OUR DOMESTIC ANIMALS.

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IN

HEALTH AND DISEASE

BY

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PREFACE.

The British stockowner has, in the improvement of the breeds and management of the Domestic Animals, brought to bear on his favourite pursuits the highest talent and the most indomitable perseverance. Our agriculture is more distinguished for its short-horns than its wheat, its horses than its hay, and the hunting farmer, the prize-taking breeder, the enlightened grazier and feeder, are as characteristic of Britain as our House of Commons and a free press.

The success of the stockowner, however, has been more due to his own industry and practical intelligence than to any advice or assistance he may have obtained from the current works on veterinary subjects, which, as a rule, do not embody the most recent information, and are far below the requisitions of the age.

As it is believed that scientific truths admit of being set forth in plain English, and as both the agriculturists and the veterinarians of this country have learnt, and are learning daily, the duties of scientific men in discovering, comparing, and balancing facts, and deducing general principles, it is the object of the author of this Treatise, to embody, in one work, the knowledge possessed, at the present day, on questions relating to the preservation and restoration of the health of our domestic animals.

The laws of health require to be known before ill-health or disease can be understood, and agriculturists require to know more of disease with a view to prevention, than with a view to active medical treatment. It is this circumstance which will induce the author to treat fully of the causes of disease—their method of action—the phenomena they induce—and the methods of checking the latter. In this Treatise the functions of animals are considered in their healthy condition, with the circumstances capable of disturbing them, and a general history of such disturbances. Thus what has to be said of disease illustrates and demonstrates all that has to be said regarding health.

With this programme clearly before him, the author has aimed at limiting his subject in the manner he deems most desirable for the class of readers for whom this Treatise is intended, viz., the well-educated stockowner no less than the veterinary surgeon.

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OUR DOMESTIC ANIMALS

IN HEALTH AND DISEASE.

CHAPTER I.

DIGESTION AND FOOD.

Introduction.—Selection of food.—Prehension of food.—Lips of horse.—The tongue of horse and ox.—Incisor teeth.—Parrot mouth.—Lampas.—Position in the collection of food.—Lips of ox.—Pad in mouth of ox.—Snout of pig.—Pigs the town scavengers at Naples.—Prehension in carnivorous animals.—A troublesome bone.—Prehension of liquids.—Suction.—Pumping.—Aspiration.—Lapping.—Diseases of organs of prehension.—'Big Head.'—Aphtha.—Inflammation of tongue.—Induration.—Suppuration.—Ulcers of tongue.—Paralysis of lips and tongue.—Abuse of bits.—Nature of food: its proximate principles.—Inorganic principles.—Hydrocarbons.—Albuminoid constituents.—Mastication.—The jaws.—The teeth.—Enamel.—Dentine.—Cement.—Their relative hardness.—Teeth of Herbivora, age determined by.—Dentition in ox; in sheep; in horse.—Dentition in dog; in pig.—Deceptions practised.—'Bishoping.'—'Cardinals.'—'Gypping.'—'Puffing the Glym.'

AMONGST the most important questions in Social Economy, are those which refer to the means of support most favourable for the health and full development of the animals subservient to man's will and wants. The management of stock resolves itself, in a great measure, into the simple problem of 'how to feed.' The satisfactory solution of such a problem can only be arrived at with a perfect knowledge of the aptitudes of animals, their disposition to thrive and grow, with a complete understanding of the nature of food, the infinite ways in which it may be favourably combined, and, lastly, with a sound knowledge of the animal functions whereby food is transformed into the flesh, blood, and bone of the horse, the bullock, or the pig.

To know that oats and turnips are very nutritious, is not sufficient to guide their use, and to indicate under what circumstances and in what form they are most advantageously employed. Moreover, the fact that both materials may be food for horse or ox is insufficient.* Experience supplies a host of facts, which, with the light of science, admit of being grouped and explained so as to establish general principles, and these may prevent future generations from blundering and throwing away time and money in superfluous experiments. Many tables of the nutritive value of feeding materials have been drawn up. Analyses are being constantly made, and will be resorted to so long as stock has to be fed, but we must progress in generalization with the progress made in the accumulation of scattered facts. Views may have to be

* A suggestive instance of the many circumstances to be considered in speaking of the nutritive value of substances is afforded by Mangel Wurzel. Mr Pringle, in his excellent *Treatise on Meat Manufacture*, says: "Dr Voelcker states that he has found mangels 'to be about the worst description of roots that can be given to sheep.' In an experimental trial of different feeding materials, he found that whilst 'sheep fed on swedes and hay increased on an average 2½lbs. per week,' those fed on mangels and hay 'at the end of four months had not increased a single pound.' From this he infers that there exists some peculiarity in the constitution of sheep which prevents them from deriving benefit from mangels, whilst cattle thrive rapidly upon them. This is another point which requires co-operative investigation on the part of scientific and practical men, as we have met with cases which seemed to corroborate Dr Voelcker's views, whilst the results in others were diametrically opposite."

modified. They will be tested by experience, and new generalizations will correct and replace the old. A more accura e and unprejudiced judgment will be formed as the field of observation extends, and as man's reason is aided by valuable beacons and resting-places, he will be spared much useless labour in unravelling hosts of morsels of information, which, with the increase in the number of authors and books will be perfectly unfathomable, especially to the practical man.

We consider that on the vitally important subject,– the feeding of stock,—much light has to be thrown from the physiological aspect. We must know how animals digest, what they digest, and what proves injurious and even de dly. With a knowledge of the nature of food, the nature of animals, and the nature of digestion, valuable rules for practice can certainly be deduced.

SELECTION OF FOOD.—The choice of food is controlled b the animal's habits and appetite. Herbivorous quadrupeds graze and devour with relish the grasses, bulbs, and grain suited to their systems, whilst the carnivora seize on the flesh of herbivorous animals, and manifest a special aversion for the carcases of creatures allied to them in their habits. The omnivorous pig devours all. He is not a dirty feeder, as some people suppose, but a universal gourmand, drinking milk, or greedily swallowing oatmeal or muscle, cabbage, and any kitchen refuse. Like man, any omnivorous animal may be restricted to a vegetable diet, or live almost exclusively on flesh; but the pig is certainly more fit for the purposes of human consumption when rendered somewhat strictly vegetarian.

An artificial mode of existence forces on animals predilections which, in a state of nature, are not observed. They are essentially moderate in their desires; but take a horse into stable life, and he will learn how to eat that which he would when at liberty refuse. He also becomes a glutton, and fills himself to repletion, devouring far more than when free in the field, and besides hay and oats in abundance, picking up his litter, and being always ready to neigh when the corn bin is approached.

The exercise connected with the natural collection and selection of food is of great importance to health in herbivora. They cannot fast long, like the lion or dog; they cannot rest in a state of torpor and listlessness to relieve an over-distended alimentary canal. They sometimes eat and kill themselves by over-feeding, when man heaps before them enormous quantities of food, but that is under circumstances when they cannot rove, and pick and browse, walk and chew, watch and swallow, lie and ruminate, travel for water, and live as nature destined them.

However trivial such considerations may appear at first sight, they clearly point to the rule to be established, that if treated artificially, animals must be managed according to their habits, unless we wish to disturb and to destroy them.

A natural craving is manifested in man and animals for that which suits their organism as feeding material. The rock salt which the horse speedily licks up, occasionally with a morbid appetite, is a necessary constituent of his body. The preference for hay over straw, though in part due to its more agreeable taste, is undoubtedly owing to its being more suitable as diet, and any injurious agents, such as musty hay, or many of the poisonous plants, are judiciously avoided. All animals manifest the same dispositions, and it is needless that I should multiply examples.

The collection of food varies materially in our different domestic animals. One bolts flesh and coarsely grinds bones, to be deposited in a capacious stomach; another speedily takes in a large quantity, and lodges it for awhile in a crop, or in a paunch. The fowl crushes beyond the crop; the ox at leisure returns the food to the mouth, to be re-masticated. The horse collects and at once thoroughly grinds, dissolves, and appropriates food to the system in regular and rapid succession, without the superadded functions of the timid animal, who would seriously suffer from dyspepsia by

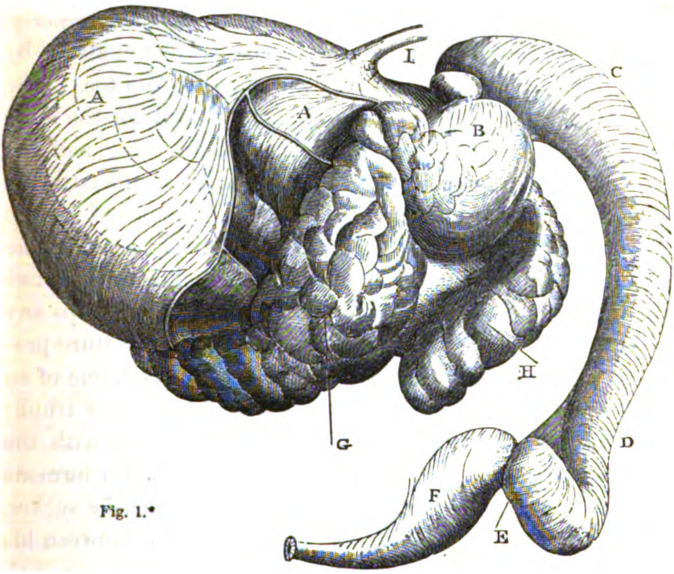

Fig. 1.*

* Fig 1.—A. Rumen.—B. Reticulum.—C. Omasum or Manyplies continuous without demarcation with the Abomasum D.—I. Œsophagus.—G. First Group of Water-cells.—H. Second Group.—E. Pylorus.—F. Duodenum.—(COLIN).

'bolting' its food. Habit, therefore, materially influences the collection of food, its retention and appropriation to the wants of the animal. The system of reservoirs for alimentary matters observed in all ruminants is beautifully exemplified in the animals of the desert for the supply of water. The water-cells shown at Fig. 1 are unabsorbing membranous sacs, which prove eminently fit for the reception and gradual rendering to the system of the water which is so scanty in the arid sandy plains of Africa.

PREHENSION OF FOOD.—According to the mode of life for which an animal has been formed, we observe a variety in the arrangement of parts destined to gather food. Man grasps with a prehensile hand, and so distinctive is this property, that the nearest allied animal—the ape—is distinguished by the imperfect thumb as well as the opposing big toe. The latter indicates that the monkey is not destined for the same erect posture which characterises the human being, and the first points to a special office to be performed in the latter by the grasping palm and fingers, under the guidance of *reason*. The primary office which the hand instinctively serves in the infant, is to carry food to the mouth. It is this which causes the baby to clutch the breast, and to approach to its lips any object which may be placed in its little hand. Nature provides active prehensile organs should the bulky frame of an animal prevent the ready movements of the head or trunk; thus the elephant, having to pick from the ground, with the disadvantage of a huge body, a short neck, and enormous head, acquires a moveable proboscis with a prehensile sucker. How dexterously he grasps a loaf, and throws it between his enormous molars. He cannot pump water into his mouth like the horse, or lap it in like the lion or dog, but he sucks it into his trunk, and then blows it into his throat, or over his body to cool the skin scorched by an Asiatic or South African sun. The giraffe has to feed on the tall trees of the tropics, and the tall fore extremities, long neck, small and easily lifted head, with a long prehensile tongue, enable him to live on that which is beyond the reach of most other non-volatile creatures.

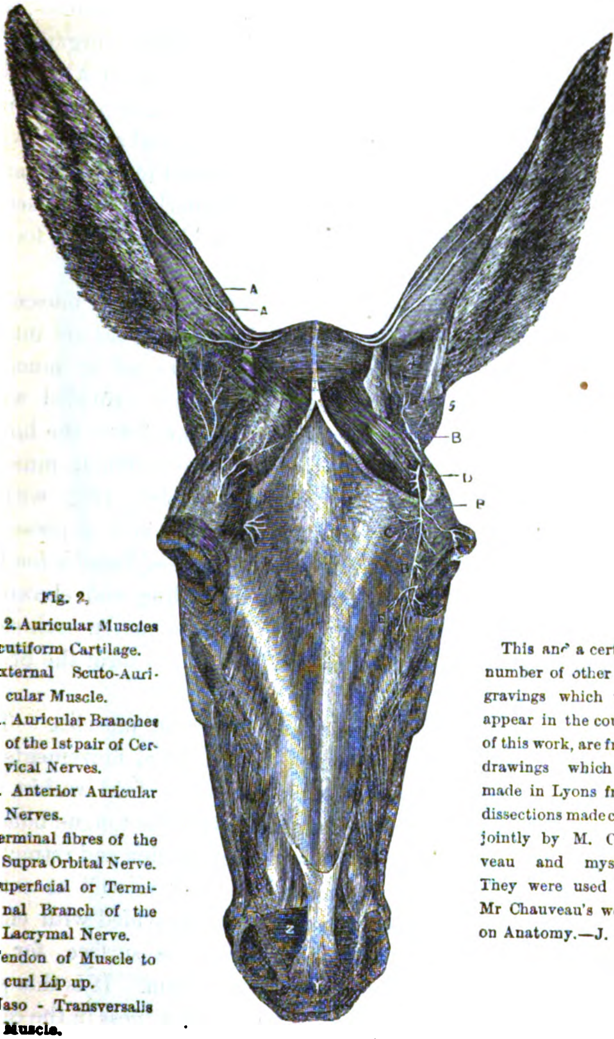

Fig. 2.

1. 1. 2. Auricular Muscles
3. Scutiform Cartilage.
4. External Scuto-Auricular Muscle.
A. A. Auricular Branches of the 1st pair of Cervical Nerves.
B. B. Anterior Auricular Nerves.
C. Terminal fibres of the Supra Orbital Nerve.
D Superficial or Terminal Branch of the Lacrymal Nerve.
Y. Tendon of Muscle to curl Lip up.
Z. Naso - Transversalis Muscle.

This and a certain number of other engravings which will appear in the course of this work, are from drawings which I made in Lyons from dissections made conjointly by M. Chaveau and myself. They were used for Mr Chauveau's work on Anatomy.—J. G

Restricting our observations to the domestic animals, we find the prehension of food is effected by different organs.

In the dog and cat, the fore-limbs indicate to a certain extent the power which is given to man to grasp food and carry it to the mouth. The stout and solid limbs of herbivorous quadrupeds are, however, alone destined for support and progression, and a long neck, and peculiarly shaped head, favour the prehensile organs, whether they be lips, jaws, teeth, or tongue.

The organs of prehension are chiefly composed of muscular tissue, amongst which, fat and glandular structure are interspersed, and the whole covered by integument or mucous membrane. Both tongue and lips are thus provided with active moving power; and, we notice, in the lips of the horse in particular, a well-developed orbicular, or circular muscle, composed of fibres, which form a complete ring within them; and, in addition, we have elevators and depressors. The muscle, shown in the preceding Fig. 2—(*Nasalis longus labii superioris*), is most efficient in curling and elevating the upper lip so as to grasp food. There is one on each side, and the two join at the point of the nose, to form the broad tendinous insertion Y.

The tongue has intrinsic and extrinsic muscles. The intrinsic are especially destined for the local movements of the tongue, favourable to the movements of food within the mouth. The extrinsic are connected with the tongue bone—os-hyoides—and chin, and favour the protrusion and retraction of the tongue, in the prehension of liquids as well as solids. The membrane covering the tongue is provided with eminences, or papillæ, destined to increase its surface, for the production of the protecting scaly epithelium. It is this protecting covering which acquires a horny hardness in the cat or lion, whereby the action of the tongue may be compared to that of a file. The arrangement of these eminences is characteristic in different animals. There are four kinds: those that are thread-like, or *filiform;* those that are shaped like a mush-

Fig. 3.

Fig. 4.

room, or *fungiform;* some that are *conical,* and others that are fungiform, but situated in recesses, and termed *papillæ circumvallatæ.* (See Figs. 3 and 4.) It is by the latter papillæ that we can at once determine if a tongue, separated from the body, belongs to horse or ox. There are other distinguishing marks, and it may be of some service, not only to enumerate them, but to show their contrast, as in the subjoined engravings: inasmuch, as it is supposed that horses' tongues find their way into victuallers' shops, whereas they should not be used as human food, though, in the vast majority of instances, no injury would accrue therefrom. The tongue of the horse (see Fig. 3) is long, with a well-marked middle depression, or line, called the raphe, and a broad flattened free end. On either side of the middle line, towards the root of the tongue, is a very large compound circumvallate eminence or papilla. In the ox, the tongue is pointed, deep, and with two diverging rows of papillæ on the base of the tongue, as seen in Fig. 4. Each row numbers from eleven to thirteen papillæ.

The selection of food is facilitated by the method of gathering it observed amongst the vegetable feeders. The horse has a sensitive upper lip, susceptible of active movement and a collecting power. The nose serves to indicate that which the lips should leave, and in some cases, the sense of touch possessed by the latter, affords the animal an indication of that which should be left and that which should be taken. The lips in the horse carry the food between the incisor teeth, so that it may be firmly held, whilst, by an active jerk of the head, grass is cut, hay pulled from the rack, or branches severed.

If the incisor teeth are malformed, so as to prevent the proper cutting of grass, a horse may be starved even on a luxuriant pasture. The malformation most commonly inducing this impediment has been termed 'parrot mouth,' in which the upper incisor teeth grow over the lower ones, from the shortness of the lower jaw. The annexed cut will sufficiently explain this peculiar deformity.

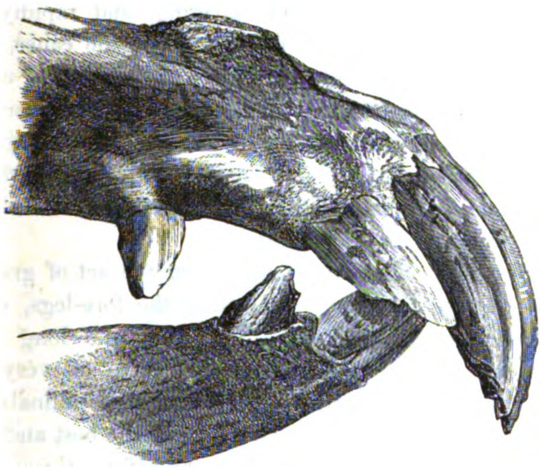

Fig. 5.

Amongst the mechanical impediments to the action of the incisor teeth, we must notice the swelling of the gums and palate, incidental to dentition, and which horsemen have from time immemorial called the 'Lampas.' Whence this absurd name was derived I cannot venture to determine: but I can say it has done much mischief, by being regarded as a specific name for a specific disease supposed to require active treatment by the hot iron. It is no disease, but simply determination of blood to parts the seat of active changes during the development of the teeth. Sometimes a few cautious pricks with a lancet, or a mild astringent solution, consisting of a tea-spoonful of alum to a tumbler of water, may reduce the swelling, and cause the animal to feed better.

It is worthy of notice how slight interference with the action of the horse's incisors may lead to apparently serious results. In one instance, a horse refused food, manifested much irritation by a constant slavering, and rapidly lost flesh. Several examinations failed to elicit the cause, until a veterinary surgeon discovered a piece of wood lying across the palate, and wedged firmly in between the upper incisors. On the removal of the offending object, the animal regained its appetite and health. From such a simple accident, this horse would have lost his life, if left unrelieved, as certainly as in the worst forms of choking.

Position is an important element in the act of grazing, and we observe the horse expanding the fore-legs, sometimes bending them, and the lips carry the long grass between the incisors. A horse cannot live on very bare pasture. He cannot thrive with close-biting animals like sheep; and, as the latter deprive a field of the best and most succulent young plants as rapidly as these force through the soil, the horse fails with his apparatus destined to gather much at every movement of his head and body.

By disease a horse may be prevented grazing in the position referred to, as by holding the head closely to the ground, congestion of the brain is favoured; and, if one, or both, jugulars (the neck veins) are obstructed, as the result of previous inflammation, or from other causes, we observe that the head swells, the animal staggers, reels to and fro, and falls. Like the horse with a parrot mouth, such an animal requires to be fed from the rack and manger.

The upper lip of the ox is short, and endowed with only slight power of motion; it is blended with the solid muzzle, which is covered by a thick secreting membrane. The tongue of the ox has, therefore, to perform the office of the horse's upper lip, and is accordingly endowed with great power, protruding far out of the mouth, curling over any object the animal may seize, and drawing it into the mouth. It is rough, with conical and sharply-pointed papillæ turning backwards, so as effectually to catch and pull grass, or other material the animal may be eating. The cutting of grass is effected by the sharp cutting incisors applied against the elastic pad which occupies the position of upper incisors. This pad, with the peculiar ridges of the hard palate, is represented at Fig. 6.

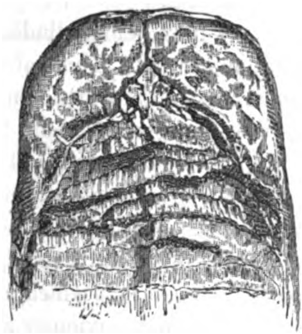

Fig. 6

In the sheep and goat the upper lip approaches the power and freedom of the prehensile organ of the horse, and aids the incisors and tongue in gathering food.

The pig, destined by nature to uproot plants, and grope for food amongst the dropped acorns and other fruit of the forest, is provided with a strong and moveable snout, having a bony and cartilaginous basis, and powerful muscles to act upon it; and, as Youatt says, "In point of fact, the snout of the hog is his spade, with which, in his natural state, he digs and grubs in the ground for roots, earth-nuts, and worms, &c." The lower lip of the pig is short and pointed. When the animal applies its snout to the ground to gather food, the latter is thrown back, and the lip is favourably placed for its reception, or to lift it in between the organs of mastication. It is to prevent the pig burrowing and destroying vegetation that a ring is occasionally placed in his nose, and with this appendage the animal would starve if left to himself in the native haunts of the wild boar or the peccaries.

The pig in his natural state is deservedly recognised as a wise animal. No creature can be easier kept, and prove more profitable, than a sow. I have before alluded to the fact that swine are omnivorous, and eat all. This habit has been taken advantage of in some parts of the world; and in Naples pigs are, or at all events were, to a great extent, the scavengers of the town. When night is far advanced, and the streets quiet, the strolling stranger may be suddenly alarmed by a grunting animal moving rapidly by. Several are met in succession, and they run about the town until daylight, when each, having picked from the streets that which, at a rapid trot, it could gather, returns home and anxiously awaits night-time again. That pigs are to be reared to hunt for their food, and find their way from home at stated periods, is illustrated by an anecdote by Sir F. Head, who, in his *Bubbles from the Brunnen*, says:—

"Every morning, at half-past five o'clock, I hear, as I am dressing, the sudden blast of an immense long wooden horn, from which always proceed the same four notes. I have got quite accustomed to this wild *réveillé;* and the vibration has scarcely subsided, and is still ringing among the distant hills, when, leisurely proceeding from almost every door in the street, behold a pig! Some, from their jaded, careworn, dragged appearance, are evidently leaving behind a numerous litter; others are great, tall, monastic, melancholy wretches, which seem to have no other object left in this wretched world than to become bacon; while others are thin, tiny, light-hearted, brisk, petulant piglings, with the world and all its loves and sorrows before them. Of their own accord, these creatures proceed down the street, to join the herdsman, who occasionally continues to repeat the sorrowful blast from his horn.

"Gregarious, or naturally fond of society, with one curl in their tails, and with their noses almost touching the ground, the pigs trot on, grunting to themselves and to their comrades, halting only whenever they come to anything they can manage to swallow.

"I have observed that the old ones pass all the carcases which, trailing to the ground, are hanging before the butchers' shops, as if they were on a sort of *parole d'honneur* not to touch them; the middle-aged ones wistfully eye this meat, yet jog on also; while the piglings, who (so like mankind) have more appetite than judgment, can rarely resist taking a nibble; yet no sooner does the dead calf begin to move, than, from the window immediately above, out pops the head of a butcher, who, drinking his coffee, whip in hand, inflicts a prompt punishment sounding quite equal to the offence."

And that the pig is clever in gathering his food, is proved from what Sir Francis Head says further on, when he remarks on the pigs being lashed on beyond the tempting morsels they find in the streets. He says:—

"No wonder, poor reflecting creatures! that they had come unwillingly to such a spot; for there appeared to be literally nothing to eat but hot stones and dust; however, making the best of the bargain, they all very vigorously set themselves to work. Looking up the hill, they dexterously began to lift up with their snouts the largest of the loose stones, continually grubbing their noses into the cool ground. Their tough wet snouts seemed to be sensible of the quality of everything they touched; and thus, out of the apparently barren ground, they managed to get fibres of roots, to say nothing of worms, beetles, and other travelling insects they met with. As they slowly advanced working up the hill, with their ears most philosophically shading their eyes from the hot sun, I could not help feeling how little we appreciate the delicacy of several of their senses, and the extreme acuteness of their instinct.

"There exists, perhaps, in creation no animal which has less justice and more injustice done to him by man than the pig. We see him gifted with every faculty of supplying himself, and of providing even against the approaching storm, which no creature is better capable of foretelling, and we begin our treatment of him by putting an iron ring through the cartilage of his nose. Having thus barbarously deprived him of the power of searching for and analyzing his food, we then generally condemn him for the rest of his life to solitary confinement in a sty."

Carnivorous animals, such as the dog and cat, grasp food with their powerful jaws, and often lacerate and fix it with their fore extremities. In prehension they are essentially biting animals, and, accordingly, their cheeks are loose and ample, the mouth opens widely, and their teeth are pointed, and curve back, to hook up any object fixed between the jaws by the masseter muscles. Persons are not always aware that, in the act of biting, an animal uses its lower jaw, which articulates with the fixed bones of the head. If a dog's lower jaw is held, he cannot bite; and when Maccomo recently was seized by a tiger, he judiciously held on to the lower jaw, diminishing the power of the animal to bite. until he could be liberated.

I have, in the foregoing pages, recorded a singular case of a horse suffering from a bit of wood being wedged between its upper incisors. Occasionally a dog is prevented from moving its jaws, indicates great agony and symptoms allied to those of choking, if any object gets fixed on his molar teeth. I can relate a quaint story regarding a dog thus tormented. I was solicited to look at a lady's pet, which, it was supposed, from the inattention of the servants, had been left on a terrace at the top of a four or five storied house, and, dissatisfied with solitary confinement, the dog jumped over into a court below, fracturing its lower jaw. This history was related to me as matter of fact, and I gazed at the pug-nosed "King Charles," wondering that it had survived the fall. His eyes were prominent and bloodshot, saliva was flowing from the partially opened mouth, and, on looking at the latter, the apparently bleeding end of the jaw bone could be seen. On feeling it, however, and exploring with my finger, I ascertained that the fracture was a myth. I uplifted the bloody bone and displaced it from between the molars, much to the astonishment of the ladies and the gratification of Charley, who, instead of practising flying from the house top, had picked up a troublesome

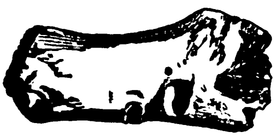

Fig. 7.

morsel in the kitchen. I here furnish a drawing of the bone, which I have preserved to this day. Such is an example of the histories of cases veterinarians, as well as physicians, get even from trustworthy persons. A supposed cause is assumed, and then retailed as certain.

PREHENSION OF LIQUIDS.—Colin has classified under four heads the various methods adopted by animals in drinking. He considers there are four,—1st, Suction, such as the act of drawing milk by the young animal. 2nd, Pumping, by immersion of the lips and action by the tongue within the mouth, on the principle of the common pump. 3rd, Aspiration, or the act of inhaling; the vacuum for the introduction of the liquid being produced by a respiratory act, as well as by the mouth. 4th, Lapping.

In the act of suction the teat is grasped by the lips, and even by the teeth, so that the mouth is closed upon it; the tongue is then pressed against the teat and withdrawn, producing a vacuum by the action of the tongue and cheeks exclusively, without any respiratory effort. The liquid is swallowed, and suction again practised. This wise provision preserves the infant, or the sucking animal, from the milk passing into the windpipe, which it might do if inhalation served to draw the fluid into the mouth.

The act of pumping is that resorted to by the horse. He drops the lips beneath the surface of the water, and sometimes immerses even the nose. A small space between the lips, opened by the rushing in of the liquid owing to the action of the tongue, represents the small aperture through which water is drawn in the act of pumping, and the tongue acts as a piston precisely as in the process of sucking. Poncet performed an experiment to prove that the act of drinking in the horse is not by inhalation, as some persons supposed. He opened the windpipe and introduced a tube into it, as in the performance of tracheotomy, and the animal drank as before, though no inhalatory force could be then brought to bear on the liquid through the mouth. The anatomical relation between the mouth and throat in the horse is, however, sufficient to prove that the horse cannot breathe through his mouth in drinking, or in any other natural action of the organs situated in the latter. The soft palate forms a complete partition between the mouth and throat, and can only be elevated, or allow the passage of food or water backwards by compression, such as that which occurs in swallowing. If there be any impediment to respiration, we sometimes hear a loud roaring noise, produced by the air rushing through the soft palate, and the animal suffers considerably from such an unnatural act; thus affording proof that, in drinking, the pumping force is effected within the mouth, and the soft palate is only disturbed in the act of passing the fluid back into the gullet. So complete is this partition, that if an animal suffering from inflammation of the throat, cannot swallow the water which it attempts to drink, when pushed through the soft palate, it is poured back through the nose. This is a valuable symptom of obstruction in the throat, whether due to inflammation or other cause.

Diseases of the Organs of Prehension.—I have already furnished several examples of impediments to the natural prehension of food, which materially affect the ease and health of animals. So important are these diseases, that special attention has been devoted to them at a very early period of the history of our profession by its most distinguished members. Amongst the most earnest writers is Toggia, a Piedmontese veterinary surgeon in high repute towards the close of last century.

Having noticed in the preceding pages a condition of the mouth, at the period of dentition, termed 'Lampas,' I have now to refer to special diseases which may interfere with gathering food. Two of these I shall treat of at length on a future occasion; they are Glossanthrax or Blain, and Epizootic Aphtha.

In some countries low-bred horses suffer from a very porous condition of their bones, constituting a disease termed *Osteoporosis.* In America it is called 'big head,' from the size attained, especially by the jaw bones, which, in swelling, contract the mouth, and soon incapacitate the animal from masticating or chewing its food. The subjoined cut is from a drawing I made from nature whilst in Stuttgard in 1854. I shall more fully treat of this interesting disease elsewhere.

Fig. 8.

SPORADIC APHTHA is a vesicular eruption of the mouth, distinguished from the epizootic disease by its very mild form and non-contagiousness. This mild affection is occasionally witnessed in all animals, and was mentioned by the earliest writers on veterinary medicine, such as Ruellio, Vegetius, and others. It is sometimes primary, and due to causes operating locally, such as the food an animal eats, the accidental introduction of acrid plants into the mouth, &c. At others it is a secondary affection, and dependent on a constitutional state; the eruptions being then usually regarded as one of nature's efforts to rid the system of deleterious principles. The aphthæ which Rammazzini describes as occurring in cattle that suffer from contagious typhoid, or the Russian Plague, belong to the *secondary* variety. In simple aphtha or thrush the symptoms are purely local, and consist in difficult prehension of food, salivation, and the presence of clusters of white vesicles on the lips, cheeks, tongue, &c. Treatment consists in the use of a mixture of equal parts of vinegar and honey, to which may be added acetate of zinc in the proportion of half an ounce to the pound.

INFLAMMATION OF THE MOUTH, and, more especially GLOSSITIS, or Inflammation of the tongue, may be observed in any of our domestic animals, and especially as the result of the incautious administration of medicine. A solution of hartshorn is often given to cattle in hove, and turpentine is very improperly administered to the horse in large and dangerous doses, and both agents have occasionally given rise to troublesome symptoms, by producing inflammation of the mouth. The symptoms of inflammation are all present,—viz., heat, pain, redness, and swelling. The animal is salivated, and experiences much general derangement. If the tongue be more particularly the seat of the disease, it is motionless, swollen, and sometimes protruded from the mouth, which, being opened, gives to the animal a very peculiar and anxious expression. In inflammation of the mouth generally, or of the tongue, the epithelium, or scaly covering of the membranous lining, peels off, and leads to a very sore and raw aspect of the implicated parts. Ulceration may set in, or the tongue and other parts remain stiff, swollen, and indurated.

INDURATION OF THE TONGUE is a result of glossitis to be dreaded, and may usually be prevented by proper treatment. Suppuration is most frequently the result; and, whether superficial or deep, resolves itself into discharge of the matter, which, when thoroughly thrown off, leaves the parts in a condition favourable to heal. From first to last, in every form of inflammation of the mouth or tongue, the swelling is apt to be considerable, and may give rise to symptoms of suffocation.

The treatment of inflammatory diseases of the mouth or tongue consists in the early exhibition of a purgative—aloes in the horse, a saline purge in cattle, and castor oil to any of the smaller animals.* In the pig, subject as this animal not unfrequently is to inflammation of the mouth, &c., tartar emetic, in half-grain doses, repeated twice a-day, proves the best antiphlogistic. Small, and oft-repeated doses of nitre, or acetate of ammonia, must be given in proportions according to the animal treated. The veterinary surgeon gains considerably by judicious scarifications or incisions into the swollen parts. An electuary, such as that recommended for aphtha, may be used, or a mild solution of alum. If pus or matter form in abundance, and is attended with fœtor, a little chlorine water, largely diluted, constitutes the best disinfectant. To keep the animal's condition up, it may be expedient to drench with gruel, linseed tea, and other nutritious materials. Animals affected with inflammation of the mouth or tongue should be encouraged to drink water freely.

Ulcers of the tongue and lips are commonly seen in cattle. They are generally superficial, but often extensive, and call for the use of caustic, astringent lotions, and careful management as to diet, &c.

* For information as to the doses of medicine, the administration of the latter, and many prescriptions, see *The Veterinarian's Vade-Mecum.*

PARALYSIS OF THE LIPS AND TONGUE, usually on one side, is occasionally seen in the horse, and is due to such injury to the nerves proceeding to these parts, as to render it incurable. The tongue is apt to drop between the horse's incisors, and to be bitten severely; and the hanging lip gives to the horse a very peculiar look, and renders him unable to pick food.

Protrusion of the tongue (*Prolapsus Linguæ*) is the most troublesome of the two conditions, and, as Hertwig says,* must be due to one of three causes: 1st, Paralysis; 2nd, Debility, and elongation of the muscular fibres of the tongue; 3rd, Wounds or injuries to the tongue. The veterinarian may have to amputate a portion of the latter organ in order to prevent the animal repeatedly injuring it. Lapdogs often have a congenital malformation, and the tongue hangs on one side of the mouth.

