exciting to Roaring, among remounts especially, and respiratory diseases come next. In the French army it is somewhat the same, if we refer to the evidence which Charon adduces. That good observer had opportunities for studying this matter which few, if any, of

our veterinary officers can command, and which he appears to have availed himself of to excellent effect, he being for many years attached to the Remount Dépôt in Caen. During two years—1879, 1880—he admitted to his infirmary 754 horses for various diseases belonging to the classes I have named, and noted their subsequent medical history. The result was as follows :

NATURE OF THE DISEASES.	NO. OF HORSES TREATED.	NO. WHICH BECAME ROARERS.	PROPORTION PER CENT. OF ROARERS.
Strangles - - -	466	58	12·46
Laryngeal and Pharyngeal Anginas	155	23	14·83
Acute Bronchitis -	44	"	"
Chronic Bronchitis -	17	4	23·52
Pneumonia - -	59	5	8·47
Typhoid Affections (Influenza) - -	13	2	15·38
Totals - -	754	92	12·20

It is remarked that these horses were from three to five years of age, and that the maladies were due to climatic influence, all the animals being under the *coup* of the Strangles diathesis (*diathèse gourmeuse*), the cases of chronic bronchitis being observed in horses recovering from that affection. The Roaring was not persistent in every case, as it sometimes disappeared after several months; but when it remained after complete convalescence, it had all the characteristics of Chronic Roaring.

CHAPTER V.

SYMPTOMS AND DIAGNOSIS OF CHRONIC ROARING.

PERCIVALL long ago remarked that the term 'Roaring' is rather a generic than a specific one ; and I have already mentioned that it does not indicate a disease, but only a symptom of a morbid condition of the air-passages of the horse. To speak of the symptom of a symptom is therefore absurd, and would be inexcusable here, had not universal custom for years caused the symptom to be regarded as the disease itself, and it has been written and spoken of accordingly by horsemen and veterinarians. It will therefore be understood that, when treating of Chronic Roaring, the signs described are those which characterize the condition that in nearly all cases gives rise to impeded and noisy respiration—viz., paralysis of the muscles on the left side of the larynx.

This condition I have ventured to designate "Laryngismus paralyticus," as conveying, technically, an idea of the altered state of that organ, and the cause which produces the constriction of its passage. Professor Møller has named it "Hemiplegia laryngis," which only partially defines the condition ; and others have termed it "Laryngismus stridulus," a designation applied to the ephemeral and spasmodic laryngeal disorder commonly known as whooping-cough in mankind, and therefore misleading as referring to the laryngeal constriction (or *stenosis*) due to paralysis of that organ in the horse.

The chief symptoms of paralysis of the muscles of the larynx in the horse are : 1. The noise (*stridor*) emitted in

respiration; 2. The difficulty in breathing (*dyspnœa*); 3. The character of the cough. In man, the alteration in or loss of voice (*aphonia*) is an early and characteristic symptom, but this is, of course, absent in the horse; and therefore the veterinary surgeon has not the advantage of it as an aid in the detection of laryngeal paralysis at an early stage, nor as a diagnostic sign.

1. STRIDOR.

In the great majority of cases, the existence of this paralysis is first ascertained by the noise the horse makes when undergoing exertion, or when made suddenly to inspire; but it is, as a rule, when in more or less rapid motion that the abnormal sound is first perceived. In healthy or physiological respiration, when the horse is at rest and the ear is held near the animal's nostril, a faint blowing or puffing sound can be heard, which is somewhat prolonged during inspiration, not so long, but louder in expiration. This gentle soft sound is produced by the air passing through the larynx and air-passages of the head; it can be heard more distinctly if the ear be closely applied to the trachea, and loudest of all in the region of the larynx. On exertion, this sound is increased, though not nearly so much in horses which are in good training or condition, as in those which are not so, or are very fat, or have the abdomen voluminous—as animals fed on bulky food, or pregnant mares—such are said to be “thick-winded;” but however much its diapason may be raised, this sound is still normal. In Roaring the sound is different—or it may be said that another sound is added to it—when circumstances cause the respiration to be increased, and the compound noise then emitted is indicative of an altered state of the laryngeal cavity.

The *timbre*, or tone, and the intensity of the new sound, vary considerably with the changes in the larynx which give rise to them. While the horse is at rest the sound is

imperceptible, but after a certain amount of exertion or excitement—depending upon the stage of the disease—it becomes audible as a faint whistling, rustling, or rattling sound during the act of inspiration; in some cases it may not go beyond this, but in others, again—and they are the large majority—it becomes louder and deeper, then more acute, as the speed is accelerated and the exertion exalted: passing by a series of intonations that are difficult to describe, but which experience can alone assist in recognising and defining as confirmed or chronic Roaring, and so enable the expert to arrive at a conclusion as to the stage the alterations in the larynx may have reached.

In quite recent cases, or those in which the laryngeal derangement is only slight, the morbid sound is usually not heard unless the animal is put to a fast gallop; and sometimes at the commencement of the disease, the noise, after being emitted for a short time, disappears if the exertion be continued; but if it is more pronounced and louder at the end of a long gallop than at the commencement, then the case may be regarded as one of confirmed chronic Roaring. In such a case, the *minimum* of intensity is an almost inaudible whistle or *sifflement* in inspiration, which in time increases to a “filing,” “rasping,” or “sawing” sound—the *bruit de scie* of the French hippologist, who, in describing a Roarer, says, “le cheval scie du bois”—the sawing respiratory sound being a very apt comparison with that of wood-sawing, though in some instances it is more like the sound produced by a saw-sharpener. The Germans try to represent the sound phonetically by the word “Chiemend.” Percivall was not quite happy in describing it. “With the *whistler’s* note,” he says, “we soon become acquainted. Whoever has listened to the ‘northern blast rushing through a crack in the window-shutter,’ need seek no description of it. In this instance, the sibilation appears to be produced by a continuous rush of air through some narrow pass in the trachea or larynx; it is seldom or never

heard, therefore, in a state of quietude.”¹ The Roaring or Whistling sound is not continuous, but intermittent, being emitted during inspiration, and scarcely, if at all, heard in expiration in recent cases.

In very bad cases of Roaring, the noise is frequently heard when the animal is only a little exerted or excited, and it quickly becomes increased to what may be termed the *maximum* intensity if the exertion be continued. It is louder and more shrill, somewhat like a scream, or, as Charon has it, a combination of the “renflement du sommeil” and the “râlement de l’agonie;” and it painfully affects the listener, who almost instinctively realizes the distress the animal must experience, even did he not observe its physiognomy. The stridulous noise continues, either until the horse is mercifully pulled up, or he suddenly stops when the dyspnœa becomes so severe that asphyxia is impending. The animal seldom falls, unless very high-couraged, and those who urge him when so distressed are either ignorant of his condition, or are too brutal to consider it.

The loudness of the sound is not so much an indication of the stage the disease has reached, as its acuteness; for there are many horses which make a somewhat loud noise, but which do not appear to be much distressed in their breathing, and can undergo somewhat severe exertion for a comparatively long period. Instances of this kind will occur to all experienced horsemen, for they are not at all rare among troop-horses, hunters, and even race-horses. Of the latter, I need only mention the invincible horse Ormonde, which, though an undoubted Roarer, and making a loud noise when he won the St. Leger in 1886, yet in 1887 beat two first-class horses—Minting and Bendigo—at Ascot, in the most exacting of mile-and-a-half races. We are told that Shadow could stay any distance, “roaring like a bull.” On the other hand, there is the case of the famous

¹ “Elementary Lectures on the Veterinary Art,” p. 244.

Prince Charlie, which in the Doncaster St. Leger in 1872, had the other horses at his mercy for a certain distance, "when he stopped as if shot," the dyspnœa being too severe for him to continue. In these two examples the larynges were in different conditions; in that of Prince Charlie, the morbid changes had reached an advanced stage; in Ormonde and Shadow they were not so developed, and although there was a certain amount of obstruction to the entrance of air into the organ, sufficient to produce a loud noise, yet enough gained access to carry on the vital function of the lungs. Prince Charlie doubtless made a whistling, screaming, or stridulous noise, but I can testify that Ormonde did not, though no doubt whatever could be entertained that he was affected with the malady of which we are treating.

The stage which the disease of the larynx has reached, may also be inferred from the duration of the sound when the horse has been stopped after exertion. In those cases in which it is only commencing gradually, or which, though in existence for some time, it has made no progress, the noise ceases at once, or almost immediately after the animal is pulled up; but in cases in which there is much alteration, the abnormal sound may be heard for several seconds—even as long as one or two minutes in very bad cases—after halting. Ormonde's Roaring ceased immediately when stopped after galloping.

The noise is also emitted sometimes, and especially in nervous horses, when frightened or otherwise excited. In the act of coition, a stallion which is a bad Roarer will emit the characteristic sound; and one of the popular tests for Roaring is threatening to strike the animal when placed against a wall—both acts causing a sudden inspiration of air. The sound is also more speedily produced, and is generally louder, if, during movement, the horse's nose is pulled in towards the chest, and especially towards the *right* side. The reason for this will be understood when we come to study the pathology of Roaring.

It may be remarked that, in all cases of Roaring, and particularly those in an advanced stage, the stertorous or stridulous noise can be greatly lessened, and the distress the horse exhibits during exertion apparently relieved, by diminishing the volume of air entering the nostrils, a fact which can be demonstrated by partially occluding these by the hand. This has been taken advantage of by those who desired to utilize horses otherwise unserviceable, who have devised an apparatus to fit over the nose, which prevents the dilatation of the nostrils beyond a certain degree.

In all cases of bad Roaring, there is an expiratory sound much louder than that of normal respiration, but, of course, much less marked than the characteristic inspiratory one. This is produced partly by the larynx and partly by the nostrils, and corresponds, in the comparison made as to the resemblance of the sound to sawing wood or filing steel, to the drawing-back sound of the saw or file in order to make another cut.

2. DYSPNŒA.

With regard to the amount of difficulty in breathing, this will depend upon the stage the disease has reached. In slight cases there may be little, if any, difficulty observed, and the animal's utility may not be impaired to any appreciable degree, the unnatural sound alone forming an objection; and even when the noise is somewhat loud, the animal may yet be capable of undergoing a considerable amount of active exertion for a long time. But it may be accepted as the rule, that the amount of obstruction to the breathing, and therefore the degree of distress the horse must suffer, is related to the intensity and quality of the sound.

The obstruction to the entrance of air to the lungs during exertion, leads to longer and more energetic inspiratory efforts, in order to obtain sufficient for the increased demands of the body, and also necessitates more hurried expiratory endeavours to compensate for the delay. In advanced cases,

inspiration may be prolonged to twice, or even thrice, the normal period during severe and continuous exertion. It is obvious, therefore, that in the quickened respiration necessitated by this exertion, which always requires a corresponding increase in the quantity of air taken into the lungs, when the obstacle to its admission is considerable, the horse must suffer to a corresponding degree—mentally and physically; and the distress occasioned by the *besoin de respirer* accentuates the physical effects of the deficiency, causing the horse—no matter how courageous—to “stop as if shot,” or, in more common parlance, to “shut up” suddenly, when asphyxia is imminent.

This disturbance in the respiratory rhythm is, like the noise, not manifested when the horse is in a tranquil state; but when the Roaring commences it then becomes evident, and as the dyspnœa increases the animal’s physiognomy betrays the amount of distress he experiences. When this is great, all the inspiratory muscles are most energetically, indeed spasmodically, active in endeavouring to overcome the laryngeal stenosis, in order to inflate the lungs to their fullest dimensions. The expansion of the thorax, wide and free at first, appears to become less and less with each inspiratory effort; the loins rise and fall; the nostrils are like the mouth of a speaking-trumpet, through their extreme expansion involving their appendages—the false nostrils—their special muscles (the inspiratory *levator alae nasi*) standing boldly out in their rigid contraction: for without this muscular aid the nostrils would tend to close, because of the rapid rarefaction or exhaustion of air in the nasal cavities. Expiration is comparatively easy and rapid, and this disproportion in the force required in the two acts constitutes the peculiar characteristic of the dyspnœa which marks cases of advanced Roaring; hurried respiration is by no means characteristic of it. In pulmonary emphysema, or “broken wind,” as it is commonly termed, the converse is the case. It is the very essence of the self-acting function of

the vagus nerve to correct or compensate for impediments in the respiration, by modifications in the mode of breathing. So it is that, if the lungs are imperfectly or with difficulty filled, the inspiratory effort will be longer and more energetic, as in bad cases of Roaring; if, on the contrary, they are easily filled with air, but can only expel it with difficulty, then the expiratory effort will be prolonged and powerful, even spasmodic, as in "broken wind."

When asphyxia is imminent, the mouth is in some cases open (though it is only under extraordinary circumstances that the horse breathes through the mouth), and the tongue, congested and blue, is protruded to give more room for the larynx, which is pulled spasmodically up and down by its extrinsic muscles, and if seized externally by the hand can be felt vibrating. The eyes are prominent and bloodshot, and the whole countenance is wild and distressed-looking.

In paralysis of both sides of the larynx (bilateral paralysis), which is extremely infrequent in the horse, the stridor and dyspnœa are much more severe, and on the slightest exertion or excitement are quickly developed; so that the animal can scarcely walk without manifesting these symptoms in the highest degree.

3. THE COUGH.

The cough of a horse suffering from one-sided paralysis of the larynx in an advanced stage, is different to that emitted when it is healthy, it being described as deep and sepulchral. The air is expelled suddenly through an imperfectly closed glottis, producing a peculiar sound, due to what laryngologists term "phonetic waste of air," followed at once by a rapid deep inspiration, which causes the characteristic noise, something between a scream and a grunt. It must be explained, however, that some horses which are not Roarers will emit a sound resembling a grunt, and such horses are designated "grunters"; but the noise is produced

by a forcible *expiration* of air through relaxed vocal cords, not in inspiration, as in Roaring.

In connection with the cough, it may be noted that the neigh of a horse which is a Roarer is modified in the same way as the cough.

DIAGNOSIS.

In alluding to the principal indications which enable us to distinguish Roaring due to laryngeal paralysis from noises produced by other causes, the measures necessary for arriving at a conclusion with regard to the existence of this condition must also be referred to.

The chief symptom, and by far the most distinctive, is the *inspiratory sound in breathing*. I have mentioned the circumstances in which this is produced when due to paralysis of the larynx. Experts, when examining horses to detect the existence of the morbid condition, resort to various tests. These are moving, exciting, and "coughing" the horse. Manipulation and auscultation are also resorted to.

The most certain way to detect whether a horse is affected with laryngeal paralysis, and also to ascertain the stage which the disease has reached, is undoubtedly to make the animal exert itself. The amount of exertion necessary to develop the characteristic sound, and the intensity and nature of this, as well as the amount of dyspnoea, are the *criteria* as to the presence and extent of the morbid state.

For riding-horses, the best test is speed. On level, firm ground the distance should be greater than on that which is soft (as soft clay-land or a ploughed field) or ascending, the object being to cause the animal to respire deeply and quickly.

Soft or sandy ground should be chosen, if possible, as on it there is less noise from the horse's feet. The animal may

be ridden by the expert, who leans forward, the easier to hear the respiration; but it is perhaps better if he stand at a particular point and the horse be made to gallop past, close to him, with its head as free as is compatible with control. Some authorities recommend keeping the animal's nose well in towards the chest when galloping, others curve the neck to the right side, while others again, gallop the horse in a circle. The latter demands care, as horses sometimes make a noise—irregular, it is true—when galloped in a small circle, which yet respire perfectly free when going in a straight line.

For draught-horses, which cannot be so conveniently galloped, putting them to draw a load in heavy ground or up an incline is the most reliable test.

Exciting or frightening is by no means a sure test, though often resorted to when the preceding ordeals cannot be imposed. Some horses which are decided Roarers when galloped or otherwise exerted, will not make a noise when threatened by whip or cane. Neither is "coughing" a reliable or possible test in all cases. When the disease is not very advanced, the cough is but little, if any, different from that of health. And when other morbid conditions of the air-passages are present, as chronic laryngitis or bronchitis, or emphysema of the lungs, these will produce their own particular effect on the cough, and so modify it. Even perfectly healthy horses, when the larynx is severely compressed and its dilator muscles temporarily paralyzed thereby, will sometimes emit a cough not unlike that noticed in Roarers. In other cases, confirmed Roarers cannot be made to cough, owing to loss of sensibility in the mucous membrane of the air-tube, from wasting of the nerve supplying it, or changes due to chronic inflammation.

Direct manual examination of the larynx itself is valuable in ascertaining the condition of that organ, especially if the muscular wasting on the left side is at all considerable; and, with practice, the expert has generally little difficulty

in pronouncing as to the existence of this wasting. When the horse's head is somewhat extended, the larynx is more exposed, and the index-finger can then readily feel its posterior (or superior) surface, which is formed by the wide expansion of the cricoid cartilage and the dilator muscles covering it. If the left muscle is wasted, this surface will be found much flatter on that than on the right side. The subsidence of the arytaenoid cartilage on the left side, which is also a noticeable feature in the diseased larynx, may be likewise ascertained in the same way. A slight amount of pressure with the index-finger on the left arytaenoid cartilage, in the like manner, will cause a loud noise in respiration, as if the animal were galloped; but there is little, if any, distress. This is not the case if the right arytaenoid is pressed upon; as then more pressure is needed to produce a certain amount of noise, and symptoms of asphyxia are quickly manifested, owing to the complete closure of the glottis through the immobility of the left cartilage.

These are the chief diagnostic signs of chronic Roaring, and they should be sufficient to establish the existence of the morbid condition which occasions it. We cannot, as in man, employ the patient's voice to aid us, neither can we examine the larynx with the laryngoscope or manually *per oram*, owing to the immense length and narrowness of the horse's mouth, its powerful jaws, and the long obstructive soft palate. It has been stated that in a case of Roaring, Hertwig passed his hand through the mouth into the larynx, and found the left vocal cord relaxed, the right one being tense; and Bassi is reported to have done the same. But it must be admitted that, for the reasons given, the attempt is attended with danger, and not at all likely to be satisfactory. The interior of the larynx can be explored in a thorough manner by opening the organ through the middle crico-thyroid membrane, or the trachea immediately beneath the cricoid cartilage, and illuminating it by means of artificial light. Auscultation, also, after excitement or exertion, will

greatly assist, under ordinary circumstances, in the detection of Roaring.