The injuries and diseases of the tongue suggest the evils which are occasionally attendant on the improper management of animals. Not unfrequently has a horse's tongue been nearly wrenched off by a high port bit, and the useless torture inflicted by absurd instruments, which rude hands prefer to guide a horse with, is reprehensible in the extreme. Bracy Clark says, with much wit, in his *Chalinologia, or Treatise on the Bits of Horses*, that, "In placing these irons in the mouth of the horse, and communicating them to the hand by the reins, we establish, or ought at least to establish, a sort of language of communication with the animal, and which, when adroitly and suitably applied, and used well, would bear no mean analogy to such; but unfortunately, however, for the worthy animal, this language of the bits at present, is possessing but too often, not the douceur or softness of the Italian, but is, in reality, a very crack-jaw, and worse language

* *Praktishes Handbuch der Chirurgie für Thierärzte.* Von Dr C. H. HERTWIG. Zweite Auflage. Berlin, 1859.

than any of the hardest dialects of Sclavonia." In referring to horses thus cruelly treated with bits, Clark says: "How often, indeed, are their sufferings, and the eloquent expression of those sufferings by various movements of the head, disregarded, till obedience and patient suffering can no longer endure such torture, and disobedience and mischief become the fruits of this use." Though somewhat digressing from the direct object of these quotations, viz., pointing to the injuries inflicted by bits, I am tempted to refer to a passage in Clark's article on bits, which shows how Rarey's idea of teaching horses with gentleness, and for which he has received much unmerited praise, was an acknowledged principle with intelligent horsemen in this country, long before Rarey crossed the Atlantic. In breaking-in young horses, Bracy Clark says: "Patience and forbearance are leading requisites in it, and, perhaps, at times, some little address; but, except on very rare occasions, nothing, I believe, should justify punishment, or the resorting to a cruel severity. It is, indeed, wonderful that so spirited, highly gifted, and powerful an animal, should so easily compound for all his natural rights,—for such, I presume, every animal has—and yields so readily an abject servility to man, and the loss of liberty and almost every natural desire."*

NATURE OF FOOD: ITS PROXIMATE PRINCIPLES.—The

* In his last publication, entitled *Fragmenta Veterinaria*, Bracy Clark says: "We hail with pleasure anything coming from this new-born land of America, unencumbered as it is with the tumours, incrustations, and impediments usually thrown in the way of advancing knowledge by old governments and laws. However, it is not to be expected that all will be good that proceeds thence, without some degree of pruning and setting to rights, as being too wild for immediate adoption. How earnestly we wish the noble example of the founder of Pennsylvania may be kept always in view by this people, who nobly refused to receive the gift of the land of Pennsylvania, though given

food which is gathered by animals is derived from the animal, vegetable, or mineral kingdoms. It must contain

him for a debt, till he had satisfied the natives of the land by a solemn treaty and purchase.

"The present performance of Rarey is brought before the public by one enamoured of his system, if such it may be called, by a fox-hunting squire, a writer on horse subjects for the newspapers—a school not very much entertained by the public for this species of investigation. In the first place, we must seriously object to the very title, which is rendering injustice to the horse, making him a sort of wild beast that stands in need of being *tamed*. Instead of which, we hold him, from his natural inoffensive disposition, to require nothing of the sort, but has been most kindly delivered to our hands by a merciful Creator, neither wild nor mischievous, but only requiring a little gentle breaking in, or education, without any punishing him, or injuring him, to become the docile, faithful, laborious, ready helpmate of man, that could be possibly desired.

"His education, we hold, should consist of gaining his friendship and confidence by gentle measures, and not by deceiving him and punishing him, by throwing him down and frightening him, and grievously *sweating* him, and accompanied with all sorts of fears and apprehensions.

"The most noble of dispositions, we know, may be subdued by extreme punishment and severity, but is this the way to make a loving, obedient slave, that should have pleasure in giving satisfaction to all reasonable demands, and, in return for it, receiving kindness and rewards?

"Better works than this exist, and should have been consulted by this writer for the newspapers, as, for instance, Beranger's second edition *On the Horse*, copied into Rees' *Cyclopædia*, and again copied in Clark's work *On the Bits of Horses*, which far transcends every suggestion in this volume. Treachery of all kinds, we believe, to a noble animal of this description, should be avoided, and the obtaining his love and confidence should be our chief aim, by patient sedulous measures, which it is not our business here to reiterate; and as to Beranger and some others, of whose labours we cannot suppose him entirely ignorant, but of which there is not even a mention; and, indeed, as a system of general *Horse-Breaking* it is almost useless, and inferior to works we already possess on the subject."

certain essential elements, such as those constituting the animal fabric. In studying the chemistry of animals, or their food, we may adopt a complex qualitative or quantitative analysis, and discover the ultimate elements composing them; or we may, by a natural process of separation, obtain certain compound substances, found in combination in any plant or animal, and recognised as proximate principles. Thus, milk may by analysis be found to contain hydrogen, nitrogen, oxygen, carbon, sulphur, and other ultimate elements; but, if we simply allow milk to get sour, we shall prove it contains a principle capable of curdling, called casein, in addition to water, fat, and salts. Thus, blood is readily found by spontaneous coagulation, or the application of heat, to contain fibrin and albumen, which are both proximate principles. The nature of these proximate principles must be investigated, in order to study digestion, and in order to deduce the general principles involved in the art of feeding our domestic animals.

In referring to the Chemistry of Food we must consider the chemical composition of animals, and I gladly seize this opportunity of entering somewhat fully into this important subject. The proximate principles above referred to have been classified under three heads:—

I. Inorganic Constituents.
II. Hydro-carbonaceous, or Non-Nitrogenous.
III. Nitrogenous principles.

I. The first inorganic constituent meriting special notice is WATER. This universally diffused compound enters largely into the composition of an animal or plant, and is there destined not only to preserve a physical condition essential to the preservation and manifestation of the phenomena of life, but is chemically important. It is true that it holds in simple solution many of the salts essential to the system, and when the liquids of the body attain a certain degree of concentration, or when the solids have lost a part of their necessary proportion of water, thirst is induced. Thirst is the indication of water being required by the system. The quantity of water needed varies largely in the organization of different animals and plants. It always constitutes a very large part of organic texture. This may be seen by taking a piece of tendon, which is even materially altered in its appearance by losing or regaining moisture. It is tough, pliable, bulky, heavy, white, and opaque in its natural state. It becomes hard, transparent, light, and of a yellowish or brownish colour if dried, and so perfectly does this white fibrous tissue preserve its structural peculiarities in the dried state, that if damped a century after it was first deprived of moisture, it acquires again the bright silvery look of ligament or tendon. I was struck by this in recently washing the ligaments of Eclipse's skeleton. The quantity of water, as compared with solid matter in animal tissue, is sometimes so great, that Owen found a jelly-fish, weighing 2 lbs., contain only 16 grains of solid matter. It usually exists in the higher animals in the enormous proportion of 70 per cent.

Robin and Verdeil found in the different solids and fluids the following proportions of water:—

Quantity of Water in 1000 parts in

Epidermis	37	Bile	880
Teeth	100	Milk	887
Bones	130	Pancreatic juice	900
Cartilage	550	Urine	936
Muscle	750	Lymph	960
Ligament	768	Gastric juice	975
Brain	789	Perspiration	986
Blood	795	Saliva	995
Synovial fluid	805		

But the oxygen and hydrogen, which form water, may be useful in the system in ways demanding their separation. In the rapid strides made in organic chemistry within the last few years, ample illustrations have been discovered of this remarkable fact. When simply coming in contact with carbonic acid, which is always present in the system, the most remarkable compounds are produced. Starchy and saccharine principles, out of which animal fat may be formed, contain only elements met with in carbonic acid and water. The following table proves this:—

Substance formed. Name.	Formula.	Carbonic acid used in eqs.	Water used in eqs.	Oxygen separated in eqs.
Cellulose . .	$C_{12}\ H_{10}\ O_{10}$	12	10	24
Starch . .	$C_{12}\ H_{10}\ O_{10}$	12	10	24
Cane Sugar . .	$C_{12}\ H_{11}\ O_{11}$	12	11	24
Gum . .	$C_{12}\ H_{11}\ O_{11}$	12	11	24
Grape Sugar, dry .	$C_{12}\ H_{12}\ O_{12}$	12	12	24
Grape Sugar, crystals	$C_{12}\ H_{14}\ O_{14}$	12	14	24

As Gregory says, this important group contains, in every instance, hydrogen and oxygen in the proportion to form water, so that the whole of the oxygen of the carbonic acid, but not that of the water, has been separated. They may be viewed theoretically as formed of carbon *plus* water; thus starch may be $C_{12} + 10\ HO$.

Water, as an alimentary principle, is found taken into the system either alone or charged with organic and inorganic constituents, or in combination with articles of food. Some people think there are animals that need not and should never drink, such as the rabbit, the sheep, and even the kangaroo. But this mistaken popular notion has arisen from these animals deriving enough water for their purposes from a succulent vegetable diet. Feed the rabbit on dry bran, and he will like a little water. Place the sheep in the desert, and it will hunt for water like any other animal susceptible of thirsty sensations.

Water not only carries into the system materials capable of solution, but it holds in suspension substances which, in some cases, are nutritious, but in others may be poisonous. The purest water is not necessarily the best for man or animals, and it is to the absence of some saline constituents in mountain waters that cretinism has been ascribed in the Alps. Dirty water is not necessarily injurious, but there is probably no more prolific source of disease in man and animals. This was proved in regard to cholera. Dr Lankester tells us, in his interesting popular lectures: "In 1854 I was requested, by the Vestry of the Parish of St James, Westminster, to examine the water from the pump in Broad Street, Golden Square. The cholera had broken out there, and killed five hundred people in less than a week, and the late Dr Snow had accused the pump of doing all this mischief. Now I detected nothing remarkable in that water but the filaments of a fungus. It was a very curious fungus, and interested me so much, that I published an account of it.* Its discovery in the water led to an investigation of the condition of the well, and then it was discovered that the well had for some time been in communication with the cesspool of an adjoining house, and subject to periodical overflows of its contents. I have since seen these flocculent fungi in impure water, and you will easily recognise them in the organic contents of well-water and sewer-water. These fungi-form filaments are accompanied with sombre, ugly-looking animalcules, which are seldom found in pure water. There is also an ill-favoured-looking little worm, much smaller than a thread-worm, and belonging to the same family of

* *Quarterly Journal of Microscopical Science*, vol. iv

animals, which constantly presents itself in impure waters. These things live in water containing decomposing animal and vegetable matter; and it is this matter which is injurious. So that, although the living creatures themselves are not injurious, the water they live in is."

On the subject of organic impurities, Dr Lankester says: "Organic matters may be dissolved in water, and then they cannot be found by the microscope. The chemist estimates these by the quantity of nitrogen which he obtains from the deposit of water which has been evaporated; but it is very difficult to estimate this form of impurity. I have found the permanganates of potash and soda a very good rough test for ascertaining the presence of this dissolved matter. Permanganic acid and the permanganates contain large quantities of oxygen; and, when they are brought in contact with organic matters, they lose their oxygen and become changed in colour. If you take permanganate of soda, which is sold in the shops under the name of Condy's Disinfecting Fluid, and put it into pure water, it produces first a deep violet, and afterwards a beautiful permanent red colour. If the water, however, contains organic matters, the red colour soon disappears, and in proportion to the quantity of organic matter will be its decolorizing agency. Now, if you take a series of waters of different degrees of impurity, you will find that the water which has least impurity retains the most colour. I have tried this in so many instances with a perfectly successful result, that I can confidently recommend it as a test for ascertaining the relative quantities of impurity in water. The same test has been applied by Dr Angus Smith for ascertaining the organic impurity of the atmosphere; and by this means he has arrived at some very interesting results. It should, however, be recollected that many other impurities besides those of organic origin mav exist in the atmosphere and act upon the permanganate. This is the case, for instance, with sulphurous acid, which is constantly present in an atmosphere where coal and coal gas are burned."

II. Chloride of Sodium.—Common salt enters largely into the composition of animals and vegetables; and when absent in the food of the former, a morbid craving for it is frequently observed. Its effects on the system, when directly introduced, are most salutary; and, in some diseases, it is valuable as a preventative and curative. It is composed of two elements possessing powerful chemical affinities. The one is an actively bleaching gas, chlorine; and the other a metal, susceptible of very ready oxydation, sodium. These elements are not separated in the system; and one of the greatest uses they serve in combination is not in connection with chemical changes, but rather with the physical transudation, or endosmosis and exosmosis occurring so constantly in the system.

The quantity of common salt in different constituents of the body, is stated by Robin and Verdeil as follows, in 1000 parts:—

Muscles	2·0	Bile	3·5
Bones	2·5	Blood	4.5
Milk	1·0	Mucus	6·0
Saliva	1.5	Aqueous Humour	11·0
Urine	3.0	Vitreous Humour	14.0

The value of common salt, as an article of diet, is proved by experiments, performed by Boussingault, on bullocks. He gave three 500 grains of salt per day, and other three had none. He says: "Though salt, administered with the food, has but little effect in increasing the size of the animal, it appears to exert a favourable influence upon his qualities and general aspects. Until the end of March (the experiment began in October), the two lots experimented on did not present any marked difference in their appearance; but in the course of the following April, this difference became quite manifest, even to an unpractised eye. The lot No. 2 had then been without salt for six months. In the animals of both lots, the skin had a fine and substantial texture, easily stretched and separated from the ribs; but the hair, which was tarnished and disordered in the bullocks of the second lot, was smooth and glistening in those of the first. As the experiment went on, these characters became more marked; and, at the beginning of October, the animals of lot No. 2, after going without salt for an entire year, presented a rough and tangled hide, with patches here and there, where the skins were entirely uncovered. The bullocks of lot No. 1 retained, on the contrary, the ordinary aspect of stall-fed animals. Their vivacity and their frequent attempts at mounting contrasted strongly with the dull and unexcitable aspect presented by the others. No doubt the first lot would have commanded a higher price in the market than the second."

Chloride of sodium favours digestion so much, and seems to excite the appetite to such an extent, that it is not to be recommended on farms where animals are liable to diseases arising from plethora; and, though I have known it prescribed for splenic apoplexy, it is attended with an unfavourable effect by stimulating the production of blood.

I have before said that chloride of sodium does not materially induce chemical changes in the body, and this is proved by Barral's researches, which indicate that, only a very small quantity disappears in the body, and, probably, undergoes there a double decomposition, with phosphate of potass forming chloride of potassium and phosphate of soda. Chloride of sodium is freely thrown off by the secretions—a certain quantity, however, remaining in the blood, and the proportion there found being subject to very slight variations.

III. PHOSPHATE OF LIME has been termed bone earth, from its hardening osseous tissue, though found in various other parts of the body. Robin and Verdeil state the quantity of this essential principle to be, in 1000 parts of the following substances:—

Enamel	885	Muscles	2.5
Dentine	643	Blood	0.3
Bones	550	Gastric juice	0.4
Cartilages	40		

Phosphate of lime is readily absorbed by milk, and exists in solution in the blood. It is deposited in solid tissues, where it combines intimately with the animal basis of the structure, and from which it can be separated by maceration in dilute hydrochloric acid, so that a bone may in a short time be twisted in any direction, and turned into a knot, as represented at Fig. 9.

Fig. 9. (DALTON.)

Phosphate of lime is a crystallizable salt, but it is not in this form that it is met with in bones in which it would appear that the presence of fluoride of calcium prevents crystallization.

Phosphoric acid, not only in combination with lime, but free, is a most important element in the animal economy. Possessed of powerful chemical affinities, this remarkable acid exists in the blood and the tissues only to contribute to their integrity and healthy state, whereas, without the body, it is dangerous to animal life.

Phosphate of magnesia is always in conjunction with phosphate of lime, and alkaline phosphates of soda and potash are likewise met with in solids and fluids, and it has been supposed that it is to these that the alkalinity of the blood and other fluids is due.

Carnivorous animals receive a proper supply of phosphates from animal food, and especially from bones, whereas vegetable feeders obtain them largely from the grasses. It is owing to the latter circumstance that the value of phosphatic manures has been recognised; and in proportion that the phosphates are soluble and capable of nourishing the plants, are they valuable in fertilizing the land. There are many districts in the south of Scotland and north of England, where, by a judicious combination of phosphatic and ammoniacal manures, a disease attended with softening of the bones, and termed "the Stiffness," or "the Cripple,"* might be prevented—the phosphates being essential to supply a want in the plants, and the ammoniacal principles favouring the full development of a luxuriant vegetation.

Dr Lankester refers to an interesting feature in the history of phosphate of lime. He says:—

"Liebig has shown that it is highly probable that one of the causes that led to the destruction of the great cities of antiquity was the difficulty of obtaining a supply of food for their inhabitants. As they went on increasing, the soils in the immediate vicinity became exhausted of the phosphate, and, at last, refused to grow food at all. As the means of transit were not so perfect as they are now, men found it easier to go to places where the virgin soil produced abundance of food, than to bring the food to their cities. Hence the migrations of peoples, and the desolation of once busy cities. In America this process is going on every day. When a district is exhausted of its mineral food, the farmer

* See *Edinburgh Veterinary Review*, vol. iii.

finds it easier to transport his whole family and possessions to the backwoods, where there is a virgin soil, than to send to a distance for his manures to fertilise his land. It has been, then, a most providential event for Europe the discovery of these artificial manures, for we have been consuming our own food, the phosphates of our soils; and instead of returning them to the land, throwing them into the sea. But even these artificial sources may fail, and then, unless we have learned the art of recovering the phosphates we have used for our life, it will be our turn to share the fate of the cities of antiquity, and men will point to the ruins of our cities, as we now do to those of Babylon, and Tyre, and Sidon."

I need scarcely add how noble the mission of the agriculturist is, when, by the light of science and mature experience, he can multiply the plants, increase according to our requirements the number of animals and invigorate their constitutions, thus tending largely to enhance the prosperity of his country.

IV. Fluoride of Calcium is found in bone in the proportion of 3 or 4 per cent., but more largely in fossil bones, in which it exists in quantities as high as 12 or 15 per cent. It is believed that this is due to the more ready solution and removal of phosphate of lime from bone by water, charged with carbonic acid, so that the proportions vary materially according to the state of preservation of osseous remains. Fluoride of calcium probably renders bones tough by preventing the crystallization of the phosphate.

V. Carbonate of Lime is a salt entering into the system of animals and plants in the form of a soluble bi-carbonate which is contained in good water. In this soluble form it exists in the secretion of the salivary glands, in the blood, and in the urine of herbivora. It is met with in some parts of the body in a crystalline form, but more largely, as in the bones, in combination with phosphate of lime, as an amorphous, granular, earthy principle, destined to contribute to the solidity of the skeleton. In invertebrate animals, the carbonate of lime forms the basis of the solidifying principles of shells, scales, &c.

VI. Carbonate of Soda is found in the blood, lymph, saliva, and other secretions of herbivorous animals, and in smaller proportions in man, and other omnivorous and carnivorous animals. The quantity, if any, under many circumstances, is with difficulty appreciated, from the readiness with which the salt is formed during the incineration of organic matters.

VII. Carbonate of Potash, like the preceding salt, obeys much the same laws, and is found under similar circumstances. Potash is a most essential element in the food of man and animals. It is found largely in many plants. Regarding the origin of the alkaline salts, we find that they are partly introduced as such with the food, and partly the result of chemical changes within the body.

"Lehmann found, by experiments upon his own person, that within thirteen minutes after taking half an ounce of lactate of soda, the urine had an alkaline reaction. He also observed that, if a solution of lactate of soda were injected into the jugular veins of a dog, the urine became alkaline at the end of five, or, at the latest, of twelve minutes. The conversion of these salts into carbonates takes place, therefore not in the intestines, but in the blood. The same observer found that, in many persons living on a mixed diet, the urine became alkaline in two or three hours after swallowing ten grains of acetate of soda. These salts, therefore, on being introduced into the animal body, are decomposed. Their organic acid is destroyed, and replaced by carbonic acid; and they are then discharged under the form of carbonates of soda and potass."

There are various principles which may be obtained from the body of an animal, or from the substance of a vegetable, and which are recognised as important in inducing important chemical changes in the body. To these the chloride of sodium, carbonates, and phosphates already referred to belong. Iron must be regarded as one. The rapid manner in which the weak and emaciated animal rallies under treatment by ferruginous tonics indicates their powerful reconstructive properties. The blood, once poor and watery, becomes plastic, of a deep red colour, and maintains a great activity of function. So remarkable is the influence exerted by iron on the production of blood red, that the latter was believed to be a red salt of iron, until Graham proved that there was not sufficient iron in the blood to colour it, and Scherer demonstrated that hæmatine retained its properties though the iron was dissolved out of it.

VIII. IRON.—Common salt is extensively diffused over the globe, in every substance, organic and inorganic, and so is iron. Our soils contain large quantities, and hence the plants receive it, through which animals acquire their necessary, though small, proportion. It is not a little remarkable that this constituent of blood and tissue, though in infinitesimal quantities, cannot be dispensed with. I have often quoted Dr Lankester's *Lectures on Food;* and we find in them, on the subject of iron: "The French are in the habit of performing the process of incremation on their dead friends; that is to say, instead of burying them, they burn them, which is a much more wholesome process. The Romans burned their dead, and collected their ashes in an urn, which they kept as a memorial; but the Frenchmen do better than this: they would not be Frenchmen unless they could improve upon the old Roman plan. The French, after burning their friends, take the ashes and extract the iron, and convert it into a mourning ring, which they wear in memory of their dead friends. Here, then, we have a very conclusive proof that iron really exists in the human body."

The circumstance here referred to cannot apply to any regular practice, because the French bury their dead as we do; still, in evidence of obtaining a certain quantity of iron from blood, I may mention that a Paris physician used to wear a little iron ball on his watch-guard composed of iron obtained from human blood. He must have laboured hard to obtain a sufficient quantity, as the amount of iron in blood is not very great. Poggiale found in 1000 parts the following proportions in man and animals:—

Man	1·26	Cat	1·23
Ox	1·25	Sheep	1·06
Cow	1·43	Rabbit	0·97
Calf	1·11	Hen	0·75
Dog	1·45	Pigeon	0·62

Iron, as an element of the animal frame, ranks in importance with common salt and phosphate of lime; and, as Liebig says, "It is quite certain that if iron be excluded from food, organic life cannot be supported."

Manganese is another metal supposed by some essential to the integrity of many animal structures. It is an ingredient of Scotch soil, and hence through plants finds its way into Scotch blood and muscle; but manganese cannot be regarded in the same light as iron. It is not essential to life.

Lehmann refers to proximate principles of animals and vegetables, which he calls accidental mineral substances. He mentions, under this head—alkaline sulphates, carbonate of magnesia, manganese, arsenic, copper, lead, ammoniacal salts, and sulphocyanide of sodium.

Alkaline sulphates, except in the bones of reptiles and fishes, do not exist as such except in rare instances, and then in small quantities, in the structures of our domestic animals.

Carbonate of magnesia is rare in the tissues of animals. It is found in the urine of herbivora, being derived from the cereals, from which traces of it are to be obtained.

It would appear that the widely diffused oxide, arsenic, is removed from the bodies of animals with some difficulty, and it has been regarded by some as a necessary principle of the body, and the same may be said of lead. Arsenic readily penetrates plants, and through them may, under certain favourable circumstances, find its way into the systems of our domestic animals.

Free ammonia, which is supposed always present in the blood, has been alluded to by Dr Benjamin Richardson as one of the most important proximate principles of animals, inasmuch as to it is due the persistent fluidity of the vital fluid. Some arguments and facts can be supported in opposition to Dr Richardson's views, but, according to him, it is the proximate principle most readily separated from the body, because escaping the moment the blood-vessels are opened and blood drawn. In some diseases ammoniacal salts exist in the blood, and it were interesting if their presence could be demonstrated in the many disorders so suddenly fatal in animals, and which depend on an almost instantaneous change in the constitution of and tendency to coagulation in the blood.

The sulphocyanide of sodium referred to by Lehmann is only found in saliva. Other chemists state it to be a sulphocyanide of potassium, and not of sodium.

HYDRO-CARBONACEOUS OR HEAT-GIVING PRINCIPLES OF FOOD.—The more we extend our knowledge on the nature of food and the principles on which our domestic animals are to be fed, the more must we recognise the importance of this interesting group of substances. If the proportions held to other alimentary principles is considered sufficient to determine their relative value, we must class the hydro-carbons first in the list, though much depends on the climate in which animals live. Amongst us, the consumption of heat-giving food is and must necessarily be enormous, and to the horse, destined as he is for fast work, the supply of materials for the rapid combustion which must incessantly go on in his system must be very great.

I. STARCH (C_{12} H_{10} O_{10}) stands at the head of this group. It was for long considered characteristic of plant structure, but, within the last few years the researches of microscopic anatomists have proved the existence of amyloid or starchy bodies in the tissues of animals.

Herbivorous quadrupeds are constantly receiving various kinds of starch into their systems. The varieties are distinguished by a peculiar shape of the granule, as indicated by the microscope. They all indicate the same chemical properties, being transformed into *dextrine* or British gum by the action of saliva or malt. In both cases, a nitrogenous body —*an animal diastase*—is regarded as inducing the change, though this is brought about even by heating starch to a certain point in sealed tubes, with water containing 1–500th part of oxalic acid. The dextrine, which passes into the intestines or which continues to be acted upon as above, is further transformed into *glucose* or grape-sugar, in which form the hydro-carbons are largely found in the blood of the mesenteric veins of any of our domestic animals, and, strange to say, in carnivora as well as herbivora. Starch is tested by iodine, with which it forms a blue colour, supposed to be owing to the iodine becoming finely divided, and adhering to the starch as a dye does to the fibres of cloth.

It is glucose that we find in the blood of animals, and especially in the veins, and the liver exerts a most important function in connection with the transformation of these saccharine elements, whereby they are either better prepared for immediate combustion, or for the production of animal fats, &c.

Cane sugar supplies the system with a similar principle, and is readily transformed into glucose or grape-sugar.

There are, however, other sugars found in the animal organism, such as lactine, or sugar of milk, which is obtained by evaporating clarified whey. It is thus obtained in the form of hard, white crystals, soluble in 5 or 6 parts of cold and 2½ of hot water. It is susceptible of the vinous, lactic, and butyric fermentations; and it is well known (says Gregory) that some nations prepare an intoxicating liquor from milk by fermentation.

Inosite is a saccharine principle obtained from the juice of flesh, and is not susceptible of undergoing alcoholic fermentation.

II. Fats and Oils.—The rapid production of fat in the body is an indication of how readily the hydro-carbons derived from the vegetable world are transformed into the heat-producing elements of the animal organization.

Fat enters largely into the composition of many substances, but is more especially stored up in adipose tissue. It is a vesicular structure, blended with the connecting tissue of the body, and becoming largely distended with fatty principles in animals in a state of obesity. Fat is deposited in the bones, where it constitutes the 'marrow.' It tends to preserve form, and, where it is destined for this office, it does not readily waste, especially in a position such as within the eye-socket of the horse.

The origin of fat in the body is three-fold:—"First, it is derived ready formed from plants; secondly, it is formed, in the absence of oxygen, or, when oxygen is deficient, by the deoxidation of sugar, which thus supplies the oxygen wanted; and thirdly, it is also formed by a species of fermentation, along with carbonic acid and hydrogen, the latter being converted into water by the oxygen of the blood."—(GREGORY.)

Both in animals and vegetables do the oils exist in vesicles, from which they may be expressed, and appear in the shape of minute globules of various sizes in the field of the microscope.

Animal fats are divided into two groups—those that are saponifiable, and those that are not saponifiable. The first undergo decomposition when in the presence of an alkali, so that the fatty acid set free combines with the latter to form soap, and a base, glycerine, is deposited. It is this change that the saponifiable fats undergo when acted upon by the intestinal juices, which are capable of forming a fatty emulsion. Fats being themselves insoluble, cannot be absorbed until thus modified by the pancreatic and other secretions.

Glycerine is a dense, sweet liquid, which does not readily decompose, and, when introduced into the system, acts much like cod-liver oil.

The crystalline fats met with in animals such as cholesterine and serolin, are developed there by chemical changes, and do not exist in vegetable matter. With regard to cholesterine, there would appear to be some relation between it and the acids of bile.

NITROGENOUS PRINCIPLES.—The third great group of principles essential in food, because existing as constituents of animal tissue, are the nitrogenous or albuminoid. They exist in both animal and vegetable matter—albumen in the first, and gluten in the second, being typical of the class.

Albumen, fibrine, and caseine are the principal albuminoid substances in animals, and they all contain a definite proportion of nitrogen, oxygen, hydrogen, and carbon, so that they have been regarded, in accordance with a theory of Mülder, as compounds of a principle, proteine, which is supposed to consist of the four elements in the proportion referred to, and sulphur or phosphorus. Proteine, according to Mülder, contains C_{40} N_5 H_{31} O_{12}, and the albumen of egg might be indicated as consisting of proteine 10 eq. + 1 eq. of sulphur and 1 eq. of phosphorus. The objections to the proteine theory are, that no such compound perfectly free from sulphur exists; with regard to the phosphorus, regarded as characteristic of some substances, it probably only exists in animal tissues, in the form of salts of phosphoric acid; Mülder's formulæ have been proved erroneous. The expression 'proteine compound' is, however, still used to indicate the albuminoid group.

The nitrogenous substances are characterised by the presence of sulphur in them, by the absence of any crystalline form, by the complex chemical constitution above referred to, and which renders them most unstable compounds; they yield at once to chemical changes when separated from the living organism, and especially if exposed freely to air, under the combined influence of heat and moisture.

The albuminoid substances agree in certain chemical characters:—"They dissolve, with the aid of heat, in potash, and the solution blackens the salts of lead, proving that part at least of the sulphur is present in an unoxidised state. They all dissolve, with the aid of heat, in strong, hydrochloric acid, yielding, if air be admitted—not otherwise—a purple solution, which after a time changes to a dark brown. The very acid liquid which is obtained by dissolving mercury in its own weight of nitric acid, gives a very intense red colour to all these substances. This character is so well marked, that we can in this way detect the presence of 1 part of albumen in 100·000 of water. When oxidised by sulphuric acid and peroxide of manganese, or by sulphuric acid and bichromate of potash, or by fusion with caustic potash, they all yield similar products; namely, compounds of the series of aldehyde; of that of acetic acid; of the nytrile series, benzoic acid, and oil of bitter almonds, leucine and tyrosine."—(GREGORY.)

I have referred to the tendency to decomposition in these complex organic compounds. But a very remarkable feature of the group is their disposition to induce change in materials with which they come in contact, and often by catalysis—that is to say, without suffering change themselves.

The peculiar tendency to solidify characterizes all proteine compounds, and the condition assumed is so peculiar as to merit the distinctive name 'coagulation.' Casein curdles or coagulates when acids are thrown in milk; fibrine coagulates spontaneously from exposure to air, and albumen hardens when heated.

The whole of the albuminoid principles are susceptible of being simply dried, and thus transformed from the liquid to the solid state; but in that condition they greedily absorb water, and are restored by it to their natural condition. They are termed *hygroscopic* from this peculiar property.

The farmer supplies them in his crops by dressing the land richly with ammoniacal manure; and, so important are the nitrogenous principles to life, that both animals and vegetables thrive most certainly and most rapidly when the elements capable of forming proteine compounds are freely supplied them. Excess is injurious, and probably more so than excess in the supply of other principles, saline, or hydro-carbonaceous, which are more easily stored or discharged from the system, and do not induce a dangerous plethora.

I. ALBUMEN.—Animal albumen is found in the shape of the white of eggs, and its analysis leads to the formula

$C_{216} N_{217} S_8 H_{169} O_{68}$, besides phosphates. The albumen of the blood's serum contains 1 eq. less sulphur. In vegetables albumen is sometimes fluid, but in most seeds it is solid. In animals it is always fluid, soluble in water, and coagulable at a temperature of 140° or 160°. The more diluted albumen is, the greater is the heat required to harden it; and when coagulated, it is insoluble in water. Mineral salts coagulate albumen, and this is particularly the case with corrosive sublimate, of which a very small quantity is required to induce the necessary change. It is the ready change which occurs by the approach between albumen and many of the poisonous mineral salts, which renders the former a valuable antidote in cases of poisoning. Creosote, acids, ferrocyanide of potassium, and an infusion of galls, are all capable of coagulating albumen; and the gastric juice effects this, in order that the solidified principle may be digested.

II. FIBRINE exists in small proportion in the blood of animals, and is the basis of their muscular system. It is spontaneously coagulable whenever it is removed from the body and exposed to the air. I must defer the consideration of the causes of coagulation and the nature of the phenomenon for some future time; but I may mention, that within the vessels and in contact with living tissue it does not readily coagulate; and when this change has occurred, it ceases to be soluble in water or serum. In coagulating, it acquires a peculiar fibrous appearance, and is very bulky, from the quantity of water it contains. If acted on by acetic acid, it swells into a jelly-like, translucent, and tremulous mass, and is then soluble in boiling water. "Coagulated fibrine, whether vegetable or animal, when covered with water, and left to itself, undergoes a change; a small part of it putrifies, and the rest is dissolved. The liquid, freed from fat by filtration, now contains albumen, coagulable by heat and acids; and this is accounted for by the fact, that the proportion of the organic elements is the same in both."—(GREGORY.)

III. CASEINE.—This, as Dr Gregory says, is the third great form of sanguigenous matter found in vegetables, and in largest proportion in leguminous seeds, hence called legumine. It is the azotised constituent of milk, and distinguished from albumen by not coagulating under the influence of heat, but by dilute acids, which are unable to coagulate albumen. "In milk, which is alkaline, caseine is dissolved, along with sugar of milk, salts, and suspended oil or butter. When milk turns sour, its alkali is gradually neutralised and overpowered by lactic acid, produced by the fermentation of sugar of milk, and the caseine at last coagulates from the presence of free acid. It is absolutely certain that caseine, in the animal body, can yield albumen and fibrine, because young animals, fed on milk alone, produce blood and muscle, and milk contains no other sanguigenous compound than caseine. Cheese is coagulated and pressed caseine, and when made from well-skimmed milk, is nearly pure; but that made from sweet milk or cream contains also much butter. The infusion of the lining membrane of a calf's fourth stomach, or rennet, as it is called, contains albumen or some other substance of a like nature, in a state of decay, that is, of decomposition. It acts on the sugar in milk, converts a part of it into lactic acid, and thus causes coagulation; but as curd is formed before the milk has become sour, we must infer either that the caseine coagulates as soon as the milk becomes neutral, or that the ferment or rennet coagulates it by an action of contact. Perhaps both are true. Nay, it has been found that milk, even when made distinctly alkaline, coagulates with rennet if warmed rather more than without the alkali. Indeed, it would appear that the curd, a coagulated caseine, is a compound of caseine with phosphate of lime. For if an acid be cautiously added, so as just to neutralise the alkali, the milk remains liquid, but coagulates on boiling, and this curd is like that from rennet, insoluble in alkaline solutions, in which pure caseine is soluble. Caseine is the proper ferment for the lactic and butyric fermentation, as fibrine or gluten is for the vinous fermentation. The caseine of peas and beans is obtained by rubbing up the seeds with water, and allowing the starch to settle. We have then a solution of caseine, turbid, and, but for the absence of butter and sugar, hardly to be distinguished from skimmed milk. The Chinese make cheese from peas and beans, and coagulate it by rennet. This cheese, when it decays or putrifies, acquires the peculiar smell and taste which characterise the cheese from milk in the same states. Fresh cheese is tasteless, save for the butter in it; but on keeping, oily acids, such as butyric and valerianic acids, and ammonia, are slowly formed, and hence the strong flavour of old cheese."

The whole of the nitrogenous principles have a remarkable affinity for the phosphates, and this is most useful in the process of nutrition. Phosphates enter largely in solution in milk, which is thus rendered fit nutriment for a young animal requiring bone earth to harden its skeleton, and albumen performs the same office for the chick *in ovo.*

There are many other substances in plants and animals containing nitrogen, and a very remarkable group in the latter may be classed under the head 'Extractive matters.' By this we mean substances obtained besides all we have mentioned, and which are soluble in water, but some also in water and rectified spirit, and others likewise in pure alcohol.

The gelatinous class of nitrogen-containing principles is a very important one. Gelatine is the basis of the connective and white fibrous tissue, and in a slightly modified form, as chondrin, it is found in cartilage and a few other structures. Gelatine is not coagulable like the albuminoid principles, but it is in the form of a tremulous mass when cold, and liquifies on the addition of heat. It is precipitated by tannic acid, alcohol, æther, and corrosive sublimate, but not by the prussiate of potash. Its formula is $C_{82}\ N_{13}\ H_{67}\ O_{32}$. Gregory says that the property of gelatinizing depends on the presence of phosphates; for when gelatine is long boiled with water alone, or with a little alkali, phosphate of lime is deposited, and the solution no longer forms a jelly on cooling. Chondrine, though regarded as a form of gelatine, differs from it in being precipitated when in solution by acids, alum, and salts of lead, which do not precipitate the latter.

Gelatine has been considered by various authorities as innutritious, but though, like other materials, insufficient in itself to support life, nevertheless it forms one of the useful elements of food. As Lewes says, "Bernard has shown that part of the gelatine is converted into sugar; and sugar, we know, is necessary to the organism. It may also be converted into fat; and, as has been said, there is much evidence to show that it may be converted into albumen, among the complex processes of vital chemistry; but whatever may be the decision respecting this point, there can be no legitimate reason for denying that gelatine ranks among nutritive principles."

The conclusions to be drawn from the knowledge possessed regarding the proximate principles of food are:—

Firstly, That they approach as nearly as possible the condition in which they exist in animals.

Secondly, That the want in food of any of the proximate principles of animal tissue often induces a special craving for it, and must be supplied to prevent disorder.

Thirdly, That no single element contains that which is necessary for the maintenance of life, and we cannot declare a material innutritious because, when given alone, it is insufficient to nourish.

Fourthly, The proximate principles vary in proportions in different kinds of food, and a combination of various forms of the latter is essential in all animals.

The facts brought out in the foregoing pages are essential in order that we may understand the process of digestion in the lower animals, and after describing the changes which the different principles undergo in the alimentary canal, I shall refer to foods and the methods of feeding.

MASTICATION.—In many animals food has to be divided and triturated in the mouth between teeth, which are lodged in bony jaws, and these moved by powerful muscles.

There are two distinct jaws: the upper, immovable; and the lower, which, by a joint with the temporal bone, moves away from or closes on to the upper jaw. The character of the joint indicates the habits of the animal. The rodent is endowed with back and forward movement by the disposition of the articular head of the lower jaw, and its corresponding concavity. In the carnivora a simple opening and closing or champing is ensured by the arrangement of the bones, and in herbivora a lateral and partially rotatory movement is possible.

The teeth, lodged in the jaws for mastication, and acting also as offensive and defensive organs, are either *simple* or *compound.* Compound teeth are only observed in herbivorous animals, presenting a surface composed of materials varying in density and hardness, so as to ensure a constantly rough surface for the purposes of grinding (see Fig. 25.) A good millstone is composed of materials which wear with a different degree of rapidity, and thus the surface rubs down most effectually the materials over which it passes. The simple tooth, as shown at Fig. 20, is all covered by solid enamel or ivory, of a distinct white colour, and harder than any other structure in the body. In the compound tooth the enamel dips into the surface of the crown, and in some animals, as the elephant, we may regard a compound tooth as a series of flattened teeth arranged in a row, and connected by a structure called *cement*, or crusta petrosa. This cement only covers the fang of a simple tooth, whereas it dips in between the layers of enamel in compound teeth, and when the tooth is still wholly enclosed within its cavity, a layer of cement covers the crown also. The pointed fang or fangs of the teeth are pierced by an opening which enters a cavity shown at Figs. 12 or 18. This is the pulp cavity, containing blood-vessels and nerves, which ramify in a delicate fibro-cellular structure, constituting the pulp. The latter is prolonged all over its surface into an infinite number of small funnel-shaped apertures, which are continuous with tubes of the *dentine* or inner structure of the tooth. The dentine constitutes the bulk of both crown and fang, and a section of the dentine proves it to be formed of a densely packed mass of tubes with distinct walls, and which run from the pulp cavity to the outer surface of the dentine, near which they ramify. In this course the dentinal tubes bend, and have a beautiful wavy appearance. The material between the tubes, or matrix of the dentine, is a perfectly homogenous substance, arranged probably in all animals in superimposed layers.

The enamel is composed of pentagonal or hexagonal long prisms or enamel fibres, closely packed together and arranged in a radiating manner from the dentinal or attached surface. The enamel prisms take a course outwards, similar to that of the dentinal canals, and decussate, so that entire band-shaped layers of them extend in very various directions from the dentine as far as the outer surface of the enamel. The enamel covers the crown, and passes over the neck of the tooth, getting thin and only partially covering the fang.

The cement is the true bone of tooth, or substantia ostoidea.

I have said that in a compound tooth the wearing surface is composed of materials of different degrees of hardness. The substances are the enamel, dentine, and crusta petrosa or cement, the chemical composition of which explains this circumstance, as seen by the annexed table.

	Dentine.	Enamel.	Cement.
Organic substances, . . .	28·01	3·59	32·24
Inorganic substances, . .	71·99	96·41	67·76

Thus the sharp angles and prominences of the compound teeth (see Fig. 23), are formed by enamel, the deeper hollows by wearing of cement, and the material worn between the two is the dentine.

I have referred to the *pulp*, which is a vascular structure endowed with exquisite sensibility, and lodged in the central cavity of the tooth (see Fig. 21.) The *pulp* is popularly termed the 'quick' of the tooth, aud when exposed to the contact of air or foreign substances, great pain is felt by man or animal. But, in addition to the pulp, we have connected with the teeth, the membrane or periosteum lining the tooth socket, which is applied over the fangs, is soft, and contains vessels and many delicate nerves. The last of the soft tissues compose the gum, which is the lining membrane of the mouth reflected over the jaw, and embracing the necks of the teeth.

Authors are not all agreed as to the periods of eruption and change in the teeth occurring in the domestic animals, and this may be seen by comparing Kreutzer's table on the annexed page with the tables which follow it, especially as regards the dentition in ruminants and in the pig.

KREUTZER'S TABLE OF DENTITION IN THE DOMESTIC ANIMALS.

	HORSE.		RUMINANTS.		PIG.		DOG.	
	ERUPTION.	CHANGE.	ERUPTION.	CHANGE.	ERUPTION.	CHANGE.	ERUPTION.	CHANGE.
I. INCISORS.								
Central.......	Before or a few days after birth.	2½ years.	Before or a few days after birth.	1½ years.	3–4 mo.	2½–3 years.	4–6 weeks.	3–4 mo.
Middle........	4–6 weeks.	3½ years.	do.	2½ years.	do.	do.	do.	do.
Outer middle	...	...	14 days after birth.	3½ years.	...	...	...	...
Corner........	6–9 mo.	4½ years.	2–3 weeks.	4½ years.	Before or a few days after birth.	6 months.	do.	5 months.
II. TUSHES..........	4 to 5 yrs.	...	...	...	Before or a few days after birth.	1 year.	do.	5–6 mo.
III. MOLARS.								
1	Before or a few days after birth.	2½ years.	Before or a few days after birth.	1½ years.	Before or a few days after birth.	...	3–4 mo.	...
2	do.	do.	do.	2½ years.	do.	2 years.	4 to 5 weeks	5–6 mo.
3	do.	3½ years.	do.	3½ years.	do.	2 years.	do.	do.
4	10-12 mo.	...	6–9 mo.	...	5–6 mo.	do.	do.	do.
5	1½–2 years.	...	2½ years.	...	1 year.	...	4–5 mo.	...
6	4–5 years.	...	4–5 years.	...	1½–2 years.	...	5–6 mo.	...
7	...	...	...	...	3 years.	...	5½-6½ mo.	...
Number of Teeth.	Horse ....40 Mare.........36		32		44		Dog......42 Cat.......30	

In order to consider this subject more fully, we may commence with the

TEETH IN HERBIVORA.—The incisor teeth vary in importance in our grass-feeding animals, and are absent in the upper jaw of the ruminant, where their place is occupied by the fibro-elastic pad referred to at page 13. In the horse there are two pairs of tushes, and we observe twelve large molars in the upper and lower jaw. In front of the molars there are occasionally small rudimentary teeth, called by horsemen wolves' teeth, and various superstitions are connected with these accidental and harmless elements of the dental apparatus. The molar teeth of the horse have the grooves produced by the cement arranged longitudinally to favour mastication. (See Fig. 23.)

TO DETERMINE THE AGE OF THE HORSE BY THE TEETH.—It is chiefly by the incisor teeth that we can tell how old a horse is, and it is important to consider the change in shape and general appearance which these teeth undergo. There are temporary and permanent incisors. The first have a broad crown, flattened somewhat from before back, with a wearing surface far wider from side to side than from behind forwards. They have a distinct neck, and a narrow sharp fang. The appearance of the temporary teeth is shelly, and there is a well-marked depression or infundibulum on the upper aspect. The front of the tooth is of a pearly white, and grooved or fluted. (See Figs. 10, 14.) The permanent incisor is much larger than the temporary. Its crown thicker, of a duller colour, and the cavity or infundibulum is deeper. (See Figs. 17, 18.) The neck of the tooth is not so well defined, and as the animal acquires age, we find a very remarkable change in the shape. This is best seen at Fig. 19, which represents different sections of the permanent incisor as its surface appears from progressive wear.

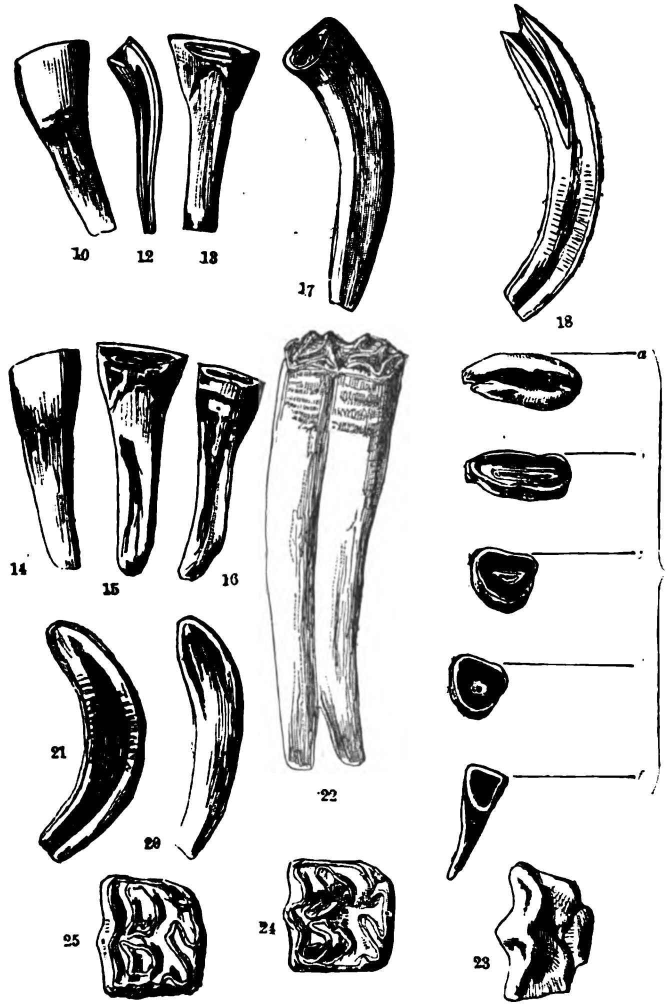

Fig. 19.

It is from birth to the age of eight years that, from the condition of the "marks" or dark cavities in the table of the incisors, we can determine the age of the horse. *There are deceptive cases.* I especially allude to this, because whatever may be our knowledge of the horse, we may occasionally, though *very rarely*, be deceived by the very marks which are our surest guides. I have seen all the marks perfect, and the incisors presenting a youthful appearance in a horse verging on twenty. Recently I examined an aged horse, which might have passed for a six-year-old from the shape and marks of the incisors.

The molar teeth are rarely looked at in determining the age of the horse, but they furnish valuable corroborative evidence on certain occasions, especially with young animals. They are not easily examined, but it is their number which in the colt confirms or negatives the opinion expressed as to the animal's age. The recently-formed molar has a shelly character, and prominent tubercles of enamel which soon wear down to form a broad grinding surface, and then the young and old teeth are not easily distinguished one from the other.

The horse has six incisors above and six below. They are compound teeth, as shown at Fig. 18, and the cavity extends downwards, having beyond and a little in front of it the pulp cavity, which in old horses is indicated, as the teeth wear down, by a dark hard structure, which then fills it, and which has been called *osteo-dentine.*

I have before alluded to the difference between the permanent and temporary incisors. The latter are in perfect apposition as the colt approaches two years of age, and not unfrequently has an animal, and especially a pony, been bought for five from the temporary teeth being mistaken for permanent.

The temporary incisor is gradually displaced by pressure from the permanent. The latter advances, and, as shown at Fig. 19, has a shelly aspect, seen in *a*. At *b*, the incisor tooth indicates two years' wear; at *c*, the result of five years' friction; at *d*, nine years', and at *f*, about seventeen years' wear. The shape of the wearing surface of the tooth is of great importance in determining approximatively the age of old horses. Before eight years of age the eruptive changes and periodic appearances of the teeth are very regular and valuable in indicating the horse's age.

The foal, at birth, indicates the fast approaching eruption of the two central incisors; sometimes these are through the gums when the animal is foaled; if not, they appear within the first month. Three molar teeth on each side of both upper and lower jaw are prominent, and in apposition for wear at the same time. One incisor on each side of the two central appears at six weeks, and then time is allowed for the jaws to grow. The cavities of reserve with teeth forming in them grow behind the teeth first formed, and by nine months the corner incisors protrude, and gradually grow until the animal is a twelvemonth old, when all the colt's incisors are in full use. Within one and two years of age, little can be seen beyond a gradual wearing down of the temporary teeth, and the protrusion through the gums of the molar, fourth in position, on each side of the two jaws. At two years the worn aspect of the incisors indicates the approaching displacement of the central ones, and the fifth molar tooth protrudes through the gums.

Between two and three years the central permanent incisors displace the temporary, and are readily distinguished by their size, yellowish colour of the enamel, and dark infundibulum. (Compare Figs. 10 and 12 with Figs. 17 and 18.) It is at this age that the Yorkshireman often knocks out the middle incisors to make the horse look "three off," or "coming four." This often retards their eruption, which is always complete at four years, when the sixth molar tooth on either side of each jaw is also advanced through the gum. By this time the three temporary grinders or molar teeth, which are noticed shortly after birth, have given way to permanent teeth. The lower tushes are felt through the membrane, between the corner incisor and first molar, as early as three years of age; but they only appear above it between four and five. It is at this age that the horse's mouth becomes fully furnished, and by five the whole of the incisors are in full wear, and indicate the extent to which they have been worn proportionate to the period since their eruption. The central incisors then appear, as shown in *b*, Fig. 19, whereas the corner ones having just protruded, are shelly, as shown in *a*.

At six years the central incisors lose their mark; at seven this occurs with the middle ones; and at eight all the infundibula are worn out, and the plate of the tooth is clean, and only very slightly marked in the corner teeth. Beyond this period the horse is stated to be aged. The incisors protrude straighter from the receding jaw—the teeth become narrower—and their wearing surface acquires a triangular form, as seen at *c*, *d*, and *f*, Fig. 19. This distinguishes the old animal.

Dentition in the Ox.—The incisor teeth of the lower jaw of the ox are simple, and eight in number. From the periods of eruption of both temporary and permanent teeth being regular, the age of the animal is readily recognised. Beyond the eruptive changes we observe the sharp teeth becoming more and more blunt and narrow, until reduced to very small stumps, which are seen in old cattle. The subjoined table indicates the succession in the changes observed in the ox:—

Simonds. Table of Early Average Improved Breeds.			Simonds. Table of Late Average Improved Breeds.			Girard. Table of Late Average (Unimproved Breeds).		
Yrs.	Mo.	No. of Teeth.	Yrs.	Mo.	No. of Teeth.	Yrs.	Mo.	No. of Teeth.
1	9	2 permanent incisors.	2	3	2 permanent incisors.	2	3	2 permanent incisors.
2	3	4 do.	2	9	4 do.	3	0	4 do.
2	9	6 do.	3	3	6 do.	4	0	6 do.
3	3	8 do.	3	9	8 do.	5	0	8 do.

Dentition in the Sheep.—In the sheep the same remarks apply, and it is by the displacement of temporary, and eruption of the permanent teeth, that the age of this animal is also determined. Professor Simonds furnishes us with the annexed table:—

Table of Early Dentition.			Table of Late Dentition.		
Years.	Months.		Years.	Months.	
1	0	Central pair of temporary incisors replaced by permanent.	1	4	Two permanent incisors.
1	6	Second pair ,, ,,	2	0	Four ,, ,,
2	3	Third ,, ,, ,,	2	9	Six ,, ,,
3	0	Fourth ,, ,, ,,	3	6	Eight ,, ,,

Teeth of Carnivora and Omnivora.—I have said that in carnivora we have all simple teeth, that is to say, covered entirely over the crown by brilliantly white enamel. The row of sharp teeth is well adapted for its object. There are three pairs of incisors, or front cutting teeth, one pair of canines, and a certain number of simple and cutting molars. It is the last pre-molars, or the first true molars, which are employed in chewing flesh; they are prominent and sharp. Behind these, especially in the dog, the teeth are armed with round tubercules on their surface, destined for a crushing or grinding action, and in breaking bones or gnawing long grass, the dog may be seen to push the substance between these back molar teeth.

DENTITION IN THE DOG.—The subjoined engraving (Fig. 26), shows the form and position of the teeth of the dog.

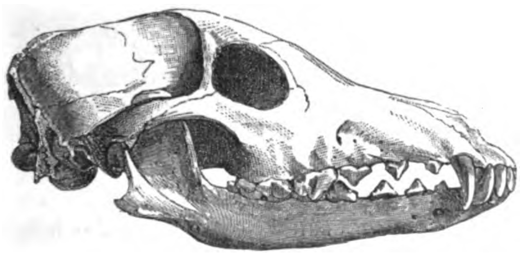

Fig. 26.

Their number in the upper and lower jaw is expressed in the following formula:—

$$\text{Incisors, } \frac{6}{6}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{6-6}{7-7} = 42.$$

The information we possess is furnished in Kreutzer's table at page 52. Girard is the only authority on the subject, and the following statement, as well as the illustrations, are derived from his work. This is a subject worthy of study, and I have the promise from kennels of the skulls of hounds whose age is known, and by such means the observations of the old authors may be confirmed or corrected.

As Girard says, the dog is born with the eyes shut, and which open on the 10th or 15th day after birth. The whole of the milk teeth are usually cut then, or very shortly after. Between two and four months old the central incisors, and often even the middle ones of both upper and lower jaw, drop out, and speedily the whole of the permanent teeth are fully developed, so as to complete the mouth by eight months.

The inferior incisors begin to wear by fifteen months. At Fig. 27, the milk teeth are shown as seen in a puppy two or three months old, whereas Fig. 28 represents them in a year-

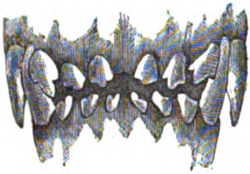

Fig. 27.

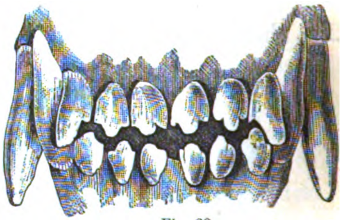

Fig. 28.

old dog At eighteen months or two years, the inferior central incisors are much worn, and between two and three years (see Fig. 29) the middle ones are also worn. The worn in-

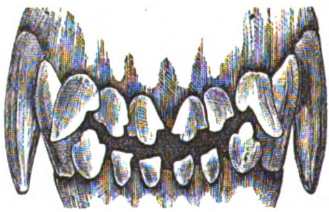

Fig. 29.

cisor bears a striking contrast with the young teeth as shown at Fig. 28, where the edge or border of the teeth is divided into three lobes, of which the most prominent constitutes the point of the tooth. "The two lateral lobes have the appearance of notches cut on either side of the principal lobe, and the union of the three resembles the *fleur-de-lis*, which, however, is, in the process of time, effaced by the wearing of the teeth."

Between three and four years the upper central incisors are worn, and between four and five, the whole give indications of much use (see Figs. 30, 31). Beyond this period the teeth offer very uncertain signs of age. The bluntness and yellow colour of the tushes and other teeth offer the best signs of increasing years.

Fig. 30.

Fig. 31.

DENTITION IN THE PIG.—This subject has acquired great importance in connection with the management of show-yards, and great credit is due to Professor Simonds and R. L. Hunt, Esq., veterinary surgeon, Birmingham, for the accurate knowledge regarding the age of the pig which they have acquired and disseminated.

The pig is born with eight teeth, which are fœtal incisors and fœtal tushes. At one month four incisors are cut, besides three temporary molars on either side of each jaw. Two more temporary incisors are added to each jaw at three months, and all the milk teeth are then in position. The jaws and teeth grow, and at six months, "in most animals, but not in all, a small tooth comes up on either side of the lower jaw, behind the temporary tushes, between them and the molars, and in the upper jaw directly in front of the molars." These teeth have been mistaken for tushes. The fourth molar in position appears through the gum also at six months. The corner incisors are displaced, and permanent ones cut at nine months. The permanent tushes are also cut at this period, as well as the fifth molar on each side of either jaw. At one year the middle incisors are changed, and the tushes appear of considerable size. The deciduous molars are likewise shed at one year, and succeeded by permanent. "At eighteen months," says Professor Simonds, "or about this period, the dentition of the pig may be said to be completed. This is effected by the cutting of the lateral incisors, and also of the last or sixth molar." Professor Simonds furnishes us with the following useful table:—

——	At Birth	One Month.	Three Months.	Nine Months.	Twelve Months.	Eighteen Months.
Fœtal { Incisors	4	4	4	...	...	...
Fœtal { Tusks	4	4	4	...	...	...
Temporary Incisors	...	4 central	8 central and lateral	8 central and lateral	4 lateral	...
Permanent Incisors	...	...	...	4 corner	8 central and corner	12 central, lateral, and corner
Permanent Tusks	...	...	...	4 (*cutting.*)	4	4
Total in both jaws	8	12	16	16	16	16

I have referred to the subject of age in connection with the process of dentition in our domestic quadrupeds, and it may not be inappropriate to allude to the fact that other signs indicate youth, adultism, and old age. In horned animals the horns grow annually a certain length, and this is shown by the appearance of an extra ring every year at the root of the horn. For the first two years the rings are so indistinct that in calculating the age in an animal five or six years old, the first ring indicates a three years' growth, so that an animal with six rings in its horn must be regarded as eight years of age.

Fraud has been practised to destroy the marks of age.

The angularity of form, sharpness of bones, and grey colour of the hair are not readily hidden, but teeth can be filed and marked, and horns scraped. Making false marks in the teeth is termed 'bishoping,'—a practice common amongst horse-copers. Why it should be called *bishoping* I cannot say, but it strikes me that the name was originally adopted as indicating cheating or cunning, for which prelates were long reputed famous. This opinion is strengthened by the following circumstance:—It is not usually known that when a horse is taken to a forge to be shod, that, instead of putting new shoes on, old ones are sometimes placed in the fire, heated and shaped to pass for new. Such shoes have always a red, rusty look, and in Italy are called 'cardinals.' There is evidently connection between the term 'bishop' and 'cardinal,' as both are used to designate a fraudulent practice, though, with regard to the last, as applied to old shoes, it is, perhaps, derived from the red colour, which is that of the cardinals' stockings.

The grey hairs of animals are sometimes painted—this is called 'gypping.' In old horses the remarkable depressions behind the orbits are sometimes pricked and blown up with air; this is called, in horse-coping language, 'puffing the glym.'

It should be remembered that with animals as with the human subject, a well-authenticated certificate of birth is more reliable than the opinion of a professional man as to age, however experienced he may be, and in the large majority of instances, not liable to be misled. The fraudulent tricks can readily be detected by us, and the cases of most difficulty are those of animals in which the wear of the teeth does not go on regularly, and other signs of age may develop tardily. Just as we see hale, old men of seventy, who are taken for being fifty or little more, so may we see a fresh, old horse at twenty retain a remarkably youthful appearance.

There are occasionally very singular conditions of the teeth of horses, and one of the most common is the persistence in the jaw of some of the temporary incisors. This arises from the latter not having been pressed upon by the advancing permanent teeth, and they then lose the colour and form of *colt's* teeth. I have known a horse with twelve incisors in the lower jaw, though most frequently the peculiarity only amounts to the presence of one or two extra teeth. Occasionally a tooth may be wanting, either from having been removed or never having been developed. Even in these exceptional cases, the appearances of the mouth are fair guides in ascertaining the age of horses.

CHAPTER II.

DIGESTION.—DISEASES OF TEETH.—INSALIVATION.

Mastication.—Opening and closing the jaws.—Lateral action in herbivora.—Regularity in the action of the jaws.—The action slow.—Peculiarity in ruminants.—Movement in carnivora.—Action of tongue during mastication.—Injuries to the temporo-maxillary joints.—Dislocation.—Open joint.—Diseases of the jaws.—Fractures.—Their consequences.—Scrofulous softening and degeneration.—Fibro-plastic growths, or osteo-sarcoma.—Abnormal state of the teeth.—Tumour on an incisor.—Buck teeth.—'Crib-biting.'—Its symptoms and prevention.—Fracture and dislocation of the incisors.—Removal of incisors.—Peculiarities and disease of the molar teeth.—Supernumerary teeth.—Wolf's teeth.—Irregularities of development.—Fistulæ on the forehead.—An instructive case in a colt.—Molar pressing through the palate.—Irregularities in the rows of teeth.—Sharp edges of molars.—Excess in length of molars.—Caries.—Deposit of bone within the tooth socket.—Diseases of the dental pulp and of periosteum.—Symptoms of disease of teeth.—Operations on teeth.—'Chewing a rasp.'—Brogniez's instruments.—Gowing's Instruments.—Extraction of teeth.—Plugging teeth.—Insalivation.—Diseases of the salivary apparatus.—Functional disorders.—Concretions.—Parotitis.—Deglutition.

THE jaws and teeth are disposed, as we have already seen, for a very various action in carnivorous and herbivorous animals. The mouth is opened by the relaxation of the powerful masseters, the dropping of the lower jaw in consequence of its own weight and the action of the digastric muscle. In the horse, another muscle, the stylo-maxillaris, aids materially in the same act. The closure of the mouth is effected by muscles which are extremely powerful in carnivora, and very effective also in herbivorous quadrupeds.

In the latter we observe a lateral movement which the French have called "mouvement de diduction," and which really is the movement of the axis of the lower jaw across that of the upper. It is rather a rotatory movement than a lateral displacement, one of the articulatory heads of the lower jaw being fixed or turning on its own centre, whilst the opposite one describes an arch. The nature of this lateral movement explains how it can only occur one way at a time, as Colin has shown by some very interesting experiments.

All the organs of mastication act with a remarkable regularity in herbivorous animals, and we find that the movement of the lower jaw may persist from one side to the other, whichever it may be, for a quarter of an hour, and even for one whole hour at a time. Thus the lower jaw may move to the right and back to the left, the grinding process going on between the right molars, and *vice versâ*. This unilateral movement, Colin says, may be observed in the horse, ass, mule, deer, hemione, zebra, rhinoceros, ox, buffalo, bison, antelope, sheep, goat, and other ruminants.

In all herbivorous animals mastication is slow, and Colin has found that, on an average, a horse requires an hour and a quarter to eat four pounds of hay, and of which, in chewing, he makes from sixty to sixty-five boluses. The process of mastication is much favoured by the flow of saliva, and the movements of the jaw are more numerous when this is scanty.

The slow act of chewing in the horse is destined for the complete trituration of food which has to pass quickly through the stomach. The act of mastication and insalivation is more essential in the horse than in omnivorous or carnivorous animals, and if oats are passed through the mouth uncrushed, or if the teeth are incapacitated from any circumstance, so that hay or any other food escapes grinding, the animal falls off in condition.

In ruminating animals the act of chewing is very rapid and incomplete whilst the collection of food is going on, but there is a very slow and perfect mastication when the aliment is returned to the mouth during rumination.

Carnivorous animals do not enjoy this lateral movement, from the fixed nature of the joint between the jaws, as well as the manner in which the teeth fix into each other, and do not present a surface for free lateral friction.

The teeth are therefore adapted for the perforation of flesh by a simple closure of the jaws in all carnivora, whereas they are truly grinders in the herbivora. The tongue, in connection with mastication, rolls the food from side to side, and from before back, whereas the cheeks, also endowed with muscular power, press the food between the molars.

DISEASES OF, AND INJURIES TO, THE ORGANS OF MASTICATION.

INJURIES INFLICTED ON THE JOINT BETWEEN THE TEMPORAL BONE AND LOWER JAW.—This joint is broad, well protected, and so formed as to render it not very liable to injury or disease, which, whenever present, is attended with much danger. In man, and some of the lower animals, *dislocation* backwards is possible. This is an accident unknown in the horse and large herbivorous quadrupeds. It is of extreme rarity even in the dog and cat, and occurs from the lower jaw being accidentally opened wider than is normally admitted by the joint. The mouth being forced open in the cruel manner we have seen adopted in giving some animals medicine, is apt to injure the joint. The displacement is usually downwards, but sometimes to one side. The first form is termed complete, and the second incomplete.

Treatment.—By pressing the thumb firmly against the neck of the lower jaw, grasping the latter with the other fingers, and then turning backwards and giving an upward direction to the chin, the jaw snaps into its proper place. Hertwig says: "One man holds the animal's four legs and body still, and two assistants firmly fix the head. A bit of wood from 10 to 16 inches long, and from ½ to 1 inch thick, must be pressed between the jaws as far back as possible, and then the operator grasps the lower jaw and straightens it, pressing it firmly upwards against the stick. In this act a powerful leverage is obtained, whereby the bones are brought in apposition." The after-treatment consists in keeping the animal as quiet as possible.

Open Joint.—Both horses and oxen are liable to blows and wounds over the temporo-maxillary joint. If the synovia or joint-oil flows at once after the infliction of the injury, we observe the part soon to swell, become hot and painful, and the glutinous discharge very abundant. Whenever the animal moves the lower jaw, the discharge increases, and it soon becomes turbid and purulent. This formation of pus or matter is attended with progressive destruction by ulceration of the joint surface, and when a case has attained this point, in the horse, it must be regarded as incurable. (See Fig. 32.) The common result is a gradual diminution of the inflammation, with increase rather than diminution of the swelling, and this is due to bony deposition. The joint may become fixed or anchylosed, the animal cannot masticate, and death is the inevitable result. The lateral action of the jaws in herbivora renders the accident more dangerous in them than in all the animals in which a simple opening and closing of the mouth is effected.

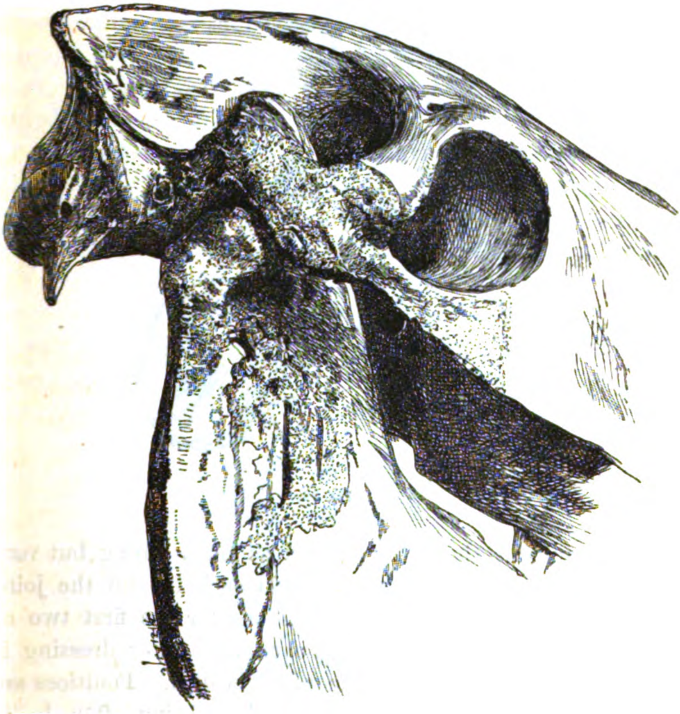

Fig. 32.

Treatment consists in applying a strap and head-collar on the horse and ox, such as the one represented below and used for fractures. (See Fig. 33.)

Fig. 33.

The animals should be allowed as much strong but very liquid gruel, milk, &c., as they will suck in, and the joint must be treated by cold fomentations for the first two or three days, and if the wound is open, cold water dressing is the best application to ensure rapid healing. Poultices are with difficulty applied, and from their being often badly made and badly fixed on the part, do more harm than good. As the wound improves, but even if inflammation should occur, the following lotion is of great value: Tincture of arnica, 1 oz., Goulard water, 1 oz., to 12 or 20 oz. of water. This must be used with layers of lint or linen tied over the part, and kept constantly wet with the mixture. The horse or ox must not be allowed a particle of solid food until the opening is closed, which, in successful cases, will be obtained in about a week or ten days. All means to close the wound early, such as caustics and the hot iron, fail.

Death in these cases may result from three causes. The most common is probably anchylosis, or bony deposition around the joint; the second in frequency is purulent infection, or poisoning of the blood by pus or matter; and the third is tetanus or lock-jaw.

DISEASES OF THE JAWS.—The horse is not very subject to the peculiar degenerations of bones which implicate the face and lower jaw of cattle. I have only seen one instance of, apparently, scrofulous disease of the lower jaw in the horse. The subjoined cut indicates the amount of destruction which occurred by suppuration, the manner in which all the teeth became loose, and were only supported by the membrane of the gums, the teeth themselves escaping free from disease. (Fig. 34.) Such a condition is clearly incurable, and for-

Fig. 34.

tunately very rare. In the ox also a remarkable condition is represented by Figs. 35, 36, due to abscess in the jaw, whereby the bone has been destroyed and the teeth displaced:—

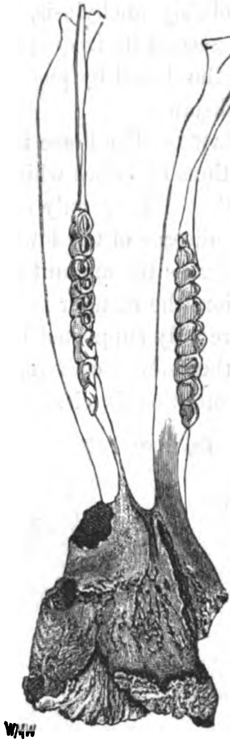

Fig. 35.