When noisy respiration is due to nasal obstruction, the sound is usually heard in expiration as loudly as in inspiration, and is of a snoring character; it may come from only one nostril, or if from both it is then unequal in intensity, as is also the volume of air entering and leaving them. Injuries to, and deformities of, the trachea can generally be discovered by palpation; auscultation will also distinguish their seat if they obstruct the breathing. In cases of tumour in the trachea, the noise is usually more pronounced during expiration, as the tube then contracts, while in inspiration it dilates. In cases of chronic laryngitis (*laryngitis chronica fibrosa*) observed by Møller, there was greater resistance in the larynx on attempting to squeeze it, but the inspiration could not be rendered noisy by moderate pressure on the arytenoid cartilages of either side. The expiration is also as noisy as the inspiration.

As has been already mentioned, swellings in the vicinity of the larynx may cause a noise in respiration; even slight congestion of the vocal cords may produce Roaring. Günther gives an instance in which distention of the laryngeal ventricles with pus caused sonorous breathing; the sound ceased when the fluid escaped by depression of the head. Møller also mentions a case in which a large collection of pus in one of these pouches dragged the larynx to one side, and occasioned noisy respiration.

Chronic Roaring can scarcely be confounded with emphysema of the lungs ("broken wind"). The hurried breathing in the former, after active exertion, is very different to that observed in the latter condition. In lung emphysema, the respiration, as observed at the flank, is altogether peculiar and characteristic, and the sound has no relation to the inspiration noise of Roaring. Indeed, horses affected with Roaring are rarely broken-winded, as difficult inspiration is far less likely to cause emphysema of the lungs

than forced expiration. This fact appears to have been known to Professor Coleman, of the Royal Veterinary College, early in this century, as Mr. Percivall has heard him say, in his lectures, "that Roarers are generally sound-winded horses, as far as regards the healthy state of their lungs."¹ The cough attending the latter condition is also very different to that of Roaring, and the respiratory movements continue abnormal when the horse is perfectly tranquil.

¹ "Lectures on the Veterinary Art," part ii., p. 256.

CHAPTER VI.

ANATOMY AND PHYSIOLOGY OF THE LARYNX.

BEFORE attempting to deal with the special morbid conditions which cause chronic Roaring, it is requisite to understand the construction and functions of the larynx—the part which is chiefly involved, and that in which the noise is produced. This study is all the more necessary in order to arrive at a correct knowledge of the medical and surgical treatment which must be adopted in order to remove the impediment to respiration, and thus restore the unsound horse to such a state of soundness as will enable it to perform useful service.

It must be remembered, also, that without a correct knowledge of the anatomy and physiology of the organs of respiration, it is impossible to get beyond the mystery which has so long encompassed the origin of Roaring in the horse—a mystery which largely prevails in many quarters, and which obscures the pathology of the disease to a most damaging extent. If certain evidence is to be accepted; we would appear to be no more advanced in this direction than was Percivall fifty years ago, who, when noticing the appearances presented by the larynx of a horse which had been affected in this way, writes: “How we are to account for these changes, to what original cause refer them, is as yet unknown: by some they are loosely spoken of as the ultimate consequences of paralysis or of spasm; but though these tales may satisfy their employers, they are no more to the profession than the baseless conjectures of their authors, and as such are deserving of no comment.”¹

¹ “Elementary Lectures on the Veterinary Art,” part ii., p. 254, 1824.

We will, therefore, notice briefly the structure and functions of the horse's larynx, before venturing on the attempt to elucidate the nature and causes of the changes which have been considered so mysterious, that nothing but baseless conjectures could be offered to account for them.

ANATOMY OF THE LARYNX.

The horse's larynx is situated between the branches of the lower jaw, beneath the lower end of the parotid gland,

FIG. 1.—UPPER PART AND APERTURE OF THE HORSE'S LARYNX.

a a, Arytænoid Cartilages; *b b*, Vocal cords, forming the *pars vocales*; *c*, Vocal or Morgagni's Ventricle; *d*, Epiglottis; *e*, Thyroid Cartilage and Thyro-Epiglottidean Ligament; *f*, Ary-Epiglottidean fold; *g*, Glottis; *h*, Inferior border of the Arytænoid Cartilage which, with its fellow on the opposite side, forms the *pars respiratoria*; *i i*, Processi musculares of the Arytænoid Cartilages; *j j*, Dilator muscles of the larynx.

which partially covers it on each side. It is the commencement of the windpipe, its upper opening being directed towards the spacious cavity at the back of the mouth called

the "pharynx," and its lower opening is continuous with that of the windpipe, or trachea. It is placed in the same direction as the latter, which, again, has the same direction as the neck. Usually it is at an angle when the neck is more or less horizontal, its long axis being obliquely directed forwards and upwards; but it becomes vertical as the head and neck are raised or extended. It will be considered as vertically placed, in order to facilitate description.

It is, fundamentally, a dense cartilaginous box, made up of several pieces which can move on each other; and it is composed, intrinsically, of cartilages, muscles, ligaments, mucous membrane, nerves, and bloodvessels. The latter need not be alluded to here.

CARTILAGES.

The cartilages which constitute the framework of the larynx are five in number—the *Thyroid*, *Cricoid*, two *Arytænoid*, and the *Epiglottis*.

There are also two pairs of rudimentary cartilages, only one pair of which—the cartilages of Santorini—may be noticed in this place.

1. THYROID CARTILAGE (*Cartilago thyroidea*), Figs. 1, *e*; 2, *d d*; 3, *d e*.—This is the largest piece in the larynx, forming, as it does, the two sides and a portion of the front of the box. Its middle part, the body (Fig. 3, *e*), is situated in front, and is a short, narrow, protuberant mass, known in human anatomy as Adam's apple (*pomum Adami*); it is usually bony in old horses. It suddenly expands in bending round, to form the sides or wings (*ala*) of the larynx, each of which is a wide, somewhat quadrangular plate, slightly convex externally, concave internally, extending the whole length, from before to behind, of the organ. Owing to its shape, a somewhat large triangular space is left between the wings in front, which is filled in by an elastic membrane or ligament, the middle crico-thyroid (*ligamentum crico-thyroideum medium*).

2. CRICOID CARTILAGE (*Cartilago cricoidea*), Figs. 1, *e* ; 2, *d d* ; 3, *e d*.—Next in size to the foregoing, this cartilage forms a complete ring, like a finger-ring with a very wide bezel, the narrow portion being in front and around the

FIG. 2.—POSTERIOR VIEW OF THE LARYNX.

a a, Arytaenoid muscle—constrictor or adductor of the larynx ; *b b*, Posterior crico-arytaenoid muscles—dilators or abductors of the larynx ; *c c*, Santorini's cartilages, appendages of the arytaenoid cartilages ; *d, d*, Posterior borders of the thyroid cartilage ; *e e*, Epiglottis ; *f*, Entrance to the larynx ; *g g*, Processi musculares of the arytaenoid cartilages.

sides, below the thyroid cartilage, and next to the first ring of the trachea ; the widely-expanded portion filling up the space between the wings of the latter behind, and completing the laryngeal box. On the back, in the middle of

the bezel, is a vertical ridge (Fig. 4, *g*). The cricoid and thyroid cartilages are united by two lateral ligaments (*ligamenta crico-thyroidea lateralia*), which are in reality portions of the middle crico-thyroid ligament; they are fixed to the margin of the cricoid cartilage by one border, like the middle ligament; their upper border, inside the wings of the thyroid cartilage, being thin and free, form the "true vocal cords" (*chordæ vocales*), or, as they are sometimes termed, the inferior thyro-arytænoid ligaments (*ligamenta thyro-arytænoidea inferiora*), from their fibres arising inside the body of the thyroid cartilage and passing backwards to the base of the arytænoid cartilages. Some fibres also passing in the same direction as these, form a superior ligament on each side (*ligamenta thyro-arytænoidea superiora*), to form the "vocal bands," which have also been named the "false vocal cords." The lower border of the cricoid cartilage is attached to the upper ring of the trachea by a ligament, the crico-tracheal (*ligamentum crico-tracheale*).

The thyroid and cricoid cartilages move upon each other by two true joints, situated on each side behind, the movements varying the tension of the vocal cords.

3. ARYTÆNOID CARTILAGES (*Cartilagines arytnoideæ*), Figs. 1, *a a*; 2, *c c*; 3, *b c*; 4, *b b*.—These two cartilages—very important in relation to the affection with which we are now dealing—surmount the bezel portion of the cricoid cartilage, prolonging the depth of the larynx behind, and curving backwards at their upper margin, where they come in apposition, forming a ewer-like projection; hence their name. In shape each cartilage is irregularly pyramidal, being somewhat like a prism, or three-sided pyramid, in fact; there are two angles at the base, the surface of which has a shallow concave surface where it forms a true joint with the cricoid cartilage. The anterior angle is long and narrow, and projects forward into the cavity of the larynx; from its receiving the insertion of the vocal cord,

this angle is named the *processus vocalis* (Fig. 3, 3). The posterior angle is thick and blunt, and, owing to its receiving the insertion of the powerful and important dilator muscle of the larynx, it is termed the *processus muscularis* (Figs. 1, *i i*; 2, *g g*; 4, *f f*). The apex of each arytenoid cartilage, and which is bent backwards to form a lip, is actually made up of a thin piece of elastic cartilage, named the "cartilage of Santorini" (*capitulum Santorini*), and corresponds to the *cornicula laryngis* of man. The horse has extremely rudimentary "cartilages of Wrisberg."

The two cartilages meet in the middle line, where they are united by a ligament, the transverse arytenoid (*ligamentum arytenoideum transversum*), and at their base they are united to the cricoid cartilage by another ligament (*ligamentum crico-arytenoideum*), which forms the capsule of the joint existing between the cricoid and arytenoid cartilages. This joint allows of rather extensive movement; the two arytenoids, when acted upon by their abductor muscles, swinging outwards and upwards from the middle, around a vertical axis, like a double door hinged in the centre; so that the vocal cord on each side, attached to the lower angle of the arytenoid cartilage, is pulled in the same direction, and the opening in the larynx between the cartilages and cords is thereby greatly increased. This movement we shall have to refer to frequently.

4. EPIGLOTTIS (Figs. 1, *d*; 2, *e e f*; 3, *g*; 4, *a*).—This is a very elastic piece, placed above the thyroid cartilage, in shape like a sage leaf, and, except during the act of swallowing, it is curved forward towards the mouth. It circumscribes the entrance to the larynx in front, and during swallowing of food or water its flexibility allows it to be pushed back over the aperture like a lid, so as to close it hermetically, and thus prevent any foreign matter obtaining admission during the accomplishment of this act. When the act is completed, the resiliency of the cartilage, together with the contraction of a muscle connecting it with the hyoid bone

of the tongue, brings it to its erect position again. Its base is attached to the middle part of the inner surface of the thyroid cartilage by elastic fibres, which form a ligament—the thyro-epiglottic—and the lower part of its sides is connected with the ary-tænoid cartilages behind, by a fold of mucous membrane on each side—the *ary-epiglottidean fold* (Figs. 1, *f*; 3, *j*)—which contains two little bodies, the *cuneiform cartilages*, or *cartilages of Wrisberg*. It is also connected with the tongue by three ligaments.

On the outer side of each ary-epiglottidean fold, between it and the thyroid cartilage, is a depression called the “pyriform sinus,” or “hyoid fossa,” containing a thin mucus which is secreted by a row of glands lying on its floor. The sinus on each side meets its fellow behind the ary-tænoid cartilages to form one channel, which passes into the œsophagus.

In young animals the cartilages of the larynx are very flexible, but with age they become rigid, and all, except the epiglottis, have a tendency to assume a bony density.

MUSCLES.

The intrinsic muscles of the larynx are divided into two sets, according to their functions: *dilators* and *constrictors*, or *abductors* and *adductors*.

DILATOR OR ABDUCTOR MUSCLES (Figs. 1, *j*; 2, *b*).—These consist of only one pair, the posterior crico-ary-tænoid muscles (*crico-ary-tænoidei postici*). As their name implies, they dilate the opening in the larynx by abducting or separating the vocal cords from each other. They are the inspiratory, or rather respiratory muscles of this organ, and are by far the most important with regard to Roaring. They are the most powerful of all the laryngeal muscles, and their full functional vigour is absolutely essential to perfect respiration.

Arising from the bezel surface of the cricoid cartilage, and separated from each other by the vertical ridge

which divides it into two portions, the fibres of each muscle are numerous, and constitute a plump, deep-red, fleshy mass; they pass obliquely upwards and outwards, and, becoming more or less tendinous, especially the fibres towards the outer border, they all converge towards the processus muscularis of the arytenoid cartilage (Figs. 1, *i*; 2, *g*), into which they are inserted, and on which they act. When the two muscles contract (in a healthy condition they always do so together), they act as levers of the first order in drawing the arytenoids backwards and outwards, causing them to swing on the cricoid cartilage in the manner already described, and in this way widening the glottis. The extent of this action will depend upon the requirements of inspiration; but as their special function is to maintain the glottal aperture always more or less open (except during swallowing, coughing, and some other acts of brief duration), these abductor muscles have an unceasing, and therefore fatiguing duty, which demands not only that they should be larger and more vigorous than the other muscles of the larynx, but that they be reinforced by tendinous fibres to relieve them from undue strain in the perpetual efforts of elevating the cartilages at rather a mechanical disadvantage.

THE ADDUCTOR MUSCLES.—These may be considered as the antagonistic muscles of those just described, inasmuch as they, in contracting, close the glottis. They consist of four pairs, which are named as follows: thyroid-arytenoid, lateral crico-arytenoid, crico-thyroid, and arytenoideus. Of these, the most active in approximating the vocal cords, and so closing the rima glottidis, are the arytenoidei and crico-arytenoidei laterales muscles. The former (Fig. 2, *a a*) are the smallest of the laryngeal muscles, and situated behind the arytenoid cartilages; their action is to bring these together, and so to diminish the space between them—the *pars respiratoria* (Fig. 5, C)—in the larynx. The crico-arytenoidei laterales pass, on each side, from the cricoid

cartilage to the processi musculares of the arytænoid cartilages, and when they contract they rotate these downward and inward, bringing the processi vocales of these cartilages nearer each other, and so carrying the vocal cords into apposition, closing the space designated the *pars vocales* (Fig. 5, C). In this they are assisted by the other two pairs of muscles, which, however, are more concerned perhaps in the production of the voice, by shortening and elongating the vocal cords. As the study of the voice has no place in the subject we are now discussing, further description of these muscles is unnecessary.

LIGAMENTS.—We have already referred to these.

MUCOUS MEMBRANE.—The larynx is lined by mucous membrane, which is continuous with that of the mouth and its wide termination, the pharynx. The same membrane also lines the trachea and bronchial tubes, and in the larynx itself forms on each side the pouch or sac known as the “vocal ventricle sac,” “lateral sinus” (*sacculus laryngis*, *sinus lateralis*), or “Morgagni’s ventricle”; it likewise constitutes a smaller cavity at the base of the epiglottis, above the origin of the vocal cord at the thyroid cartilage called the “middle sinus” or “sac” (*sacculus laryngealis*), or “sub-epiglottic sinus.” Another sinus—the “sub-arytænoid”—is found at the crico-arytænoid joints. It is covered with squamous epithelium at its upper part, below this by ciliated epithelium, and is abundantly supplied with mucus-secreting (muciparous) glands, which are most abundant in the vocal ventricles, the ary-epiglottic folds, and the epiglottis, but none are found in the mucous membrane covering the vocal cords. The membrane varies in thickness in different parts of the laryngeal cavity, and the sub-mucous connective tissue is also variable in quantity, being abundant in some situations and very scanty in others. For instance, the membrane is thinnest and has least connective tissue, and is, consequently, most adherent, on the vocal cords and lower part of the arytænoid carti-

lages; but it is thickest, most vascular, and loosest, having much connective tissue, on the ary-epiglottic folds, ventricular bands, at the lower part of the epiglottis, and in the ventricles. These parts are, therefore, most liable to inflammation and rapid œdema—a fact to be remembered when considering the surgery and pathology of the organ.

It should also be noted, that between the mucous membrane and the cartilages is a continuous layer of elastic fibrous tissue, which strengthens the larynx and assists the movements of the different pieces that compose it.

NERVES.—The nerves supplying the larynx are derived from the tenth cranial or vagus nerve—the *pneumogastric*, *nervus vagus*, or *par vagum*—which more especially ministers to the functions of organic life. This arises by a number of rootlets from the sides of the medulla oblongata, in two portions or nerves, one of which passes down each side of the neck, after giving off branches to probably all the muscles of the pharynx and its mucous membrane; and a branch—the superior laryngeal nerve—that endows the mucous membrane of the under surface of the epiglottis, the glottis, and the greater part of the larynx, with acute sensation, while sending supposed motor fibres to one muscle of that organ, the crico-thyroid. In the furrow on each side of the neck, immediately above the trachea, the nerve accompanies the carotid artery, and passing into the chest, detaches most important branches to the chief viscera in that cavity, as well as to some in the abdomen.

The branches which require most notice here are those it gives to the larynx. They are the *superior laryngeal* and the *inferior laryngeal* nerves.

SUPERIOR LARYNGEAL NERVES.—There are two of these, one for each side of the larynx. Each is derived from its respective pneumogastric trunk, which it leaves soon after the latter has emerged from the cranium; it passes to the larynx, where it is distributed, as already mentioned, to the

mucous membrane, to endow this with sensation, and to the crico-thyroid muscle, which it stimulates to contraction, according to physiologists. But veterinary anatomists, and especially Günther, Franck, and Möller, maintain that the motor fibres are derived from the first cervical nerve. Möller satisfied himself of this by experimenting on horses while they were in a state of narcosis. He exposed the crico-thyroid muscle and laid bare the first cervical nerve, and in stimulating the latter he found the former to contract promptly and energetically; when the finger was passed into the larynx through an opening in the middle crico-thyroid ligament, the contraction of the muscle and approximation of the cricoid to the thyroid cartilage could be distinctly felt every time the nerve was excited. When the superior laryngeal nerve was stimulated, this muscle, as well as the other muscles of the larynx, was quite unaffected. It was clearly demonstrated that, in the horse at least, the muscle receives its motor fibres from the first cervical nerve, and not from the superior laryngeal. Möller also concluded from his experiments that the latter nerve supplied, in addition to sensory filaments to the larynx, trophic or nutrient filaments to the muscles. In one experiment on a middle-aged horse in which respiration was healthy, he divided the superior laryngeal of one side, immediately before it entered the larynx. The animal did not exhibit any signs of disturbance or Roaring subsequently, and when it was killed, six weeks afterwards, the whole of the laryngeal muscles on the operated side were in a state of marked atrophy, evidenced by their smaller size and pallor. The other horse, also middle-aged, was free from Roaring until shortly before it was killed, more than four months after the operation, when advanced atrophy of the muscles on the same side was noted. In the first case, the superior laryngeal nerve was found to have undergone degeneration, but the recurrent did not show any change.

INFERIOR LARYNGEAL OR RECURRENT NERVES.—These

are also two in number, one on each side, right and left ; they are given off from the pneumogastric nerve within the chest, and in consequence of their having to pass upwards towards the head, in order to reach the larynx, they have been designated "recurrent" nerves. They are chiefly motor nerves, and supply all the muscles of the larynx, dilators and constrictors, with the exception of the crico-thyroid. We will consider each nerve separately, with regard to its origin ; as upon this consideration will depend our arriving at a correct notion of the proximate cause of Roaring, and, indeed, of the nature of the morbid condition which occasions it.

Right Recurrent or Inferior Laryngeal Nerve.—This nerve arises from the main trunk in the right side of the chest, at the posterior border of the first rib, and at the origin of the dorso-cervical artery, round which it bends to get near the trachea. Along the lower surface of this it passes forwards until it reaches the base of the neck, where it places itself beside, but below, the carotid artery, with which it proceeds up the right furrow of the neck, giving twigs to the mucous membrane and muscular fibres of the trachea, as well as to the œsophagus, and at the larynx sends its terminal filaments to the muscles on the right side of that organ, with the exception already alluded to. Its relations are comparatively few, when compared with its fellow on the left side, as it is only connected with nerves of the heart and the middle cervical ganglion of the sympathetic nerve.

Left Recurrent or Inferior Laryngeal Nerve.—The peculiarities in the origin and relations of this nerve deserve close attention. It is not detached from the vagus nerve, like the right one, at the first rib, but as far back as the base of the heart, at the anterior border of the posterior aorta, round which it turns to get between it and the left bronchus, which is close to the great artery, and where it is related to the *bronchial lymphatic glands*. The nerve is

directed backwards and slightly upwards, bending from left to right round the posterior surface of the *ligamentum arteriosus*, and passing over the internal face of the pulmonary artery; then it proceeds upwards, inwards, and forwards, to the lower surface of the trachea, to which it is attached by connective tissue, and there it is also bridged over by an expansion of the endo-thoracic fascia, which is connected with the pericardium. In passing along the trachea, the nerve gradually ascends to gain the left side of that tube, above, but very close to the *tracheal lymphatic glands*. The relations of the nerve to lymphatic glands and to the pleural membrane are very intimate; as from its origin until it reaches the trachea it is placed between the pleura and pericardium, and when crossing the pulmonary artery it is enveloped in a quantity of connective tissue that supports the bronchial lymphatic glands, while behind the aorta it gives off numerous fibres that may be traced to the surface of these glands.

Before leaving the bronchial glands, the nerve is constantly found intimately related to a median branch of the inferior cervical ganglion, and this relationship is maintained to within two or three inches from this ganglion; some of the fibres of this sympathetic branch also pass to the surface of the glands. It is also to be noted that the angle separating this nerve from the vagus nerve is partly occupied by nerve fibres, which pass from one nerve to the other.

Giving off twigs to the trachea and œsophagus, the nerve passes out of the chest and up the left side of the neck in the same manner as the right nerve, and is ultimately distributed to all the left laryngeal muscles except the cricothyroid.

It will thus be seen that the left recurrent nerve differs most materially from the right, not only in its peculiar relations with the pleural membrane and its fasciæ in immediate proximity to most important organs (lungs and

heart) and bloodvessels, as well as lymphatic glands, but also in its greater length. The influence of these anatomical peculiarities in the production of Roaring will be fully dealt with hereafter.

Bischoff, Schech, Chauveau (for the horse), and others, have shown that the spinal accessory nerve gives motor fibres to the recurrent nerve, which would go to prove that the two nerves are identical in their function, a circumstance which should also be remembered in discussing the origin of Roaring.

THE LARYNX AS A WHOLE.

Having considered the different parts of the larynx, we may now view it as a whole.

We have remarked that it is placed between the branches of the lower jaw, towards their angle, at the upper part of the windpipe, and the back part of the mouth or pharynx, its upper opening looking into that cavity, in which it is suspended from the base of the cranium by the long processes or horns of the hyoid bone. Immediately behind or above it is the œsophagus, which is attached to the middle ridge on the bezel of the cricoid cartilage.

The cavity of the larynx (*cavum laryngis*) is described as divided into three spaces or portions—upper, lower, and middle; it opens into the floor of the pharyngeal sac by its upper space or *supra-glottic* portion (*aditus ad laryngeum, introitus laryngis*, Figs. 1, 3). This large opening is in shape that of an equilateral triangle (Fig. 1, *g*), the base being the epiglottis in front, while the apex is formed by the two ary-tænoid cartilages, and the sides by the ary-epiglottic folds of mucous membrane (*plicæ ary-epiglotticæ*). It must be noted that the form and dimensions of the larynx often differ considerably, even in animals of the same size. In a medium-sized horse, the length of this triangular space in the passive condition is from $1\frac{3}{4}$ to $2\frac{1}{8}$ inches, and width of base $1\frac{1}{4}$ to $1\frac{1}{2}$ inch. Its depth is about $1\frac{1}{2}$ inch. The

lower opening, or *infra-glottic* division (Fig. 3, 4), is formed by the cricoid cartilage, which circumscribes it; it is continuous with the tracheal lumen, and measures $1\frac{1}{2}$ inch,

FIG. 3.—INTERIOR OF LEFT SIDE OF THE HORSE'S LARYNX.

1, Supra-glottic or upper portion of the laryngeal cavity. 2, 3, Glottis or middle division. 4, Sub-glottic or lower portion. 2, Commencement of the *pars vocales*. 3, Commencement of *pars respiratoria*. *a*, Thyroid cartilage. *b*, Arytænoid cartilage, with *c*, its appendix—the cartilage of Santorini. *d*, Posterior or bezel portion of the cricoid cartilage. *e*, Anterior portion of cricoid cartilage. *f*, Vocal cord with entrance to vocal ventricle (*sacculus laryngis*) immediately above it. *g*, Epiglottis. *h*, Basal process of epiglottis. *i*, Sub-epiglottic sinus. *j*, Ary-epiglottic fold of mucous membrane. *k*, Vocal band above the ventricle.

the rings of the trachea measuring from $1\frac{1}{2}$ to 2 inches in diameter.

The middle or *glottic* division—the *glottis*, *glottis vera*, or, better, *rima glottidis*—is the most important of the

three; it is about the centre of the cavity of the larynx, and is formed by the vocal cords on each side in front, and

FIG. 4.—VIEW OF THE ENTRANCE TO THE HORSE'S LARYNX, SEEN FROM THE MOUTH, THE VOCAL CORDS BEING IN THE POSITION THEY OCCUPY IN TRANQUIL RESPIRATION (EXPIRATION).

a, Epiglottis, pointing towards the mouth. *b b*, Arytaenoid cartilages. *c c*, Vocal cords thrown rather into relief to make them more distinct. *d*, Glottis or opening between the vocal cords into the trachea. *e e*, Ventricles of the larynx leading to the vocal pouches or Morgagni's ventricles, and surmounted by the false vocal cords or bands on which the letters are placed. *f f*, Processi musculares or angles of the arytaenoid cartilages into which the dilator muscles of the larynx are inserted. *g*, Ridge of the cricoid cartilage.

the bases of the arytaenoid cartilages on each side behind (Figs. 1, *g*; 3, 3; 5, *c d*). The space between the vocal

cords is designated the *glottis vocalis*, *pars vocales*, or *inter-ligamentous* portion; that between the arytenoid cartilages, the *glottis respiratoria*, *pars respiratoria*, or *inter-cartilaginous* portion. The entire space, in what is termed the "cadaveric position" of cords and cartilages, is in shape something like a lance-head. It varies considerably in shape and dimensions during life, however, being that part of the larynx in which movement chiefly takes place, especially in respiration, the chink through which the air passes having been appropriately termed "the portal of the breath of life." It offers for consideration, on each side, the vocal cords, vocal bands, and arytenoid cartilages, with the lateral ventricles. Its narrowest part in front is limited by the body of the thyroid cartilage and the origin of the vocal cords therefrom, while its widest part behind is formed by the cricoid cartilage.

The "vocal cords," or inferior thyro-arytenoid ligaments, which extend nearly half the length of the glottis, are two bands or ledges, paler in colour than the adjacent parts, and composed of yellow elastic tissue, covered with thin mucous membrane; they are capable of considerable elongation and retraction, according to the movements of the arytenoid cartilages. Their surface is somewhat oblique, the free border being slightly higher than the fixed one, which is thicker; this allows their thin free margins to meet more easily and closely in neighing, coughing, and other acts in which the glottis has to be closed.

The "ventricular" or "vocal bands," situated above the vocal cords, are longitudinal folds of mucous membrane enclosing a small quantity of fibrous tissue, and containing numerous glands, the secretion of which, mucus, serves to moisten the vocal cords. They arise from the thyroid cartilage, and are inserted into the anterior surface of the arytenoid cartilages; they can be closely approximated, so as to separate the upper portion of the larynx from the two lower ones, and thus form a narrow tube with a closed bottom. This

FIG. 5.—DIAGRAM OF A TRANSVERSE SECTION OF THE LARYNX OF A MEDIUM-SIZED HORSE, THROUGH THE THYROID, CRICOID, AND ARYTÆNOID CARTILAGES AND VENTRICLES, IMMEDIATELY ABOVE THE VOCAL CORDS, WITH THE MEASUREMENTS OF THESE PARTS.

A, Front of larynx, or *Pomum Adami* of thyroid cartilage. B, Posterior part of larynx. C, *Pars vocales*. D, *Pars respiratoria*. 1, Thyroid cartilage. 2, 3, Left and right arytenoid cartilages. 4, Bezel of cricoid cartilage. 5 5, Vocal cords—each $1\frac{1}{4}$ to $1\frac{3}{4}$ inch long, by $\frac{1}{2}$ inch at widest part. 6 6, Morgagni's ventricles—from dotted line $1\frac{1}{2}$ inch long by $\frac{1}{2}$ inch wide. 7 7, Insertion of vocal cords into arytenoid cartilages. 8, Width of glottis between the latter points $\frac{5}{8}$ inch. 9, Width between the arytenoid cartilages at their posterior part $\frac{7}{8}$ inch. 10 10, Length of each arytenoid cartilage $1\frac{1}{2}$ inch, thickness $\frac{3}{16}$ inch. 11 11, Entire length of glottis $3\frac{3}{8}$ inches. 12, Length (transverse) of cricoid cartilage 2 inches, thickness $\frac{7}{16}$. 13, Length of thyroid cartilage each side $4\frac{1}{2}$, thickness $\frac{1}{8}$ inch. 14 14, Distance between each wing of the thyroid cartilage 3 inches. 15, Mucous membrane lining the cricoid cartilage. 16 16 16 16, Muscles and connective tissue.

approximation occurs during swallowing, and in some other muscular movements in this region.

The "ventricles of the larynx" or "Morgagni's ventricles" (Figs. 1, *c* ; 3, *k* ; 4, *ee* ; 5, *6*) are two somewhat capacious sacs or pouches of mucous membrane, one on each side of the cavity of the organ, the entrance to them being rather wide, and lying between the ventricular bands and vocal cords. These sacs are oblong in shape, and pass out between the upper and lower portions of the thyro-arytænoid muscles. They extend only a short distance forward towards the origin of the vocal cords, but dip down to the base of these, and are continued behind the processi vocales of the arytaenoid cartilages. They are very dilatable, have numerous mucous glands, and permit free movements and vibrations of the vocal cords.

PHYSIOLOGY OF THE LARYNX.

The essential function of the horse's larynx is related to respiration, and in a lesser degree to deglutition, as well as to coughing, sneezing, defæcation, and other expulsive efforts of a voluntary or reflex kind ; it is rarely required for phonation or voice-production, which is one of its chief uses in mankind.

It has been already stated that the larynx is always more or less open, for the passage of air to and from the lungs, except during the acts above-mentioned, the degree of patency depending upon the inspiratory effort. During respiration, the arytaenoid cartilages and vocal cords move in a combined and rhythmical manner. In inspiration, by the action of the abductor (posterior crico-arytænoid) muscles, we have seen that these cartilages are drawn upwards and outwards, the cords, being attached to their anterior extremity, passing in the same direction towards the sides of the thyroid cartilage, against which they lie flat when inspiration is deep. By this movement, the middle space (*rima glottidis*) is enlarged to a degree

corresponding to the elevation of the arytenoid cartilages, and for this reason Ludwig has termed them "position cartilages" (*Stellknorpel*). The larger the volume

FIG. 6.—VIEW OF THE HORSE'S LARYNX DURING LABOURED INSPIRATION, SEEN FROM THE MOUTH.

The vocal cords, *c c*, and arytenoid cartilages, *b b*, being drawn upwards and outwards to the utmost degree, so as to widen the glottis, *d*, as much as possible, for the ingress of air to the trachea. *e e*, Entrance of the ventricles closed.

of air required, the more space must be allowed for its entrance, and the width of this space will depend upon the energy and activity of the abductor or dilator muscles, as they may be termed, which elevate these cartilages. When

the muscles are healthy and vigorous, the space between the vocal cords at their junction with the arytaenoid cartilages is two or three times greater than in the passive state of these muscles (Fig. 6, *d*); should a simultaneous contraction of the ary-epiglottic muscles take place, the upper compartment of the larynx will be also enlarged.

In expiration, the abductor muscles are relaxed, and the arytaenoid cartilages fall downwards and inwards by a kind of elastic recoil, aided, no doubt, by the lateral crico-thyroid and thyro-arytaenoid muscles, which approximate the arytaenoid cartilages and vocal cords to each other, causing them to move towards the centre of the laryngeal cavity (Fig. 4). But unless under the special circumstances already referred to, the adductor muscles do not bring these parts into contact, a space always existing between them during expiration for the passing out of air from the lungs, and which meets with but little resistance from the relaxed vocal cords, as it easily lifts these aside. This space is somewhat less than in expiration, in what is termed the "cadaveric position" of the vocal cords and arytaenoid cartilages—that is, the position in which we find them after death. The function of these adductor muscles of the larynx is, therefore, not very important in respiration, and they only act as antagonists of the dilators on certain occasions. For instance, it has been stated as a clinical fact, that if inspiration be unduly forced the adductors are brought into play, and the glottis may then be narrowed rather than increased. Though they are the vocal muscles in man, yet in the horse they may be looked upon as constituting, in conjunction with the muscles which close the supra-glottic portion, a sphincter or ring muscle for the larynx, such as is found around the mouth, eyes, and other openings; but here the opening is maintained always patent by the abductors, just as the nostrils are by their dilator muscles, though they are also provided with a sphincter or closing muscle. There is this further resemblance between

the nostrils and the larynx, that the widening and contraction of both occur synchronously in inspiration and expiration.

From what has just been stated, it will be understood that, in order to have respiration performed in a perfect manner under all conditions of active exertion, the dilator or abductor muscles must be in the healthiest condition possible. Various causes may impair the vigour of the laryngeal muscles, but the chief is diminished supply or total loss of nerve-stimulus to them; and how this is effected can best be made clear by briefly describing what is known with regard to the innervation of the larynx. With respect to this subject, however, it must be stated that notwithstanding the most careful investigations of physiologists and pathologists for many years, there are several important points yet to be settled.

When treating of the construction of the horse's larynx, the distribution of the nerves was described, these being the superior and inferior laryngeal, and a portion of the first cervical nerve. In elucidating the functions of the laryngeal nerves, the way was led by Vesalius, Haller, Majendie, and Legallois. But it may be remarked that the Greek physician, Galen, who lived about the middle of the second century of our era, observed the difficulty pigs experienced in breathing, and their inability to scream, after division of the recurrent nerves; and Riolan, in 1618, was also aware of these phenomena as a result of such an operation. But it was reserved for Legallois, in 1812, to determine the full significance of section of this nerve on the larynx, and consequently on respiration, by experiments on young dogs, cats, and rabbits. He found that all the muscles, with the exception of the crico-thyroid, received their motor filaments from the recurrent nerve on each side. Majendie likewise described the chief points in the innervation of the larynx, though he erred in stating that the recurrent only supplied the dilator muscle (posterior crico-

arytæmoid). Bischoff afterwards demonstrated that motor filaments in this nerve were derived from the spinal accessory nerve.

With the superior laryngeal nerve we are not now so much concerned, and may therefore merely mention that it is chiefly a sensory nerve, endowing the larynx with sensation; it also gives fibres to the crico-thyroid muscle, which, according to some physiologists, are motor, and therefore stimulate that muscle to contraction, but which, according to Møller, are trophic filaments, and are concerned in the nutrition of all the laryngeal muscles.

Stimulation of the superior laryngeal nerves is stated to cause paralysis of the crico-thyroid muscles and slowing of the respiration; but Møller satisfied himself that the muscles remained unaffected under such stimulus. However this may be, it is certain that division of the nerves deprives the larynx of sensibility; so that saliva and particles of food pass through it into the trachea and lungs without causing reflex contraction of the glottis, or coughing, and this leads to the production of "traumatic pneumonia."

Experimental stimulation of the recurrent nerves produces spasm of the glottis, while section of them paralyses all the muscles they supply. When stimulation is applied to them, after the larynx has been exposed for observation, the effect is very perceptible. As soon as the electrodes are brought into contact with the central stump of the divided nerve, or with the peripheral end of the vagus, the arytæmoid cartilages begin to move convulsively; and by inserting the finger into the lateral ventricle, one is soon convinced of the energetic contraction of the lateral crico-arytænoidei and thyro-arytænoidei muscles, the crico-thyroid muscles remaining passive. The glottis is narrowed, and at every inspiration the vocal cords approximate considerably, as do also the arytæmoid cartilages, while during expiration they are separated from each other. Hence the inspiration, especially in young animals whose glottis respiratoria is narrow, is difficult and noisy, while

expiration is easily effected. After a few days, however, the animals experimented upon (carnivora) become tranquil, respire with less effort, and the passive vibratory movements of the vocal cords diminish. But even after a considerable time, if the creatures are excited, they are seized with severe dyspnœa, which disappears only when they have become quiet again.