In young cattle there is a somewhat frequent disease termed by some veterinary writers 'Osteo sarcoma,' 'Spina ventosa,' and other inappropriate names. The only term I can give to it is fibro-plastic degeneration of bone. There is no recognised cause of the disease. It occurs most readily from 2 to 5 or 6 years of age, and affects steers in preference

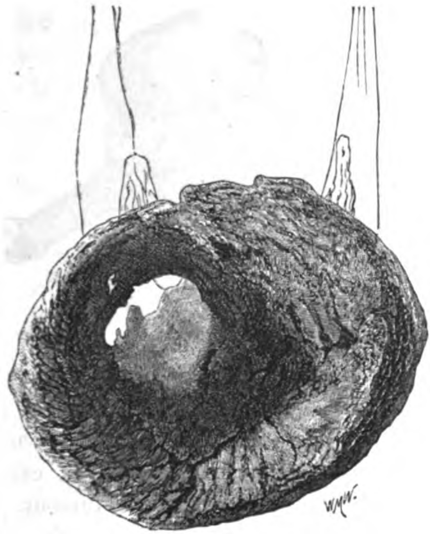

Fig. 36.

to bulls, the lower jaw is most frequently seized in the vicinity of the second and third molar teeth. (See Fig. 37.)

Fig. 37.

Sometimes the upper jaw is implicated, and from a beautiful specimen I obtained the subjoined illustration:

Fig. 33.

Symptoms.—At a spot on the side of the face corresponding to the roots of the third or fourth grinder, above or below, a small, hot, circumscribed swelling occurs. The animal experiences no inconvenience from it, except when the part is struck or pressed upon. The tumour, however, grows and pain increases. In some cases the growth is rapid, and in a few months the disease has invaded the larger part of one half of the upper or lower jaw, and gives rise to severe symptoms, which arise chiefly from disturbed mastication, pain, and often from various cruel methods of treating the disease. The teeth become loose in their sockets, may be affected by caries, and drop out. Anacker says that sometimes a fistula opens into the mouth.

Nature and causes of the disease.—It is evidently a morbid condition of the bony structure. On dissecting the skin off the tumour, we find it covered with tough fibrous tissue arranged in layers. The fibrous element diminishes towards the deeper parts of the growth, where at various parts yellow accumulations of a friable, cellular, or granular matter are enclosed in solid cavities, surrounded by bony plates or a tough gristly tissue. M. Collignon, veterinary inspector of the slaughter-house of Montmartre, has observed the disease three times in 300 oxen, and those he found affected came from the marshy plains of La Rochelle. In the plains of Ferrara and in the Maremme of Tuscany the disease is very frequent. Low-bred animals are most subject to it, and its origin is usually attributed to a blow.

Treatment.—In the early stage, the small tumour may be blistered, or iodine ointment rubbed over its surface daily for a week. Should this fail to disperse the disease, it progresses in spite of all treatment, and most rapidly if any attempt is made to extirpate the growth. The proper advice in any such case, is to consign the animal as soon as possible to the butcher. As I mention in my work on *Dairy Stock*, "this malady is incurable, and dairy-keepers should not allow cows to be treated for any length of time, as I have seen them occasionally in Yorkshire."

Fractures of the Jaws.—The upper jaw is not much subject to this kind of injury, but the lower is very liable to be broken. The causes are falls, kicks, and other blows. Partial fractures may result from animals biting incautiously very hard substances, or from the withdrawal of teeth.

Sometimes the bone is cracked, but oftener broken, so that distinct grating may be heard when the lower jaw is moved. In young animals the fracture is longitudinal, and separates the two halves of the lower jaw between the incisor teeth. A curious form of oblique fracture is represented at Fig. 39.

FIG. 39.

This is very uncommon, and more frequently do we observe the fracture represented below:—

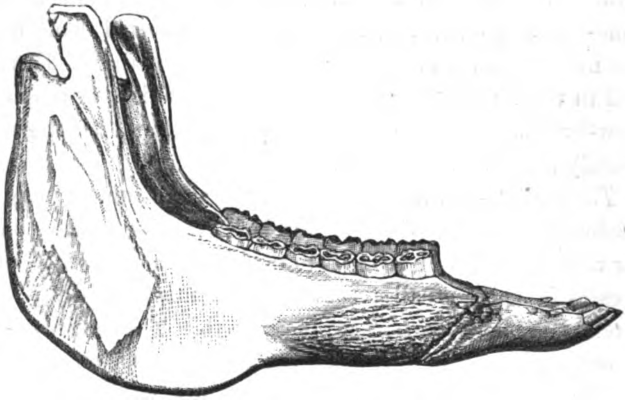

Fig. 40.

The skin may be wounded by the blow which induces the fracture, rendering this *compound*, and occasionally the bone may be splintered—that is to say, the fracture comminuted. The most dangerous position for a break in the jaw is below the thick muscular structures at its broadest point.

The *symptoms* are easily recognised. They are: difficult mastication, slavering, sometimes slight hæmorrhage, some swelling, and very decided grating on rubbing the ends of the broken bone. If the fracture is about the branch between the molar and incisor teeth, by passing the fingers along the lower margin of the jaw, the irregularity due to the break is observable.

Treatment varies according to the nature and position of the fracture. In longitudinal fractures of the chin, the best plan is to tie firmly together the central incisor teeth, so as to hold the parts in perfect apposition, and in all animals provided with tushes the latter may be tied together across the mouth. Silver wire is the best kind of ligature for such an operation. Charges have been applied over the seat of injury, but, as they cannot limit the movement of the jaw, are of no use. Splints of wood or iron are easily applied in the inter-maxillary space, and on either side of the head, to keep the bones in apposition; and a head-collar, shown at Fig. 33, has been used, but is not sufficient alone. Even in transverse and oblique fractures of the neck of the lower jaw, the ends of the bone may be cut down upon, trephined, and tied together by silver wire. This plan has not been recommended by any veterinary writer that I am acquainted with, and the most usual method is to rely on external applications as means of diminishing movement, and ensuring the apposition of parts.

The consequences of ununited or irregularly joined frac-

Fig. 41.

tures about the chin are shown in the annexed cuts, (Figs. 41, 42.) The portions of separated bone have been surrounded by deposit in order to consolidate the parts. The incisor teeth have been irregularly displaced by the chin

Fig. 42.

splitting up, and the continuous increase in the bony deposition led to the animal experiencing more and more difficulty in collecting and chewing food. The animal was necessarily destroyed.

PATHOLOGY OF THE INCISORS.—Professor Bouley states, in an admirable article on the Diseases of the Teeth,* that the incisors of the horse are never affected with caries. The only

* *Nouveau Dictionnaire Pratique de Médecine, de Chirurgie et d'Hygiène Vétérinaires.* Tome Quatrième. Paris: Labé. 1858.

structural disease I have noticed has been, in one case, the development of a tumour from the cement at the neck of one of the lower incisors. The tumour was about the size of a walnut, and in structure approached as much the characters of true bone as any specimen of cement which may be examined. Such a growth is easily knocked off with a chisel.

The *position* of the incisors is subject to some deviations from the normal state. This is well illustrated by Fig. 43,

Fig. 43.

which represents a peculiar curling in of the alveoli, and consequent contracted appearance of the arch of the teeth. This is certainly rare, and more commonly do we find anomalies as to number.

Fig. 44 indicates one of the very common irregularities which give a still more peculiar appearance to the mouth when the teeth over-ride each other, and as many as eleven, and sometimes twelve incisors, have been seen in the lower jaw, constituting a double row of teeth.

In all our domestic animals peculiar deviations from the

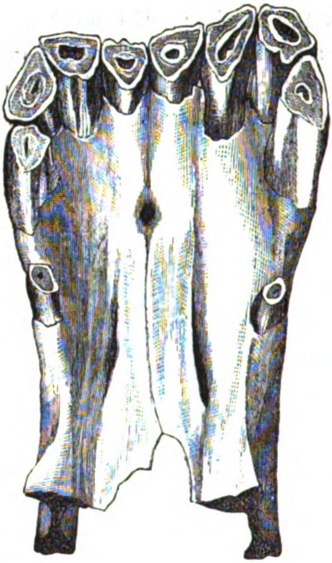

Fig. 44.

natural development and eruptions of the teeth are observed These are calculated occasionally to give rise to very serious local destruction and general disturbance. In the first place, we must refer to displacement during growth. Thus an incisor tooth may be seen to protrude on one side of the jaw, instead of being situated in a row with the rest. This is called a buck tooth, and requires removal. Sometimes the temporary tooth must be extracted in order to admit of the straight eruption of the permanent one.

When teeth are not in apposition, their continued growth leads to remarkable deformities, the most common and important of which is *parrot-mouth*, represented by Fig. 5, p. 11.

The incisor teeth of herbivorous quadrupeds are often subject to excessive wear, and in no animal is this more frequently seen than in the horse, when the habits of gnawing the manger and of crib-biting are indulged in. '*Crib-biting*' is a peculiar propensity, which is regarded as a decided vice, because, when the habit becomes confirmed, it is attended by very disagreeable symptoms.

A 'crib-biter' is always known by the worn aspect of the incisors, and this not from a fair way of biting, but rather pressing or rubbing the edge of the teeth either of the upper or lower jaw, or both, against any hard object, especially the manger, as the most convenient spot. In the act of cribbing, a horse fixes his head, curves his neck, and appears to eructate, or to swallow air. Whatever may be the nature of the act, there is soon evidence of a dyspeptic state, as the abdomen swells, and the horse may seriously injure himself by persistence in indulging in this bad habit. In some cases the evils attending the vice are not so great, but at all times a crib-biter must be looked upon very suspiciously. In the course of time the gullet becomes thin and distended in crib-biters, and from the irregularity in the width of the passage, choking is sometimes favoured.

The only cure for a crib-biter is to do away with the manger, or any object against which the horse can crib. By placing straps round the throat, and thus pressing on the windpipe, the animal is stopped from the bad practice, but this is attended with the danger of producing distortion and constriction of the air-passage, rendering the animal an incurable roarer.

The incisor teeth are often broken, or partially displaced. When broken, it is possible that, as they grow, the deformity disappears, though sometimes it is necessary to remove one. This is effected by forceps, which are billed or necked with a deep fossa or notch, so as to enable the operator to get a firm hold of the tooth close to the gum.

Attention must be paid to the direction of the teeth in drawing them, the upper incisors curving upwards and backwards, and the lower ones downwards and backwards. To prevent injury to the alveolus or tooth socket, the incisor to be removed should be shaken and loosened, before much traction is employed in order to withdraw the tooth. I may mention, that it is most frequently a temporary incisor, with a short slender fang, that we are called upon to extract, and this is attended with very little difficulty.

Peculiarities and Diseases of the Molar Teeth.—Bouley justly states that it is rare to see supernumerary molars, yet he remembers a case in which a horse had double rows in the upper jaw. This, says Bouley, must have arisen from the dental papillæ, or, as he calls them, 'pulps,' having exceeded the proper number in the development of the dental apparatus. The so-called wolf's tooth, often seen in front of either row of molars, and serving no purpose in the process of mastication, must be regarded as a supernumerary, and various prejudices prevail regarding its evil effects. There may be some foundation in truth for some opinions in favour of the wolf's teeth being injurious, from the fact that they occasionally, but very rarely, deviate from the straight direction, and interfere somewhat with mastication.

Amongst the abnormal developments of teeth we must class a series of interesting cases, in which tumours, composed entirely of tooth substance, are formed at the root of the ear, in the vicinity of the petrous temporal bone. According to Lafosse, they are the result of deviations from a normal method of development of true teeth. In 1856

I published some notes on a case,* which I think may not be unworthy a place here. I said:—

"M. Lafosse,† professor of clinical medicine in the veterinary school of Toulouse, had under his treatment a four-year-old mare, which, two months before admission into the infirmary, was affected with a phlegmonous tumour in the vicinity of the left ear. This was opened; the wound that resulted rapidly contracted, but a fistula remained. On the 8th of February, 1855, when Lafosse first saw the case, he found a painful tumour, with a granulating wound just behind the scutiform cartilage, and near the upper part of the parotid gland. The mare was restless, and the parts could only be examined in a complete manner the day after, when she was cast. By probing, he ascertained that at the bottom of the fistulous tract was some hard substance, which he supposed to be the scutiform cartilage in an ossified state, or a portion of the temporal bone exfoliating. A severe operation was performed, and the solid object, with some difficulty, extracted. It was double, deeply seated, and firmly adherent to surrounding textures. Slight hæmorrhage occurred, from division of the anterior auricular artery, which was easily stopped; the wound was dressed, and the animal soon recovered, having shown only a few symptoms of sore throat after the operation.

"I shall not translate M. Lafosse's description of the products he extracted. They were composed of tooth-substance; and although it has been questioned whether it is real tooth that is developed in the shape of accidental growths in the vicinity of the ear, still it is now a well-established fact, however puzzling to the minds of some it may be to comprehend the origin of their existence.

* See "Contemporary Progress of Veterinary Science and Art, by John Gamgee," *Veterinarian*, page 393.

† *Journal des Vétérinaires du Midi*, June, 1855.

"Lafosse attempts a teratological explanation, but first asks, 'If teeth are looked on as arising from the tegumentary system, considering them in most animals as emanating from papillæ and mucous membrane, where was the dermoid papilla that constituted the basis of development of this tooth, deeply seated and close to the ear, especially as what might be taken as the crown looked towards the inner surface of the skin?'

"Further on, Lafosse shows that in certain animals teeth absolutely emanate from the osseous system, such as in the *coluber scaber*, and other serpents, in which true osseous eminences, coated by enamel, pierce the œsophagean tunics, and project into the tube, whereas they are attached to about thirty vertebræ, of which they form the inferior spinous process. These are intended to crush the eggs that the serpents feed upon.

"Having established that, as well as developing from mucous membrane, teeth may spring from bone, Lafosse leads us to consider the dental tumours, above spoken of, as congenital, and he looks on them as having sprung from some rudiment of a maxillary bone. In a word, he looks on it as an aberration of development. 'It cannot,' says Lafosse, 'be looked on as an osseous transformation of certain tissues.'"

A satisfactory account of the morbid developments under consideration is given in the *Edinburgh Veterinary Review*, page 189, for the current year. The article is entitled "Fistula of the Temporal Region," in which it is stated that "M. Macrops has operated on numerous cases of this nature with a happy result. They consist in the development of a dental tumour in the substance of the temporal bone, in front of the ear: leading to the production of a fistula, discharging a greyish pus, possessed of a disagreeable odour. The fistula is commonly straight, and opens in the midst of a slight tumour, covered by skin of a hard and warty structure. The animal eats slowly and with difficulty, it is in consequence in a lean and unthrifty condition.

"The last case of M. Macrops which is recorded at length, had been previously treated by three veterinary surgeons without success, and was about to be slaughtered as incurable when it fell into his hands.

"After securing the animal properly, a crucial incision was made over the tumour, and the skin raised from the osseous parietes, to which it was firmly adherent. The outer plate of the cranium was then found to be attenuated by the pressure of the foreign body. By means of pincers and a knife a sufficient amount of this was removed to allow of the introduction of a strong instrument beside the dental tumour. By this instrument pressure was effected on the tumour in different directions, always avoiding any measure calculated to cause pressure on the brain, and, after some difficulty, the offending body was removed, leaving a deep cavity with smooth edges.

"M. Macrops has always found these fistulæ dependent on a similar cause, and in all the cases operated on by him, the crown of the tooth has been turned towards the cranium.

"Out of fourteen horses on which the same operation was performed, thirteen were completely cured in the course of from ten to fifteen days. The fourteenth was twice operated on, with an interval of three months, and at each operation a similar tumour was extracted. After the second operation there still remains a soft, encysted tumour, of the size of a small egg, from the inner surface of which is secreted a transparent albuminous fluid. When the tumour is full, the liquid escapes by a very delicate canal, opening opposite the middle of the ear. All means resorted to for the cure of this cyst have failed,—the injection of tincture of iodine, the application of the hot iron to its inner surface, and the passage of a seton through it, have been equally ineffectual. M. Maccrops is accordingly of opinion that in this case a third tumour of a similar kind is in progress of formation.

"A remarkable feature in these cases is, that the subjects are all young animals, and during the period of dentition. This can easily be understood; another circumstance, however, is not so easily explained, the tumours have all been on the right side. This, if possessed of no definite cause, must be looked on as at least a remarkable coincidence.

"M. Macrops has also found them invariably directed upward toward the poll, so that he looks on them as resulting from a sort of reversing of the embryo tooth.

"In the April number of this Journal there is a description of a similar case, operated on by M. Tyvaert, Government veterinary surgeon at Mechlin. His subject was eight months old, and had been treated for three months by an empiric without effect. In this case there was a fluctuating tumour, containing a quantity of whitish liquid, on the opening of which the dental tumour was exposed. It was first loosened with a hammer, and *rogne pied*, after which it was easily extracted by strong pincers. The walls of the sinus were then cauterised with a hot iron, and speedily healed up."

The importance of this subject to the rearer of young horses cannot be overrated, and I have a case in my own practice which proves how necessary it is to understand the nature of many apparently simple disorders. During the year 1859, Mr A. C. Muir, veterinary surgeon then at Auchtermuchty, consulted me about a case in a three-year-old colt, nearly thorough-bred, which had a deep fistula over the forehead on the right side. The fistula had been slit up, but was so deep that Mr Muir hesitated to cut lest the joint should be opened. The disease was believed to be due to an old injury, and as the animal got worse, he was sent to the New Veterinary College on the 3rd of April, 1860. At that time the horse's condition was very bad. Mastication was evidently impeded, and the animal's muscles wasted. I cast him on the 6th, and passed a probe two inches downwards and outwards. The discharge was scanty, and a hard circumscribed tumour about the size of a pigeon's egg was situated above the temporal arch. A crucial incision through the thickened skin and fibrous structures exposed the black top of the tooth substance drawn at Fig. 45. I took a pair

Fig. 45.

of bone forceps and tried to extract it, but failed, and with a hammer and chisel easily knocked out of its cavity the larger portion, which had evidently become detached from a small bit readily removed with forceps and scalpel, as it was loosely connected to the walls of a cyst containing the tumour. The whole proved to be made of true tooth substance, and was affected with caries, as shown above. From that day the horse improved, but the fistula never closed perfectly, and during the first week in February last he was again placed under my care. On the 7th I cast him, opened up the fistula, and found a broader tumour had developed beneath the seat of the first one. Its base was deep and wide, and at every stroke of the mallet and chisel, the horse indicated, from convulsive twitching and great struggles, that the concussion was directly transmitted to the brain. The tumour could only be partially removed, and the horse thus proved incurable. It is evident, as Macrops has shown, that several dental formations may succeed each other.

Fortunately the incurable cases are few, but it is essential to know the true nature of the disease, in order to direct our remedies with effect.

IRREGULARITIES IN THE ROWS OF TEETH.—There are numerous irregularities in the direction of molar teeth. I remember, during the period that I was a pupil at the London Veterinary College, a colt was brought in, suffering much from a molar tooth, which, instead of protruding on the alveolar margin of the upper jaw, passed inwards through the palate, and had grown a considerable length downwards so as to press on the tongue. The animal could not eat, and was destroyed for dissection. The head is still, I believe, in the museum of the St Pancras College.

The lower jaw is, as stated when on the subject of parrot-mouth, sometimes shorter than the upper. This leads to an imperfect apposition of the molars as well as of the incisors, and the first molar on either side of the upper jaw is apt to indicate excessive growth at the anterior part, and the same happens with the back part of the last grinders on the lower jaw. These projections may attain considerable length, and inflict injury on the cheeks and tongue.

By far the most common irregularity from imperfect wear of the teeth depends on the breadth of the upper jaw as compared with the lower. Frequently the outer margins of the superior molars, and the inner margins of the lower, become sharp and jagged. This tends to induce excoriations in the mouth; the movements become more and more limited, and the irregularities more marked. Bouley refers to a specimen in the Alfort Museum, in which the tables of the teeth form such inclined planes as to be parallel with each other, and crossing each other like scissor-blades. The cause of this, according to Professor Bouley's observations on the specimen, appears to have been caries of two molars which, having limited the action of the jaws to one side, led to growth on the opposite side of the teeth, and gradually the confined movements of the jaws favoured the full development of the deformity.

The lower molar teeth being smaller than the upper, are occasionally most worn, and this often leads to excessive wear of the middle molars on each side, the anterior and posterior ones remaining larger. The middle molars may be worn down to the gums, and the latter then sustain injury.

I have before mentioned, that from a molar tooth not being worn over its whole surface, a portion may exceed a natural length. This is sometimes the case with an entire tooth, when the opposite one is absent.

During my experience in Scotland, I have met with a large number of colts two, three, and four years of age, suffering from the displacement of a temporary molar, the non-eruption of the permanent tooth which should have taken its place, and the production of much irritation from food and other substances entering the empty socket. Sometimes the opposite tooth grows up, as seen in Fig. 46.

The annexed illustration shows how a projecting molar tooth may, by pressure, induce inflammation of the upper jaw, ulceration, and a discharge by the nose, which is often offensive, and very difficult to cure. Before such destruction has occurred, signs of difficult mastication are perceptible, and soon a swelling of the face and imperfect passage of air through the nose are observed.

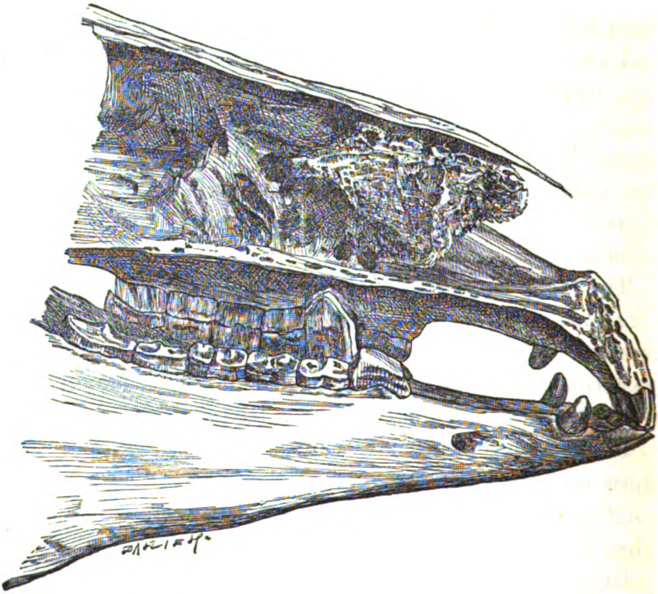

Fig. 46.

CARIES is unquestionably the malady most frequently affecting the teeth of man and animals. It consists in structural degeneration of the enamel and dentine, though even the cement around the fang may become the seat of disease. Mayhew gives a drawing of a molar tooth in which tho crusta petrosa appears to have been partly thickened and partly ulcerated. In considering the diseases of the teeth in the lower animals, we must not forget that the molars are certainly more subject to caries and other destructive changes than the incisors. The morbid process is sometimes slow, and at others rapid.

Two views have been maintained as to the origin of caries. The one, that it is due to a chemical action on the teeth by substances in the mouth; and the other, that it depends on a cause operating through the nerves and blood-vessels affecting the nutrition of the tooth, and leading to its destruction, gradual or quick. The latter is, in my opinion, the true explanation of the origin of the disease. My readers must not forget the reference I made in my last chapter to the highly vascular and sensitive pulp, which sends delicate branches into the numerous dentinal tubes. It is the pulp with its prolongations which, when inflamed and affected by exposure to air, or by heat and cold, becomes extremely tender, and is the true seat of pain. Horses and all animals suffer intolerably from toothache. They cannot eat, depress their head, or lay it on the manger or side-post, and indicate marked relief when the offending tooth is removed—no easy task, as we shall presently see.

The caries, in the early stage, may lead to opacity, and gradually to a dull brown or black hue of the enamel. A hole is formed, and the dentine then becomes diseased. It seems often to exfoliate, and gradually to break up into its constituent elements, which are softened, and soon disintegrate. It is the accumulation of putrefactive substances in the holes of diseased teeth which induce great fœtor.

The fang of the tooth may primarily become diseased, the pulp is destroyed, and the tooth, being deprived of nourishment, dies, and is rubbed down by the opposing tooth. This is often the cause of fistulæ of the face. An abscess forms in the alveolus, the bone swells and softens, the matter points to the surface and is discharged, so that, in the course of a few days, a regular sinus or fistula is formed, which is usually treated by caustics, but without any good result.

Professor Bouley refers in a very happy manner to important changes which occur in carious molars in the horse. When the tooth socket is opened through the tooth, the membrane which lines the alveolus becomes inflamed, and soon there is a deposition of bone or cement irregularly around the tooth. The root of the tooth is, therefore, the seat of a true exostosis; and from the tension of parts inflamed and thickened, it is easy to believe that the poor animal must suffer intense pain. The thickening of the bone or cement around the fang of a diseased molar tends to render the extraction of the tooth more difficult than when such change has not occurred.

If caries affects either or both of the first two molars, they are apt to induce atrophy of the bone, disease communicating with the nasal chamber. The root of the third molar corresponds to the point where the sensitive fifth pair of nerves pass out of the facial bones, and inflammation or thickening of the parts here is attended with the most excruciating pain. Disease of any of the three last upper grinders, on the other hand, leads to extensive tumefaction and disorganization in the cavities known as the maxillary sinuses, which communicate with the nose, and discharge through it the fœtid pus which often forms there as a consequence.

Diseases of the Dental Pulp.—There is but one case recorded, and that a very singular one, in which the pulp within one of the roots of a molar tooth had evidently been inflamed, and had afterwards undergone a calcareous degeneration. The affected root was enormously enlarged, and the crown of the tooth gave indications of commencing caries. Professor Bouley, who reports the above case, refers to another very singular one of

DISEASE OF THE MEMBRANE LINING THE TOOTH SOCKET.—In this case the horse could not masticate, the teeth became loose, and the jaws swollen. From the easy withdrawal of one or two molars, and the absence of any tendency to restoration, the animal was destroyed. The only lesion which could be observed was inflammation of the membranous lining of the tooth sockets. The cause of this singular condition was unknown.

SYMPTOMS OF DISEASES OF THE TEETH.—Frequently the teeth are not looked at until horses are perfectly emaciated, or after fruitless efforts to relieve in cases of oppressed breathing from supposed nasal tumours. Imperfect mastication and rejection of partially chewed food from the mouth first indicate some source of pain or imperfect action of the teeth. Corn is greedily swallowed, but without being crushed by the molars, and is therefore seen whole in the excrement. The system soon suffers, and the animals, hide-bound and languid, are readily attacked with disease, especially from colic, due to the undigested food which distends the large intestine.

When symptoms such as the foregoing are witnessed, examining the mouth by holding the tongue, or using a balling-iron like either represented by Figs. 47, 48, may enable us to determine with precision the nature of the disease.

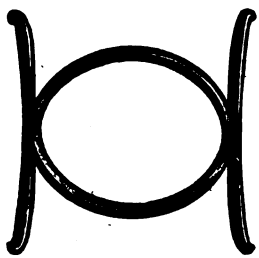

Fig 47.

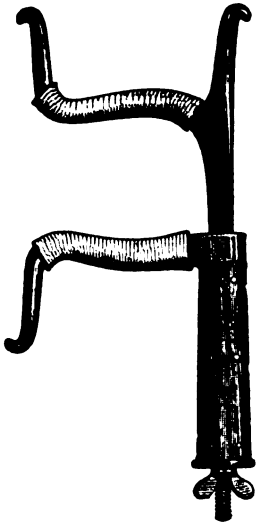

Fig. 48.

There are certain special symptoms of caries which Bouley has noticed in the following order:—

1*st.* Remarkable fœtor, which is peculiar to the disease, and pervading the mouth and the secretions within it.

2*nd.* Flow of saliva from the mouth.

3*rd.* The appearance of a black spot on the carious tooth, or of a cavity varying in extent according to the duration of the disease.

4*th.* Sharp pain indicated when a tooth is struck by any instrument.

5*th.* Swelling of the gums, redness and pain around the diseased tooth.

6*th.* The accumulation of food about the diseased tooth, and which undergoing putrefaction, produces the most repulsive smell.

The root of the tooth may be inflamed, and the jaw swollen and tender. Abscess may form, and extensive osseous disease, such as we have represented by Fig. 46.

It is true that this may be produced by inflammation attacking the tooth socket, independently of a projecting molar, to set up irritation, and I have operated in several cases, believed by practitioners to have been instances of nasal polypus, or of glanders, and which have yielded to the removal of diseased bone.*

* As interesting examples of mistaken diagnosis, I may quote two related by Mr J. Purves, H.E.I.C. Service, and which are recorded in the *Veterinary Record*, vol. ii., pp. 146, 147 :—

"CARIES OF TEETH GIVING RISE TO SYMPTOMS SIMULATING GLANDERS.

"*Aug. 24th*, 1836.—For some time the animal has been affected with a muco-purulent discharge from the near nostril, and the lymphatic glands on the same side are enlarged. Place on a course of alteratives.

"*Sept. 5th*.—No alteration perceptible. Give cup. sulph. ʒss daily, and allow liberal diet.

"*Oct. 5th*.—The discharge from the nostril has ceased, but the glands remain swollen. Give the sulphate of copper as before ordered.

"*23rd*.—The discharge has again returned, and the glands remain undiminished. Pass a seton over the latter, and increase the dose of sulphate of copper to a drachm and a half daily.

"*Nov. 13th*.—The discharge has increased, and otherwise the symptoms continue highly unfavourable. Treatment as before ordered.

"*19th*.—The discharge has become copious of late, and it is now mixed with blood. Substitute sulphate of iron for that of copper.

"*Dec. 16th*.—The discharge continues copious, and has been so ever since the last report. This day I discovered a carious tooth, the fifth molar. I think this very likely to be the cause of the discharge from the nostril and enlargement of the glands.

"*19th*.—Attempted to extract the tooth with an instrument made after the form of that used for the human subject, but could not fix it

OPERATIONS ON THE TEETH.—The oldest on record is '*chewing the rasp,*'—a practice of the old farriers, who, in order to remove the sharp edges on the molar teeth of horses,

on the tooth, it being split into two pieces and a portion bulging outwards; I therefore knocked one half of it out.

"*Jan. 3rd*, 1837.—No discharge from the nostril this morning, but during the week it has been much the same as before. Knocked out the other half of the broken tooth.

"*30th.*—The discharge has returned and become offensive.

"*Feb. 7th.*—Animal destroyed as glandered, by order of a special committee.

"*Appearance of the head after death.*—The last molar tooth but one on each side of the superior maxilla affected with caries. That on the near side I had partly extracted; the off side one was split parallel with the jaw, and bulged out as that on the near side when I knocked off the broken pieces. A communication existed between the mouth and cavities of the head, through the diseased action set up, and a quantity of food was in one of the cavities. Immediately over the fang of the near tooth was a polypus about the size of a small hen's egg, extending into the nostril. The mucous membranes throughout the head were very much discoloured and injected, but more particularly that covering the septum. There is no doubt but that the diseased tooth was the cause of the discharge from the nostrils, and also led to the formation of the polypus. The lungs were not much diseased.

"A SIMILAR CASE.

"The horse arrived at Leypore, 4th December, 1835.

"*Symptoms.*—Discharge copious and offensive from the right nostril; the left nostril also discharges, but not near so much; the glands are swollen, and those on the right side very considerably. A committee assembled in the evening and condemned the animal to be shot: in their opinion it was a case of glanders.

"*Post-mortem appearance of the head.*—The Schneiderian membrane lining the septum on both sides was highly injected, and of a pale blue colour; the right maxillary sinus was full of fetid pus, and a mass of apparently ossific matter existed there, which was connected with a diseased or carious tooth"

Cases like the above are of frequent occurrence placed a rasp in the mouth, which the animals attempted to displace by movements of the jaws, not altogether insufficient for the removal of asperities which injured the mucous membrane of the mouth, and interfered with mastication. The guarded rasp shown at Fig. 49, is employed frequently to lower the sharp edges of teeth in old horses' mouths, but where the prominences of teeth are very considerable, Brogniez's system, called by him '*odontritia,*' is the best. Brogniez, for long Principal of the Belgian veterinary school, was a man of great ingenuity, and to supersede the rasp and other coarse instruments, he devised his 'rabot-odontriteur.' This instrument, represented by Fig. 50, is composed of an iron rod 3 feet in length, with a curved frame at one end, in the middle of which a steel plate, sharp on both edges, is fixed. The handle is of some weight, and, by fixing the sharp prominences in the spaces before and behind the cutting plate by slight taps, projections are knocked off.

Brogniez constructed another instrument, 'ciseau-odontriteur (Fig. 51), to knock off projecting portions of molar teeth, and this instrument has been ingeniously modified by Mr Gowing, whose dental sliding chisel is the most efficient and satisfactory instrument that can be used for such morbid conditions of the teeth. It is represented at Fig. 52, and Mr Gowing says, it " consists of a cylindrical tube, which is attached to a guarded frame with an opposing or cutting chisel at the extremity so placed as to receive the concussion, so that when the working chisel is struck, it prevents the shock from being felt or sustained by the posterior teeth. The active chisel, as you perceive, moves in the cylindrical tube which forms the handle, the cutting part of it being guarded and protected by the frame of which I have spoken. The round part of the chisel plays or works through the cylinder, and to it is attached a steel head or button for the receiving of

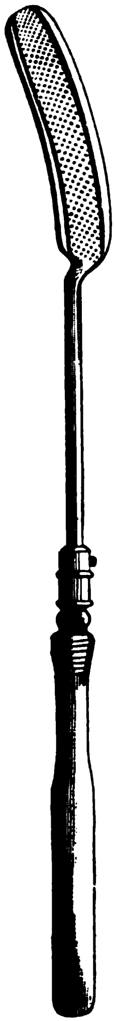

Fig. 49

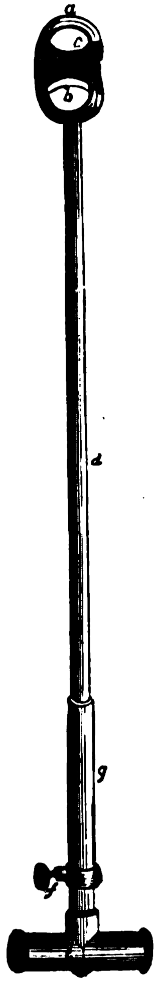

Fig. 50.