In this condition, also, owing to paralysis of the laryngeal muscles, foreign matters are likely to enter the trachea, because of the paralysis rendering the initial stage in the act of swallowing more difficult in the œsophageal region. Hence broncho-pneumonia may ensue.¹

It is, therefore, a well-established fact that division of both pneumogastric nerves, or their recurrent branches, is often very quickly followed by fatal results, especially in young animals. But in old ones, section of the recurrent is not generally fatal, and even that of both pneumogastric nerves is not always so; when it does occur, it only ensues slowly. This difference is probably because the laryngeal cartilages are very elastic in young creatures, and in yielding permit the glottis to be closed by the excess of external atmospheric pressure in inspiration, over that of the rarified air within the trachea; and though in expiration the glottis returns to its original size, yet these animals will quickly die of suffocation, unless tracheotomy be performed upon them.

In old animals, on the contrary, the rigidity and prominence of the arytenoid cartilages prevents the glottis from becoming completely closed by the atmospheric pressure; for even when all the muscles are paralysed, the posterior portion of the pars respiratoria remains open, and through this sufficient air can be drawn so long as the creatures remain tranquil.

Schech's experiments on dogs, made in 1873,² show that

¹ "Landois and Stirling: *A Text-Book of Human Physiology*," 2nd edition, vol. ii., p. 874.

² "Experimentelle Untersuchungen über die Functionen der Nerven und Muskeln des Kehlkoffs," Würzburg, 1873.

after division of both dilator muscles, the vocal cords pass beyond the ordinary position inwards, towards the middle line, and lose the power of separating on inspiration. But the full median position and continuous dyspnœa do not immediately appear, and the power of narrowing the glottis, as well as the vibratory function of the vocal cords, is undisturbed; so that the voice or bark remains intact. As a rule, the operation was immediately followed by considerable dyspnœa, but this soon subsided; and Scheech was of opinion that it was the result of the constriction of the glottis, which takes place at once after the operation, and which, again, necessitates deeper and more frequent respirations. In this way there arises a difference of tension in the columns of air above and below the glottis, the vocal cords approach each other still closer, and thus the entrance of air is yet more impeded. The abatement of the dyspnœa soon after the operation on animals is due, on the one hand, to the fact that the respiration gradually becomes quieter, and, on the other, because the creature soon becomes accustomed to the hindrance in breathing; though it is assumed that the constrictors of the glottis never exert their power suddenly, but only after a certain period. The dyspnœa and stridulous inspiration make their appearance, however, immediately the animal attempts any sudden and violent exertion.

Such is the function of respiration and its mechanism, so far as the larynx is concerned; and it is necessary to bear these details in memory while studying the pathology of Roaring, and especially the part the recurrent nerve assumes in relation to its muscles. It is also necessary to remember that conclusions arrived at from experiments on creatures other than the horse cannot always be made applicable to that animal with certainty. Exner,¹ Mandelstamm,² and others, for instance, have maintained that in the distribution of the recurrent nerve there are frequent individual variations.

¹ "Centralblatt für Laryngologie," February, 1885.

² "Monatschft. für Ohrenheilkunde," December, 1884.

Exner, experimenting on rabbits, concludes that, while the external thyro-arytænoid muscle is supplied chiefly, if not exclusively, by the inferior or recurrent laryngeal nerve, the internal thyro-arytænoid derives a large share of its innervation from the superior laryngeal nerve. He also demonstrated the existence of a third or median laryngeal nerve in the rabbit and dog, which is believed to be of great motor importance. He and Mandelstamm, in rabbits, and Weinzweig in man, have found that sometimes the recurrent nerve of one side sends fibres to that of the opposite side. But we agree with Möller, that further investigations are needed to ascertain whether these variations occur in the horse, and if they can be taken into account in explaining the graduated differences in the respiratory sounds which constitute Roaring. It appears certain, at any rate, that the differences observed by Exner with respect to the innervation of the dilator muscles in rabbits—section of the recurrent nerves at one time leading to degeneration of these muscles, at another time having no such result—are not observed in horses; for section of these nerves in them always brings about more or less pronounced atrophy of the muscles, according to the duration of their paralysis.

The movements in the horse's larynx during respiration can be readily noted when that organ is opened, as in the operation for Roaring—the opening being made through the middle crico-thyroid ligament, and also through the cricoid cartilage and first tracheal ring if necessary. It will then be seen that in gentle breathing the action of the laryngeal muscles is slight, the arytaenoid cartilages and vocal cords moving very little, the natural tension of the dilator muscles ensuring sufficient width of the glottis. In deep, forcible respiration, however, these muscles are most active in effecting dilatation of the upper and middle portions of the larynx, by their traction on the arytaenoid cartilages, as already described. As has been pointed out,

in the horse the adductor muscles of the larynx appear to act primarily during swallowing, coughing, and neighing; the first is demonstrated by touching the vocal cords at their junction with the arytaenoid cartilages, when there occurs a regular swallowing movement, succeeded by deep inspiration and a sharp pushing of these cartilages towards the middle line of the cavity. This movement was observed by Günther some years ago, and it is a valuable *criterium* as to the existence of paralysis; as the cartilage on the affected side remains immovable during the act.

In this way, we also obtain at the same time an insight into the act of swallowing. When it takes place the entire larynx is raised, and its adductor muscles almost completely close the upper compartment, while the ary-epiglottic folds, as well as strong folds of the mucous membrane of the pharyngeal cavity, cover it. This mode of closure was first described by Möller, who observed it in a horse from the larynx of which both arytaenoid cartilages had been removed; and it serves to explain how swallowing can be safely accomplished a few days after one or both of these cartilages have been extirpated.

Möller has also pointed out that the epiglottis is not passive during deglutition, as it is pushed over the folds of mucous membrane which occlude the supra-glottic space. If the hand is introduced into the pharynx, and an act of deglutition is induced by touching the larynx, the movement of the epiglottis can be distinctly felt, and if attempts are made to seize it, it slips away from the fingers. If the finger is inserted into the larynx when the horse is drinking, at the moment of swallowing it is energetically squeezed between the two arytaenoid cartilages; this movement can also be seen.

As the result of experiment and observation on the horse, then, we may accept it as a fact that the larynx is innervated chiefly through the pneumogastric or vagus nerve, and in such a manner that the sensory and trophical filaments are supplied by the superior laryngeal nerves, and the motor filaments from the spinal accessory and recurrent nerves.

CHAPTER VII.

PATHOLOGY AND COURSE OF CHRONIC ROARING.

AFTER what has been described of the anatomy and physiology of the horse's larynx in the last chapter, there will be less difficulty in understanding the nature of the morbid alterations which occasion those disturbances in breathing that chiefly manifest themselves by Roaring.

It is now nearly three-quarters of a century since the characteristic changes that are observed in the larynges of horses which had been affected with chronic Roaring during life were first alluded to. But, then, as we have seen when reviewing the history of the infirmity, the notices of these changes were only casual and rare; and, though the appearances are extremely striking, and should have received serious attention, yet but little importance seems to have been assigned to them, and their significance was lost amid the many conjectures indulged in as to what was really the cause of the noisy, and oftentimes distressed, respiration.

Percivall, in 1824, saw some of the more marked of these changes exactly as we now see them. "Another, and a not very uncommon cause of Roaring," he says, "is a wasting, or, in some instances, a total absorption of one or more of the small muscles of the larynx. I have lately examined a horse of Mr. J——y's—a remarkable instance of it. In his larynx, upon the near side, the crico-arytænoideus posticus was very pale, and shrunk to half its original size; the crico-arytænoideus lateralis, the thyro-arytænoideus, and the arytænoideus, were altogether colourless, and scarcely

recognisable as muscles; but their antagonists upon the other side were unusually red and strong. Now, these muscles, contracting in pairs, are all employed in dilating (*sic*) the glottis; but if one set act by themselves, this orifice is not only distorted, but actually diminished in dimension, in consequence of the arytænoid of the opposite side being drawn over it. Thus it is, then, that Roaring is produced." But the cause of these changes were beyond his comprehension, and the conjectures of others he deemed unworthy of comment.

The alterations in the larynx of a horse which had been a Roarer to a severe degree for some time, is singularly striking when compared with a healthy larynx, and its appearance is shown in the frontispiece to this work. The horse from which this larynx was obtained was known to have suffered for a long time from Roaring, and was greatly distressed when much exerted. It will be seen that the left dilator muscle (posterior crico-arytænoid) has disappeared, its place being occupied by some fat and connective tissue, and that the arytænoid cartilage which that muscle elevates in inspiration is lower than its fellow; while the arytænoideus muscle above it has only a few fibres of muscular tissue left. The epiglottis, in consequence of the depression of the arytænoid cartilage, is slightly inclined to the left side. The dilator, as well as the arytænoideus muscle, on the right side, is healthy, and even more developed than in an unaffected larynx. The other muscles on the left side offered the same appearance of degeneration as the arytænoideus, with the exception of the crico-thyroideus, which was quite healthy and plump: this muscle, it will be remembered, being supplied with motor filaments by the spinal accessory nerve, the wasted muscles by the inferior laryngeal or recurrent nerve.

The deformity in the larynx, due to this wasting of the muscles on its left side, is perhaps still more apparent if we look into its cavity. In consequence of the depression of

the arytaenoid cartilage, and its taking an oblique direction inwards, the supra-glottic cavity is asymmetrical in shape, and, instead of being oval, has become comma-shaped, and therefore greatly diminished in size. The processus vocalis of the cartilage, as well as the vocal cord attached to it (and which is now flaccid), share in the depression to a corresponding degree; not only so, but they are much nearer the middle line of the cavity than those of the right side. As a result of this, the pars vocalis, and to some extent the pars respiratoria, is narrower than we find it in the healthy larynx: showing that, even after death, if the dilator muscles are not wasted, they still possess sufficient tension to prevent the arytaenoid cartilages falling so deeply into the cavity of the larynx, as when they are weak or atrophied. As a rule, the lining membrane and vocal cords are healthy, and the cartilages themselves may or may not be ossified; but this is quite independent of Roaring.

These are the principal alterations found on the left side of the larynges of horses which have been affected with chronic Roaring to a serious degree. In all the autopsies which I have made of such horses, I have never found any other changes, strange to say; while Professor Goubaux, of the Alfort Veterinary School, has dissected sixty-five horses which had been Roarers, and Leblanc, of Paris, sixty-one, and both have found all the larynges affected with left-sided muscular atrophy. I have already mentioned that Günther was of opinion that this uni-lateral atrophy is the cause of 96 per cent. of the cases of Roaring, and I am inclined to place it still higher.

When the muscles of the right side are also involved (bi-lateral paralysis), very few cases of which are recorded as occurring in the horse, then the atrophy is said to be not so marked in them.

In very rare instances, there is found disease of one or more of the cartilages (perichondritis), contraction of the whole laryngeal cavity (due to inflammatory processes in the

mucous and submucous tissues), polypi, and other alterations mentioned in a preceding chapter. These conditions the veterinary surgeon who determines on operation for the removal of Roaring should be prepared for, though they are so extremely unusual.

The gross appearances which I have described as characteristic of the morbid changes found in the larynges of horses which were Roarers, belong to an advanced stage. In this the muscles of the left side, with the exception of the one which has a different nerve-supply, are wasted, but the dilator or abductor muscle shows this more markedly than the constrictors.

At an early stage, before the Roaring is very pronounced or continuous, the left dilator appears to be alone affected; its colour being paler—the paleness being in proportion to the wasting of the muscle-substance, which leaves the sheath of this more apparent—and its texture softer than that of the right muscle.

In this condition, there is only weakness (*paresis*) of the left dilator muscle. At a more advanced stage, this muscle has lost much of its convexity, is softer and paler, and there are yellowish streaks of fatty tissue among its fibres, especially towards its inner border—fat granules or cells having taken the place of the muscle-substance. The constrictors on the same side now begin to manifest a similar, though less advanced, change, and the left arytenoid cartilage is on a lower level than the right. In some instances, the dilator muscle is unequally involved in atrophy, the change being limited to one or more portions of its substance, the outer border of the muscle being evidently the last to undergo degeneration. The constrictors are certainly the last to suffer seriously.

The degenerative process may cease at any stage, or pass on rapidly to the final one, in which all the muscle-substance of the affected muscles has disappeared; while the corresponding muscles of the right side appear to have

become much augmented in size and deeper in colour, they having undergone a kind of compensatory hypertrophy in the efforts to perform the work of their vanished fellows.

It may be remarked that the changes which the atrophied muscles of the larynx undergo are simply those observed in other muscles as a result of prolonged inactivity, especially due to loss of nerve-stimulus (*neuropathic origin* of atrophy).

That the atrophy is owing to defection of the left recurrent nerve, and not to disease of the muscles themselves (*myopathic* origin), is supported by the strongest evidence. In the first place, if chronic Roaring were occasioned by myopathic paralysis, we should find proof of it in the appearance of the muscles, and particularly if it were due to inflammation in them; one of the results of this would be an increase of the fibril sheaths (perrymisium), such as is observed in chronic myositis. And, in the second place, we should not have the muscles of the left side of the larynx alone involved in nearly every case of Roaring, and those on the right side not only perfectly healthy, but unusually developed.

In cases of long-existing chronic Roaring, the left recurrent nerve and its filaments have become so wasted, that little is left of them except their sheath; and this, even, is so attenuated that a most careful dissection is required to find it: a circumstance that has led some investigators to the conclusion that the nerve was congenitally absent. Of course, this is not the case. Like the muscles, this nerve undergoes, after a certain time, such degenerative changes as other nerves are liable to from various causes; the nerve-sheath, then the axis-cylinder, becoming atrophied and altered, the white substance of Schwann being sometimes increased; this change is coincident with a lighter colour of the nerve, and diminution in its circumference, until it is completely wasted.

This implication of the nerve in the morbid changes has

strangely escaped the investigation of veterinary writers until lately. For instance, Williams asserts that "dissections have failed to discover any change in the nerve-trunk itself, although the animals dissected have been confirmed Roarers for years previous to their death. In the form of disease involving the laryngeal muscles, which commonly causes Roaring, there is no change in the nerve itself."¹

The effect of these anatomical changes on the respiratory act will be examined when we come to inquire into the immediate cause of Roaring.

COURSE OF ROARING.

Considering Roaring to be produced by morbid conditions having a neuropathic origin, we will now glance at its course, anatomically and clinically.

The course of the defect—as every experienced veterinary surgeon and horseman knows—varies within wide limits, sometimes proceeding rapidly from an almost imperceptible *sifflement* to a screaming sound, with urgent dyspnœa on the horse being subjected to only moderate exertion. In other instances, it increases slowly until it reaches a certain degree, and then remains stationary for a long time—perhaps for years, varying only slightly and temporarily, according to the condition of the animal or surrounding circumstances. In rare cases, the noise, after continuing in a more or less notable degree for some time, spontaneously disappears, and the horse is again sound, so far as its breathing is concerned. Of this there are many instances, but perhaps the most remarkable is that of the race-horse Brigantine, one of the best of what were, in their time, called the "Buccaneerids"—a rather renowned family. Her own trainer vouched for the fact, which was otherwise well known, that the mare began her racing career in a very promising manner as a two-year old, but ran badly at a

¹ "Principles and Practice of Veterinary Medicine," pp. 509, 510.

July meeting at Newmarket, when she was probably unwell. Immediately afterwards she was discovered to be a Roarer, and continued so until the end of the following spring; when it was found that the noise was gradually diminishing, and it ultimately disappeared altogether, until at last she was as sound as on the day she was foaled. After this she won the Oaks, Ascot Gold Cup, and Hurstbourne Cup, easily.

In the first class of cases, the whole of the muscles of the left side of the larynx (always excepting, of course, the crico-thyroid) are usually involved throughout their entire structure, and the process of degeneration goes on rapidly in them. In the second class, these muscles are not wholly affected, their innervation being only weakened or partially suspended. For we may conclude, judging from the appearances presented by the left abductor muscle and one or two of the adductors, that individual fibres of the left recurrent nerve have alone lost their conducting power, the remaining fibres continuing to stimulate the portions of muscles to which they send filaments. Consequently, a part of the muscle may retain its irritability or contractile property, while another part is paralysed. Cohen¹ has remarked that it is not known whether the double function of the recurrent nerve is due to innervation by a common centre, or whether distinct centres preside over separate sets of filaments; while the influence which the pneumogastric nerve may exercise upon abduction of the vocal cords as an organic feature of the respiratory act, is a problem as yet unsolved.

In the third and somewhat rare class of cases, there is only temporary derangement of the function of the recurrent nerve; the suspension or modification not being sufficiently prolonged to allow serious atrophy of the muscles to take place.

When the recurrent nerve becomes more or less incapable

¹ "International Encyclopædia of Surgery," p. 783.

of stimulating the laryngeal muscles it supplies, apparently the first of these to suffer in function is the dilator muscle. This, failing to contract for want of stimulus, leaves its arytaenoid cartilage and attached vocal cord more or less immovable towards the middle of the glottis, and itself undergoes those histological changes with which we are so familiar, before the constrictor muscles, whose office is not nearly so important in respiration.

Clinically and experimentally, the evidence is strong that such is the fact. Semon¹ has shown that in all cases of acute or chronic organic disease or injury of the nuclei or trunks of the motor laryngeal nerves (spinal accessory, pneumogastric, recurrent laryngeal), the abductor muscle or muscles first feel the effects; whilst, on the other hand, in cases of functional disorder, the adductors usually alone suffer. That authority and Horsley,² experimenting together, found that, in all classes of animals experimented upon (monkeys, dogs, cats, rabbits), if the larynx was excised immediately after death and its muscles individually stimulated, the dilators (posterior crico-arytaenoids), which are absolutely the largest of all the laryngeal muscles, lose their electrical excitability long before the adductors. This is, in all probability, due to the circumstance that the two sets of muscles are histologically different, the dilators, according to Grützner and Simanowsky, belonging to the class of Krause and Ranvier's red muscles, and the constrictors to the so-called white muscles.³

Onimus had already demonstrated that, after death, both the extensor muscles and their nerves elsewhere lose their excitability before the flexors; and Rosenbach and Semon compare the dilators of the glottis to extensor muscles. Jeanselme and Lermoyez have found, on stimulating, within

¹ "Archives of Laryngology," 1881, No. 3; Berlin, *Klin. Wochenschrift*, 1883, No. 46.

² "On an apparently Peripheral and Differential Action of Ether upon the Laryngeal Muscles," London, 1886.

³ *Ibid.*, p. 5.

three-quarters of an hour after death, the laryngeal muscles of people who had died from cholera, that no contractions at all could be obtained of the dilators, while the thyroarytænoids responded well.

This difference in the physiological characteristics of the constrictors and dilators of the larynx, is, in all likelihood, related to the very important and constant activity of function demanded from the latter.

For how long a period the dilator muscles of the larynx of the horse may retain their vitality when their nerves no longer stimulate them, we have no exact knowledge. Bassi found commencing atrophy of the laryngeal muscles two months after division of the recurrent nerves, in a horse. Experiment has demonstrated that, after section of the motor nerve of an ordinary striped muscle, there is increased excitability for mechanical stimuli until about the seventh week, when it gradually diminishes, until it is altogether abolished towards the sixth to the seventh month. Fatty degeneration begins in the second week after section of the nerve, and goes on until there is complete muscular atrophy.

In young horses, Roaring usually appears more suddenly than in old ones, and has a tendency to become more rapidly acute in them, the dyspnœa being also more severe. This is no doubt owing to the difference in the condition of the laryngeal cartilages, as has been already mentioned when treating of the physiology of the organ and the results of division of the recurrent nerves. In what may be termed really chronic cases, the affection does not become modified as the horse advances in years, but, on the contrary, has a tendency to become more developed, for reasons which will be given in the following chapter.

The condition of the horse, weather, food, and other circumstances, influence the noise emitted in respiration, no less than the dyspnœa. Horses so affected roar less when in good working condition, than when "soft" and fat.

Damp weather, and especially if it is also cold, is unfavourable for such horses ; and an attack of catarrh or bronchitis, if ever so slight, greatly aggravates the Roaring. The good effects of abstention from water have often been noticed ; and to relieve the distress consequent upon severe exertion, it has been sometimes found advantageous to administer a quantity of an oleaginous or lubricating fluid previously. To diminish the breathing capacity, and so lessen the strain on the larynx, the nostrils have also been partially occluded, or bulky food has been given.

With regard to the latter treatment, Youatt gives an amusing anecdote. He writes: "There are few hunts in which there is not a Roarer who acquits himself very fairly in the field, and it has occasionally so happened that the Roarer has been the very crack horse of the hunt ; yet he must be ridden with judgment, and spared a little when going uphill. There is a village in the West Riding of Yorkshire, through which a band of smugglers used frequently to pass in the dead of night. The horse of the leader, and the best horse of the troop, and on which his owner would bid defiance to all pursuit, was so rank a Roarer that he could be heard at the distance of a quarter of a mile. The clatter of all the rest scarcely made so much noise as the roaring of the captain's horse. When this got a little too bad, and he did not fear immediate pursuit, the smuggler used to halt the troop at some convenient hayrick on the roadside ; and, having suffered the animal to distend his stomach with this dry food, as he was always ready enough to do, he would remount and gallop on, and for a while the roaring was scarcely heard. I am not compelled satisfactorily to account for this ; but the loaded stomach now pressing against the diaphragm, that muscle had harder work to displace the stomach in the act of enlarging the chest and producing an act of inspiration, and accomplished it more slowly, and therefore, the air taking longer time to rush by, the Roaring was diminished. I will not

stop to calculate what must have been the increased labour of the diaphragm in moving the loaded stomach, nor how much sooner the horse must have been exhausted. This did not enter into the owner's reckoning, and probably the cruel application of whip and spur would deprive him of the means of forming a proper calculation of it." ¹

¹ "Veterinary Lectures"—"The Veterinarian," 1833, p. 61.

CHAPTER VIII.

CAUSES OF CHRONIC ROARING.

THE causes of Chronic Roaring may be considered as “mechanical” and “pathological;” the first being related to the impediment in respiration which occasions the noise, and the second to the morbid changes to which the impediment is due. We will study the causes in this order.

Mechanical Causes.

It has been already stated that the abnormal sound heard in respiration is coincident with the act of inspiration—at least it is loudest then; for in advanced stages there is a more or less audible noise also during expiration. The way in which the noise or stridor is produced, and the parts which produce it, has afforded matter for discussion for a long time; but remembering the physiology of respiration, and the share the larynx takes in this function, there should not be much doubt as to the origin of the noise.

We have seen that, during breathing, the arytenoid cartilages, and the vocal cords attached to them, are moved outwards and upwards in inspiration, so as to widen the glottis and allow the necessary volume of air to pass through to the lungs, the degree of movement depending upon the physiological requirements of the body. In tranquil respiration the movement is only trifling, as the space existing between the vocal cords (*pars vocalis*) and their movable cartilages (*pars respiratoria*), when they are at rest in the living animal, is almost sufficient for the admission of the

required amount of air. But in proportion as the need for an increased supply of air becomes urgent, so the movement of these parts is extended to afford more glottal space, until, in forced and deep respiration, the glottis is dilated to the utmost, by each arytenoid cartilage being drawn by its dilator muscle upwards and outwards, and the vocal cord pulled close to the side of the thyroid cartilage; so that the middle division formed by these in the organ has almost entirely disappeared, and the lumen of the larynx is nearly of the same dimensions throughout (Fig. 6). Inspiration being accomplished, the cartilages fall downwards and inwards, chiefly by the dilator muscles ceasing their contraction (though they are never entirely relaxed during life), and the natural elasticity of the cartilages and vocal cords coming into play; then they are in the passive position assumed in tranquil respiration, in which the glottal opening is wider than when they are in what is termed their "cadaveric position." Expiration now taking place, the air expelled from the lungs easily pushes cartilages and cords aside, in its course through the larynx towards the nasal passages.

It will now be perceived what must happen when the dilator muscles are weakened or paralysed, and the respiration is increased. The vocal cords and arytenoid cartilages not being moved sufficiently out of the way of the intruding column of air, they form such an obstacle in the laryngeal cavity as to allow only a portion to enter, and this is drawn in with such force as to produce a noise, all the more shrill the narrower the glottal space has become. It may be observed that in man a similar condition is remarked; paralysis of the abductor muscles of the larynx is always manifested by inspiratory stridor.

When the dilator muscle of only one side is affected—the left, for example—then the stridulous breathing is not so marked or distressing on exertion; as the opening of the glottis is wider, not only because the other dilator muscle is

healthy, but also because it is more energetically called into action to compensate for the defectiveness of its fellow.

In commencing Roaring, or in those cases in which it remains at a less advanced stage, and in which the muscle is only slightly affected, the sound is probably produced by the vocal cord alone ; the thin border of this, projecting into the cavity of the larynx, meets the inspired air and produces the characteristic sound. But in more advanced cases, when the muscle is feebler, or altogether paralysed, then, during exertion, there can be no doubt that the ary-tænoid cartilage shares with the vocal cord in obstructing the admission of air, and renders the noise louder and of a different tone. When the muscle is completely wasted, both vocal cord and cartilage assume and maintain the "cadaveric position" when the horse is at rest ; but during severe exertion they even pass beyond this, and still further constrict the air-passage, diminishing it by more than one-half.

This movement of these parts beyond the centre of the cavity, is due to the pressure the air exerts upon them, and also to the part played by the sac or ventricle on their outer side. During inspiration, when the larynx is in a healthy condition, this somewhat extensive sac is obliterated and its slit-like entrance shut ; but when the glottis is closed, as during neighing, then it is inflated with air, to allow the vocal cord more liberty of movement for vibration, and to act, with the upper laryngeal cavity, as a resonator. In Roaring, from its flaccid condition, its elasticity, and its wide opening, it catches a portion of the air which should pass into the trachea, and this inflates it to a considerable degree, causing the vocal cord to be pushed still further towards the opposite side (Fig. 7). At the same time, this movement of the cord downwards and inwards also compels the ary-tænoid cartilage to which it is attached to be drawn in the same direction, this action being supplemented by the air also pressing down the upper

part of the cartilage itself, and so still further decreasing the glottal space at the *pars respiratoria*, as well as at the *aditus*. Consequently, the greater the volume of air enter-

FIG. 7.—VIEW OF THE LARYNX OF A HORSE AFFECTED WITH ROARING, DURING EXTREME INSPIRATION, SHOWING THE DIFFERENCE IN POSITION OF THE RIGHT AND LEFT ARYTENOID CARTILAGES AND VOCAL CORDS.

a, Epiglottis. *bb*, Arytænoid cartilages, the right being pulled outwards and upwards, while the left (dark-shaded) is beyond the cadaveric position. *cc*, Vocal cords: the right is drawn close to the side of the larynx, while the left remains in the middle line, and diminishes the aperture of the glottis, *d*. *ee*, Ventricles of the larynx.

ing the pharynx from the nasal passages, the less will pass through the larynx, owing to its distending this pouch and

depressing and pushing inwards the vocal cord and arytaenoid cartilage; at the same time that this encroachment narrows, to a serious extent, the "portal of the breath of life," the upper division, or *aditus*, is correspondingly diminished in size by the passing forward of this cartilage into its cavity. So that after a certain amount of weakening of the dilator muscle, and resulting protrusion of cord and cartilage into the breathing space, the condition becomes yet more aggravated by the pressure exercised on them by the air which should pass into the lungs, but which drives against their upper surface instead. The more frequently a horse affected with Roaring undergoes severe exertion, so the more rapidly will the morbid displacements of these parts become serious and permanent, and especially if the animal is young—for then their softness allows them to yield all the more readily to the pressure of the air.

In this way can the striking distortion observed in the larynges of horses which have been for some time bad Roarers be accounted for; the atrophy of the dilator muscle would not alone explain it.

It will now be understood why limiting the admission of air at the nostrils during active exertion benefits, rather than inconveniences, a horse which is a Roarer.

When the vocal cord does not advance to the middle of the larynx, but is only rather relaxed, it is thrown into coarse vibrations by the forced inspiration, and the horse then "roars"; when still less advanced, and the cord is more tense, he whistles—the constrictor muscles of the same side probably acting, though feebly, in shortening the cord. But when cord and cartilage pass to or beyond the median line, then on slight exertion the inspiration is noisy, and when the exertion is increased, the sound becomes painfully loud and shrill; at the same time, the right dilator muscle has to act in a continuous and spasmodic manner to allow as much air as possible to reach the lungs, and also to pass from them.

The noise heard in expiration in these cases is caused by the air pushing past, and lifting to one side, the obstructing cord and cartilage.

It has been denied that the immobile vocal cord has anything to do with the production of the noise in Roaring; but that it must have a large share in this, might be inferred from the anatomical and physiological facts which I have given, as well as those of a pathological kind, derived from observation of morbid conditions of the vocal cords in man and animals.

The distension of the ventricle with air would alone produce noisy respiration. Falconio¹ describes a case of sub-mucous emphysema of this ventricle in a horse, through air obtaining access to the cellular tissue; this condition caused a whistling sound in breathing. Such an accident may be more frequent than might be supposed, judging from the extreme rarity of the recorded instances; as stalks of fodder may readily wound the mucous membrane at this part. Günther reports the case of a horse in which the ventricle was filled with pus, and which caused a noise in breathing; the sound disappeared when the pus escaped. Möller had a similar case.

The difference in the dimensions of the air-passage during deep inspiration in the healthy larynx, and in that of a horse affected with Roaring, will be better realised, perhaps, by comparing fig. 6 (p. 91) with fig. 7 (p. 113).

Pathological Causes.

Having considered the mechanical causes of Roaring, we will now inquire into the pathological conditions which lead to these impediments.

Beginning with the fully ascertained fact, that debility or atrophy of the left dilator muscle is the *causa proxima* of chronic Roaring, the questions to be answered are: why

¹ "Giornale di Anatomia, Fisiologia," etc., 1886.

the left side of the larynx should be in, it may be said, every case alone involved; and what occasions the muscle-wasting?

Here, again, we find much mystery and obscurity prevailing. "Why the change is greater on the left than the right side, is," says Williams, "one of those things for which no more satisfactory explanation can be given than why the ulcers of Glanders are oftener seen in the left than in the right nostril."¹ I am not aware that the ulcers of Glanders are more frequently noticed on one side of the head than the other—all my experience leading me to believe that neither is particularly favoured in this respect. But why the left side of the larynx should be that which is alone involved in chronic Roaring, there should be now no difficulty whatever in comprehending. It is due entirely to the difference in the course and relations of the left recurrent nerve, and which I have been at some pains to indicate in describing the innervation of the larynx. The anatomical distinction between the right and left nerves was shown to be remarkably great; and it is upon the special features observed in the detachment, situation, connections, and environment of the latter nerve, that we can account for the side of the larynx it supplies with stimulus being the one to suffer from the characteristic pathological changes which occasion Roaring.

It has been shown that the right nerve is comparatively short, being given off from the right vagus nerve immediately after the latter enters the chest, in which it has scarcely any relations or connections: whereas the left one is detached from the left vagus nerve deep in the cavity, at the base of the heart, and is connected and related with the sac (*pericardium*) in which that organ is enveloped, with the great arterial trunk springing from the heart, with the pleural membrane and its dependencies, with lymphatic glands—intra- and extra-thoracic—and with ganglia of the

¹ *Op. cit.*, p. 510.

sympathetic system of nerves. But outside the chest there is no difference between the right and left nerves, and up to and on the larynx they have the same course, relations, and distribution. Therefore it is to the thoracic differences in the nerves that we must look for the exemption of one side of the larynx, and implication of the other.

I have stated that chronic Roaring is a neuropathic disease, its nervous origin being undeniable. If it were due to any local inflammation or swelling in the region of the larynx, we should doubtless find the right side as frequently involved as the left, and the morbid changes presenting other characters than those described. Absence of mobility of the arytaenoid cartilages and vocal cords might doubtless be due to paralysis of the dilator muscles, from infiltration of their fibres and nerve-filaments; but this would be obvious on *post-mortem* inspection.

In chronic Roaring there are no indications whatever of such inflammatory action, and the fact that very many cases occur without any inflammation being present in the larynx or its neighbourhood, is sufficient to prove that we must seek for the causes elsewhere, and ascribe them to other influences. Attributing the wasting of the muscles on the left side of the larynx to some imperfection in the condition of the nerve distributed to them, and also accepting as a fact the statement that such imperfection, even when slight, is more apt to affect the dilator than the constrictor muscles, it now remains to inquire what influences render the left recurrent nerve defective. Here, however, we come upon less certain ground, and must extend our inquiry over a wide area, if we are to arrive at a satisfactory conclusion.

The causes which will render a nerve incompetent to perform its function in one part of the body will do so in another, and the left recurrent nerve cannot prove an exception. Experimentally, it has been demonstrated that division or ligation of the right recurrent nerve in its course

up the neck will give rise to precisely the same symptoms and the same morbid alterations on the right side of the larynx as when this is performed on the left nerve. External injury, or alterations in the nerve-structure, due to changes in its histological elements, will modify or altogether abolish the conductivity of a nerve. Such are in operation in the development of chronic Roaring. Pressure upon, or disease of the nerve, in any part of its course, from its origin close to the heart up to its arrival at the larynx, will impair or destroy its function, and in time alter its structure.

How is this pressure or disease brought about? Any change affecting other organs or tissues in immediate proximity to the nerve will affect it. Aneurism of the aorta, tumours, inflammation or disease of any portion of the pleura with which the nerve is in contact; inflammation, hypertrophy, and induration of the lymphatic glands in any part of its course, or any other morbid conditions in which it may be involved either directly or indirectly, will impair its use either partially or wholly, temporarily or permanently.

Perhaps, of all causes, the pressure or disturbance exercised by diseased intra-thoracic lymphatic glands—chiefly the bronchial—is the most frequently observed. So long ago as 1838, Ferguson, when examining the body of a horse which had been a Roarer for a long time, found the left recurrent nerve enveloped and compressed by a voluminous indurated bronchial lymphatic gland, while the remainder of the nerve between this gland and the larynx was quite different to that on the opposite side, it being greatly wasted and its fibres scarcely distinguishable. All the laryngeal muscles which received filaments from it were so completely atrophied, that it was difficult to perceive their structures, while the glottal opening was twisted and the borders of the arytaenoid cartilage partly obstructed it.¹

¹ "The Veterinarian," 1838.

In 1846, Lafosse related a case in which a horse at first manifested Roaring at intervals, but soon became continuously affected, and the dyspnœa finally became so serious that the animal died asphyxiated. At the autopsy the bronchial lymphatic glands were observed to be extremely enlarged, brownish in colour, indurated, adherent to each other and to the lungs, and containing pus at various points, while the pneumogastric nerves were compressed in them, and almost confounded in their mass.¹ Trasbot² made many autopsies of horses that had been Roarers, and invariably found that the left recurrent nerve was surrounded by indurated, enlarged, or in some other way altered, bronchial lymphatic glands, or was compressed between them and the aorta, and that it was atrophied from its entrance among them; in some instances it had almost disappeared, or was reduced to a thin gray filament throughout its entire length up the neck.

Other observers, among them being Dupuy, Bouley, Colin, and Zundel, have noted similar implication of the nerve in these thoracic glands; and my own examinations of horses which had been affected with Roaring have, in the majority of instances, yielded results the same as those of Trasbot. Bassi reported a case in which a horse was destroyed because of this defect, and an examination showed that the left recurrent nerve had been pressed upon by an enlarged lymphatic gland near the twelfth tracheal ring, and was only one-third its ordinary volume.

Bouley, so long ago as 1825, found this nerve compressed and altered by engorgement of the pre-pectoral lymphatic glands of horses so affected;³ and F. Günther records an instance of confirmed Roaring being caused by the left thyroid gland compressing this nerve, and leading to wasting of the laryngeal muscles on the same side. Professor

¹ "Journal des Vétérinaires du Midi," 1846.

² "Archives Vétérinaires," 1879.

³ "Recueil de Médecine Vétérinaires," 1825, p. 38.