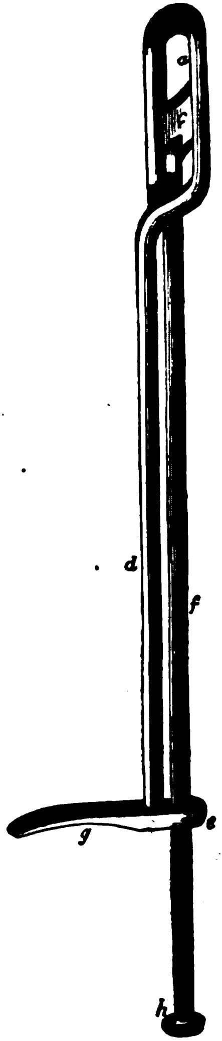

Fig. 51.

the blow or force necessary to be given. When we desire that it should cut through the hard and solid tooth of the horse, it will be seen that the rod of the chisel, working through the cylinder, would fall from any situation in which it might be adjusted, on account of the elevated and standing position in which the animal's head would necessarily be held by the operator. To guard against the chisel slipping backwards, and to render it steady, but not fixed, I have attached, as you will perceive, at this end of the cylinder a brass bulb, which gives to the handhold of the operator more security. The inside of the brass bulb, first mentioned, is hollow, so as to allow of some packing being placed within; when pressing upon the rod of the chisel, it acts on the same principle as it does in the piston box of a steam engine. To make this more clear, the brass bulb is screwed down upon the cylinder, thereby causing the packing to be so compressed as to retain the rod of the chisel in its desired situation. The mode of operating with this instrument will require some explanation from me, for I have been asked by some gentlemen whether the chisel is to be drawn back to the utmost range of the guard? I mention this that others may not fall into the same error; for if it were so placed before the chisel reached the tooth, the force of the blow would be expended to a great extent, on account of the distance it would have to travel, and the resistance it would naturally have to overcome. For these reasons we should probably be foiled in the performance of that which we were desirous of accomplishing, and the tooth would in all likelihood, remain entire.

"A balling-iron being placed in the mouth, and retained in its situation by an assistant, the chisel is to be drawn sufficiently back through the cylinder to allow the frame to be placed over the tooth, surrounding that portion we are desirous of removing. This will be better accomplished by the operator grasping the cylinder firmly close to the brass bulb, at the same time employing so much traction as will suffice to keep the chisel at the posterior part of the frame close to the back of the tooth. The tooth being closed in, laterally by the guards and posteriorly by the passive chisel, the active chisel is then to be brought in contact with the anterior part of the tooth. It will thus be seen that the tooth is imprisoned on all sides, and a hammer of about two and a-half pounds weight is to be selected to give the blow with."

To serve the purpose of Brogniez's 'rabot odontriteur,' Mr Gowing has invented the 'guarded chisel,' drawn at Fig. 53, which is of sufficient width or space to cover the table or upper surface of the molars, and is used with the 'lateral repeller' shown at Fig. 54.

"It consists of a solid entire piece of steel. At one end is the handle, which is encased on either side with pieces of wood, retained in their situation by rivets. The other end is shaped into a hook-like form, flattened and bevelled, with a guard on one side, for the purpose of retaining the instrument in its situation, and preventing its being displaced from the tooth. It possesses some of the advantages of the former sliding chisel; but this instrument is not meant to be used by itself; it is intended to prevent the concussion on the jaw, while the operator, with a chisel, strikes off any projecting angle of the tooth."

The instrument indicated by Fig. 55 is Mr Gowing's 'posterior repeller,' destined to be used principally for the back or posterior teeth when the 'lateral repeller' cannot be applied.

EXTRACTION OF TEETH.—A carious tooth requires to be removed, but there is the great difficulty in extraction, and the broad gap left after it, which deter many anxious to operate. Whenever the fang of a tooth has been diseased, leading to facial fistula, I have adopted the plan of cutting through the cheek in a line with the diseased tooth, removing

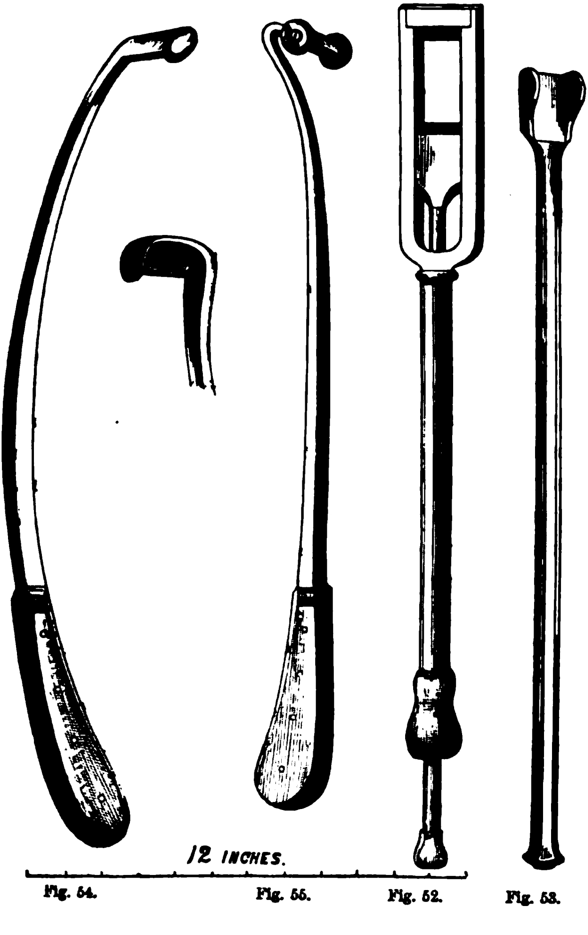

Fig. 54. Fig. 55. Fig. 52. Fig. 53.

the outer wall of the alveolus, and striking the tooth inwards. By this means the tooth is easily removed, and, with care, the wound heals without leaving perceptible blemish. This operation should always be performed when there is any great difficulty in the withdrawal of the tooth, and this will often be met in cases such as I am referring to.

Apart from disease, the molars are not readily extracted. They have not a well-defined head, and a very long, broad, and well-implanted fang. Various kinds of forceps have been invented, the best being those designed by Mr Gowing.

These forceps are certainly preferable to the clumsy keys which, if perchance a good hold is obtained with them, lead to severe fracture of the jaw in order that the tooth may be removed. I may here quote Mr Mayhew's remarks on the forceps. He says:—

"They are about twenty-two inches long, in order that they may be applied, if required, to the most backward of the grinders, and of such substance as renders impossible any springy action which might cause the bite to be lost when the force was applied. As will be imagined forceps of such dimensions are not to be used by the unassisted hand. The reader, by looking at the end of the handles, will observe that one is comparatively large; the smaller of the two contains within it a female screw, and the other is only a plain eye. To act on these, a cross handle or lever is added (see Fig. 56).

"This, as is shown in the woodcut, consists of two pieces, the smaller of which works freely in a hole made for its reception, and being curved at one end, can be either extended in the manner represented above, or laid close to the lever in the way depicted in the next view of the instrument. It is what is technically called a 'tommy,' and its use is to gain dispatch and power in the employment of the forceps. The main part consists of a rod of steel, having in the centre a screw, which, at the end towards the 'tommy,' exhibits an enlargement or shoulder. Such are the various parts, and, when using them, the operator having fixed the claws of the forceps upon the tooth he wishes to extract, gives the forceps

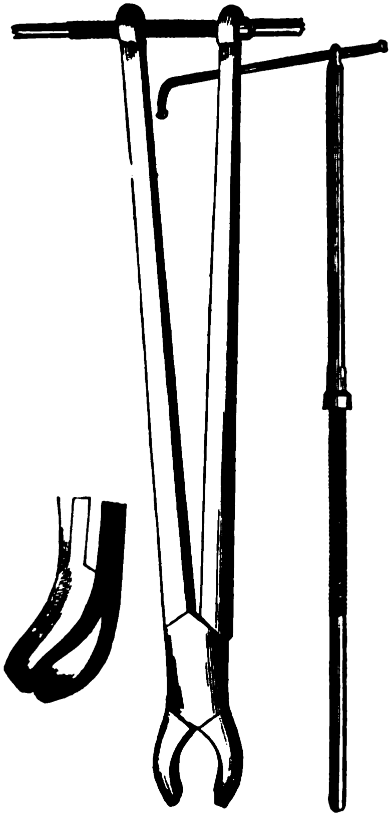

Fig. 56.

to an assistant, whom he orders to hold them firmly in their situation. He then takes the handle, and introducing it through the open eye with the 'tommy,' as rapidly as possible, winds it round until he feels the grasp is secure. Any amount of power can be thus obtained; for as the screw threads through one handle, the shoulder presses against the other, and thus forcing the claws together, fixes them upon the substance which may be placed between them. When this is done, the operator closes or folds up the free lever, and using both hands, has at his command a power which will not necessitate employment of his utmost strength.

"The above woodcut depicts the forceps as they appear when put together. The advantages which these forceps have over the tooth-key in common use, are so obvious, that the reader will not require they should be pointed out. The benefits which this instrument confers, are indeed great; neither can it be supposed that the principle can be changed, or its adaptation improved upon. For its purpose, the thing appears perfect; and I can speak confidently as to the admirable manner in which it acts. One caution, however, may not be unnecessary. All surgical instruments are capable of being abused, and in exact proportion to their utility is their liability to abuse. With Mr Gowing's forceps a horse's jaw could be easily broken, or he who did not know the power of the screw, would, if he kept on winding the handle, crush the tooth it was his intention to secure. So much strength is gained that the judgment must be employed to regulate it. Huge as the instrument looks, it requires delicacy in the hand which uses it. With such a tool at his command, a child is in power equal to a giant; and the man therefore must exercise his mind rather than strain his muscles, when he has to operate with it. In cautious hands, it gives every facility that could be desired, and is both more certain in its action, and more expeditious in its results than anything of the kind which we at present possess, besides having the further advantage of not requiring those adjustments and unsatisfactory changes which the common instruments necessitate to be made. For extraction, nothing beyond these forceps is wanted: they answer every purpose."

A smaller pair of forceps, especially useful for loose teeth, are shown at Fig. 57. I cannot, however, quit this subject without drawing attention to Wendenburg's simple forceps, and to the more complex ones of Pillwax. The engravings suggest how, by affording lever power, the first (Fig. 58) proves of service, and how, by a simple screw action with the second instrument (Fig. 59), a tooth may be drawn out vertically from the jaw.

I have yet one instrument to allude to, and that is Mr Gowing's gum lancet, drawn at Fig. 60, which, from its length, enables us to scarify the gum without inserting the hand through the balling-iron, and thereby obstructing the view of the part to be operated upon.

Plugging Carious Teeth.—Dental surgery has not received that attention from the veterinary surgeon which it merits, and it is only the great importance of this much-neglected subject, from the serious and curable diseases incidental to the teeth of young horses in particular, that I have ventured to encroach so much on my space for the remarks in the foregoing pages. One great obstacle to extraction of the teeth of the horse, has undoubtedly been the difficulty of so filling the space left as to check the growth of an opposing tooth, and prevent the accumulation of material which putrifies and injures the gums and jaws. I had a favourable opportunity, two years since, to try gutta percha as a stopping for teeth in a bay gelding which, for a whole year, had baffled several veterinary surgeons, with a facial fistula communicating with diseased teeth. I removed one of the latter and opened the sinuses. By great care the parts healed, but

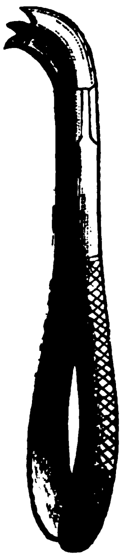

Fig. 57.

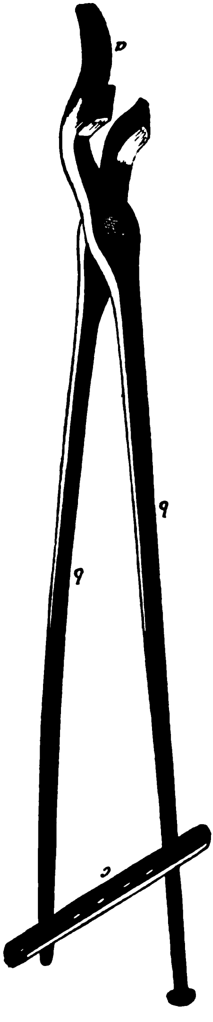

Fig. 58.

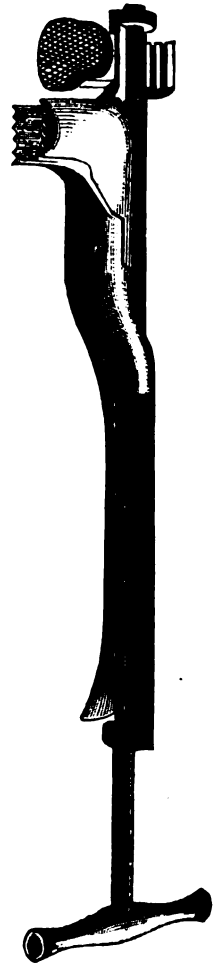

Fig. 59.

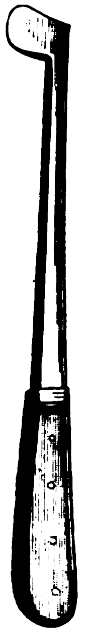

Fig. 60.

when the animal was restored to its owner, the food again pierced through the soft tissues, and threatened to render the case a hopeless one. I cast the horse, cleaned out the accumulated matter, and carefully moulded gutta percha in the space left from which the molar had been extracted, and at the same time plugged an adjoining carious tooth; the mould was made on a level with the row of molars, and I have since traced the horse, obtaining most satisfactory evidence of the success attending the simple plan which I was induced to adopt. Corks and other objects have been pressed between the teeth for the purpose of filling a void; but no method, so far as I am aware, has succeeded like the gutta percha plug.

INSALIVATION.

Whilst food is being triturated, it is mixed thoroughly with the secretions in the mouth. The mucus, which is very small in quantity when the flow of saliva is rapid, is an acid liquid mixed with scaly epithelium, and seems to exert very slight influence in the changes which the food undergoes in the mouth. A considerable quantity of mucus is secreted from the mucous crypts, which consist in small depressions on the mucous membrane like little bags, and the walls of which have openings communicating with rounded vesicles. Some are spread, such as over the surface of the tongue, and others are congregated, as on the side of the throat, constituting the *amygdalæ* or tonsils.

The most important physical and chemical transformations occur by the process of

INSALIVATION.—The salivary glands are important organs, composed of tubular prolongations of the mucous membrane of the mouth, and which are of different degrees of complexity in different animals, constituting, in our domestic quadrupeds, what the anatomist calls compound racemose glands. There are two great groups of salivary glands—1st, Those that are within the mouth, or directly applied to its mucous membrane; and, 2nd, Those that are beyond the mouth. The first are in the lips—labial; in the cheeks—buccal; and in the tongue—lingual glands. The buccal glands are sometimes largely developed above the molar teeth, and are called *molar glands*, and the lingual are only seen in man and monkeys.

The large salivary glands which communicate with the interior of the mouth by tubes of considerable length are

Fig. 61.

the parotids, one on either side (see Fig. 61); the submaxillary and the sublingual. The parotid glands, situated behind the margin of the lower jaw, and below the ear, have each a long tube which opens into the mouth through the cheek, opposite the upper second molar tooth. (See Fig. 61.)

Fig. 62 represents the parotid of the dog, which secretes a very liquid saliva, whereas the small gland represented at B, yields a secretion possessed of considerable viscosity. It is an accessory gland which has been specially noticed by Bernard in the course of his investigations on the salivary fluid.

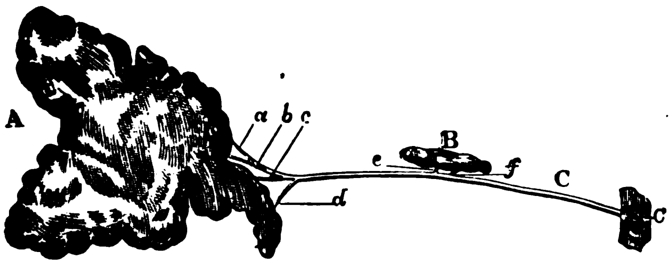

Fig. 62.

The submaxillary glands, situated within the lower part of each parotid, and extending forwards, open into the mouth behind the barbs. The sublingual glands open by numerous small ducts on either side of the base of the tongue. See Fig. 63, which represents at C C the coiled ducts, and in A the duct of the submaxillary.

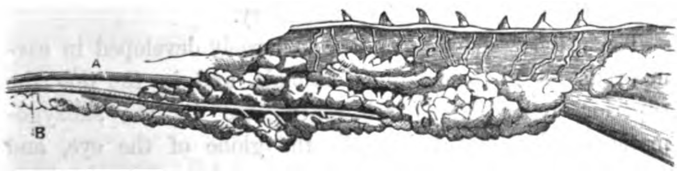

Fig. 63.

It has been stated that the dog has no sublingual gland; and Bernard, writing in 1856, said that recently Bider and Schmidt continue to regard the sublingual in the dog as intimately connected with, and inseparable from, the submaxillary. This fusion is, however, only apparent as the ducts of the two, which are applied to each other during the greater part of their course, are perfectly distinct. (See Fig. 64.)

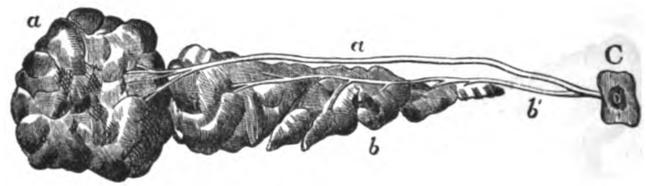

Fig. 64.

The saliva may be collected by dividing and even introducing tubes into the various ducts of the larger glands. By such experiments Claude Bernard indicated the watery secretions of the parotid as contrasted with that of the submaxillary glands, and two distinct kinds of saliva are recognised according to their watery or dense condition. The watery secretion is derived from the labial and buccal glands, as well as the parotids, and all these are large in our herbivorous quadrupeds, especially the horse, who has to live on dry fodder. The muciparous saliva is derived from glands in the palate, the sublingual and submaxillary.

The salivary glands are not so largely developed in carnivorous as in herbivorous animals, and in the dog the superior molar glands are represented by the subzygomatic gland, situated beneath the globe of the eye, and pouring its watery saliva through a tube called the duct of Nuck. Milne Edwards* refers in his work to Colin's careful weighing of the different salivary glands, and justly states that no general result can be deduced from the data thus obtained. Colin found that the weight of the submaxillary glands varied from 20 to 38 hundredths of the weight of the parotids in the pig, horse, ass, the roebuck, and dromedary, whereas in the cat it is 97 per cent., and in the dog 108 per cent., but in the sheep this proportion attained $\frac{84}{100}$ths, and in the ox, $\frac{105}{100}$ths. The size of these organs is probably not the only circumstance which influences the degree of functional activity of these glands. In the pig, ox, and sheep, the sublingual glands are sometimes double. (Fig. 63), the one part emptying its secretion by a long duct, and the other by a number of coiled ducts, well seen in the annexed cut. Milne Edwards says that with the salivary apparatus must be classed Jacobson's organ, which is a long pouch on either side of the *septum nasi*, opening behind the incisor teeth close to the incisive foramen.

The quantity of saliva secreted is very considerable, and it is not easy to estimate the average amount in different animals. Jacubowitch obtained from a dog in one hour 49.19 gr. of parotidean saliva, 38.94 of submaxillary saliva, and 24.84 gr. of sublingual secretion. Colin opened the œsophagus to determine how much saliva passed into the stomach of the horse or ox. He obtained 4960 grs. of saliva per hour in a small horse, whereas a large one yielded nearly 18 lbs. weight. He calculates the daily secretion to amount to 42 French kilogrammes, or nearly 84 lbs. In the ox the secretion is more active, and would seem to attain 56 kilogrammes or 102 lbs.

In man it is commonly and justly stated that his "mouth

* *Leçons sur la Physiologie et l'Anatomie Comparée de l'Homme et des Animaux.* Par H. MILNE EDWARDS. Victor Masson, 1861.

waters,' that is to say, saliva is secreted when dainty food is presented to him, especially if the individual is hungry, but this does not occur in the horse. The secretion of the parotid glands is totally suspended when the horse is not masticating, and only occurs from the gland on the side on which the teeth are grinding during the act of mastication. In the ox the secretion is constant, though very slow when the jaws are at rest. Dry food leads to an active flow of salivary secretion, which amounts to five or six times more than when green or wet food is eaten. The submaxillary glands secrete abundantly when the material taken into the mouth has an agreeable taste, and great in proportion as the animal relishes the food. Thus Colin found that in eating hay, a horse secreted from 17 to 38 grammes in 15 minutes from one gland, whereas 50 grammes flowed when the animal was allowed corn. The sublingual gland in the horse secretes constantly.

The salivary glands act under the influence of the nervous system, and though the parotids have been regarded as secreting from compression due to the movements of the jaw, Borden has shown that such is not the case, and that this is due to nervous influence. A similar cause leads to a secretion of saliva when the stomach is stimulated to secrete, or when materials possessed of taste are taken into the mouth. Various interesting experiments have been performed to show that these glands are brought into play by stimuli, which operate through the nerves and nervous centres.

CHEMICAL CONSTITUTION OF SALIVA.—The parotidean saliva is alkaline, and has a slightly saltish taste. It is watery, and according to Lassaigne, has a density of 1·0108 in the cow, 1·0045 in the horse, and 1·0102 in the sheep, at a temperature of 150 centigrade. The chemical constitution of the same secretion is as follows:—

HORSE.

Water . .	992·00
Mucus and albumen	2·00
Alkaline carbonate .	1·08
Alkaline chloride .	4·92
Alkaline phosphate and phosphate of lime	traces
	1000·00

COW.

Water . .	990·74
Mucus and soluble animal matter .	0·44
Alkaline carbonate .	3·88
Alkaline chloride .	2·85
Alkaline phosphate .	2·49
Phosphate of lime	0·10
	1000·00

SHEEP.

Water	989·00
Mucus and soluble animal matter	1·00
Alkaline carbonate . .	3·00
Alkaline phosphate . .	1·00
Alkaline chloride . .	6·00
Phosphate of lime . .	traces
	1000·00

Tiedemann and Gmelin found in the saliva of the parotid of the dog:—

1*st.* Very little animal matter soluble in water or osmazome.

2*nd.* Salivary matter, soluble in water, and insoluble in alcohol.

3*rd.* Mucus.

4*th.* Much alkaline chloride; a moderate quantity of carbonate; little acetate and sulphate; very little phosphate of soda; and a mere trace of potash salts.

5*th.* Phosphate, and a little carbonate of lime.

The submaxillary saliva is thick, viscid, ropy, and less alkaline than that of the parotid. M. Lassaigne examined some obtained by Colin, and found that this secretion in the cow contained:

Water	991·14
Mucus	1·73
Soluble animal matter	1·80
Alkaline carbonate	0·10
Alkaline chloride	5·02
Alkaline phosphate	0·15
Phosphate of lime	0·06

Its density was 1·0065.

To show the points of contrast between the saliva secreted by the parotids, and that flowing from the submaxillary gland, Colin has prepared the following table:—

Reagents.	Parotidean Saliva.	Submaxillary Saliva.
Distilled Water.	Nothing.	Nothing.
Well Water.	Slight turbidity.	No change.
Heat.	No change.	Becomes thick and opaline.
Nitric Acid.	Slight effervescence, without turbidity.	Becomes turbid and viscid.
Nitrate of Silver.	Yellow serous precipitate, partly soluble in nitric acid.	White opaque deposit like thick mucus.
Subacetate of Lead.	White flocculent precipitate.	White opaque and and semi-solid deposit.
Sulphate of Iron.	Yellowish white precipitate.	Reddish yellow and gelatinous deposit, of same consistence.
Chloride of Mercury.	Turbidity and slight white precipitate.	Thickens and is transformed into a transparent jelly (glaire)
Tannic Acid.	Nothing.	Thickens and becomes ropy.
Alcohol at 80°.	Slightly turbid.	Glary and viscid flocculent precipitate.

Bernard indicated in 1847 the specific characters of the sublingual secretion. It is less alkaline than the parotid and submaxillary, and effervesces but slightly on the addition of acids. It is very viscid and ropy, and according to Bider and Schmidt, it contains, in the dog:—

	Water	990·02
	Organic Matter soluble in Alcohol	1·18
Inorganic Matter	Chloride of sodium „ of calcium	5·29
	Phosphate of soda „ of lime „ of magnesia	0·84

This saliva, says Bernard, is distinguished from the others by the large proportion of ropy organic matter which Berzelius calls ptyaline.

Nuck's gland, before referred to, secretes a saliva very similar to that of the sublingual. The buccal glands secrete an equally viscid fluid.

The mixed saliva, which is the produce of all the glands and of the mucus follicles in the mouth, varies in viscidity according to the proportions of the different secretions, and is also dependent on the state of the animals. Thus Lehmann found in a horse that had not drank water for twelve hours, that the density of the parotidean saliva attained 1·0074, whereas, after the animal had taken about 3 kilogrammes of water, the density was not above 1·005. The saliva is alkaline, and this property is due to soda. The mixed saliva contains about 99 per cent. of water in the horse, and the remaining solid matter is chiefly made up of ptyaline or salivary matter, which Bernard regards as similar to caseine, soda, chloride of sodium, sulphocyanide of potassium, and phosphate of soda.

The saliva undergoes material change in disease, and becomes acid, being likewise charged with an excess of organic principles. It may contain urea and various other adventitious principles.

The uses of the saliva are various. In the first place it acts mechanically in softening the food. This is one reason why vegetable feeders require more than carnivora. It facilitates the trituration of food, and combines, with the pharyngeal liquids hereafter to be described, in enabling the bolus to pass through the œsophagus.

The saliva, in virtue of the large proportion of water it contains, is a solvent for all soluble materials such as sugar, salts, &c., which the food contains.

But the saliva is destined for another purpose which is totally unconnected with the act of mastication, and which it serves, especially in ruminants, by being swallowed and retained in compartments of the stomach in contact with food. This action consists in the transformation of starchy matters into dextrine or gum, and into sugar. This change does not occur with any of the secretions taken separately outside the body; and, according to Bernard, even if the various salivæ are separately obtained from the principal glands and mixed, the starchy principles are not acted upon. The buccal glands seem to exert a special function in connection with the production of a chemically active saliva, and this depends probably on the tendency to decomposition, the change being favoured by all causes which favour chemical changes. Many other organic substances induce such a transformation of starchy principles, and in some animals the digestion of amylaceous principles by the saliva, seems to be a very unimportant office. The acid of the stomach stops its action, and, as we shall afterwards see, it is in the large intestine of the horse that the change referred to in amylaceous matters goes on, whereas in ruminants it undoubtedly occurs in the first two stomachs. Regarding the slight change observed in food from its admixture with saliva in some animals, Dr Dalton says:—

"If a dog, with a gastric fistula, be fed with a mixture of meat and boiled starch, and portions of the fluid contents of the stomach withdrawn afterward through the fistula, the starch is easily recognisable by its reaction with iodine, for ten, fifteen, or twenty minutes afterwards. In forty-five minutes, it is diminished in quantity, and in one hour has usually altogether disappeared; but no sugar is to be detected at any time. Sometimes the starch disappears more rapidly than this; but at no time, according to our observations, is there any indication of the presence of sugar in the gastric fluids. Bidder and Smith have also concluded, from subsequent investigations, that the first experiments performed under their direction by Jacubowitsch were erroneous; and it is now acknowledged by them, as well as by the French observers, that sugar cannot be detected in the stomach, after the introduction of starch, in any form or by any method. In the ordinary process of digestion, in fact, starchy matters do not remain long enough in the mouth to be altered by the saliva, but pass at once into the stomach. Here they meet with the gastric fluids, which become mingled with them, and prevent the change which would otherwise be effected by the saliva. We have found that the gastric juice will interfere, in this manner, with the action of the saliva in the test tube, as well as in the stomach. If two mixtures be made, one of starch and saliva, the other of starch, saliva, and gastric juice, and both kept for fifteen minutes at the temperature of 100° F., in the first mixture the starch will be promptly converted into sugar, while in the second no such change will take place. The above action, therefore, of saliva on starch though a curious and interesting property, has no significance as to its physiological function, since it does not take place in the natural digestive process. We shall see hereafter that there are other means provided for the digestion of starchy matters, altogether independent of the action of the saliva."

Viewing this question as a veterinarian, I must say that I attribute far greater importance to the chemical changes occurring during a slow mastication, with an abundant secretion of the liquids of the mouth than Dr Dalton does. It is of great moment in herbivorous animals, though the mechanical use of the saliva is most important, and if the two parotid ducts of a horse are simultaneously opened, the animal will soon choke from the want of liquid to soften the food.

DISEASES OF THE SALIVARY APPARATUS.—The secretion of saliva may be diminished, increased, or perverted. Its diminution is observed in febrile diseases, and also in affections associated with a free discharge of water from the blood. Its density then increases, and the mouth of the animal becomes hot and clammy. The saliva may be diminished in quantity from disease of the glands, or closure of the ducts.

Ptyalism, or excessive secretion of saliva, is not so common in the lower animals as in man, in whom it has been frequently witnessed, as the result of the administration of mercury. Mercurial ptyalism is, however, seen, and especially in cattle, from rubbing mercurial ointment on the skin for mange. It has been seen in the horse from the internal exhibition of calomel and opium, purposely to obtain salivation, and also by rubbing the mercurial ointment over the parotidean region. Severe salivation in the horse has been observed from this animal having been forced to eat green food highly charged with mustard, and this is a common cause of ptyalism also in the ox. Mathieu saw peculiar attacks of salivation in the autumn of 1852, from horses, cattle, and sheep eating clover and esparcet, which had become of a brown colour, and this was believed to be due to a change in the chlorophyl in the leaves. Two pounds of such hay caused horses to lose from 30 to 36 pounds of saliva in from five to six hours, giving rise to great thirst.

When any source of irritation exists in the mouth, the discharge of saliva is often very great.

Treatment in all such cases consists in removing the cause, and using locally cold water injections into the mouth, coupled with frictions around the salivary glands, with slightly stimulating embrocations.

The saliva undergoes serious changes in disease. It becomes poisonous in rabies, and preserves its poisonous properties about twenty-four hours after the death of the animal; but Count Salm has experimented on the dried foam from the mouth, and has been successful in communicating the disease.*

The saliva becomes charged with the virus of epizootic aphtha, with the poison of glossanthrax, and is perverted also in the contagious typhoid or *steppe* disease.

Dilatations of Salivary Ducts.—Hertwig states having frequently seen distension of a parotid duct in the horse caused by some injury to the canal, obstructions of various kinds, and, especially, produced by salivary concretions.

Ranula is a condition referred to by several veterinary surgeons, and I have seen several remarkable cases. It consists in dilatation of one of the ducts of the sublingual gland. The tumour has been described as an abscess or cyst, but it is distension of a duct by a ropy liquid. I remember one

* See the *Veterinarian's Vade-Mecum*, page 216.

case, in which a tumour of this description, the size of a pullet's egg, existed on either side of the tongue, giving rise to considerable inconvenience.

These cases call for the removal of any obstruction, and puncturing the distended duct.

Salivary Calculi, or concretions, form chiefly in the parotid duct of herbivorous quadrupeds. They are composed of carbonate of lime, containing about 84 per cent. of this salt, besides phosphate of lime, animal matter, and water. In the submaxillary and sublingual ducts of the horse, small roundish or mulberry form, smooth and yellowish white concretions are sometimes found.

The common cause of such concretions is an accidental nucleus, either penetrating the canal from the mouth, or formed from the salts of the saliva.

Treatment consists in removing the calculi by the knife, and afterwards treating as recommended under the following head.

Salivary Fistulæ.—Wounds communicating with a salivary gland or duct, are of somewhat frequent occurrence, especially from the incautious aperture of abscesses in awkward situations. They always implicate the parotids. The chief symptom is the discharge of saliva, especially during mastication. I have treated many cases of this description, and never experienced difficulty, by adopting a plan of treatment most favourable to granulation and gradual contraction of the sinus. I am opposed to rash measures such as the hot iron and caustics. Where the salivary duct has been accidentally cut, I should recommend shaving the hair, and applying collodion or adhesive plaister. The animal must be kept for many hours without food and water, and then allowed only gruel. Where the parotid gland has been injured in opening a deep-seated abscess, I have found poultices, followed by cold-water dressing, of great service, and sometimes the application of a blister all round the seat of injury, protecting the wound by a layer of lard around it. The parotid duct has been tied, and the parotid gland destroyed or extirpated, and notwithstanding the horse has regained health. I do not recommend a practice which requires such extreme measures. By patience and care, the cases of salivary fistula always prove curable.

PAROTITIS—THE MUMPS.—Inflammation of the parotid glands has been rarely seen in the horse, but I have been consulted several times regarding its occurrence in feeding cattle. It prevails in the winter months, and when the animals are nearly fat. They are seized with symptoms of sore throat, such as cough, difficult breathing and impediment to swallowing, coupled with considerable fever. The inflammation is usually confined to one side, and does not persist or lead to suppuration. The gland is apt to remain hard and inactive, leaving some obstruction to the passage of air through the throat, but notwithstanding this the animals fatten well. Treatment consists in the administration of a saline purgative, and applying hot fomentations or poultices locally. The parts may have to be blistered, and in cases in which there is very difficult breathing, the windpipe may have to be opened.

Organic disease of the salivary glands has been occasionally noticed, such as cancer and melanosis. The latter, seen in grey horses, chiefly implicated the lymphatic glands situated on the inner side of the parotid.

DEGLUTITION.

ORGANS OF DEGLUTITION.—The act of swallowing, or deglutition, consists in the passage of food from the mouth to the stomach. The tongue, cheeks, pharynx, and œsophagus or gullet are successively brought into play for the propulsion

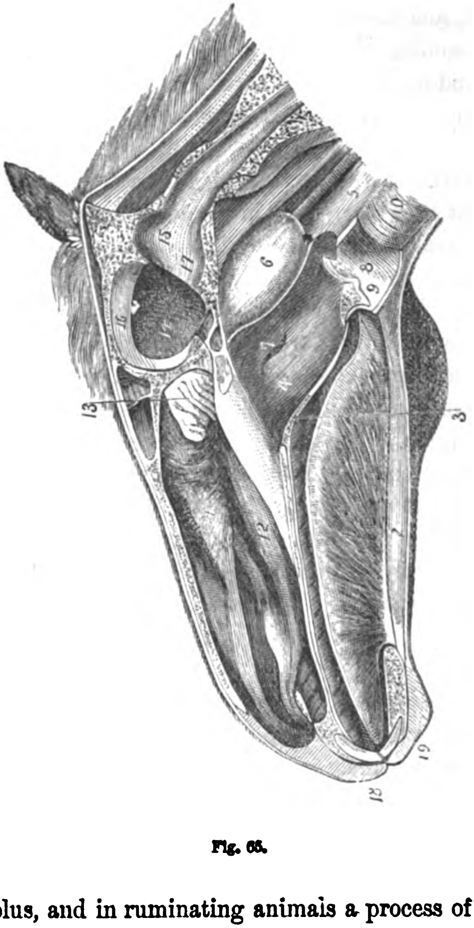

Fig. 65.

of the bolus, and in ruminating animals a process of regurgitation is also witnessed as one of the natural acts in connection with digestion.

The tongue and cheeks have the power to press back food, that it may pass the *isthmus of the fauces*, as represented at Fig. 65.

The pharynx is that part of the alimentary canal which admits of the passage of air from the nasal chamber into the trachea, as it does of food from the mouth to the gullet.

In the above engraving, it will be seen communicating with the mouth and nose in front, with the eustachian tube going to the ear by a slit, 7, with the gullet marked 5, and with the windpipe, 8. 3 represents a section of the soft palate, which is very long in the horse, and prevents the return of food into the mouth, when it has once passed back through it. Thus, when a horse with a violent sore throat makes a violent effort to drink, and pain prevents the water passing into the gullet, it falls back into the pail through the nose.