Sewell, in dissecting the body of a horse which had been a Roarer, found a bony tumour growing from the cervical vertebra between the first ribs, which had exercised pressure on the nerve.¹

Many other instances of a similar kind could be given, in which compression of the left recurrent nerve has produced Roaring. In the days when bleeding was fashionable, it was not at all an infrequent consequence of inflammation of the jugular vein, due to phlebotomy.

Goubaux was of opinion that harness horses wearing small collars were liable to become affected, as the left recurrent nerve is more superficial at the bottom of the neck than the right one. This is not at all a likely cause, however.

Some authorities, as K. Günther, Franck, and others, have favoured the view that the paralysis was related to the course the left recurrent nerve pursues around the posterior aorta; the pulsations of this great artery are supposed to strain the nerve and weaken its function. But it may be pointed out that the relations between the artery and nerve are the same in horses inhabiting countries in which Roaring is unknown.

Martin² supposed that during the development of the body in youth, the neck becomes lengthened and the heart pushed back, straining the left recurrent nerve and pressing it at the aorta, and so impairing its function. In this way it was attempted to account for the greater frequency of Roaring in horses with long, thin necks; and Ellenberger, according to Möller, adopting this view, lays stress on the high development of the arterial system and the absence of fat in English thoroughbred horses, whereby the nerve is but little protected at the aorta; this exposes horses to become Roarers when their condition is fine—as during training. The influence of this arterial pressure in

¹ Percivall, *op. cit.*, p. 253.

² "Oesterreich. Monatsschrift," 1885.

damaging the nerve at the aorta is supposed to be further supported by the observation of Sussdorf, that the left recurrent nerve shows a flattening, perceptible by means of the microscope, where it passes between the aorta and trachea.

But the objection I have offered above applies also here. English horses, however much they may be liable to become affected in their own climate, appear to lose this predisposition in warm dry climates, and yet we cannot believe that the anatomical relations of arteries and nerves are altered with the change of latitude. Arab horses in training (as they often are in India) cannot differ much, anatomically, from English horses; and yet Roaring is all but unknown among them. Besides, nerves are not inelastic cords, but can be extended to a considerable extent without their function being interfered with. In small animals, the recurrent nerve may be raised as much as half an inch, without any effect being produced on the laryngeal muscles.

Notwithstanding these objections, however, there is reason to suspect that there is some foundation for the supposition in the case of very young thoroughbred race-horses. The early age at which these animals—immature as they are—begin to be treated as if fully mature; their stable management, feeding, training, and altogether very unnatural existence, must severely test their organization; and it can scarcely be wondered at if the left recurrent nerve, like all other organs and tissues, sometimes, or even frequently, suffers overstraining and pressure, particularly at the point where it lies in contact with the posterior aorta. Fast racing at two and three years of age must impose a very heavy task upon the heart and its large vessels, at a time when they are only partially developed, and their dilatation must be all the greater as their tissues are soft and yielding. The posterior aorta, from the large amount of blood it has to carry, must participate in the

undue blood-pressure attending such severe and abnormal exertion, and become greatly distended—the greater proportional increase in its circumference, and which Stahel describes as “*Spindelbildung*,” being probably in consequence of a sudden change or twisting in its direction during distension. This will impose a condition of alternate extreme tension and relaxation on the nerve, which must be highly unfavourable for its functions and histological arrangement in the almost embryonic state in which it yet is in such juvenile creatures. In the course of a very few generations we can reasonably infer that, in families which may perhaps have some anatomical peculiarity in the disposition of this nerve in the chest, the weakness induced in this way will become inherited—as other defects often are; and the predisposition thus existing, Roaring is developed when certain predisposing or exciting causes, be they ever so slight, come into operation. Of course, this line of reasoning can only apply to young race-horses, not to other or adult horses.

Chronic Roaring not unfrequently follows certain diseases, chiefly those in which the respiratory apparatus in the chest is involved, and particularly those parts of this apparatus which are more or less closely related to the left recurrent lung. Pleurisy, inflammation of the right lung or the pericardium, or of the lymphatic glands in the vicinity of the nerve, are often followed by Roaring, from the extension of the inflammation to it, or the pressure exercised on it by inflammatory products. In this way it is often a sequel of influenza, and similar febrile disorders in which the chest is affected. What are called “colds,” which may be bronchitis or pleuro-pneumonia, in addition to catarrh, often have this result. The infectious fever known as “Strangles,” in which there is abscess formation in the submaxillary lymphatic glands, is perhaps the most frequent cause of Roaring met with among army horses, and probably also among others than these. The occurrence of this

defect after Strangles in all likelihood depends upon whether the tracheal and bronchial glands—between which and the submaxillary glands there is great sympathy—are inflamed and swollen.

It has long been known that Roaring often follows the above diseases, though its cause was not suspected. Sixty years ago, Professor Sewell, of the Royal Veterinary College, wrote, in reference to it: "When it takes place in colts that have not been broken or regularly domesticated, it is usually the result of severe cases of Strangles that have not terminated favourably, but left a thickening, and often chronic ulceration, of the mucous membrane lining the larynx; in others it is preceded by severe colds and sore throats, producing similar lesions of structure. The latter is frequently the cause in all kinds of horses, and in all unhealthy seasons, in spring especially, the disease has its origin."¹

The occurrence of Roaring in young horses which have never done any severe work—in fact, no work at all—such as army remounts, but which have suffered from Strangles and fevers implicating the chest and its contents, militates against the development theory of the defect, and also that of nerve stretching by the posterior aorta.

Whether a high temperature will cause disturbance in the function of the left recurrent nerve in horses unaccustomed to it, cannot be decided; but it is most probable that there were, in the instances recorded of English horses becoming Roarers in hot climates, antecedent or collateral causes in operation which were overlooked, but which were more potent than this: such as fever on board ship, with congestion of the lungs and pleuræ, exhaustion, etc. Spooner-Hart ascribes the cases of Roaring observed among imported horses at Calcutta, to the elevated temperature of the summer, which induces what he terms "thermic fever." "A patient, after an attack of such high

¹ "The Veterinarian," 1829, p. 68.

fever, is left with his nervous system permanently damaged, and is never a horse again. . . . His body temperature, even when at rest, stands abnormally high, and on the smallest exertion in the sun it rises quickly. He never cools down, and stands and blows over his food in the stable—he is in a state of chronic fever. A little work in the sun, and he falls, registering a very high temperature. A horse of this class becomes a Roarer, and is of little use here.”¹

I have already alluded to English troop-horses becoming Roarers in South Africa and Egypt. In the latter country an extraordinary number became affected, but they were exposed to various causes besides the thermic one. Of this I might cite many instances, but content myself with giving the following, furnished me by Veterinary Surgeon (First Class) Case, Army Veterinary Department. He says :

“During the campaign of 1882, in Egypt, I served with G Battery, B Brigade, Royal Horse Artillery, a corps I had been with for two years. When we embarked, on August 2nd, there was not a horse affected in its breathing in the ranks ; but soon after landing many of the horses, more especially the draught ones, began to show symptoms of Roaring. This began to appear during the latter part of our first march from Ismailia, which place we left on August 17th, at four o’clock in the afternoon, and continued marching until five o’clock the next morning, when we halted for four hours. During the early part of the night we were subjected to a fearful dust-storm, and the bank of the Fresh-water Canal, on which we were marching, was very rough going ; so that at the time I attributed the Roaring to over-exhaustion—the horses only just having landed, and being somewhat out of condition. On continuing, the march was more distressing, as the direction lay across the desert, the guns and waggons having to be pulled through deep sand. The Roaring of many of the horses then became much more perceptible, and could be heard at some distance. More

¹ “The Veterinary Journal,” vol. xxv., p. 4.

especially were the ammunition-waggon horses affected, and they were quite unable to move their loads, which necessitated the horses being taken from the other waggons to assist. The waggons were then drawn alternately for about half a mile, the horses returning for the remaining waggons. This excessive exertion was continued throughout a dreadfully hot day, with but little food, and without water for the animals. The laboured and distressed breathing of these horses could be heard a long way off—in fact, it was quite painful to witness their distress.

“The next morning we marched at two o’clock, but had to leave three horses behind, their breathing being so bad it was impossible to move them; and two were still Roaring badly, although they had been at rest for about five hours. The road now was somewhat better, but the Roaring of the horses had increased, and there were several fresh cases. After arriving at Kassassin, where we stayed some days, the horses picked up in condition; but when we marched again, I noticed the Roaring had not disappeared—in fact, many more horses were affected. And after Tel-el-Kebir, on September 13th, and during our march on Cairo, several animals had to be destroyed, as the Roaring brought them to a standstill, while others were left behind at villages in charge of the sheiks, who afterwards brought them to us.

“On arriving at Cairo, out of the 210 horses embarked, about 185 were with the Battery, including officers’ chargers; of which number 33 were Roarers, 13 ‘broken-winded,’ and several others more or less affected in their breathing (Whistlers). Many of the affected horses afterwards died of fever; some were destroyed from various causes; others were cast and sold; and a few were sent to the Mounted Military Police, and are now (1888) serving at Cairo and Alexandria.

“After I arrived at Cairo (in 1886), I saw many cavalry horses that had become Roarers during the campaign.

“The immediate cause I attributed to fever, contracted

either on board ship, or after landing—in the former case by the heat between decks, especially among those horses that were in the lower hold, and by the emanations from the excretions; and in the latter by climatic causes, filthy water, etc.—and which became aggravated by exhaustion. In some cases the fever may have been so slight as to pass unnoticed. I think in some horses, more especially the draught ones, the Roaring might have been caused by the muscles of the larynx becoming partially or wholly paralyzed from over-exhaustion.

“I may mention that I brought to this country a half-bred mare, perfectly sound in every respect. On the voyage out she suffered from rather a severe attack of fever; she was placed in the upper deck with other horses, the weather being fine. The day we landed she met with an accident which caused her to be left behind at the sick depôt at Ismailia. She remained there about seven weeks, arriving at Cairo about the 1st of October. She soon after began to show symptoms of Roaring; at first it was slight, but it gradually increased. I took her home in March, 1883. She never recovered, and when I left England, in March, 1886, she was still a bad Roarer. She was very high-spirited, and the least excitement, even at a walk, caused her to roar so badly that she could be heard at some distance.

“Veterinary Surgeon Griffiths states that a large number of the horses of the regiment (7th Dragoon Guards) he served with in 1882, became Roarers soon after landing. He attributed it to the excessive heat on board ship, the horses perspiring a great deal; and as the vessel changed her course a sudden current of air would rush through the port-holes, which, he thinks, caused the horses to be chilled.

“He adds that one of his own horses commenced to roar soon after it arrived in Egypt, and, by January, roared so badly that it could be heard a long way off. He sent the animal home in February, 1883. It was then a very bad

Roarer, and remained so during the winter, but in July of the same year it was passed sound by a veterinary surgeon, the noise having disappeared."

So far, then, there does not appear to be anything mysterious in the constancy with which the immediate cause of Roaring is found to be localised on the left side of the larynx; it is simply due to the fact that the left recurrent nerve in the chest is exposed to injurious influences from which the right nerve is altogether exempt; and that these influences are many and diverse, we know full well. When one or more of these influences act upon the nerve, weakening of the muscles it supplies is soon manifested; and the first muscle to be affected being the left dilator, a noise in respiration becomes evident, through imperfect opening of the glottis. The rapidity with which the inspiration becomes impeded, and the noise grows louder, will depend upon the extent to which the conductivity of the nerve is involved. Outside the chest, both nerves are alike exposed to injury; but as it is indeed rare to find the right side muscles of the larynx wasted, the risk of damage in the region of the neck must be infinitely small.

CHAPTER IX.

PREVENTIVE AND CURATIVE TREATMENT OF CHRONIC ROARING.

IN view of the increasing prevalence of chronic Roaring, its tendency to occur in the most valuable horses, and the serious and often rapid manner in which it leads to their depreciation, only too frequently destroying their utility, the necessity for adopting every means for preventing its development, or, when it has become evident, removing the causes upon which it depends, need not be insisted upon. In fact, there are perhaps no questions connected with the production, improvement, and utilization of horses, which demand more serious examination and solution than those relating to the prevention of this defect, or its removal when its existence has become manifest. They have already engaged the attention of veterinary surgeons and horsemen for a long period, and the time has now arrived when, on account of the great interests involved, no less than on behalf of the noble creature himself, they should be seriously discussed, and measures suggested for dealing with them in a practical and satisfactory manner.

These measures must be devised : (1) To the prevention of Roaring, from a sanitary and medical point of view ; (2) To the removal of the causes which give rise to it, either by medical or surgical treatment. We will deal with them in this order.

1. PREVENTION, FROM A SANITARY POINT OF VIEW.

The prevention of chronic Roaring is of the utmost importance, and should be the chief aim of those who have it

in their power to carry out the measures essential to this end. They may be enumerated as follows: (a) Exclusion of unsound horses for breeding purposes; (b) Care in the management of young horses; (c) Hygienic management.

(a) Exclusion of Unsound Horses for Breeding Purposes.

Numerous and incontestable facts pointing to hereditary predisposition as a potent factor in the genesis of Roaring, it becomes imperative, in order to diminish its frequency, to exclude from breeding, be they males or females, horses which are already suffering from the defect. This is a severe measure, knowing the high value of some horses, due to their excellent qualities; but its urgent necessity is obvious. Of course, this measure applies more especially to animals in whose ancestors Roaring has been noted for two, three, or more generations, and in which it has become evident without any, or apparently a very slight, assignable cause—especially at an early age. For it must be remembered that the defect may arise from a number of what may be termed “remote causes”—such as pleurisy, pneumonia, pericarditis, congestion of the lungs or pleura, strangles, etc. — without hereditary predisposition being present. Whether such predisposition exists in a horse, we have no means of ascertaining, except by instituting inquiries into his pedigree; for this tendency, in all probability, consists in transmitted anatomical peculiarities, which form the *causa internâ*, and therefore undiscoverable agencies, in the origin of Roaring.

(b) Care in the Management of Young Horses.

I have already alluded to the abnormal precocity which is forced upon very young thoroughbred horses, as a likely cause in predisposing them to Roaring; and I think this has been too much lost sight of, in accounting for the greater and increasing prevalence of the defect among them. For

other breeds, as the coarser and heavier horses and ponies, which are not so abused in their very juvenile days, and are allowed to develop in a more natural manner, there is no necessity to insist upon this predisposing cause being abolished—as the defect is rare in them; but for the thoroughbreds, upon which the perfecting of our speed-horses must depend, such injurious, premature treatment as they now receive merits earnest condemnation. Until a horse has reached an advanced stage of development, its organs and tissues cannot be subjected to severe wear and strain with impunity, no matter how much that development may be forced artificially. Growth may be accelerated, but with it consolidation is required to constitute maturity—and this cannot be so easily controlled, or hurriedly brought about. Nature cannot be coerced beyond a certain degree without resenting the compulsion; and to exact exertion from a two-years-old horse as if he were a four-years-old—no matter how he may be stimulated to growth by hot stables and rich food—cannot be otherwise than damaging to him, and especially to the organs of respiration, circulation, and locomotion.

By deferring the training and racing of thoroughbreds for a year or two, the predisposition to this and other damaging defects would be immensely lessened, if not altogether got rid of, and a more healthy and useful race of horses ensured.

(c) Hygienic Management.

In cold, damp countries, and especially those in which there are sudden falls and rises in temperature, in order to maintain horses fit for labour, and indeed as an essential element in their improvement, they must be protected from the effects of climate by lodging them in stables, and keeping them comfortable. But unless much care is exercised in this housing, harm is done, and a predisposition to disease of the respiratory organs established. Badly-ventilated and

over-heated stables are eminently prejudicial to the health of horses, and it is in these that we find those fevers and disorders prevailing which are so often followed by Roaring. For none of the other domesticated animals is plenty of pure dry air so essential, and it should be rather cool than hot. If the horses must be kept warm during cold weather, then this should be done by clothing the body, and, if need be, the limbs. This treatment has been insisted upon by the most experienced horsemen, who have not ceased to point out the injury inflicted upon horses by hot, foul stables. Admiral Rous, for instance, speaking of Roaring in race-horses, mentions the advantages of cool stables and fresh air, and says: "I have no doubt that Roarers might be improved a stone if they were trained from an open shed, sheltered from wet and rain, keeping them warmly clothed, and always in the open air."

The hygienic management which is best adapted to prevent the occurrence of coughs, colds, fevers, pleurisies, pneumonias, and other affections of the air-passages and chest, is that which will afford most security against the development of Roaring, whether or not the predisposition to it be present in horses. Everything should be done to prevent their being attacked by Strangles—a very infectious disease, spreading only by its infectious properties, and which, in western countries at least, is so frequently followed by Roaring. Indeed, so marked has this sequel been in my experience among horses, that for some years, while I was a regimental veterinary surgeon, I treated every case of Strangles in such a way that, in my opinion, injury to the left recurrent nerve was less likely to occur from pressure upon it by enlarged bronchial lymphatic glands. This treatment chiefly consisted in the administration of iodide of potassium, or iodide of iron; and I have reason to believe that it was very successful.¹

Food does not appear to have so much influence in pre-

¹ "Veterinary Journal," vol. xiv., p. 93.

disposing to the affection as is often imagined it has, and there is no reason why it should, so long as it is not of a toxic nature.

2. MEDICAL AND SURGICAL TREATMENT OF ROARING.

What is called the "cure" of chronic Roaring, has formed a very vexed subject in veterinary medicine, and has engaged the earnest attention of the majority of distinguished veterinarians. A detailed account of the attempts made to get rid of the noise in respiration would form a curious chapter in the history of perplexed "cure-hunters."

Percivall, who knew little or nothing of the pathology of Roaring, in 1841 expressed the opinion that its successful treatment was hopeless, especially in cases of long duration, no matter what causes they might be due to. "Also such as there appears any reason to believe hereditary, or dependent upon an original malformation of parts. Cases of distortion are equally irremediable when the distortion has existed so long as to destroy the original form and properties of parts, and in their place to have established fresh ones. Such can only be benefited by the French treatment, which consists in the performance of bronchotomy, or tracheotomy as they more properly call it. They make a large aperture, and use a proportionally large tube, so constructed and adapted that the animal can not only breathe through it, but do his work, and gallop with it in his neck."