The pharynx is capable of being dilated by three pairs of muscles, and another three pairs act as constrictors.

In the passage from the mouth into the pharynx, on either side are the tonsils, and the pharynx itself is lined by mucous membrane, which is always moistened, and in the horse especially, by an abundant secretion.

When not feeding, a horse is observed at intervals to swallow liquid. This secretion has been collected and studied by M. Ricquet. At each of such acts of swallowing, about half an ounce of fluid descends the gullet, and it is found alkaline and very viscid. Ricquet believes that about 16 pounds, or 8 kilogrammes daily, are secreted. To prove that the liquid was really from the pharynx and not from the salivary glands, Ricquet opened the ducts of these, and the amount of fluid swallowed continued the same. When food is swallowed by a horse, it is found covered with this viscid secretion, which Ricquet found alone secreted by the membrane just behind the base of the tongue. This abundant pharyngeal product is evidently destined to favour deglutition.

The œsophagus, or gullet, is a musculo-membranous tube, with a funnel-shaped aperture, formed by the pharynx, and terminating at the cardiac opening on the left side of the stomach. In ruminants, it enters the paunch, and forms there (as seen at Fig. 66), a canal, with two prominent lips

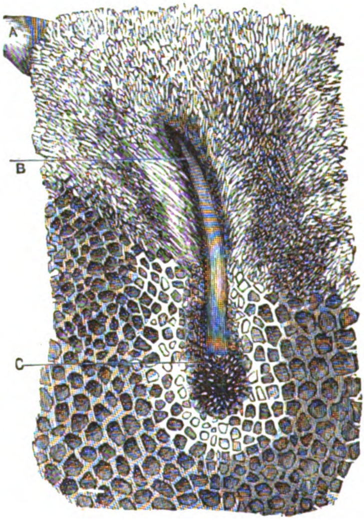

Fig. 66.

or pillars, communicating with the first and second stomach, and by an opening to the right, with the third gastric cavity.

In all animals the œsophagus may be divided into the neck portion, or cervical, and into the chest portion, or thoracic divisions. The first may be traced along the left side of the neck above the windpipe, and the second through the middle of the chest. The œsophagus becomes wider as it descends, and is endowed with very great elasticity and remarkable contractile power.

In order to adapt the muscular coat of the œsophagus for a progressive or vermicular action from above downwards, or from below upwards, its fibres interlace each other obliquely, as seen at Fig. 67, which I borrow from Peyer's *Merycologia*.

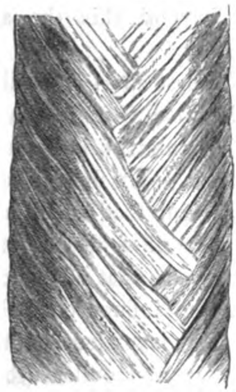

Fig. 67.

This arrangement I believe to be very similar in all animals, though most marked in ruminants in which the œsophagus is extremely active. The pillars on each side of the œsophagean canal before mentioned are strongly muscular.

The mucous lining of the gullet secretes a scanty mucus, and is protected by a stratified layer of cells or epithelium, which has been termed its cuticular coat. This dense cellular covering is evidently destined for protection. The mucous membrane is so ample, that when the gullet is at rest and closed, its lining is thrown into longitudinal folds, which are readily distended by the food swallowed.

From the foregoing description, it will be understood that the food has to pass from the mouth into the pharynx or throat, from this into the gullet, and from the gullet into the stomach. Muscular power is exerted for this purpose, and in the first step the will controls the act, so that deglutition is effected, or not, according to the animal's desire. In the second effort, the will is only partially capable of influencing the movement, and beyond this the act is perfectly involuntary.

When I say that the first effort in swallowing is voluntary, it must not be understood that, in the ordinary process of feeding, a special act of the will induces the animal to pass the food into the throat. We find, in ourselves, that it is difficult to resist swallowing food which has been sufficiently masticated; and the marvellous feature of an act which calls into play so many organs as that of deglutition is, that they all co-operate under the influence of the nervous system. When a bolus is formed, independently of the will and by reflex action, the mouth, throat, and gullet act in succession, and force the morsel into the stomach.

In considering the three stages in the process of deglutition, I refer the reader to Fig. 65 to see how favourably situated the throat and œsophagus are for the passage of substances from the mouth to the stomach. The tongue and cheeks press the food back through the pendulous soft palate 3, and at the same time, from the active muscles being connected with the *hyoid* bone supporting the tongue, the larynx and the windpipe are drawn upwards. The throat, in fact, advances, and opens for the reception of the food. The larynx closes, and this is effected by a lateral contraction, as well as by a lid, the epiglottis, closing over it. This cartilaginous lid rests on the back and lower part of the soft palate, so that when food pushes up the latter, it must force the epiglottis over, though, as the larynx advances against the rigid tongue, which is pressing back the food, the epiglottis is necessarily pressed against its base. If, perchance, the rapid passage of food or liquid into the throat leads to a particle touching the margin of the larynx, the part is so sensitive as to induce a violent expulsive coughing fit.

In the horse the passage into the pharynx is narrower, and hence calling for more active effort in deglutition than in the ox. From the mouth being closed behind when the parts are at rest, a horse will hold up his head, with an abundance of fluid, and resist any act of swallowing for a long time, whereas the ox is forced to swallow more readily. The pharyngeal liquid, which I have stated as being very abundant in the horse, favours very materially the act of swallowing, and indeed this, in conjunction with the salivary secretion, is essential in order to ensure a rapid descent of any dry substance to the stomach.

A practical lesson may be learned from the necessity of moisture to lubricate the gullet. In giving a ball covered with dry paper, it is apt to adhere for some time in its course downwards; and I shall hereafter describe some bad forms of choking due to this circumstance. Some practitioners smear the balls with grease; whereas we recommend an animal being caused to swallow some water immediately after the ball has been seen to pass down the neck.

The mucous membrane of the œsophagus, covered by a dense layer of protecting scales, does not secrete much, and when any substance adheres to it the muscular coat acts powerfully to remove this obstruction, and by such spasmodic action interfering with the regularity of the act we often find a bolus fixed and choking an animal, which from its size might have readily passed downwards.

The œsophagus is devoid of sensibility, and we do not feel the passage of any ordinary bolus; but when injured, the pain and irritation are intense, and death may speedily result. This occurs in cases of ligature of the œsophagus, and many of the facts observed by toxicologists, regarding the effects of poisons which they caused the stomachs of dogs to retain by ligature of the œsophagus, have proved quite unreliable from the influence afterwards observed to attend the simple ligature of the canal.

The act of swallowing is not due to gravitation, as some persons have supposed, and though liquids descend more rapidly than solids, they call into play the vermicular contraction of the organs of deglutition. In vomiting and rumination, we observe a regurgitation of food and liquids as rapid as their passage downwards: and such regurgitation is, as we shall afterwards show, due to an anti-vermicular contraction from the stomach to the mouth.

CHAPTER III.

ORGANS OF RUMINATION.—THEIR DISEASES.

Rumination.—Position and capacity of organs in cattle.—Rumen.—Water pouches in camels.—Reticulum. — Manyplies. — Rennet. — Œsophagean canal.—Act of rumination.—Changes of food in the rumen.—Regurgitation of food.—Colin's experiments.—Paunch of llama.—Movements of food in paunch.—Second mastication.—Aristotle and Brugnone.—Quantity contained by stomachs of ruminants.—Stomach of the horse; of the pig; of carnivora. — Crop of birds. — Guizzard. —Movements of the stomachs.—Vomiting—Its mechanism.—Action of stomach; of œsophagus.—Horse not susceptible to emetic action.—Mechanical impediments.—Circumstances under which vomiting may occur in horses.—Treatment of vomiting.—Pharyngeal polypi.—Choking.—Causes.—Symptoms.—Treatment. — Dilatation of gullet.—Stricture of œsophagus.—Laceration of œsophagus.—Inflammation of gullet.—Parasites.—Tympanitis or hove.—Chronic hove.—Impaction of paunch.—Fardel bound or grass staggers.—Lead poisoning.—Diseases of reticulum.—Concretions.—Fistulæ.—Stomach staggers in the horse; mad, comatose, and paralytic forms.—Diseases with which they may be confounded.—Treatment.

THERE is no more interesting physiological act than that, peculiar to a large class of timid herbivora, of leisurely chewing a mass of food which has been collected hastily in a capacious paunch. Ruminating animals instinctively rely on quickness of sight, acute hearing, and extraordinary agility in evading their enemies. When wild, they congregate in large masses, and one or more of their number may be observed to watch and signal approaching danger. With a powerful prehensile tongue, long and thick tufts of grass are rapidly carried into the mouth and swallowed. However tough the herbage, it is but very slightly broken down by one or two strokes of the molar teeth. It then passes into the capacious compartments, which receive the name of stomachs, but are in reality pouches of the œsophagus, and situated between the latter tube and the true stomach. Retaining, however, their common name "stomachs," they are three in number, in addition to the true stomach, and Chauveau states that the average capacity of the whole is 250 French *litres*, that is to say, about the same number of English quarts. The first cavity, that of the paunch or rumen, (see Fig. 68, A B), is by far the largest, and constitutes about

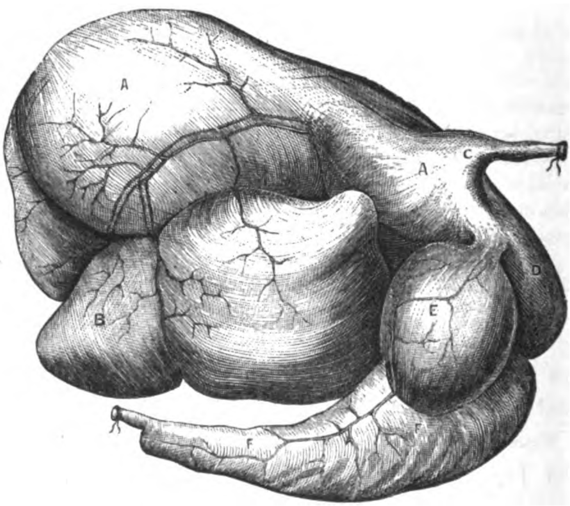

Fig. 68.—(Colin.)

nine-tenths of the space represented by the interior of the ruminants' stomachs; the second, D, is called the honeycomb bag, or reticulum; the third, E, is the manyplies, or omasum; and the fourth, F, which communicates backwards with the intestine, is the rennet or abomasum.

The gullet, C, enters the first stomach or rumen at its upper, and left anterior and side. The paunch occupies three-fourths of the abdominal space, having the spleen on its left side, the reticulum in front, the remaining stomachs and the intestines on the right. Fig. 70 represents the interior of this organ divided into compartments by constrictions, and these are due to two muscular bands. The rough character observed in the engraving is due to eminences or papillæ on the mucous membrane, which is covered by a dense scaly epithelium or protecting structure. The papillæ are very large in the dependent sacs into which the paunch is subdivided.

I must here specially allude to the remarkable construction of the rumen of camels and other animals of the desert. There are two large collections of prominent dilatations, which prove on dissection to be a number of large cells arranged in parallel rows, and separated from each other by membranous folds, the free margins of which are thickened by muscular fibres or sphincters, capable of closing the opening by which each cell communicates with the cavity of the rumen. There are eight hundred of these cells, and they always contain water, for which, indeed, they are believed to be constructed. One of the group of cells is to the left, and another to the right. Solid food does not penetrate them, but it has been found the right group would hold more than five quarts of water. In the camels the mucous membrane of the paunch is not papillated as in the ox and sheep. The cells above referred to are represented at Fig. 69.

The reticulum, or honeycomb stomach, has been called *bonnet* by the French, from its resemblance to a cap. (See

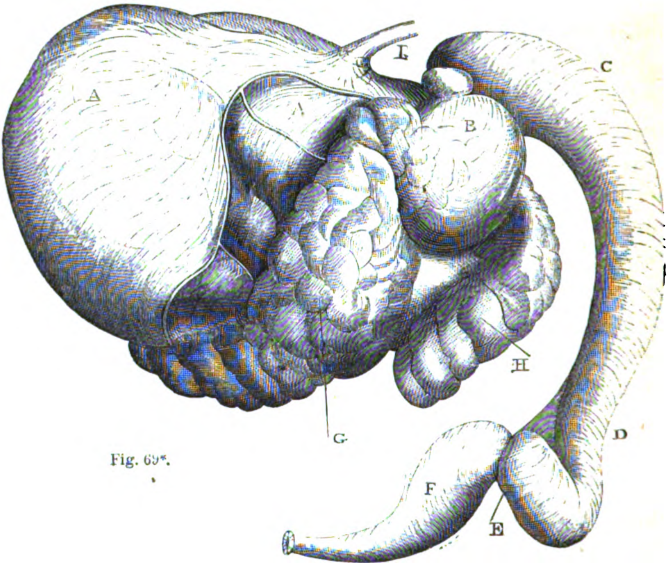

Fig. 69*.

* Fig 69.—A. Rumen.—B. Reticulum.—C. Omasum or Manyplies continuous without demarcation with the Abomasum D.—I. Œsophagus.—G. First Group of Water-cells.—H. Second Group.—E. Pylorus.—F. Duodenum.—(Colin).

Fig. 68, D.) It is the smallest of the four compartments, being fixed above by the œsophagus to the diaphragm, connected with anterior part of the rumen, and attached below also to the diaphragm. Communicating freely with the cavity of the paunch, the reticulum constitutes a dependent pouch lined by mucous membrane, which is disposed in papillated folds intercepting the surface in hexagonal spaces, within which the tubes of glands are seen.

The omasum, or manyplies (Fig. 68, E), is situated on the right side of the rumen and reticulum, descending from before backwards, and lined by a mucous membrane, which is disposed in broad folds. The folds are of unequal breadth.

there being from twelve to fifteen, which form almost complete partitions to the organ, but between them are others gradually diminishing in size. They are all papillated on their surface, the eminences being flattened on the sides and pointed on the free edge of each fold. When the contents of this stomach are examined in animals slaughtered in perfect health, they are always found dry, and there is a disposition for the epithelium to become detached in shreds, and adhere to the pulpy mass.

The canal, of which a drawing after Colin has been given at page 66, and which is, moreover, represented by the annexed cut (Fig. 70), communicates to the left with the paunch and reticulum, and on the right with the manyplies.

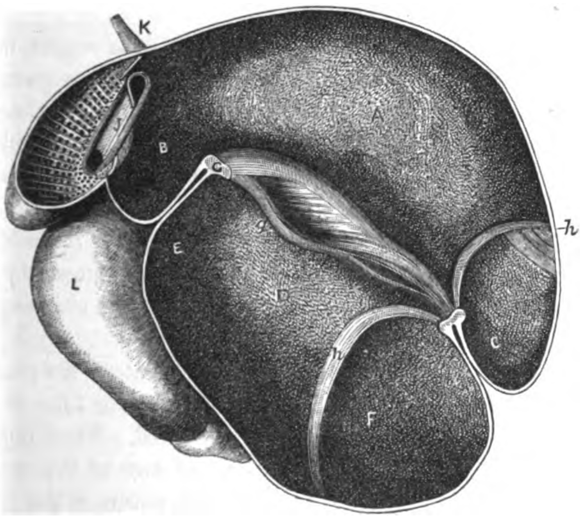

Fig. 70.—(Chauveau.)

Its direction is from above downwards and backwards, the anterior lip or pillar entering the honeycomb bag, and the posterior the rumen. The lower angle is raised above the level of the third stomach, especially during the action of the gullet and stomachs, so that it is only when the pillars of the canal are at rest, and liquids or soft food descend, or when the contents of the first and second stomach strike against the canal, that any drop into the omasum.

The fourth stomach, abomasum, is the well-known rennet which, secreting an acid solvent juice, performs a function similar to that of the single stomach in other animals. Its mucous membrane is arranged in folds, transverse at the upper end, longitudinal in the middle, and gradually effaced at the intestinal opening (Fig. 70, B), which is provided with a stout ring of muscular tissue, to prevent the passage of food incompletely digested; hence the name pylorus given to this opening.

The act of rumination calls into play all the organs mentioned, with the exception of the abomasum or rennet. It is to a very considerable extent under the control of the will, and any one may observe this by approaching an animal chewing its cud. The process is disturbed and voluntarily recommenced. Fear and any slight disorders stop the act, and although the paunch may contain solid food in its lower pouches, unless the amount is sufficient to be moved by the ordinary rolling action of the organ against the œsophagean canal, rumination cannot go on.

The coarsely ground food which first enters the paunch and reticulum, is subjected there, for a variable time, to the action of heat and of the liquids contained. These liquids are the saliva, mucus, and secretions of any of the organs themselves. In proportion to the tough nature of the vegetable food is its presence in the rumen prolonged. Liquids, such as the milk of young animals, which need no second mastication, pass chiefly into the second and third cavities;

the rumen is then dispensed with, and it is therefore quite rudimentary in the suckling animals. The reaction of the contents of the first two stomachs is slightly alkaline. Tiedemann and Gmelin found it acid in calves, and Colin thinks his experiments warrant him in declaring the reaction as slightly acid when digestion is disturbed or suspended. It is evident that this depends much on the changes occurring in the food, because there is not sufficient secretion to give a decided character to the mass contained, during digestion, in the two first stomachs. Peyer, Bourgelat, Spallanzani, and others, thought that the rumen secreted abundantly; but Colin refers to the absence of a secreting structure as possessed by the membrane lining this organ, which is papillated for the production of an abundant protecting epithelium. Colin, however, performed the following experiment, which proved how insignificant in amount the secretion must be. He opened the rumen and applied, against the membrane, a glass capsule, containing a fine sponge, which he had previously weighed. No sensible increase in the weight occurred by allowing the sponge to remain in contact with the stomach half an hour or an hour.

The food lodged in the rumen and reticulum is subjected to a slow churning movement, and not to the active grinding or violent propulsive efforts which were once believed to aid in the trituration and regurgitation of food. Fluorens showed, that substances dropped into the posterior pouches of the rumen rose, and were forced gradually forward into the reticulum and back, without any very sensible contractions of the muscular walls of the viscera. By exposing the interior of the paunch in a young bull, Colin noticed the welling of the semi-fluid food, and the production of distinct waves, with an ebbing flow, indicating the commotion set up in every portion of the abundant contents. The newly swallowed food is, therefore, speedily mixed with the portion which must necessarily lodge, however long an animal may fast, in the lower pouches of the rumen, notwithstanding the most perfect digestion.

It is evident, that prolonged maceration in the paunch will reduce food to a pulpy mass, facilitating the trituration and after-solution by the digestive fluids. All soluble materials which the saliva and other fluids swallowed may dissolve, are rendered fit for passage onwards in the alimentary canal; and however feeble the action of the diluted secretions above referred to, nevertheless it must aid in the changes to be effected on the starchy principles which the food of ruminants so largely contains. Flesh, on the other hand, yields its soluble principles, and undergoes a kind of digestion in the rumen, as Colin has proved.

The precise nature of the action is involved in some mystery. It is regarded as a fermentation; but this process is most marked in cases of disease, when an abundant evolution of gas indicates a dangerous and rapid chemical change in the contents of the paunch, which may soon prove fatal to the animal. At all times, however, a certain amount of gas is disengaged from the food.

The infusion and solution of substances occurring is indicated by Tiedemann and Gmelin's analysis of the liquids in the paunch. They found—

1. Free carbonic acid disengaged by heat.
2. Sulphuretted hydrogen.
3. Acetic acid.
4. Butyric acid.
5. Carbonate of ammonia.
6. Acetate of ammonia.
7. Butyrate of ammonia.
8. Albumen.

9. Three animal substances of undetermined nature.

10. And lastly, chlorides, carbonates, phosphates, and sulphates of soda and potash, besides carbonate and phosphate of lime. These different salts varied according as to whether the animals received straw, hay, or oats.

Gruby and Delafond have shown that myriads of infusoria develop in the rumen. Their development appears due to the germinating powers of heat and moisture, which seem to be the chief causes of the disintegration and partial solution of alimentary matters; changes which appear, as Colin says, totally distinct from any true digestion, such as that occurring under the influence of the acid secretions of the true stomach.

In the reticulum, food undergoes changes precisely similar to those observed in the rumen; and indeed the second stomach might almost be regarded as an extension or pouch of the first. Its special function appears to be retaining fluids swallowed and fluids passing into it from the rumen, its contents being always very liquid. The fluids within it are remarkable for a greater alkalinity than those of the paunch. Peyer believed the food underwent a process of crushing in the honeycomb bag, but this is not the case.

Referring to the passage of the contents of the two first stomachs back to the mouth, I may mention that the forcing action attributed to the whole, or only to the anterior part of the rumen, or, again, to the reticulum by some, is all imaginary. Colin has shown, by a very interesting experiment, that the gradual insinuation of food between the pillars of the gullet is sufficient for the regurgitation essential in the act of ruminating. He introduced three metallic sutures through the lips of the canal, as represented by Fig. 71.

The animal was fed, and afterwards ruminated as usual, indicating no disturbance or perceptible difference in the regurgitation from the natural state. This simple experiment upset the view entertained by Fluorens, that regular boluses were formed between the pillars of the œsophagus, to be carried back to the mouth. It, moreover, proved how

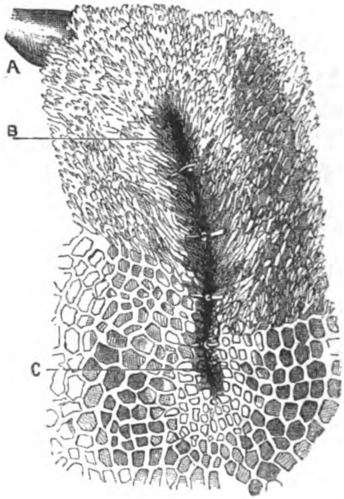

Fig. 71.—(Colin.)

false was the view, that masses could be forced up into the gullet by spasmodic contractions, which never occur in the rumen and reticulum.

Comparative anatomy, as shown also by Colin, demonstrates how false were the theories regarding the uses of the œsophagean pillars. He indicated, as may be seen from the subjoined cut (Fig. 72), which I borrow from his work, that the llama, and even dromedary, have only a single pillar over which the semi-solid food is directed, and by which it is certainly not pressed into the gullet.

I have especially to caution my English readers from believing Youatt's description of the position of the rumen, and much less the action he attributes to this stomach or the reticulum, in the regurgitation of food. I have before said, that the contents of the two first stomachs are subjected to a

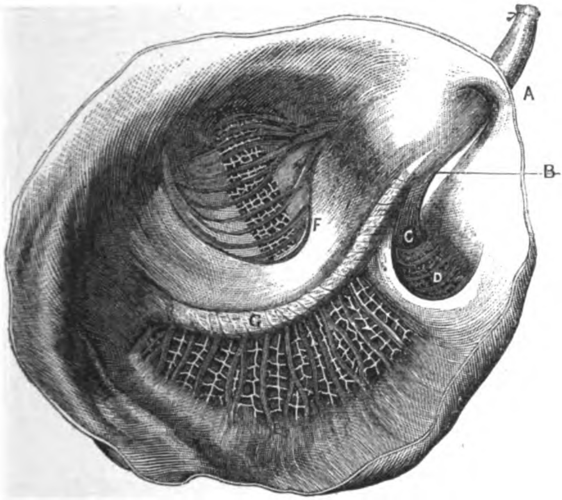

Fig. 72.

churning action, and at Fig. 73 it is evident that the tendency is for the food to strike forwards against the pillars of the œsophagus; as it presses by its own weight, and the slight degree of impulse which the rumen gives to it, against the canal, there is a contraction of the diaphragm and abdominal muscles, which especially aid in the passage upwards of the liquids contained in the reticulum, as well as engaging a portion of the contents of the rumen in the lower end of the gullet, from which it is carried up by an antiperistaltic movement. Fluorens proved that the diaphragm and abdominal muscles were essential to the act of regurgitation. He divided the phrenic nerves in a sheep, and this animal afterwards ate, and next day ruminated, but the abdominal muscles were called upon to make an extra effort owing to the paralysis of the diaphragm. When the abdominal

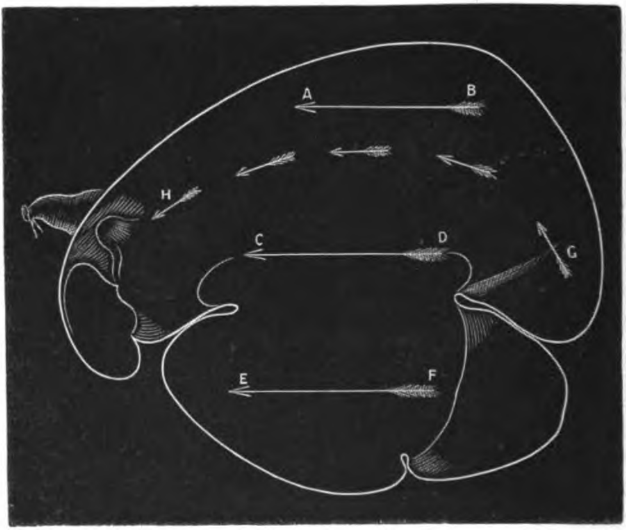

Fig. 73.

muscles were paralysed by division of the spinal cord, rumination could not occur.

The act of regurgitation is a very apparent one, from the considerable mass which ascends and distends the œsophagus, making a considerable eructating noise at the same time. The moment that the rejected bolus enters the mouth, there is an act of swallowing, by which the abundant liquids accompanying the solid food are carried back to the stomachs, entering, in fact, the third stomach, as well as the first and second.

Ruminating animals require a considerable length of time effectually to rechew their provender, and it is calculated by Colin that the fourth of the day requires to be expended by them in rumination. I may here refer to an important observation I have made, viz., that rapidly-grown grasses, such as the crops grown on irrigated meadows, distend the rumen far more in proportion to their solid elements than other food. The distended paunch, however, soon diminishes in size, and the animal then appears very empty, and cannot as effectually ruminate such food as the harder and better kind. It must not be forgotten, that a certain volume of food must exist in the paunch, in order that rumination may go on, and if the essential bulk of very soft grasses is readily reduced by a speedy separation of the moisture, the act must be comparatively imperfect. This is a subject which merits investigation in connection with determining what foods most favour the natural action of the stomachs in ruminants.

The mastication of the regurgitated bolus is very complete, and varies in accordance with the toughness or succulent nature of the food. Many circumstances seem to affect the extent to which food is chewed the second time, and Aristotle declared that animals ruminated more in winter than summer. Brugnone said that green food required from 30 to 33 strokes of the teeth, and dry food 45 to 55, during the second mastication. Young and very old animals chew more than healthy adults.

The act of chewing is either one-sided or alternate, and a very strange fact has been noticed, that the first stroke of the molars is in an opposite direction to the regular action which follows it. Thus, if on the one side chewing, an ox is masticating from right to left, the first stroke will be observed from left to right.

Colin confirms a statement made originally by Fluorens, that from the period of feeding to that of rumination, there is a constant deglutition of saliva, which, if stopped, causes the contents of the paunch to become dry, hard, and unfit for regurgitation. Colin adds, that if the secretion of the parotids alone is made to flow from the opened ducts, and not allowed into the stomachs, however much water the animals may be allowed, rumination is suspended.

We have before said, that solid food, when first swallowed, must pass into the rumen and reticulum. The quantity with which these cavities may be charged is enormous. Colin has found 100 ℔s. weight even in sick animals that had not fed for some time, and he found 150 ℔s. in the rumen of a bull that had not taken food for twenty-four hours, and 200 ℔s. weight under similar circumstances in a cow. One-fourth of the total weight may be set down as liquid. From 20 to 25 per cent., at the outside, would be the amount of solid material.

After the food has been masticated a second time, it returns partly in the rumen and honeycomb bag, and a portion passes directly into the manyplies. The same happens with water and other liquids, of which, however, a great proportion enters at once into the third stomach. As the softened mass in the anterior part of the first and in the second stomach, rises, from the slight contraction of these organs, it passes over into the manyfolds, whence it enters the rennet.

In the manyfolds the food is subjected to a certain degree of compression, and Tiedemann and Gmelin believed that an acid secretion from its membrane acted on the food. There is no doubt that the almost constant acid reaction of the contents of the third stomach is due to a reflux of gastric juice from the rennet. It is my impression that the great purpose of the manyplies is to regulate the descent of the food into the true stomach, though absorption may also go on between its ample folds. The constant dryness of its contents is, however, I believe, to be attributed more to the effects of compression, and the onward flow of the liquid portions, than to any free absorption.

Before referring to the function of the true stomach in ruminants, I must refer to the simple gastric cavity of other domestic animals, and to the movements to which the food is subjected within them.

The stomach, in all monogastric animals, is in reality a dilatation of the alimentary tube. The latter being bent on itself just beyond the diaphragm, and enlarged along the convex margin of the curve thus produced, constitutes the stomach which lies in the fore and left side of the belly, having the gullet entering it on the left or cardiac side (thus called from its proximity to the cardium or heart), and the small intestine issuing from it to the right. The large dilatation near the cardiac opening is called the fundus of the stomach. (See Fig. 74.)

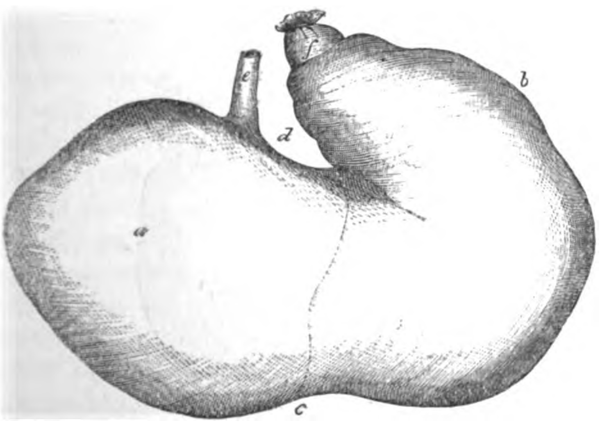

Fig. 74.

Near the intestinal opening, which is guarded by a muscular ring, hence called the pylorus, is a lesser pouch, called the antrum pylori.

The convex margin, *c*, is called the greater curvature, and the concave one is the lesser. Along the first is situated the spleen, and the pyloric end is connected with the posterior surface of the liver.

The horse's stomach is remarkable for its smallness in contrast with the size of the intestine, and of the body generally. The average capacity does not exceed from 14 to 15 quarts. A horse dying from indigestion, with repletion of the stomach, has not more than from 20 to 30 lbs. weight of food in it. By accustoming the animal to very bulky soft meat, the stomach becomes very large and very thin, whereas the natural size of the organ is preserved when horses are fed on sound dry fodder. These facts should not escape the attention of all who have to direct the feeding of horses.

The stomach of the pig (see Fig. 75) is larger in proportion

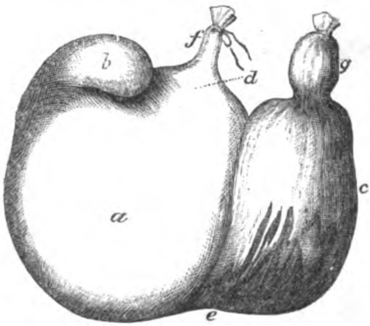

Fig. 75.

than that of the horse, and it is remarkable for a peculiar pouch or diverticulum on the left side. In all carnivora, not excluding the dog and cat, the stomach is less curved on itself than the horse, and the capacity is proportionately much larger.

Amongst the peculiarities which are especially interesting to the physiologist, we find that the inner lining of the stomach is in the horse, however small in this animal the organ may be, only in its right half, formed for the secretion of gastric juice. The left half, which is distinguished by a dotted line in Fig. 74, is covered by a non-secreting tough coat, protecting the organ, and not yielding any solvent fluid to act on the food. This lining is densely folded on itself, so much so, that when the stomach is inflated by blowing air through the right opening or pylorus, none escapes through the left or cardiac orifice.

The muscular coat of the stomach in the horse is very strong, especially where the gullet terminates in the stomach, but there is not, at this part, as Colin and others have imagined, a muscular guard or sphincter to prevent regurgitation.

In carnivorous or omnivorous animals, the stomach is not only ample, but lined throughout with a membrane which secretes the gastric juice.

Before entering on the function of the stomach, I may allude to the annexed engraving, Fig. 76.

It represents the crop of a pigeon M M, and this cavity may be compared to the three first stomachs of ruminants, as a dilatation formed for the preparation of food to undergo digestion in the true stomach below. This organ, as John Hunter observed, is capable of acquiring great activity in secretion, and the inner lining which is usually as seen in O, may become highly developed as in N, just before the birth of young, and last in this way until the newly-born birds are acquiring some strength. It is from this crop that a secretion flows of whitish colour, and which has been called pigeon's

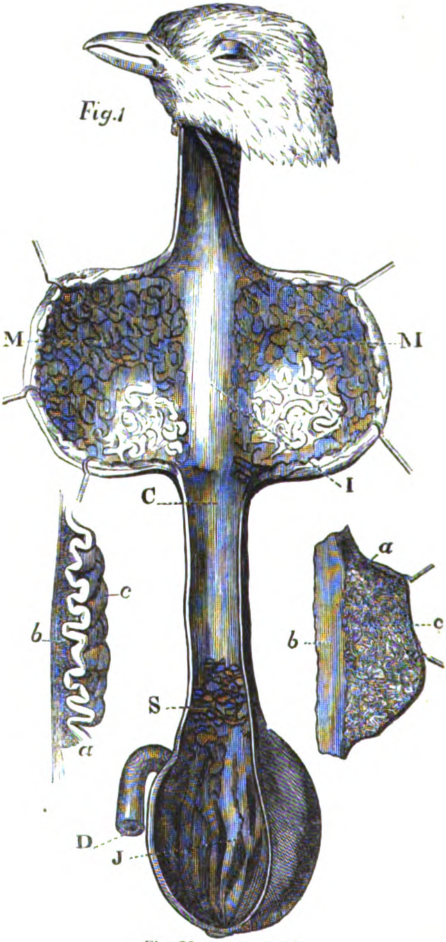

Fig. 76.—(BERNARD.)

milk. Though nourishing when carried into the stomachs of the young birds, it is doubtless most useful in moistening grain and preparing it for effectual digestion. The crop of the domestic fowl is seen at 4, Fig. 77, and the guizzard, 7, is a muscular organ destined to grind the food, compensating for the want of teeth. It is connected with the secreting stomach, 6, which is technically called ventriculus succenturiatus.

Returning to the simple stomachs of our domestic quadrupeds, we find that the muscular fibres are destined to cause, 1stly, A movement of the contents from left to right, or *vice versa;* 2ndly, A rolling movement; 3rdly, A mixed movement. Thus the food is exposed most freely to the action of the gastric juice.

None of the monogastric animals ruminate. Instances have been recorded of human beings becoming addicted to the habit, or suffering from the tendency to ruminate, as a symptom of a morbid state of the alimentary canal. The regurgitation of food in all animals, with a simple stomach, constitutes the act of

Vomiting.

This is the simple means by which an animal discharges that which the stomach refuses to digest, or is likely to be injured by. The act is under the control of the nervous system, and in order to be induced, the phenomena included under the name nausea or sickness must be observed. All animals are not equally susceptible to nauseating agents, or to substances capable of causing the evacuation of the stomach. This is regarded by my brother, Mr J. Sampson Gamgee, as the true cause of the difficulty of the act in the horse, and in other animals who manifest but rarely the tendency, and, never in health, the power to vomit. A very

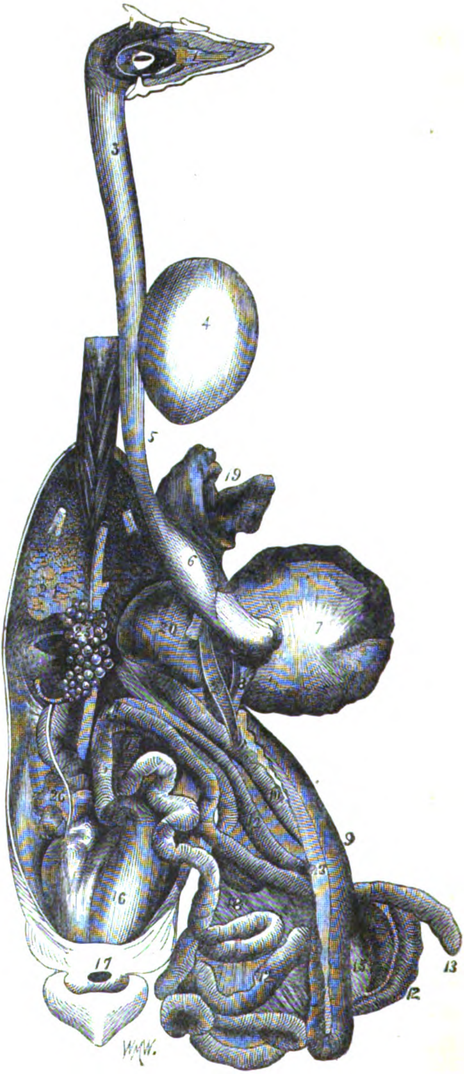

Fig. 77.—(Chauveau.)

minute dose of tartar emetic causes active efforts to clear the stomach in the human subject, in the dog, pig, and other creatures, whereas large quantities are taken by the horse without indicating the slightest effect. Even the most refractory nervous system is, however, liable to be acted on by some emetics, and the tincture of white hellebore injected into the blood-vessels produces even in the horse symptoms of nausea and spasmodic, but ineffectual efforts for the discharge of the stomach's contents.

Before further entering on the question why the horse rarely vomits. I may describe this act in animals in which it occurs freely. The first symptom is the expansion of the chest, drawing air into the lungs so as to fix the ribs and enable the diaphragm to act from them. Then the muscles of the belly act, and at the same time the neck is shortened, its muscles grow rigid, there is a regurgitation in the gullet and ejection through the open mouth. It is found that the fluids usually secreted in moderate quantity in the throat, increase in quantity under the influence of the emetic, and it is probable that this is destined to favor the ejection of materials thrown up from the stomach. When the normal contents of the stomach have been dislodged, and vomiting continues, bile, and even stercoral matters are thrown up, proving that the antiperistaltic movement extends even beyond the pylorus along the intestinal tube. The action of the stomach, though not essential to the act of vomiting, tends to close the pylorus, and this favors the pressure of the contents against the open gullet. It is very remarkable how slight the contraction of the stomach is in vomiting, and Francis Bayle demonstrated in 1681, that if a finger is introduced in the stomach of a dog during the act of regurgitation, there is no perceptible effort noticed on the part of the organ; moreover, if the muscles of the belly are rendered powerless by a large incision through them, vomiting cannot occur. Chirac, Schwartz, Hunter, and lastly, Majendie, confirmed the views entertained by Bayle. Majendie's experiments consisted firstly in causing the stomach to be exposed through the walls of the abdomen in a dog, when, from the injection of tartar emetic in the veins, no contraction occurred in the organ, and the contents were not expelled. The second experiment consisted in tying a pig's bladder, in the place of the stomach, filled with liquid, which was expelled by the action of the abdominal walls. The latter experiment simply proved, that emesis, or the desire to vomit, occurred without the presence of a stomach in the body, and it is not a fact that the organ is incapable of action, or in no way affected by an emetic, because when the intestinal opening or pylorus has been tied, the unaided stomach proves sufficient to accomplish the rejection of its contents.

The action of the œsophagus has to a certain extent been overlooked in the act of vomiting, though Legallois and Beclard observed its active contractions. No one has denied its antiperistaltic movement, but its contractions are seen to be very violent in cases of impaction of some foreign substance close to the stomach. Liquids are then swallowed till the lower end of the œsophagus is distended, and by a forcible contraction of the latter they are soon expelled. I shall refer to this subject again under the head Choking.

The conditions favourable to vomiting are susceptibility to the action of emetics, or any influence capable of producing nausea, a moderately distended state of the stomach, and favourable form of the œsophagus, especially at its cardiac end, That the distended state of the stomach, independently of any decided sickness, is sufficient to produce regurgitation, is proved by the remarkable cases of so-called rumination in the human subject. Several instances are recorded in which, either under the control of the will or involuntarily, food is returned to the mouth after a meal.

All the persons who have referred to the subject of the difficulty of vomiting in the horse, have overlooked, to a great extent, the point which my brother has justly insisted on, that the emesis, or the tendency to vomiting, is not readily excited in this animal. Nevertheless there are cases in which it is observed, and vomiting is possible. These are, 1st, Cases of *inordinate* distention of the stomach; 2ndly, Cases of dilatation of the lower end of the œsophagus; 3rdly, Cases of obstruction to the pylorus; 4thly, Ruptures of the stomach; 5thly, Hering refers to cases of vomiting due to ulceration of the mucous membrane of the stomach.

The mechanical impediments to vomiting, insisted on by many physiologists, with the exception of two, and which are the disadvantageous direction of the œsophagus into the stomach, and the tendency of the mucous membrane to fold on itself and plug the cardiac orifice, are all false.

Many have described a spiral valve at the cardiac opening of the stomach, and I here reproduce a drawing of it from Leyh's *Anatomy*, but no such valve exists. It is simply a

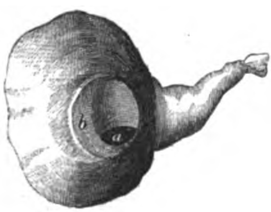

Fig. 78.

false appearance in a *dried* stomach, from the folds of the mucous membrane curling spirally when pressed upon by the distending air.

The sphincter which Bertin, Lafosse, Fluorens, and many others have taken for granted as existing at the lower end of the œsophagus of the horse, certainly does not exist.

The pathological facts, which I have carefully collected and examined, prove to me, firstly, that horses are liable to vomiting, and may manifest the disposition at intervals, or any time when the stomach becomes distended, if the mucous membrane has space enough not to be thrown into folds at the cardiac orifice. The subjoined cut indicates a dilatation

Fig. 79.—(Colin.)

of the lower end of the œsophagus, which is indicated during life by the troublesome and frequent rejection of the contents of the stomach. There is no doubt, however, that in cases of inordinate distention of the gastric cavity, especially coupled with spasm of the duodenum, regurgitation occurs. We had a case lately in the practice of the New Veterinary

College, in a horse which vomited during the paroxysms of a violent attack of colic. This horse recovered. The late Mr John Field relates a very interesting case* of vomiting from distention of the stomach and spasm of the duodenum.

* At page 85 of his *Veterinary Records*, we find: "About one o'clock in the morning of the 21st September, 1839, a bay cart-gelding, belonging to Messrs R—, was seized with retching, having been at work till very nearly that time drawing goods from the railway station, Euston Square. I saw him about twelve hours afterwards, when the following symptoms presented themselves: viz., pulse 84 to 90, and very feeble—haggard countenance—respiration but little disturbed—surface warm—mouth moist and clean—much fœtor from the nostrils, with frequent ejection of dirty fluid, attended with much moaning, but unaccompanied by any particular effort or retching, although much spasmodic contraction of the neck had attended the earlier vomiting.

"Percussion of the sides gave loud resonance; but there was no audible murmur, much less any purulent or mucous rattle, although the fœtor indicated abscesses or purulent secretion in the air-cells. There was no rolling, looking back, or other indication of abdominal disease.

"A blister was applied to the breast, and plugs were inserted, and subsequently, the probang was introduced; but it was not readily passed beyond the lower part of the œsophagus, where it brought on retching.

"During the day and night the horse continued to take water, was constantly dabbling in it, while from time to time that which he took was rejected by retching, and there was regurgitation of fluid in the œsophagus in the intervals between the vomitings. He was restless during the night, but he did not look back. He kept on his legs until eight o'clock on the following morning, when he lay down, and, after a few expiratory efforts, died.

"*Post-mortem examination.*—On removing the sternum from the thorax, the odour precisely corresponded to what was emitted from the trachea. The lungs were remarkably bulky, but crepitant throughout, except at the anterior and inferior fringed edges of both, where small spots of hepatized lung were observed, containing very small points of pus. Some ulcers in the air-cells. The bronchial tubes were filled

But veterinary surgeons are well aware that in acute cases of vomiting, in cases of stomach staggers, the stomach has already given way, and by this the mucous membrane forming hernia, through the laceration, any obstruction at the cardiac orifice is overcome. The close manner in which the organs are applied to each other in the abdomen explains how, with an inert and, indeed, torn stomach, by the action of the abdominal walls, ejection readily occurs. Those who may be incredulous that, after the walls of the stomach having given way, there could be any vomiting, may be reminded of a case referred to by Longet, in which a woman, having swallowed sulphuric acid, suffered from violent vomiting up to the time of her death, after which it was found that the walls of the cavity had been completely destroyed.

with spume generally, and some of the smaller ramifications contained similar dark fluid to that ejected. The lining membrane of the bronchial tubes was inflamed. The heart was perfectly natural: no staining of arterial or venous tubes.

"The abdomen presented distention of the stomach, which was very large, and contained fluid of the same kind as that retched up: also, some fragments of half-digested hay, part of a ball with its paper envelope, some bots which were adherent both to the cuticular and to the villous coats, and several irregular elevated spots of ecchymosis beneath the villous coat, particularly contiguous to the cuticular coat, which must have been effused during the great contractile effort of the stomach: internally, this viscus was not inflamed, but externally it was discoloured. The duodenum was also distended for eighteen inches of its length, and then suffered contraction, as if tied with a band, about an inch and a half broad. On opening the intestine it was extremely inflamed, almost approaching to gangrene, just anterior to the pallid and compressed portion. The other intestines were healthy. The liver was much gorged, and the hepatic duct and branches were distended with bile, which flowed out freely when the duct was divided.

"Thus we have another condition inducing vomiting in the horse. Although I have seen hernia of the foramen of Winslow, vomiting did not accompany it."

The frequent ruptures of the stomach have been ascribed to active muscular effort of the organ, but I regard them as due to the pressure of the impacted mass on the paralysed coats. I say paralysed coats, because all hollow organs, unduly distended, suffer a kind of paralysis, or are stretched beyond the limit within which they can act. Doubtless when the muscular coat has partially given way, the pressure during the efforts to vomit would increase the hernia of the mucous lining, and favour the regurgitation.

Admitting, therefore, the fact that horses are not liable to vomit, because they are not subject to impressions by emetic substances, yet I find that when they do vomit, the conditions of distention of the stomach, rupture of this organ, or dilatation of the œsophagus, one of which is essential to the act, are precisely those which overcome the only mechanical impediment, and which is the disadvantageous position of a narrow cardiac opening with a folding of the internal lining of the organ.

My brother says, in his last Memoir on the subject:* "Comparing the stomach of a horse and of a dog in the body and on the dissecting table, it is obvious that the mechanism of the latter must, from its shape and mode of construction, be more simple than the former; it is obvious that extrinsic pressure must produce greater results on the thin, simple, tube-like viscus of the flesh-eater, than on the thick, short, and pouched stomach of the great solipede; but the latter, like the former, has provision for movement, and its construction involves no condition which can act as an impediment to any movement which its nervous affinities may stimulate." Admitting this almost without qualification, it is clear that the cardiac opening is, in the horse,

* *The Veterinarian*, 1857.

alone unobstructed for the purposes of vomiting when the stomach is inordinately distended, or has suffered injury, or the œsophagus is morbidly dilated. Relax, beyond any point consistent with health, the muscular coat which throws a very ample mucus membrane into innumerable folds at the cardiac end, and not only nausea, but the act of vomiting occurs. It is unquestionably the fact, that in the morbid states characterised by vomiting in the horse, the stomach is usually incapacitated for any response to nervous stimuli, and the expulsion is undoubtedly effected by the abdominal walls.

In ruminants, vomiting is rare, but possible. They are only very slightly susceptible to the action of emetics, and this is very remarkably shown by the enormous doses of potassic tartrate of antimony which cattle will bear without manifesting the slightest symptom.

Treatment of Vomiting.—We are sometimes called to check the violent retching seen in dogs when suffering from general disorder or intestinal affections. I find, under these circumstances, the best remedy is the dilute hydrocyanic acid, given in doses of from one to four drops in water, wine, or other fluid. The following is a useful prescription in some cases:—

Tincture of opium . . .	10 drops.
Chloroform	20 drops.
Cold water	1 ounce.

This may be given at once or in two doses. A little pure lemon juice or some ice, may allay gastric irritation when other substances fail.

As dogs are easily acted on by emetics, they are frequently dosed with them, and I have seen many cases of death from exhaustion, diarrhœa, or dysentery, especially in cases of distemper, from abuse in the employment of drugs given with a view to unload the stomach.

Pharyngeal Polypi.

The pharynx is subject to few special disorders. It is the seat of inflammation in sore throat, a condition which I shall more especially refer to under the head Laryngitis. One of the most common conditions observed in cattle is the production of pendulous tumors or pharyngeal polypi, which hang from the posterior part of the nose, and sometimes suddenly drop on the larynx and choke the animal.

The symptoms which these growths produce in the passage between the mouth, nose, gullet, and windpipe, are chiefly efforts to swallow, and obstruction to breathing, with an occasional cough relieved by the animal hanging down its head so as to press the tumour forwards.

These growths, which are formed from the mucus membrane, with areolar tissue as their principal constituent, may be removed by tortion, if discovered.

Choking.

This is an accident of very common occurrence in herbivorous animals, and attended with great danger to life. It is interesting to observe how nature has avoided, in the construction of the organs of deglutition, any disposition of parts which might favour choking. This is especially seen in carnivora. Persons are apt to believe animals are choked when they really are not, and this happens chiefly with dogs. If a dog coughs or indicates any peculiar symptom, he is believed at once to have a bone in his throat. Such an error is often committed with cases of rabies.

Causes.—These are either dependent on the animal itself, or on the nature of food. The causes included under the first head are,—1stly, Any influence which may favour the contraction of the throat or gullet on the object swallowed. This is a cause frequently operating in man, and dependent chiefly on mental operations. Thus what difficulty some persons experience in swallowing a small pill, and when by bread crumbs or water they can feel satisfied the pill has passed on into the stomach, they still experience a choking sensation. It is this choking sensation or irritable condition of the muscular coat which persists after animals have been relieved of an obstruction, and which induces a relapse if they are allowed cut roots. 2ndly, Inflammation or ulceration of the throat and gullet favour choking. The ulceration which follows bad accidents of this description, and which is especially troublesome a week after an animal has been relieved, often causes a dangerous accumulation of alimentary matters low down in the œsophagus. 3rdly, Organic disease of the œsophagus, especially constrictions such as are observed in crib-biting horses. 4thly, Injuries and diseases of the salivary apparatus or organs of mastication, whereby food is imperfectly chewed and moistened. If the parotid ducts in a horse are both opened, so as to allow of the escape of the secretion, the animal soon suffers from impaction of the gullet. 5thly, Voracious appetite and rapid deglutition of bulky or dry food.

The second class of causes may be classified under three heads. The object to be swallowed may be sharp-pointed, too large, or too dry. Amongst the first we include fish bones, which are very troublesome in puppies; large bones which transfix the œsophagus in different parts of its course in the dog; and thorns, such as the one represented here (see Fig. 80), and which are occasionally met with in hay.

The œsophagus is so dilatable that objects are not often too large for it which an animal can conveniently grind between its teeth. This is especially the case with the carnivora. I have often been interested to see the lions and tigers

Fig. 80.

in menageries greedily swallow a large mass of flesh, and from its size it might penetrate the gullet, but was ejected to be torn again before it could pass on to the stomach. Persons have often singular notions of food going the wrong way, that is to say, penetrating the windpipe. This is very rare in the lower animals; but last year I was asked to ascertain the cause of a sudden death in a favourite setter; and I found a lump of beef fixed by its lower end in the larynx, and distending also the pharynx. In shape it was not unlike a champagne cork, but much larger. Amongst the bulky objects the most dangerous, are cut roots or potatoes. Formerly many horses were choked by eggs given to them whole, in the belief that they favoured good condition. Balls are not unfrequently causes of choking, and this from their improper administration, if left across the pharynx instead of being delivered straight. If too large, or if given when the secretions are scanty and the passage dry, they are apt to stick down the neck, or in the chest.

Lastly, bruised materials, and especially dry farinaceous substances, or chaff, bran, broken locust beans, are apt to accumulate in the gullet of the horse. These are most dangerous cases of choking in the latter animal, and I have seen instances in which the whole length of the œsophagus was distended by such food.

Symptoms.—These may be classed under the heads General and Special.

Symptoms of obstruction might be due to inflammation of the passage, or to spasm, but the history of the case, coupled with the general symptoms, suffice to diagnose obstructions from foreign substances. The first general symptom is, that liquids cannot pass into the stomach, but are ejected at once. The second is the coughing and violent efforts at regurgitation. In cattle a symptom common to all forms of choking is tympanitis or hove. Uneasiness, more or less difficulty in breathing, involuntary movements of the jaws and flow of saliva from the mouth, are the other general symptoms.

The special symptoms of choking depend on the positions of the bolus, as well as to a certain extent its form. Thus, when a ball, thorn, or other substance becomes fixed in the pharynx, there is great distress, coughing, slavering, symptoms of suffocation, and in carnivora especially there is ineffectual retching. It is in the horse and ox, but particularly in the former, that greatest suffering is evinced in pharyngeal choking. The impossibility of returning the mass into the mouth, in consequence of the length of the soft palate (see Fig. 65, page 122), leads to urgent symptoms of oppressed breathing, and if any fluid is poured into the animal's mouth, it is thrown back through the nose, if pressed beyond the soft palate. By careful manipulation, either through the mouth or pressing on either side of the throat, the mass may be detected in the pharynx.

In cases in which the obstruction is in the cervical portion of the œsophagus, there is an obvious swelling in the course of the latter on the left side of the neck; the general symptoms are more or less intense, and the animal, with anxious countenance, sunken head, tremor, and partial sweats over the body, manifests, not long after the first symptoms appear, great exhaustion.

The presence of an obstacle in the portion of the gullet situated within the chest, is indicated by the absence of the most urgent symptoms of suffocation, but the addition in all animals of violent retching, whenever the œsophagus is filled by fluid. The distensions of the gullet by liquids swallowed, and the regurgitations to clear the canal, indicate, with the symptoms above-mentioned, and which are common to all cases of choking, this dangerous form of accident.

When the œsophagus is entirely filled, urgent symptoms sometimes appear tardily. Loss of appetite, sunken head, bloodshot eyes, costiveness, discharge of saliva and mucus from the mouth, with the evident swelling in the left side, indicate the impaction. I have known this form of choking overlooked for a week by a veterinary surgeon, and when I was in the act of emptying the passage, the animal sank exhausted.

With regard to ruminants, I must especially call attention to the urgent symptoms due to hove, and which often require to be relieved before any attempt to remove the obstruction. The violent cough, contractions of the muscles of the neck and abdomen, with expulsion of fæces and even urine, are very marked in bad forms of choking in cattle.

Treatment.—Having determined on the position of the obstruction and its nature, relief is afforded by various plans, which I shall enumerate.

I. *By the Hand.*—In cases of impaction in the back part of the mouth or in the throat, the animal's mouth is opened, and the offending object is withdrawn. In some cases this may lead to the discovery that the obstruction is a pharyngeal polypus, as stated above. If so, the operator must wrench it out. When, in any instance of impaction in the pharynx, the pulling out of the tongue and attempts to grasp with the hand fail, an assistant may press outside and push upwards.

II. *By causing the animal to swallow liquids.*—I have found that in horses choked with chaff, &c., if the extent of œsophagus plugged was not above six or eight inches, much good might be done by allowing time, and causing the animal to swallow tepid water or oil at intervals. By rubbing the neck, and breaking up the mass as much as possible, good has been effected. Some practitioners trust too much to spontaneous cures in these cases, and I have known them return two or three days in succession to see if the animal had been relieved by persistence in the above method. This is highly reprehensible, as exhaustion reduces the chances of success when an operation has to be decided on. When the offending object is bulky and hard, it is not advisable to persist long with the treatment by liquids, and efforts must be made with the probang.

III. *The Probang.*—About the end of last century, Dr Monro, the Professor of Anatomy in the University of Edinburgh, suggested a substitute for the ropes and sticks which were occasionally used to relieve choking cattle. He had a hollow tube made six feet long, and which was especially devised to relieve in cases of tympanitis; but it proves the best instrument to press a turnip or other such substance down the neck. It should be used cautiously. A gag is fixed in the animal's mouth, the head is stretched out, and the probang pushed steadily along, until it reaches the offending mass, when, by gentle pressure, it often causes the latter to pass onwards. In the horse, the probang may be passed through the nose, but the instrument is not so manageable in this animal. When, by well-directed efforts, the obstruction is removed, the probang may be cleared of the stilet, which usually occupies its interior, and through the aperture the gas freely escapes. (See Fig. 81, *a*.) A light gutta percha probang, without stilet, and provided with a perforated bulb at the end, is perhaps the cheapest and best which can be used. A pair of forceps, as represented by *b*, Fig. 81, may be of some use occasionally, but not often.

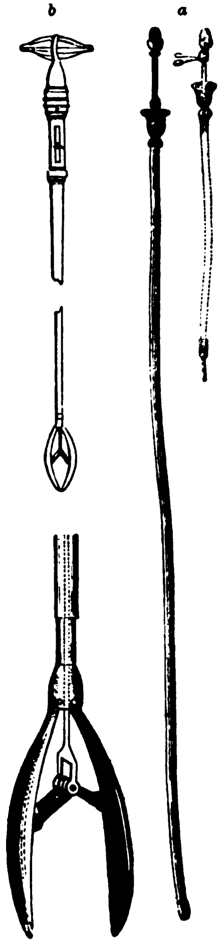

Fig. 81.

IV. *Puncture.*—If perchance an egg remains fixed in the cervical portion of the gullet—a rare accident now-a-days—the horse may be relieved by crushing the offending object. This is not an easy operation, in many cases, unless, by means of an exploring needle of any shape, the shell is pricked. It is then not difficult to crack the egg by a blow.

V. *Œsophagotomy.*—This operation is the last means to be resorted to in ordinary cases of choking; it is one of the first, however, when the gullet is impacted throughout its whole length, or when the obstruction is situated, in the horse, in the chest portion of the gullet. It consists in an incision into the latter so as to evacuate the canal directly through the opening, or in the horse to push along a flexible reed or tube to clear a passage into the stomach.

When an animal has been relieved, it is expedient to allow it liquids to drink, but no solid food for some time. If a ravenous appetite is observed, an aloetic purge may relieve the animal, and attention must be paid to the food allowed for several days.

DISEASES OF, AND INJURIES TO, THE GULLET.—DILATATION OF THE GULLET—"ŒSOPHAGUS VENTRICULOSUS."

In the horse, remarkable cases of this description are observed. Under the head Vomiting, I have alluded to cases of dilatation occurring near the stomach, and which are characterised by frequently relapsing efforts to vomit. Occasionally a general enlargement is observed throughout the whole length of the neck portion of the gullet, and more frequently about two or three inches from the part where the œsophagus enters the chest. The lesion is noticed by the food and liquids swallowed distending the part. The degree of swelling varies, and is always greatest when the animal is feeding. In some cases the enlargement is not greater than a pigeon's egg, and at others it is larger than an infant's head. The absence of any inflammation, the diminution of the swelling on pressure, and the peculiar character of the contents distinguished by manipulation, enable the practitioner to detect the nature of the lesion.

Professor Hertwig recommends œsophagotomy and the resection of the lips of the wound made in the gullet in order to diminish the diameter of the canal. Pressure may, in some instances, answer the purpose of removing the swelling, and eventually favouring a contraction of the tube.

Stricture of the Œsophagus.

This is a condition the reverse of the foregoing, but not unfrequently associated with it. That is to say, if in any animal the gullet becomes constricted from the constant tendency to accumulation of material above the seat of stricture, the canal becomes there dilated, and it is evident that the worst form of choking may be met with in these deformities of the gullet.

The symptoms are:—difficulty in deglutition, and the occasional regurgitation of food or liquids swallowed. It is the persistent nature or frequent appearance of these symptoms which draw the attention of any observer to the neck, and the stricture may be discovered by the peculiar dilatation above it when the animal attempts to swallow, or by the passage of a probang.

There are cases of stricture due to thickening of the coats or cancer, melanosis or other deposit around the tube. These are all incurable varieties of the lesion, which, indeed, is at all times a very troublesome and dangerous one. The most common cause of stricture is injury from operations.

Treatment consists in attention to the animal's diet, and in well-defined cases of stricture the knife may be advantageously employed.

Laceration of the Œsophagus.

This is the most untoward accident which may occur, especially when efforts are being made to relieve an animal choking. Hertwig refers to a case observed in a filly, in which the gullet was punctured by a needle, and this pierced the carotid artery, from which fatal hæmorrhage ensued. I believe such a case to be singular in the annals of veterinary surgery; but lacerations interfering with important structures in the neck are very common.

Symptoms.—The rupture occurs most frequently in the neck portion of the gullet, and during the passage of a probang, so that as the latter appears to overcome the obstacle, the swelling increases rather than diminishes; and when the animal is allowed water to drink or food to eat, the pouch formed outside the œsophagus becomes distended, and swelling occurs, with a tendency to increase downwards, from the gravitation of the fluid in the areolar tissue. These œdematous swellings, which indicate the rupture, point also to a danger of materials penetrating the chest, and inducing inflammation and suppuration within the thorax. In some instances the pouches formed externally to the rupture become enormously distended, and are relieved of their contents by the movements of the animal's neck or by pressure. This depends much on the shape and size of the wound. I have not found that wounds in the œsophagus are difficult to heal, though, if they are much torn, and there is loss of substance, the animal may afterwards suffer from stricture of the tube.

Treatment.—The rule to follow in all these cases is to expose the wound in the gullet by a free incision into the pouch formed by the food. Indeed, from the treatment recommended for dilatation of the gullet, it will be understood that any, sometimes mysterious, diverticula or pouches formed along the course of the œsophagus should be laid open. When this is done, if the wound is large, it must be neatly pared, and its edge drawn together by silver wire sutures. The external wound should not be closed, though its lips may be held together by sutures. The operator must obtain healing from within outwards, or the skin may close over a fistula in the canal. To obtain this, the animal must be kept from all solid food for at least a week or a fortnight, and indeed until the wound in the gullet is closed. Gruel, milk, linseed tea, and in fact any sloppy material capable of supporting the animal, should be allowed, but not a particle of dry or fibrous food. It may be necessary to dress the wound occasionally with astringents or caustics.

INFLAMMATION OF THE GULLET.

This is one of the very rare forms of disease characterised by painful swelling and tenderness on pressure in the course of the gullet. It is apt to occur after cases of choking, and indeed ulceration may ensue, which may favour the distention of the œsophagus by any liquids swallowed, and consequent dilatation. Such ulceration I have before referred to, and my attention was especially called to it by that most intelligent veterinarian, Mr Charles Hunting, South Hetton Collieries. As a very remarkable case under this head, I may refer the reader to the foot-note for a case first published in the *Edinburgh Veterinary Review* for June, 1861.*

* On Monday, the 22nd of April, 1861, Mr Hunting was requested to visit a very valuable two-year-old bay colt, by the celebrated horse "Nonpareil," which was said to be choked—the property of W. Forster, Esq. When he arrived, the following history of the case was given him by the farm steward:—About a year ago, when the colt

PARASITES IN THE ŒSOPHAGUS.

There are two parasites occasionally found imbedded in the coats of the œsophagus in the dog. They are the spi-

was at grass, he was observed to be unwell, breathing heavily, pawing the ground, and exhibiting other symptoms of choking; at the lower part of the neck was an enlargement about the size of a small turnip, oblong in form. A little water was given to the animal, and in a short time all the symptoms of choking had passed off, and the enlargement disappeared. During the past year, the colt had had some three or four similar attacks, the enlargement at the inferior part of the neck always being present; but on each occasion the animal got relief in an hour or two, without further assistance than was rendered by the men, which was confined to giving a little tepid water, and gently rubbing the swollen part with the hand. On the last occasion, however, the symptoms were rather more severe, and professional assistance was sought, when a probang was passed down the œsophagus—and which, Mr H. said, was done without any difficulty—and as soon as the instrument reached the stomach, an immense quantity of a light-coloured fluid was ejected through the tube, possessing a most disagreeable, sour smell. The animal appeared to gain a little relief from this operation for a short time, but the enlargement of the neck did not disappear as before in similar attacks, the breathing continuing very loud and difficult. At this stage Mr Hunting saw the animal, when the following symptoms presented themselves:—colt standing, head protruded as far as possible, upper lip almost doubled upon itself, exposing nearly the whole of the buccal membrane, and a disagreeable, sour fluid, mixed with large quantities of saliva, constantly dribbling from the mouth; the inferior third of the neck greatly tumefied, and at the superior part of which, on the left side, was a tumour, oblong in form, about eight inches long and six wide. When the tumour was compressed, it disappeared, the contents of which passed upward, enlarging the gullet as it went; when the pressure was removed, it immediately refilled to the same extent as before. About every ten minutes the animal became restless, pawing with his feet, and protruding the head as far as possible, ejecting about two pints of a most offensively sour fluid, after which he was always easy, but he could not detect that the roptera sanguinolenta and strongylus trigonocephalus, both round worms, most frequently lodged close to the stomach, and which lead to the production of a swelling of considerable size. This creates much irritation and persistent efforts

enlargement was less than before; but, after giving about a pint of tepid water, to ascertain if fluids could pass into the stomach, the tumour was visibly larger, and also the œsophagus higher up. Mr H. concluded from this that there was rupture of the muscular coat of the gullet, and that no fluid given per mouth could pass into the stomach. The right lung and trachea were also much interfered with, both the inspiration and the expiration being very much louder than normal. He concluded from this untoward symptom that when the œsophagus became full of saliva and mucus, that a part of its contents passed over and into the larynx, producing that condition of windpipe and lung which the breathing indicated; the pulse also was 95 and hard, and the mucus membranes intensely injected, the ears cold, and the countenance anxious. Believing that he had ruptured œsophagus to deal with, he considered the case all but hopeless, but, as nature sometimes does wonders in her reparative processes, he thought it prudent to recommend hot fomentations to be continued without cessation, and about a tablespoonful of ol. olivæ opt., mixed with which was some opii pulv. and morphia, to assist in some measure to allay the irritation constantly going on. Twenty-four hours elapsed, and he saw the patient again, when there was little or no alteration of symptoms, except the pulse quicker and the breathing rather more laboured. On Wednesday morning fomentations with blankets was discontinued, and a poultice applied instead, shortly after which the tumour in the neck disappeared, and the animal drank nearly a pailful of gruel and linseed tea without any difficulty. On Thursday afternoon, 1½ pints of oil were given, as the bowels had not responded since Wednesday morning, but the colt died early on Friday. Having been requested by the owner to make a *post-mortem* examination, he did so on the Saturday afternoon, when, to his very great surprise, he found that the walls of the œsophagus were not ruptured, but immensely dilated for some twelve or fourteen inches, and to a less extent quite to the stomach; all the areolar tissues and muscles surrounding the enlargement, just anterior to where the gullet passes between the two first ribs, were filled with black clotted blood, to vomit, which are only relieved at intervals, or when the parasites become displaced.

presenting the same appearances as muscles which had been excessively bruised, and this condition of the areolar tissue extended for several inches into the chest. Nearly the whole of the right lung was consolidated; the pleura covering, which was green in colour, and adhering to the pleura costalis; the left lung was filled with tar-black blood, as also were all the large venous trunks, and the blood perfectly fluid. The abdominal viscera were all perfectly healthy. Having removed the œsophagus, stomach, and wind-pipe entire, he proceeded to lay them open, and on seeing the condition of the cuticular lining membrane of the œsophagus, Mr H. at once concluded that my students would be pleased at the opportunity of seeing so rare a case. We would also see by the lining membrane of the trachea, that particles of bran and other ingesta were adhering to it; they were also to be seen in the bronchial tubes, which proved the correctness of his fears of what was taking place when Mr H. first saw the case.

[The origin of the dilatation above referred to appears to have been an inflammation and superficial ulceration of the mucous membrane, over which the cuticular coat was detached in patches. Whatever may have been the cause originally of this disease, it must soon have affected the action of the muscular coat, which, yielding to its contents, had become paralysed and flaccid. Towards the lower part the muscular coat was of considerable thickness. It is here that not unfrequently abnormal dilatation occurs, and which, by favouring the effacement of the folds at the cardiac orifice, favours regurgitation and vomiting. The distension of the œsophagus by fluid in Mr Hunting's case, with contraction probably at the lower end, led to the enormous and ultimately incurable dilatation and atrophy of the muscular coat. What our practice should be in these cases has not been well established. Our experience would favour in all cases of enormous distension in the cervical portion of the œsophagus, to open, and, by injection or otherwise, to treat the mucous membrane. This opinion is based on the observation of occasional thoracic obstruction treated by œsophagotomy, and in which the œsophagus had suffered very considerably.—J. G.]

Diseases of the Three First Stomachs in Ruminants:—Tympanitis.—Hove.—Blown.—The Sickness.—Fog Sickness.—"Dew Blown."

By many more names than those here mentioned is the disease known, which consists in distention of the paunch by gas. The term tympanitis owes its origin to the drum-like sound emitted on striking the belly of ruminants affected with the disorder.

Causes.—These are numerous; but most commonly rich grass on damp autumn mornings gives rise to the distention. Amongst cattle that have been fed low in the strawyard during the winter, many cases may be observed when these animals are first turned on luxuriant pasture in the spring. Clover appears to be the grass most apt to produce the disorder, and especially on foggy mornings, or after a shower. Many instances are recorded in proof of the frequent dependence of the disease on excessive moisture of grass, but one of the most singular is related by a French veterinarian, Papin, who, in the year 1845, when at Sampigny, on the borders of the Meuse, was called one Sunday afternoon about three o'clock, after a fine and abundant rain had been pouring, and on a field which had, some days previously, been overflown by the river, to attend to some cows which had scarcely been an hour in the field. The herd observed several of the number to begin to swell, and in the course of a very few minutes five of them were stretched on the ground dead. Other cows were so swollen as scarcely to be able to walk, and some were lying inflated and could not rise. Papin saved all those he found affected by means of the trochar and other remedies.