From Percivall's time up to a quite recent period, little has been done in the way of treatment for the defect, and that little has been, as a rule, of the most empirical kind: due to the fact that the morbid conditions upon which Roaring depends were unknown or not understood.

Attempts at removal of the defect have seldom been made, even in the case of most valuable animals; and for many

years it has been rare indeed to hear of veterinary surgeons undertaking the treatment of horses so affected, such being regarded as hopeless, even at the very commencement of the Roaring. Blistering the throat, or applying the *ferrum candens* over the larynx, has been the principal treatment; but even this appears to have been long given up.

Now that we understand the pathology of Roaring, we are in a better position to adopt rational measures for what we may term its "cure," and with much certainty of successful results. In this respect, we may venture to hope that veterinary surgeons will be more fortunate in the future than surgeons; as laryngeal paralysis is always a serious condition in man, because the disease which gives rise to it is so frequently of a fatal character.

(a) *Medical Treatment of Roaring.*

Medical treatment, it must be confessed, has not been found very successful in the removal of Roaring, and the reason for this is obvious. Atrophied muscle cannot be regenerated, and if the left dilator of the larynx has wholly, or even partially disappeared, its restoration is impossible. It is only in cases in which the muscular tissue though weak (*paresis, simple atrophy*), can be again developed to its original condition, and the compressed or damaged nerve brought to its normal state, that medical treatment is likely to be beneficial. So long as it is mere weakness, through feeble conduction in the recurrent nerve, then the resources of therapeutics may be made available in removing the Roaring.

If it is suspected that the thoracic lymphatic glands are the cause of nerve impotency, then the administration of preparations of iodine—as iodide of potassium, iron, or mercury, will probably prove of value. Percivall, long ago, suggested the employment of iodine. After recommending bleeding, purging, alterative medicines, and counter-irritation, he remarks: "I know of nothing more that can be done by

way of treatment for Roaring, unless we choose to try iodine; it may either be given internally, or employed as an ointment, or used in both ways. I have not yet myself had an opportunity of making trial of it."¹ Trasbot has given iodide of potassium with good results, and I have also employed it, alternately with arsenic (Fowler's solution), with excellent effect in some cases in which Roaring was recent. Zundel has tried this treatment, and lauds it highly.²

Strychnine, given internally, and also applied hypodermically over the larynx, has been favourably spoken of by several Continental veterinary surgeons. It has also been employed to discover whether Roaring may be really due to paralysis of the abductor muscle, and whether the muscle yet possesses any contractile power, by injecting it beneath the skin over the left side of the larynx.

Electricity, in the form of Faradisation, I have employed in two cases, which perfectly recovered.³ It was tried, in conjunction with the administration of iodide of potassium, alternated with Fowler's solution of arsenic, upon the Duke of Westminster's Ormonde, and it certainly appeared to have the effect of preventing an increase of the noise, and consequent distress in breathing of that grand race-horse. It might be claimed, I think, that it assisted him to achieve the victories of his final year on the turf; and it would, in all probability, have kept him a successful horse during the following year. For in Ormonde, when I first recom-

¹ "Hippopathology," 1840, vol. ii., p. 53.

² "Veterinary Journal," vol. xiv., p. 93. The same treatment appears to be serviceable in our own species, when similarly affected. Lennox Browne, for instance, gives the case of a lady who consulted him for severe attacks of hoarseness and dyspnoea. A careful examination led to the conclusion that there was congestion and paralysis of the left vocal cord, due to enlarged bronchial glands pressing on the recurrent nerve. Under the influence of doses of iodide of iron, as well as external counter-irritation, the patient greatly improved.—"The Throat and its Diseases." Second Edition, p. 478.

³ "Veterinary Journal," vols. xiv., p. 94; xxiv., p. 353.

mended this remedy, though the noise was somewhat loud, there were indications that the dilator muscle was only weak, and not wasted, and Faradisation was adopted in order to strengthen it, or at least to prevent its degeneration; while the medicine was given with the view of restoring the function of the left recurrent nerve. The current was applied to the nerve on its course in the jugular furrow, the battery employed being specially constructed for this purpose

FIG. 8.—BATTERY CONSTRUCTED FOR THE TREATMENT OF ROARING.

(Fig. 8), and the application being made for some minutes, in a mild degree, several times a day.

This treatment, however, demands patience and constant attention for a considerable time; it is, of course, of no permanent value if the nerve cannot be restored to its normal condition, and is valueless if the dilator muscle has disappeared entirely, or even partially.

(b) Surgical Treatment of Roaring.

The surgical treatment of Roaring was for many years limited to applying the actual cautery to the skin over the larynx, and blistering that part; but this was found so

unsuccessful that it was generally given up, and the relief of horses affected with the defect was considered hopeless, except through the adoption of tracheotomy, and constantly wearing a cannula in the opening made in the windpipe—a palliative remedy introduced by French veterinarians early in this century.¹

But this cannula-wearing is so objectionable in many respects, that it was soon generally discontinued, and is now only resorted to on rare occasions. It does not remove the cause of Roaring, but is merely designed to circumvent it by establishing an artificial breathing-opening below the larynx and nearer the lungs. In connection with this operation, Percivall, in speaking of bands of lymph causing the noise, alludes to another,—a kind of will-o'-the-wisp hunt—which is curious. “It is said—for its truth I cannot vouch—that, once upon a time, a veterinarian, in performing the operation of bronchotomy on a Roarer, had the good luck to cut against one of these bands of lymph, and so, like a prudent man, excised it, and thus fortuitously achieved a cure on the horse which he had anticipated but to relieve. The circumstance was eagerly caught at as opening a new and successful field to experimenters, and the windpipes of Roarers were most mercilessly slit open in search of similar bands. Alas! so many disappointments followed that the novel operation was abandoned.”²

¹ A similar palliative to tracheotomy may be noticed here. To diminish the volume of air passing to the larynx of Roarers during exertion, and so to lessen the noise and distress, it has sometimes been the custom to fasten a narrow strap over the nostrils, so as to prevent these becoming too widely dilated. The strap is fixed to each side of the branch of the bit, and is kept in position by another strap, also attached on each side to the head-stall of the bridle. To the inner surface of the nostril strap, immediately over each false nostril, is sometimes fixed an oval pad. When applied, these pads press upon the triangular spaces formed by the point of the nasal bones and the upper jaw, and in this way they prevent distension of the false nostrils, as well as limit the dimensions of the true nostrils.

² “*Hippopathology*,” vol. ii., p. 52.

So long ago as 1834, Günther, of Hanover, from a careful study of the alterations observed in the larynges of affected horses, ventured to attempt relief to them by operating directly or indirectly on the larynx, but without success.¹ He and his son, K. Günther, again instituted experiments in 1845, upon affected and healthy horses, with the view of testing the feasibility of removing the obstruction in that organ, so as to allow the passage of a larger volume of air through it. Operating through the trachea, at first both vocal cords were removed in horses that roared, but the result was negative. Then the vocal cord of the affected side was extirpated, but the Roaring was not diminished, but rather increased—owing, it is supposed, to the retraction caused by cicatrization, which drew the arytaenoid cartilage deeper into the larynx. Trial was made of passing a seton through the laryngeal sac, but this failed; then the experiment was made of removing the vocal cord and the laryngeal sac, as it was believed that the latter also hindered the admission of air; but here, again, the success was *nil*. The entire arytaenoid cartilage was then excised, but all the horses died, through food and water passing into the trachea and lungs. Better results, in some instances, followed excision of the anterior part of the arytaenoid cartilages (*processus vocalis*) and its vocal cord, great improvement being noted; but in other instances the defect was aggravated, in consequence of cicatricial contractions. When very severely exerted, however, though the horses roared, there were no signs of asphyxia. One horse was rendered much worse, because of caries and distortion of the cartilage. Finally, they endeavoured to bring about a firm adhesion between the inner surface of the thyroid and the outer surface of the arytaenoid cartilage, by excising the laryngeal sac, but leaving the vocal cord intact. Here, again, the result was uncertain; for while in

¹ "Die Topographische Myologie des Pferdes," etc. Hanover, 1886.

some cases adhesion between the cartilages took place sufficiently high to fix the arytaenoid well back out of the way, and consequently to prevent Roaring, in others this union occurred too low or was incomplete, and the horses remained roarers.

On the whole, the results obtained by the Professors Günther were unfavourable; and when Gerlach,¹ of the Berlin Veterinary School, was unsuccessful in effecting any improvement in the condition of Roaring horses by partial removal of the arytaenoid cartilage, operation for the defect appeared to be generally condemned in Germany.

The distinguished Danish veterinarian, Stockfleth,² director of the Copenhagen Veterinary School, who visited Hanover in 1857, concluded that removal of the upper part of the left arytaenoid cartilage would prevent the noise in inspiration, and experimented in this direction. He endeavoured to avoid injuring the left vocal cord (which he said was difficult), as he considered it should be left entire, in order to maintain the remains of the arytaenoid cartilage *in situ*. But he found that, though operation was limited to the upper part of the cartilage, yet considerable swelling ensued, owing to inflammation of the perichondrium; the glottal space was consequently much encroached upon, and therefore the Roaring persisted. But when the healing process took place without perichondritis and tumefaction, the noise was no longer perceptible, and the horse was fit for work. In Stockfleth's hands, however, the operation was almost as uncertain as in those of the Günthers, and deaths from asphyxia were not infrequent, while some of the horses operated on were worse than before. He considered that the operator must be twice favoured by fortune to be successful: he must have removed sufficient of the arytaenoid cartilage, without wounding the vocal cord or thyroid carti-

¹ "Gerichtliche Thierheilkunde," 1862.

² "Handbuch des Thierärztlichen Chirurgie." Translated from Danish by C. Steffen, Leipzig, 1881, p. 263.

lage; and no great amount of connective-tissue tumefaction should occur to fill up the glottis.

Professor Bassi, of the Turin Veterinary School, and a few others, tried Stockfleth's method, and with the same uncertain and, on the whole, unsatisfactory results.

The exceptional importance of the subject induced Professor Möller,¹ of the Berlin Veterinary School, to take it up, and to institute experiments with the same object, and somewhat after the methods of Günther and Stockfleth, in 1887. He tried extirpation of the left vocal cord, but failed to remove the Roaring. Concluding that the noise was caused by the inferior and posterior portions of the arytaenoid cartilage, attempts were made to effect a cure by fixing this cartilage. To accomplish this, three methods were tried: 1. Opening the articulation between the arytaenoid and cricoid cartilages, from the trachea, and separating part of the connection between these; this was unsuccessful. 2. Dividing the *left dilator muscle*, by making an opening on the side of the neck, beneath the parotid gland, and through the constrictor of the pharynx, with the idea that retraction and cicatrization of the divided muscle would fix the arytaenoid cartilage. This operation was also a failure, as might have been expected, when we know that in the great majority of cases there is little or no muscle left to operate upon. 3. Fixing the arytaenoid to the cricoid cartilage, by attaching it to the upper part of the thyroid cartilage by ligature, without opening the trachea or larynx. Here, again, the result was not satisfactory, for the Roaring continued. Möller then decided to extirpate the arytaenoid cartilage, by intra-laryngeal operation;² and in this he appears to have been pretty successful, though he would probably have been more so had he entirely removed it and the vocal cord; but he claims to

¹ "Das Kehlkopf-Pfeifen der Pferde," Stuttgart, 1888.

² I was not aware that Professor Möller was performing this operation until he kindly sent me a copy of his booklet immediately after its publication, in August.

have cured twenty-two of thirty Roarers operated upon. Of the remaining eight, five were relieved somewhat—one of them having paralysis of both sides of the larynx, and, consequently, both arytaenoid cartilages were removed; two died from blood-poisoning (*septicæmia*), or doubtful phlegmonous laryngitis; in another case there was a relapse in ten months; and the eighth, during recovery, had to be destroyed because of a fractured limb.

In the cases in which a noise still remained, this was much less than before, and the breathing was so much relieved that work could be performed. The result was more favourable in cart than in riding horses.

For many years, Roaring in horses had received much of my attention, and the practicability of its prevention and cure by medical treatment has been tested for a long time. So long ago as 1878, the feasibility of successful operation on the larynx for the removal of the obstruction to respiration was suggested by an accident which happened to an aged horse, in which the thyroid cartilage was fractured. In attempting to remedy this injury, the cavity of the larynx was exposed, and I was astonished at the impunity with which its interior could be manipulated. Operations upon the larynx of the horse were previously unknown, I believe, in this country—at least, I can find no record of them, and there seems to have been a dread of opening it; consequently, disease in it could not be observed until after death, and if polypi or tumours were present in it or in its immediate neighbourhood, there they remained, notwithstanding the distress the horse may have experienced. The revelation afforded by the accident alluded to, induced me to attempt the removal of Roaring by the simplest and safest operation possible; but, like those who had preceded me in this business, though not then cognisant of any except the Günthers' attempts, the way had to be felt, as all was novel and strange, so little being known of the physiology of the horse's larynx, or of its

amenability to surgical treatment. The inadvisability of attempting the removal of obstruction by lateral extra-laryngeal operation was evident, for anatomical reasons; also, because

FIG. 9.

Vertical antero-posterior section of the Horse's larynx, showing the interior of the left side, and direction of incisions in the vocal cord and arytenoid cartilage; *i* to *j*, excision of vocal cord and processus vocalis of the arytenoid cartilage; *g* to *k*, excision of inferior portion of arytenoid cartilage; *l* *g* *k*, excision of upper part of arytenoid cartilage.

in this way one could not be certain that the Roaring was really due to immobility of the left arytenoid cartilage; and, lastly, because success was far less likely to be the result.

Removal of the obstruction was sought to be obtained with as little mutilation as possible, and it was resolved to proceed step by step until it was ascertained what, and how much, it was necessary to excise in order to enable the respiration to be carried on noiselessly and with ease.

The left vocal cord (Fig. 9, *g*) was extirpated through an opening made in the middle crico-thyroid ligament, between the wings of the thyroid cartilage. This was not found satisfactory, so far as the noise was concerned, and the excision was then extended to the anterior portion of the arytaenoid cartilage (*processus vocalis*. Fig. 9, *i* to *j*, *black dotted lines*). For about a month, two horses operated on in this manner made no noise, but whether from being put to severe exertion too soon, from exuberant granulations springing up in the laryngeal wound, or from the remaining portion of the arytaenoid cartilage falling deeper into the *aditus*, the Roaring reappeared, though the distress in breathing was removed. A portion of the vocal cord and the greater part of the arytaenoid cartilage (Fig. 9, *k* to *g*, *light dotted line*), were next removed; but with no better results, so far as the Roaring was concerned, the chief trouble being the extraordinary tendency of the remaining cartilage to rapidly throw out luxuriant granulations of great density, and which occupied almost more space in the cavity than did the parts that were removed.

Next the upper portion of the cartilage was excised (Fig. 9, *l g k*), but this also was unsatisfactory.

Then it was decided to excise the whole of the left arytaenoid cartilage; this, in causing close adhesion of the vocal cord, and consequent obliteration of the laryngeal sac, by which the larynx would be completely cleared of the obstruction, must, it was surmised, allow ample space for a full volume of air; while, no fragment of cartilage being left, troublesome granulations were not so likely to interrupt the healing process. The experience gained in the previous operations showed that there could be little danger in this

one, notwithstanding Günther's misfortunes; and that injurious contraction from cicatrization was not likely to follow.

It was found, however, that the small opening through the middle crico-thyroid ligament, though permitting easy access to the interior of the larynx, would not allow extensive intralaryngeal operations to be easily performed; the incision was therefore carried through this ligament, the cricoid cartilage, the crico-tracheal ligament, and, when necessary, one or more rings of the trachea. By this larger opening, removal of the left arytaenoid cartilage could be easily effected, its passive condition during swallowing (caused by passing the finger or a long probe up towards the epiglottis) or active respiration, being previously ascertained through the wound. Not only was this the case, but for a day or two after the operation, when swallowing was imperfectly performed, it was observed that any food or water that passed into the larynx escaped by this dependent opening; while the healing process could be watched and regulated for as long as there was any chance of excessive granulation, or other cause, rendering the cure less certain.

The results were in some cases satisfactory, in others not so; and it was then discovered that, in the latter, the persistence of the noise was due to the left vocal cord, which, owing to cicatrization of the wound not having drawn it close to the thyroid cartilage, projected into the larynx and caught the entering air. This was a practical demonstration of the share this part takes in noise production. Consequently, it was found necessary, in order to ensure a more certain cure, to excise the vocal cord and arytaenoid cartilage. This added very little to the operation wound, as in removing the cord the incision was limited to its fixed border, which is narrow, and the thyroid cartilage, being lined by mucous membrane to the bottom of the ventricle, was in no way endangered.

This perfected operation has had most encouraging

results, and so far as these go, it might be anticipated that a very large percentage of horses affected with Roaring may be rendered serviceable, and perform their work without impediment in respiration.

In a few cases there may remain a slight "coarseness" in the breathing for some time after the operation, and the noise may even be rather marked until the wound has completely cicatrised, and the larynx has had time to accommodate itself to the altered conditions.

A large number of troop and officers' horses have been operated upon, under my direction, by Mr. F. Raymond, of the Army Veterinary Department, and without a fatal case or accident of any kind, notwithstanding that every horse was thrown down and placed fully under the influence of chloroform for the operation; besides having the interior of the larynx frequently examined, and sometimes the wound surface dressed, during the healing process. Of course, this success depended upon the skill with which the horses were treated, both during operation and subsequently; care in the administration of the chloroform; expertness in surgical manipulation, acquired by practice; close attention to the wounds for some days; and the strict observance of sanitary precautions.

Cicatrization has generally taken place favourably and rapidly, and without undue, if any, contraction of the mucous membrane. The walls of the larynx (thyroid and cricoid cartilages) being firm and unyielding, and the mucous membrane being rather closely attached to them at the seat of operation, contraction is not very probable. In some cases, the granulations, being rather exuberant, required checking or removal; but with the acquirement of expertness in excising the arytaenoid cartilage, and the adoption of certain precautions, the wounds gave little trouble, and the healing process was generally rapid.

It may be mentioned that of all the horses prepared for operation, only one was found with both arytaenoid carti-

lages alike movable when the larynx was opened ; showing that the noise made in respiration was not due in this case to laryngeal paralysis ; and also demonstrating the value of operating in the larynx from the front.

A very old horse (sixteen years at least), an extreme case of Roaring, was operated on ; but it was observed that the right cartilage moved very feebly, and that the cavity of the larynx appeared altogether constricted. The operation did not afford much relief, and the animal was consequently destroyed about three months afterwards for examination. The left vocal cord, which had not been excised, projected from the inner surface of the thyroid cartilage, but there was no constriction from retraction of mucous membrane ; the right dilator muscle was pale and much degenerated in its middle portion, and its arytaenoid cartilage and corresponding vocal cord consequently obstructed the lumen of the larynx. This might almost be designated a case of bilateral paralysis.

It may be noted that, notwithstanding removal of the arytaenoid cartilage and the vocal cord, the horse can swallow, cough, neigh, sneeze, and perform expulsive acts as if these were still present, and that the operation does not appear to cause any inconvenience whatever to the animal afterwards. In the course of a few months it is very difficult to discover any traces of the operation in the region of the neck.

CHAPTER X.

THE OPERATION FOR ROARING.

HAVING stated the results of operation for Roaring, so far as they have been ascertained, it now remains to describe (1) the operation itself, and (2) the after-treatment. It is of course understood that the operation is intra-laryngeal, the larynx being opened from the front. This has been found to be the simplest, safest, and most expeditious operation, as well as the most certain in its results, of any yet attempted for removing the obstruction to respiration.

1. *Operation.*

APPARATUS AND INSTRUMENTS NECESSARY.—These consist of:

1. Hobbles for casting the horse.
2. Side-line, or piece of rope.
3. Twitch, which may be necessary to ensure quietude before casting.
4. Chloroforming apparatus. Carlisle's chloroform bag or muzzle (Fig. 10) is the best. This consists of a leather bag fitting closely over the nose, with an aperture at the bottom, into which a tray slides. This tray is of tin, and is furnished with a sponge covered by a perforated metal-plate (4). The chloroform is poured upon the sponge when the horse is cast, and the tray is slipped into the aperture in the bag, which is then fastened on the horse's head. Between the perforated plate and the nose a few small

round iron bars pass across the interior of the bag, to support it and prevent the plate being damaged.

5. Buckets of water and two or three sponges. Some

FIG. 10.

small sponges, each securely fastened to a cane ten or twelve inches long, are very useful.

6. Syringe to contain a pint or quart of water.

7. Strong ordinary forceps and scalpels (Fig. 11).

FIG. 11.

8. Bull-dog forceps.

9. Tracheal tampon-cannula (Fig. 12). This is a modification, by Möller, of Trendelenburg's cannula for tracheal operations in man. It consists of a long tracheotomy tube,

with an indiarubber bag surrounding its middle. This bag is inflated by an india-rubber air-pump after the tube has been inserted in the trachea, and is useful in preventing

FIG. 12.

blood flowing into the bronchi during the horse's getting up after the operation, and for half an hour subsequently.

10. Razor-shaped knife, for excising the arytaenoid cartilage (Fig. 13). This knife, suggested by Möller, has the

FIG. 13.

end of the blade like that of a razor, and is consequently safer than a scalpel. The blade is $3\frac{1}{4}$ inches, and the handle 8 inches long.

FIG. 14.

11. Bent knife, for removing the muscles from the outside of the arytaenoid cartilage (Fig. 14). The length of the blade is 3 inches, and handle 4 inches.

12. Hook, for seizing and raising the lower end of the arytaenoid cartilage (Fig. 15). This is $3\frac{1}{2}$ inches in length, the handle being 7 inches.

FIG. 15.

13. Special forceps, with toothed ends, to seize the body of the arytaenoid cartilage, and a catch at the handles to fix the blades, and eyelets for the fingers (Fig. 16). The length is 8 inches.

FIG. 16.

14. Curved scissors, to cut through the mucous membrane (Fig. 17). The length is $8\frac{1}{2}$ inches.

FIG. 17.

15. Two retractors, to keep the trachea open during operation (Fig. 18). These are perhaps best made of strong wire slightly flattened, double, and opened and bent, so as to

FIG. 18.

form an angular portion about 3 or 4 inches wide. The length of the handle part may be 6 to 8 inches, that of the bent portion about 2 inches.

16. Electric-lamp, to illuminate the interior of the larynx. Mr. Raymond has introduced a most useful lamp for this purpose (Fig. 19). It is bent at an angle within about two inches of the end of the handle, and a shield fits upon this part; the front of the shield, being plated, forms a reflector; while the back is covered with vulcanite, which, lying against the tissues, protects them. The advantages of this lamp are the excellent light it throws upwards into the larynx and pharynx; it may remain in the trachea for a long period without doing any injury, while it hangs into it by its bend, and does not require to be held by the hand.¹

FIG. 19.

A bucket containing a ten per cent. solution of common salt or borax should also be ready.

OPERATION.—The horse should be well fed for a day or two before the operation, but have little or nothing to eat or drink for some hours before being operated upon. In the case of thoroughbred horses, Mr. Raymond thinks it advantageous to administer four ounces of tincture of opium in a pint of water half an hour before operating. The hair must be removed closely from around the upper part of the trachea and larynx before the horse is cast.

¹ All the instruments and apparatus are made by Arnold and Sons, surgical instrument makers, West Smithfield, London.

The animal is thrown down in the usual manner, on a good bed of straw or moss litter. The chloroform bag is put on; the tray having been previously removed from it, the chloroform is now poured over the sponge in it, and it is inserted in its place in the bottom of the bag.¹ The suitable state of narkosis having been induced, and which is promptly arrived at in from one to two or three minutes—being indicated by cessation of struggling, more tranquil breathing, the appearance of the eye, and the loss of sensation—the animal is placed on his back and maintained there by sacks filled with straw, placed close under each side of the body. If there is a beam above, the hobble-rope may be passed over it and held by one or two men; this will maintain the body in the dorsal position. Or, with the same object, a man may be placed on each side with an arm round a fore leg. The neck and head are extended in a line with the body, the head being placed on the vertex, and kept steady by an assistant. The operator places himself in a kneeling position on the off, or right, side of the body, if he be right-handed, beside the neck, with his back to the shoulder and face towards the head.

He is now ready to operate, and for clearness of description the operation may be divided into three stages.

¹ The quantity of chloroform required to produce complete narkosis does not vary much. For the great majority of horses one and a half ounces has sufficed, and a very few required two or two and a half ounces. More than seventy horses have been chloroformed for this operation without a single mishap; and though it is generally maintained that, to ensure safety, the drug should be administered with a free admixture of air, yet into this bag very little air can enter, and the horse must breathe almost pure chloroform. The rapidity with which insensibility is produced without any trouble in administration, the great economy in chloroform, and the brief delay in return to consciousness, are important advantages to be gained by the use of Carlisle's bag, while the after-effects are scarcely perceptible. By the ordinary way of administering chloroform, a large quantity of the drug is required—as much, sometimes, as eight or ten ounces, or even more—the inhalation often occupying half an hour, and recovery from the effects is generally protracted.

First Stage.—With a scalpel, an incision of from four to six inches in length is made through the skin in the middle line of the larynx and trachea, opposite the posterior border of the lower jaw, extending from the body of the thyroid cartilage to the second or third tracheal ring. This exposes the subscapulo-hyoid, sterno-hyoid, and sterno-thyroid muscles, which are incised to the same extent, and as close as possible at their line of junction (*raphé*) in the middle, the section being carried clean through to the larynx and trachea. There is a variable amount of hæmorrhage now to contend with; this, if only oozing, may be checked by sponging dry until blood has ceased to flow; and if from twigs of arteries or veins, these may be seized and twisted, or ligatured.

Second Stage.—The middle cricoid-thyroid ligament, cricoid cartilage, and one, two, or three tracheal rings are cut through in a straight line, exposing the interior of the larynx and trachea. If any blood-vessels are cut, these should be taken up. A retractor (Fig. 18) is applied to each side, and, these being pulled gently apart by an assistant, there is ample space to manipulate in. The convex lower border of the arytenoid on each side can now be seen, and if respiration is deep, that next the operator (the right) will be observed to move actively from the side towards the middle; while if the Roaring is due to paralysis of the left dilator muscle, there is no movement in the opposite cartilage. When the breathing is very tranquil, which is often the case, the right cartilage moves almost imperceptibly, and it is then necessary to ascertain whether the left one is really immovable. This can be done by passing the finger, or a long probe, up towards the epiglottis, when swallowing will be excited, during which act the right arytenoid cartilage is energetically jerked into the middle of the cavity; but the left one does not stir, or only feebly, depending upon the degree of wasting of the constrictor muscles on that side.

Any blood that lodges in the trachea can be removed by large or small (handled) sponges, which may be passed to the operator by an assistant, who receives and washes them. As the horse is now breathing through the wound, the chloroform bag may be removed, being no longer necessary.

FIG. 20.—LEFT-SIDE SECTION OF LARYNX, SHOWING THE PARTS EXCISED IN THE OPERATION FOR ROARING.

It is always advisable to examine the interior of the larynx carefully, in order to ascertain its exact condition, as there may be something more than an immovable cartilage. For this purpose Raymond's lamp is invaluable.'

The left arytenoid cartilage may be excised by commencing at the lower convex border (Fig. 20, 2), or at the

upper part, where it meets the right cartilage (Fig. 20, 1). If the last method is resolved on, then with the razor-shaped knife (Fig. 13) a cut is made through the mucous membrane, inter-arytænoid ligament, and arytænoid muscle, as close to the margin of the cartilage as possible, beginning between the cartilages of Santorini, downwards and then upwards to the vocal process, at the insertion of the vocal cord (Fig. 20, 2). The hook (Fig. 15) is inserted into the vocal process, which is raised, and the vocal cord is separated from the cartilage by scissors; then, with the bent knife (Fig. 14), the muscles on the outside of the cartilage are cut, or better, pushed from its surface as close as possible. The hook is removed, and the body of the cartilage seized by the ratchet forceps (Fig. 16). With the curved scissors (Fig. 17) the mucous membrane connecting the cartilage to the vocal pouch is divided, cutting as close to the cartilage as possible, so as to save the membrane. The arytænoid cartilage is now free, except at its articulation with the cricoid, and by means of the scalpel it may either be disarticulated or cut through at this point, care being taken to leave no loose portions or shreds. The cartilage being now only retained by the soft parts at the upper portion (base of the arytænoid cartilage), with scissors these are cut through close to it, when it is altogether detached.

Care must be taken not to wound the other cartilages or the pharyngeal mucous membrane, and to spare that membrane in proximity to the arytænoid cartilage as much as may be, removing only that which covers its surface and the cartilage of Santorini.

The vocal cord is now removed close to its attachment to the thyroid cartilage in front, and at its fixed border (Fig. 20, 4). This can be done with scissors, a finger being passed to the bottom of the ventricle to facilitate the excision; or the cord may be drawn from the side by a hook inserted into it, so as to allow the scissors free play.

If the hæmorrhage is troublesome, which it seldom is,

the blood can be mopped out of the trachea by the sponges; it cannot pass down that tube, owing to the position of the neck. If necessary, the electric-lamp may be employed to ascertain how the operation has been performed, or even during the operation; but after a little experience this is not needed.

Third Stage.—The trachea is completely freed from blood, and the tampon cannula introduced, the bag being inflated after it has been properly passed into the trachea, by means of the indiarubber pump; the cannula is then secured in position by a tape round the neck. It is only required for about half an hour, until the hæmorrhage has ceased, as it will prevent blood passing into the lungs while the horse is getting up, and for a short time afterwards, respiration being carried on through the tube. It ought not to be left in any longer, as it is liable to injure the interior of the trachea. The blood is again cleared out of the larynx, and one or two syringefuls of the common salt or borax solution are injected into it and the pharynx. This washes out these cavities and the sinuses of the head—a necessary precaution, as putrefying blood in them sometimes gives rise to troublesome consequences. Swallowing should be induced by touching the epiglottis, and then the horse may be turned on his side, the lower margin of the wound being depressed to allow the remaining blood and water to flow out. This completes the operation.¹

The horse is now allowed to recover from the chloroform, and when ready he may be assisted to get up, care being

¹ Though it has required some time to describe it, yet the operation may be rapidly performed by an expert operator. I was present on one occasion when Mr. Raymond went through the whole course of operation in five minutes; this embracing throwing the horse down, giving the chloroform, opening the larynx and trachea, excising the cartilage, and inserting and securing the cannula. The usual time he occupies is ten to fifteen minutes.

taken that the cannula is not displaced while doing so. The wound is kept open by the finger for a short time, to allow any blood to escape; afterwards the blood is cleaned away from and around the wound, the face and nostrils sponged to refresh the animal, and the body clothed and legs bandaged, if the weather is cold.

2. After-treatment.

When able to walk after the operation, the horse is led quietly into a loose box which has no litter on the floor, and the head-collar is removed. It is very necessary, in order to ensure healthiness of the wound, that the box and its surroundings be kept scrupulously clean, the drainage being good and the air sweet. The wound is to be left open and undisturbed. Serosity and mucus will escape from it for a short time after the bleeding has ceased, succeeded by slight purulent discharge as the healing process goes on. The external wound is to be kept free from discharge, and if flies are troublesome it may be dressed with a weak solution of carbolic acid, or covered with a piece of thin muslin, tied by tape around the neck.

The advantages of removing the cannula soon after the operation lie chiefly in the injury it is likely to inflict in the trachea if left there for a considerable period; respiration is not so easy with as without it; while its accidental displacement or obstruction might be serious.

Leaving the entire length of the external wound open is also essential to success. Not only does this permit the horse to breathe entirely through the aperture, and so obviates air passing over the intra-laryngeal wound, but it also allows the movements of the larynx to be greatly diminished, and this still further promotes rapid and favourable healing; while it renders inspection easy, and any needful dressing of the interior can be effected. Another advantage is, that the external wound, being immediately below the

pharynx and larynx, any food or water which might chance to pass into the latter a few days after the operation falls directly through the opening, instead of finding its way into the lungs.

For a few days, the horse does not seek to eat or drink much. Indeed, it is better not to give food or water for two or three days, as swallowing is not easy, and is, besides, not favourable to the earlier stage of the healing process. A small quantity of water may be allowed at first, being offered in a bucket placed on the floor. Some of this may escape through the external wound, but none passes down the trachea. When water can be swallowed, sloppy mash of bran and oatmeal may be given—still in a bucket on the floor; and in a day or two after, good soft hay.

It is advisable not to have any litter in the box, for sanitary reasons, and also because the horse may eat it, if it be straw; while it may get into the wound and cause trouble. In the course of a fortnight or three weeks, the horse may be fed in the usual way on the ordinary diet.

The dangers to be apprehended are traumatic pneumonia, pyæmia, œdema of the larynx, and excessive granulation and tumour formation at the seat of operation.

With regard to œdema, a certain amount of inflammatory infiltration must take place after such an operation; but it ought not to cause inconvenience, and should in no way embarrass the respiration, as it is present for only a short time, and the laryngo-tracheal wound permits the free admission of a sufficiency of air.

The intra-laryngeal wound need not be examined closely until about the eighth day; though the external wound should be cleaned frequently—twice or thrice a day—with a soft sponge, and dressed with a mild antiseptic lotion. A good *criterium* as to the condition of the internal wound is afforded by that of the external one. If in the latter the granulations are small and firm, then in the former they will generally be found the same; but if they are soft

and spongy externally, and form rapidly, then it may be surmised they are in this condition in the larynx.

In order to examine the interior of the larynx—which may be done in about a week after the operation—it is safest and most satisfactory to put the horse in the dorsicumbent position, as for the operation, though anæsthesia is not necessary.

The electric lamp will prove useful in illuminating every part, and the retractors are needed to give sufficient space for scrutiny. A solid retractor (Fig. 21) does not injure the external wound so much as the open one.

FIG. 21.

Granulations, if too luxuriant, may be cleaned from mucus or pus by the small sponges with handles, and swabbed with a solution of chloride of zinc (1 to 10), sulphate of zinc (1 to 60, or 2 grains to the ounce of water), or corrosive sublimate solution (1 to 1,000); or touched with solid nitrate of silver, securely held in a caustic-holder with a long handle. In some cases there is no need for this interference with the healing process, which goes on favourably from beginning to end. In other cases this dressing may be necessary more than once, and may be repeated in the way indicated above; while in some instances tumours will appear, seemingly in spite of all precautions: though it must be admitted that, if the operation is not well performed, and small pieces of cartilage, or shreds of mucous or muscular tissue are left, they are likely to spring from these. If they are discovered on examination of the intra-laryngeal wound in a week after the operation, they should be removed by means of scissors or the

galvano-cautery, and the parts dressed with a mild caustic or astringent solution. They rarely appear after the first or second week.

When the internal wound is healing favourably, the external one should be allowed to close; this is effected usually in three weeks. In about a month little trace is left of the wound, and in two or three months it has to be closely looked for. A head-collar may be worn when the external wound is nearly well, and then litter can be allowed.

The general health of the horse is rarely disturbed after recovery from the immediate effects of the operation. The temperature sometimes rises to 102° (Fahr.), but it has never been noted beyond that point.

No instance of pneumonia, pyæmia, or other serious condition has been met with; and if proper precautions are adopted, there seems to be no reason why mishaps should occur. If all has gone well, in a month or six weeks after the operation walking exercise may be permitted, and in another month trotting for a mile or two should be prescribed; but severe exertion ought not to be imposed for some time longer. Not only should cicatrization be allowed to become completed and consolidated in the larynx, but that organ must be gradually allowed to accommodate itself to the altered conditions in which it has to perform its functions. In trotting, at first a noise may be heard, but in time this diminishes, and usually disappears.

If any harshness should remain in the respiration, there is, notwithstanding, no distress exhibited, no matter how severe the exertion may be.

When exercise is first begun, the horse sometimes coughs, especially if the weather is cold; but as the interior of the larynx becomes less sensitive by complete healing of the wound in it, this slight irritability disappears.

So far, the weather does not appear to exercise much influence on the immediate results of the operation, which

has been performed in summer as well as in winter. The great majority of the horses hitherto operated on have been troopers—Cavalry, Artillery, and Transport; all were so seriously affected as to be considered unfit for further military service. Their ages varied from four to fourteen years, and they were of all temperaments. With the exception that the operation was more difficult in thick-necked, coarse-bred horses, and the wounds were more inclined to granulate too luxuriantly in them, there was little difference noted in the whole of the cases.

THE END.

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