Various grasses and potatoes, turnips, and any green food or roots, may produce hove, but not so rapidly and dangerously as clover.

Tympanitis is a functional disorder of the rumen frequently attending other maladies, such as impaction of the third stomach, or disorders of the bowels, &c.

Symptoms.—Whilst the animal is eating, or shortly after, a swelling is observed about the left flank. The swelling increases, and the animal lifts its head, pants, and appears dull. Eructation is occasionally noticed, especially in the early stage, and rumination is suspended. In proportion to the rapidity in the accumulation of the gas, does the breathing become more laborious. The animal moans, and stands with arched and stiff back. The protruded tongue, bloodshot and prominent eyes, dribbling of saliva from the mouth, and rigidly expanded nostrils, indicate the oppression produced by the swollen paunch. Unless relieved, the animal staggers, falls, and dies suffocated, ejecting a greenish liquid by the nose and mouth. A few minutes occasionally suffice for the disease to run its course, but oftener the malady develops more slowly. Indeed, it may be divided into two forms, the acute and the chronic.

The chronic form of tympanitis is seen in stall-fed cows, and is characterised by relapses whenever an animal is allowed green food. In some cases a trochar has been worn for many days or weeks, and whenever removed, the accumulation of gas was observed.

Nature of Tympanitis.—In many instances it is simply a gaseous evolution from actively fermenting fodder, but in the chronic variety there is functional derangement of the organs involved. The character of the gas evolved has been stated to be carburetted hydrogen at the commencement of the disease, and sulphuretted hydrogen as the malady advanced.

Lameyran and Fremy* found that in the tympanitis due to clover, the gas consisted in—

Sulphuretted hydrogen	80·0
Carburetted "	15
Carbonic acid	5·0
	100·0

These proportions are not constant, as Pflüger found four-fifths of the gas in hove to be composed of carbonic oxide.

Treatment of Tympanitis.—When any sign of hove is observed, the animal must be stopped feeding, and indeed appetite is soon lost. In the absence of drugs and instruments, Papin recommends a quart of cold water in which a handful of common salt has been dissolved. A method long in practice, but which has attracted special attention lately, consists in pouring cold water over the animal's body, and the effect of this treatment is most remarkable. Mr Menzies, one of the students in the New Veterinary College, had occasion to observe, in the summer of 1860, the beneficial effects of this plan, and although it may not be reliable at all times, it evidently exerts a remarkable influence on the condition of the paunch. The *modus operandi* is easy of explanation on physiological principles. The cold water acts through the nervous system, or, in technical language, it induces contraction of the rumen by reflex action, whereby the gas is eructated, and by the motion set up in the stomach, rumination is soon restored, and the animal thus cured.

The remedies that have for long been regarded as specifics are agents which neutralise or combine with the gases formed. The most valuable of these is liquor ammoniæ, or the aromatic spirit of ammonia. From half an ounce to one ounce of

* Tiedmann and Gmelin, *Researches on Digestion*, Part I.

this may be given in a quart bottle of cold water, and the dose repeated in half an hour. Warm water is not suited for the administration of ammonia, as this agent is very volatile, and, under the influence of heat, would soon escape. The greatest reliance may be placed in this method of treatment. Another neutralising agent, recommended by Youatt, is chlorinated lime; but Mr Finlay Dun says that it is of little if of any service in the treatment of hove. I have heard some practitioners extol the powdered corn or seeds of the meadow saffron—*colchicum autumnale*—given in one-drachm doses. This agent is a cathartic, and occasionally acts as an emetic, and may, perhaps, be of service in favouring the eructation of the gases from the rumen.

Various stimulants are occasionally employed, and the most common, but the most dangerous, is turpentine given in linseed oil. We think it should be discarded for this purpose, and in the absence of ammonia or its preparations, we recommend the trial of salines. A dose of Epsom salts sometimes relieves in a very short time, but the animal may die before its effects are observed, and purgation may set in without relief being afforded to the rumen. Enemata are of value in conjunction with the remedies above mentioned, but should the symptoms of suffocation be urgent, no hesitation should be felt in relieving the animal by mechanical means. The first method is by the passage of a hollow probang into the rumen, as recommended first by Dr Munro; and the second is to puncture the rumen with a trochar.

There cannot be a more simple operation than puncturing for hove. A trochar is usually employed, which with a pointed stilet, and sufficiently large tube properly fitted so as to transfix the belly and the stomach, the latter is perforated at its most prominent part in the upper region of the flank.*

* See *The Veterinarian's Vade-Mecum.*

In the absence of such an instrument, a penknife and large quill or hollow cane may be used, and Papin relates a case in which a lady, aware of the danger incurred by delaying, thrust her own scissors into her cow's side and saved her. We cannot recommend an instrument so awkward and usually so blunt as a pair of scissors, but almost any sharp object will give vent to the confined gas and save the animal from death by suffocation.

Chronic Hove

Presents itself under a variety of circumstances, and varies consequently in its progress and termination. A cow sometimes is predisposed to indigestion, and after a severe attack the stomachs are with difficulty reduced to their normal condition. This manifests itself usually by gaseous distention whenever any green food is allowed the animal, and requires a very careful system of diet, and the exhibition of aromatics and tonics.

A couple of tablespoonfuls of the following mixture:—

Bruised coriander seeds,
Carbonate of soda,
Common salt, } equal parts,

given with food, such as bean meal and boiled turnips, daily, may exert a beneficial influence.

Some cases of chronic hove are coupled with obstructions and other functional derangement or organic disease of the third stomach or intestine. In such a case the cause of the hove must be attacked.

When the trochar has been used there is difficulty in removing it, in occasional instances, from the accumulation of gas whenever the trochar is displaced. The size of the instrument should then be gradually diminished and the above aromatic mixture used. But should that fail, the animal must be purged, and afterwards must only be allowed hay and a very moderate amount of boiled roots. A mild stimulant laxative, which may be repeated once or twice in such cases, is the following:—

Assafœtida, . . .	2 drachms.
Linseed oil, . . .	1 pint.

This should be well mixed and given as a dose.

It is impossible to state with any degree of precision the various methods to be adopted in managing such cases, and particularly as to diet, from the innumerable ways in which animals are fed and otherwise treated.

Mrs Scott's rule is a very good one as applied to all animals in health, and more especially for the prevention of hove, viz., "not to gorge cows with more than they can comfortably devour, but keep the appetite always sharp."

Suckling animals are subject to tympanitis. In them the rumen is very small; but whenever symptoms of indigestion appear, the abdomen swells, and fœtid flatus constantly escapes per ano. In rare instances do we find a distention which is calculated to endanger the animal's life, and treatment consists simply in using enemata, mild laxatives, or moderate doses of aromatics.

Hove in Sheep.

This malady presents itself amongst sheep as severely, though not as frequently, as amongst cattle. They are preserved to a great extent from it by living constantly on pasture, whereas the cases of hove in cattle are seen chiefly in animals incautiously turned out very hungry, or on pasture ill suited for them, and especially when damp.

Impaction of the Rumen.

When the evolution of gas is not very rapid, and an animal swallows a large quantity of moist herbage, the paunch may be filled to repletion, and the distention increase, from a process of fermentation setting up within the mass.

Various kinds of grain and bran are apt to induce this condition, and it is noticed to develop more slowly than hove, the symptoms being very similar but not so urgent. The means of recognising one disease from the other is afforded by the absence of the drum-like sound on striking the flank in a case of impaction, and the manner in which the impression of the fist is left on pushing the rumen inwards. The pulse is small, frequent, and often feeble; rumination is suspended, and if the probang is passed, or the trochar used, no gas escapes. In the same way, if draughts are given of ammonia or ether, little effect follows, and the contents of the rumen require then to be removed mechanically.

The removal of large masses of food from the rumen is so often practised by non-professional persons, that I think it desirable they should have a few words of caution about the matter. The method of operating is as follows:—Place the animal with its right side against a wall, and have it firmly held by the nose; measure a point midway between the last rib and haunch bone and about a span from the spine. A sharp carving-knife is the best instrument for the purpose, and this may be plunged at once into the cavity, and made to open the incision about five or six inches downwards in the act of removing it. It is then that the operator requires dexterously to lay hold of the lips of the wound in the stomach and walls of the belly, to prevent any food passing into the cavity of the latter. For this purpose a suture may be passed through each lip of the double wound, and a handkerchief or cloth carried in. The hand is then the best instrument to evacuate the paunch. Some food had better be left in the lower pouches. It will be found occasionally that the instant the knife is withdrawn the stomach partially protrudes, and the food emerges itself. This is not unfavourable if care is taken to fix the paunch, so as to prevent the grass from entering the peritoneum.

The last-named accident is not the most dangerous which may happen, and animals often, and, indeed, generally recover after it. We have chiefly to fear the imperfect closure of the wound. To insure this after the food is cleaned from the wounds, the opening in the paunch must first be closed, taking especial care that the lips are slightly turned inwards so as to get the outer coat of the stomach in apposition. If the inner lining meets there is not so ready a union. Having fixed the lips of the inner wound, the outer one is tied by three or four stitches of strong flexible metallic wire, and a stick is used on either lip over the skin, round which each suture may be fixed so as to prevent dragging on the soft tissues themselves. This in surgical language is called a quilled suture.

After the operation the animal requires to be very judiciously managed as to food, though not starved.

Impaction of the Third Stomach.—Vertigo.—Fardel Bound.—Grass or Stomach-Staggers.—Lead Poisoning.

It is the third stomach of ruminants which frequently arrests a quantity of fodder, and obstructs the alimentary canal. The two first stomachs necessarily participate in this disease, and as I have before said, hove is not an unfrequent complication.

The term staggers has been applied to a host of disorders, varying much in nature, and arising from causes of the most opposite description. A horse is said to have staggers when, from compression of the veins by a tight collar, he is seized with violent convulsions, more dangerous to the lives of the persons in the carriage behind him than to his own. It is also the name applied to a condition connected with tumours in the brain; and the sheep with a parasite in its skull is said to have staggers. Stomach-staggers is a condition peculiar to our domestic animals, and most frequently seen in horses and cattle. As the name implies, the nervous symptoms are connected with the state of the stomach; and during certain seasons there is a remarkable prevalence of indigestion, with enormous distention of the gastric cavity, which bring about states of stupor or delirium, alternating in the course of a case, and soon fatally exhausting the animal's powers.

As affecting cattle, stomach-staggers may be divided into two forms:—1st, The most dangerous due to lead-poisoning, from lead accidentally distributed over pasture land with town manure. 2ndly, The form known as grass-staggers, and which arises from over-distention of the stomach, and particularly with rich grass.

The distinction between these two very different forms of stomach-staggers in cattle is easy, because the first is peculiar to districts on which the police manure is carted; and the second is usually localised on lands famed for rich produce no less than for the troublesome disorder which, under some circumstances, may much deteriorate the value of several acres on a good farm.

The late Mr Cuming, veterinary surgeon, Aberdeenshire,* was the first to notice that the refuse of paint, sheet lead from tea chests, and pieces of painted oil-cloth, are deposited on land amongst the town manure. These substances are greedily chewed and devoured by cattle, especially the white

* See the *Veterinarian's Vade-Mecum*, by John Gamgee, page 173.

paint or sweet carbonate of lead, of which considerable quantities may be found in the stomachs of animals that have died from the disease under consideration.

The farmer should be made aware that though lead may be the source of the disease, it is not easy to discover whence the poison has been derived. Occasionally laying down a row of pipes to convey water some distance may cause the distribution of white lead, which plumbers use extensively; and many instances have occurred in which tenant farmers have claimed damages from landed proprietors for deaths amongst stock from this cause. Recently a case occurred in which the working of a coalpit ceased, and a quantity of *débris* was left scattered about, amongst which ropes and other substances thickly smeared with white lead were found. Some cows, with the morbid appetite often observed amongst these animals, were poisoned, and died, rendering the owner of the pit liable in damages for not enclosing the deserted and exposed works.

A very important circumstance, which has often led to doubt as to the real cause of a general attack of staggers, though analysis proved it to be due to lead, is, that after the police manure has been driven on the land, there may be several crops in rotation before animals are allowed to graze on it; or, by the process of working the land, a quantity of lead formerly deposited on the surface, but afterwards buried from the common operations on the farm, may be dug up again, and, washed by rain, it constitutes a sweet but deadly morsel for the cattle. Indeed, we have found that, scattered over extensive districts, where at one time or other much poison may have been deposited with manures, certain fields are reputed dangerous to cattle. It is certainly true that these dangerous fields have not been made the subjects of any careful inquiry, though they offer many very interesting points for investigation to the scientific man. Some that are avoided by the grazier have been proved to be contaminated with lead in a solid form, which appears to resist, for a considerable time, any solution or penetration into the soil.

The form of lead-poisoning here referred to, and which by the symptoms may readily be mistaken for grass-staggers, is totally different from the disease which occurs in the vicinity of lead mines, and which is due to finely divided lead, probably in the state of oxide, floating in the air or being deposited on the grass. The latter is a slow form of poisoning, whereas the solid lead seems to act by paralysing the stomach though not at once destroying the appetite, and thus animals fill themselves to repletion and manifest symptoms only slightly different from those due to obstructions in the third stomach from non-poisonous vegetable foods.

The grass-staggers, properly so called, is very common in the spring months, and when cattle are first put upon good strong grass. If the latter is succulent it generally induces a little diarrhœa, or may give rise to hove, a disease more frequently seen in the autumn months. But on certain soils the grass, greedily devoured by cattle which have only recently been removed from shelter and straw, gives rise to a series of symptoms as severe as any observed in other fatal cattle disorders. Recently we heard that a veterinary surgeon had afforded a farmer the consoling information that grass-staggers was as bad as the "disease"—meaning the lung complaint, the contagiousness and epizootic character of which invest it with the importance attached only to destructive plagues.

The symptoms of grass-staggers vary much at the origin of the disease. Appetite continues undisturbed, though constipation and some uneasiness may have been observed for the space of twelve or twenty-four hours. Often dull, and with drooping head, the animal picks about, but suddenly acquires a wild look, with prominent bloodshot eyes, quick breathing, and protruded tongue; appetite and rumination being totally suspended. Occasionally the animal looks round to the right side, and in some cases there is a marked tendency to hove. Delirium soon manifests itself, and if tied by the head animals will fall forwards, drop on their side, and lie with rigid quivering limbs lifted in the air until the attack subsides. Cattle that are loose in the fields rush frantically forwards, and indicate impaired vision or total blindness by stumbling over the smallest obstacles, or dashing their heads against trees, hedges, dykes, or human beings. There is no ferocity, but violent and prolonged symptoms of derangement of the brain. We have seen animals tear up the soil with their horns, stamping and roaring in the most violent manner. Some cases are characterised by stupor, awkward gait, and even partial paralysis of one or more limbs. The animals cannot walk, and if they move along they prove totally blind from amaurosis or paralysis of the nerves of vision. It is no pleasing task to drive such an animal from place to place, as it manifests some obstinacy to move in its own chosen direction, and falls in a ditch, or breaks through a hedge, or tumbles over in a convulsive fit.

The duration of the disease, according to the severity of the attack, varies from an hour or two to several days, death being the usual result unless treatment is very carefully and perseveringly directed.

The nature of the disease is not, as many have thought, an inflammation of the brain occurring from a distended stomach, but it may be defined as sympathetic delirium from the latter cause. It is not an inflammatory disorder, and treatment consists in adopting the most effectual means to unload the stomach. These consist in purgatives and injections. As a purgative, a pound and a-half of salts may be given in water. Many persons prefer a large dose of common salt to create great thirst, which the animal may be allowed to appease with chilled water to any extent. The administration of fluids in large quantities is very essential in order to soften the solid mass and carry it off. Injections of warm water given repeatedly at intervals of a quarter or half an hour materially aid the treatment, and all solid food should be kept from the animal for some time after a passage through the alimentary canal is obtained. There are other

Diseases of the Reticulum.

This organ suffers in cases of hove and impaction as much as the rumen, and its diseases may in part be regarded as in common with those of the paunch, but these are peculiar states incidental to the form, function, and character of the mucous membrane of the honey-comb bag.

Hair Concretions.

These are very frequently seen in cattle of all ages, from licking each other, and especially in cows, from licking their young. The hair thus swallowed becomes entangled in the folds and spaces of the second stomach, and gradually accumulates at its most dependent part, where, from the rolling movement to which all the contents are subject, a spherical mass or concretion is soon formed. The hairs are partly woven together, but the liquids of the cavity tend to agglutinate them so as to render them firm and smooth. These hair-balls are occasionally found in large numbers, and at other times single, but attaining a large size.

Many foreign substances are apt to accumulate in the reticulum, such as pins, needles, and stones. This is especially seen in troublesome cases of pica, or voracious appetite, which are not unfrequently seen in cows. The most strange concretion I ever saw from the reticulum was a man's nightcap, encrusted with salts of lime, and which had been swallowed by a cow long before her death; the latter was due to a totally different cause to the hardened nightcap in her stomach.

Fistulæ of the Reticulum.

A passage through the walls of the reticulum may be effected by sharp objects entering this cavity, or by irritant poisons. In the first form we usually have a wire, knitting-needle, or nail pushed forwards, gradually getting coated by a protecting layer of lymph, through the diaphragm to the lungs or heart. Sometimes the object deviates towards the sides of the chest, and passes out beneath or behind the shoulders, and escapes. More frequently the heart is interfered with, pierced, and the animal drops, and dies suddenly, without having shown any sign of ill health until a few minutes before death.

Irritant poisons, such as arsenic, may lodge in the reticulum and produce inflammation, and death at its most dependent part, so as to lead to a passage through the walls of the belly. This is noticed by the food which the animal swallows dropping on the ground, and the animal soon presenting a starved appearance.*

Impaction of the Stomach in Sheep.

As in cattle, we occasionally observe the contents of the

* *Edinburgh Veterinary Review*, vol. i., p. 202.

third stomach become hard and dry.* Certain kinds of food may induce the disorder, and Mr John Hawes of Taunton relates an interesting case in the *Veterinarian* for 1840, in which sheep were destroyed by eating new wheat:—

"In the month of September in the last year, a flock of sheep, more than 200 in number, strayed into a field where was a quantity of wheat that had not been carried in consequence of the unfavourable state of the weather. They fed rather bountifully on it before they were discovered by the shepherd, when they were immediately removed to the pasture on which they had previously been grazing, and no further notice was taken of them until the following day, when four of them were found dead, and several others were evidently ill. To all that evinced any symptoms of disease, Epsom salts and castor oil were immediately given; but on the following morning, finding that twenty-eight had already died, and nearly as many more were almost dead, the owner sent for me, as is too frequently the case, when it was too late to be of much service.

"The first thing that I did was to examine some of those that had died, and I found the rumen in every instance filled with wheat, barley, and straw; the abomasum highly inflamed, as well as the bowels; the spleen had the appearance of a mass of coagulated blood, its structure being entirely

* A dry condition of the contents of the omasum is, as I have already shown, normal, but we find it erroneously referred to as a characteristic morbid appearance in many diseases when there is really but slight difference from a healthy state. Some of the most fatal diseases have been regarded as simply impaction of the third stomach, such as the pestilential typhoid disease which originates in the steppes, and for which the Germans have an old name, Löserdürre, signifying the hard condition of the third stomach. Practitioners should carefully examine the stomachs of any animals slaughtered in health before drawing any conclusions as to disease.

destroyed; the lungs, in most of the cases, presented a healthy appearance, as did also the liver. Fifty-eight died in the course of five days after eating the wheat. The others were bled, and half a pint of linseed oil given to each, and they recovered, but many of them have since thrown their lambs."

Impaction of the Stomach in the Horse.

This disorder, very frequently seen in Scotland, and which I have witnessed in France, raging like an epizootic, has received more names than perhaps any other disease affecting the lower animals. Amongst us it has received the name of stomach-staggers, but remarkable cases of it have been described under the heads apoplexy, phrenitis, and classed amongst diseases of the nervous system. Continental authors have been even more vague and absurd in their designations of this malady. They have even called it gastro-conjunctivitis—gastro-hepatitis—gastro-cephalitis—indicating an inflammatory nature which it does not possess, and the affection of parts which are only slightly disturbed in function. The terms, vertige-abdominal, stomach-staggers or magenkoller of the Germans, are more appropriate, because indicating certain facts such as the staggering or vertiginous symptoms, and the derangement of the stomach or abdominal organs.

Causes.—The malady appears as an enzootic or epizootic in districts and countries deluged with rain, especially during the hay-making season.

This was the cause of the disease in many parts of France in 1854-55, and also in Scotland in 1856, and even last year. In the *Veterinarian's Vade-Mecum,* referring to the injurious influence of musty hay, I say:—

"During my sojourn in Lyons in 1855, I had occasion to see a very large number of cases attributed to the same cause. Scarcely a day passed but one or more cart-horses were literally dragged to the Veterinary School. They moved along with hanging head, sunken eye, depressed lip, and tottering gait, suffering from pain in the abdomen, with considerable tympanitis; partial sweats bedewed the body, the visible mucous membranes were of an intensely yellow colour, and the urine dark. On reaching the loose box, the horse was tied to a centre post, which turned as he moved round; thus keeping him from dashing his head against the wall. The muscles twitched, the horse writhed with pain, and dashed about in fits of delirium. Two hundred and forty-nine cases of this sort were admitted into the Infirmary from August 1854 to August 1855. The disease raged as an epizootic from the month of September 1854, and not only in the neighbourhood of Lyons, but in many departments of France. A large number of animals suffered from colic and skin diseases at the same time, and all referable to the same cause. The stomach-staggers which prevailed in Scotland in 1856 was often followed by partial paralysis of the hinder extremities."

I have before alluded to the ill effects of new wheat on sheep. Horses are remarkably prone to gastric derangement from the use of wheat, unless given in small quantities, and in combination with other foods. Even wheaten flour thrown in water instead of oatmeal has induced violent colic, but when, by accident, a horse gets at some whole wheat, a comparatively small quantity will induce a firm impaction, though not necessarily inordinate distention of the stomach, which usually proves fatal, and has a strange tendency to induce laminitis if the animal lives beyond a few hours. Keeping horses long without food, and then allowing them a large quantity of oats or bran, and, indeed, any food capable of distending the stomach, and which may not be well chewed when swallowed by a ravenous feeder, may produce the characteristic symptoms of stomach-staggers.

Symptoms.—In order to diagnose these cases satisfactorily, their history must be ascertained, and this is not a matter of doubt when many animals are simultaneously affected, and all are under the same system of management. It is difficult to estimate the severity of the case, however, when we have no means of judging the amount and kind of food which the animal has partaken of. There are three distinct forms of the disease, occasionally intermixed or complicated by typical instances of either form, often to be seen. I should name the three forms as, 1st, the delirious; 2ndly, the comatose; and, 3rdly, the paralytic. The second is probably the most dangerous, and however marked the madness or paralysis in the other two forms, they are often as rapidly cured as they are produced.

The general symptoms in all forms are constipation, often colicky pains, no discharge of urine, full bounding pulse, tremors, partial sweats bedewing the body, in some instances eructation, in all a very anxious expression of countenance, drooping lids, hanging lip, and often total blindness. The severity of these general symptoms may vary to a very great extent in different cases.

The special symptoms may be described separately, and we shall here notice the means of distinguishing each from other disorders with which they may be confounded.

Firstly. *Impaction of the Stomach associated with Delirium, usually called Mad-Staggers.*—When the stable is entered in which a horse with this affection is enclosed, he is found in a violent shivering fit, and appears excited as if some injury had befallen him. Comparative calm is restored, especially if the place is darkened, but at intervals the animal thrusts its head against the rack or manger, stamps and kicks convulsively, rears, hangs back, and breaks the halter shanks, or leaps with his fore-feet into the manger. The pulse is frequent, hard, and wiry; respiration difficult; eyes fixed, and pupils dilated; mouth clammy, and sometimes containing half-masticated food. Visible mucous membranes injected, and sometimes of a yellow tinge. Fæces hard and dry, and sometimes coated with yellowish mucus. The fits increase in number and severity, the animal soon falls in a convulsive fit, dashing about, and sinks exhausted. The stomach may rupture, and vomiting occur shortly before death.

This form has been erroneously described as phrenitis, and all the symptoms have been regarded by some as denoting an inflammatory disease, but we can distinguish readily between the two diseases as shown by the subjoined table:—

Stomach-Staggers with Delirium.	Phrenitis, or Inflammation of the Brain.
A common disease, often enzootic or epizootic.	Very rare. Never enzootic or epizootic.
History indicates the cause of repletion of the stomach.	History indicates the cause to be some local injury; sometimes due to disease of the ears.
Comes on suddenly.	Originates and progresses slowly.
Marked signs of derangement of alimentary canal.	Usually very slight functional disturbance of stomach and intestines, indicated by costiveness.
Febrile symptoms easily dispersed.	High fever of a persistent type.
Severe symptoms of pain.	Stupor, listlessness.
Colic, sweats, tremors.	No signs of colic, and rarely sweats.
Paroxysmal derangement, and severe delirium.	Permanent uneasiness, varying very slighly in intensity. Delirium occasionally marked, but more frequently coma.

When evacuation of the stomach by purging is obtained, and even very shortly after the administration of a dose of aloes, the delirium disappears, and the animal soon recovers.	Symptoms yield slowly and with difficulty to treatment.
Consequences. — Death in a few hours in many cases. Ruptured stomach indicated by symptoms of vomiting.	*Consequences.* — No tendency to ruptured stomach. Suppuration often results with marked symptoms of coma or pyœmia.

Secondly. *Comatose form of Stomach-Staggers.* — The horse in this case may manifest the general symptoms with great severity, but there is great listlessness, rigidity of spine, expanded limbs, laboured breathing, but rather slow; in some instances it is often stertorous and accompanied with a moan; a full, frequent, oppressed or bounding pulse; head sunk and eyes closed; vision impaired. A loud noise or strong blow may cause the animal to lift its head and tremble, but the stupor is such that it is surprising the animal stands as long and as obstinately as it does. Delirium may appear at the end, and the animal falls and dies in a convulsive fit. Even in cases of recovery animals may be left permanently blind from amaurosis.

This form is sometimes confounded with sleepy staggers, known also by the names *coma*, immobility, and which is a chronic disease, often associated with tumours or other organic disease of the brain.

Comatose form of Stomach-Staggers.	Immobility, Coma, or Sleepy Staggers.
An acute disease.	A chronic affection.
Seen in horses of any breed.	Usually in low-bred animals.
Enzootic or epizootic.	Only sporadic.
Due to sudden repletion by food, and the latter is often bad hay.	Occurring on any system of feeding.

Animal usually lively and well. Never known to have staggering fits.	Known to be sluggish, and found sleeping in stable with food between the lips. Apt to fall when suddenly excited, or from a noise or blow startling it.
Rarely any relapse. Should an animal once affected be seized again shortly after, death often ensues.	Frequent fits; and though fat and in good condition, manifests symptoms of coma often and for a long time before a fatal termination.
Curable.	Incurable.

The third or paralytic form of stomach-staggers is characterised by the absence, in many cases, of symptoms as urgent as those which distinguish the two first forms. The first indication is frequently a peculiar straggling gait observed, especially by the loose, irregular action of the hind legs. The animal walks awkwardly, moving to and fro, and if pushed back or suddenly turned round, may stumble, and even fall. So much do these cases invest the character of local injuries, that a common expression in Scotland, when such an animal is seen by non-professional persons is, that he is 'racket in the back.' I have seen the disease in stallions, and they were first noticed from incapacity to rise on the hind legs, however eager to serve a mare. If the animal is not immediately relieved, the general symptoms become aggravated. From the first, the conjunctivæ are of a yellowish-red colour; pulse full and frequent; temperature of the body irregular; bowels costive, and urine scanty. But if injudiciously treated, or left alone, colicky pains are observed; pulse becomes more frequent; respiration laboured; signs of prostration supervene, and death occurs as in the comatose form.

The absence of any sign of injury, and the fact that the animal has not been hurt, so far as all persons around it can testify, coupled with the peculiar origin of the case, and simultaneous occurrence of others similar, distinguish this form of repletion of the stomach with sympathetic paralysis from injuries to the spine.

Treatment.—A brisk aloetic purge and copious enemata. In all the forms of staggers our attention must be directed to the prompt evacuation of the stomach. The animal may be allowed as much water as it will drink, and a good plan is to administer a little salt in the water, if only to create thirst, and to induce a free introduction of water into the alimentary canal. All food must be removed from before the animal, and, notwithstanding the operation of the aloes, except if very active purgation has resulted, a second dose, but a smaller one, may be administered the third or fourth day after the first. The paroxysms may be relieved by cold cloths applied to the head, frictions to the extremities, and in very urgent cases, by applying mustard over the loins, and covering with straw and horse-rugs so as to induce active perspiration. This is of value in the paralytic cases. When the severe symptoms are overcome, the animal must receive tonics, and must be gradually brought back to its usual diet.

CHAPTER IV.

THE STOMACH.—THE GASTRIC JUICE.—INTESTINAL DIGESTION.

Impaction of the stomach in dogs.—Impaction of the crop in birds.—Parasites in the stomach.—Spiroptera.—Amphistomum conicum.—Strongylus Contortus.—The horse bot.—The effects of bots on the health of horses.—Solvent function of the stomach.—Movements of stomach.—Mucous Membrane—Gastric glands.—Gastric juice.—Gastric Fistulæ.—Chemical composition and action of the gastric juice.—Its action on the coats of the stomach.—Functional and structural disease of stomach.—Dilatation and Contraction.—Dyspepsia.—Gastritis.—Poisons.—Animal Irritants.—Naphtha and fish oil.—Cantharides.—Souse.—Vegetable irritants.—Metallic irritants.—Non-metallic irritants.—Gastrorrhœa.—Intestinal digestion.—Small intestine.—Its coats and glands.—Large intestine.—Movements of the intestine.—The liver.—Bile.—The pancreas.—Pancreatic juice.—Intestinal secretions.—Solution of food in the intestines.—Absorption.—Excrements.—Production of concretions.—Stercoral masses.—Phosphatic calculi.—Dust balls.—Mixed calculi.

IMPACTION OF THE STOMACH IN DOGS.

THE state of repletion so frequently seen in the horse, and which I have discussed in the foregoing chapter, is occasionally met with in the dog, and even in the cat. It is unknown amongst well-kept hounds, and is only rarely seen even in pampered lap-dogs. The readiness with which the act of vomiting occurs in these animals usually acts as a preventative to that over-distention when the stomach cannot act, and the mass within it remains unchanged and unmoved for a considerable length of time. In order to recognise these cases, it is usually necessary to learn their history, and if information can be had that an animal has gorged itself with a large quantity of solid food, an emetic usually satisfies the practitioner as to the cause of symptoms which are subject to great differences, though always severe.

In puppies it is not unusual to observe, with a tense and over-distended belly, convulsive attacks, colicky pains, and retching. I have seen a dog quite unconscious, blind (amaurotic), with its head turned round into its flank, and breathing heavily. In this particular case a stimulating enema, the active principle of which was assafœtida, produced violent vomiting, whereby an enormous quantity of food, including even raw vegetables, was thrown up, and the animal was perfectly cured.

Treatment.—Though it is necessary not to weaken the animal by emetics in the convulsive diseases usually dependent on distemper, or severe catarrhs, it is nevertheless found, that a single dose of the potassio-tartrate of antimony may relieve, by unloading the stomach, The dose should be from one to four grains, according to the size of the dog. A purgative is of service, and preferable to a repetition of the emetic. Time should be allowed for the action of the latter to subside, and then a pill may be given, containing—

Aloes	10 to 20 grains.
Jalap	15 grains.

Castor oil is a very safe medicine in such cases, given in doses varying from half to one ounce. Injections are of great service, and should the state of stupor interfere with the administration of drugs by the mouth, a good effect may be secured by mixing half a drachm of assafœtida with a couple of ounces of milk, or decoction of oats, and giving as an enema.

IMPACTION OF THE CROP IN BIRDS.

Our domestic fowls are very liable to an enormous distention of the crop by food which, in the absence of secretion, and from the quantity accumulated, becomes hard and incapable of being moved from the distended cavity. The fowl lingers on without appetite, and manifesting great dulness, torpor, and progressive emaciation. Death soon puts an end to the case, and then alone, in the majority of instances, the enormous crop indicates the nature of the fatal malady. The crop in these cases, as shown in the subjoined engraving,

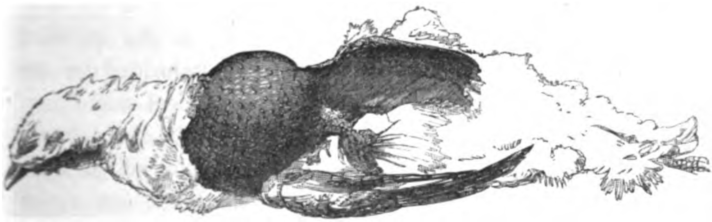

Fig. 32.

is so large as to render it a mystery how the condition may at any time escape detection.

Treatment.—In mild cases, this consists in pouring tepid water in the gullet, and manipulating the crop so as to soften its contents and press them back through the mouth or onwards into the stomach. In severe cases, no hesitation should be experienced in making a bold incision, evacuating the crop, and drawing the lips of the wound together by silver wire suture. The fowl must then be fed for a few days on materials which do not need to lodge in the crop, in order to be prepared for the action of the guizzard, and well broken down meat with sloppy bread and milk, are the best forms of food for it.

PARASITES IN THE STOMACH.

Though many infusoria develop probably in certain conditions of the contents of the stomach, we rarely find entozoa occupying this cavity as their natural habitat. Ascarides and strongyli are occasionally carried up into it, but of the round worms or nematoda, the only specimens found there, and not usually elsewhere, except in the lower end of the œsophagus, are the different species of Spiroptera. Thus sp. megastoma is found in the hypertrophied coats at the cardiac end of the stomach of the horse; sp. strongylina, in a similar situation in the pig, and sp. sanguinolenta in the dog. These parasites are peculiarly interesting to the medical zoologists, and the tumours they become imbedded in are worthy of the special notice of the pathological anatomist. Galleries or canals pierce the thickened coats in every direction, and on cutting into these, the coiled but active little worms are displaced in large numbers. These are never recognised as existing in the stomach during the lifetime of animals, in which they may be accidentally discovered after death.

Practically it is also of little importance to trace the Amphistomum conicum, which is the only sucking worm, lodged in the gastric cavities of ruminants, it being sometimes found in the rumen of the ox, goat, or sheep. Strongylus contortus is the only round worm of the true stomach of the sheep.

THE HORSE BOT—OESTRUS EQUI.

In 1815, Bracy Clark published his *Essay on the Bots of Horses, and other Animals,* and was for long referred to as the only authority on the subject. With his usual ingenuity, Clark explained the derivation of the term Bot. He says that "lexicographers appear to have been at a loss respecting the true origin of this word, on which we shall venture a suggestion that will appear, we believe, tolerably satisfactory. The derivation of it, we apprehend, is from the French word *Bout,* signifying the extremity or end of a thing, in the way we see it in the words *About, Bottom, Bottle, Botville,* &c.; the last of these alluding to one living at the end or extremity of a town, by elision or for brevity the *u* being omitted. From the same origin also we have *Butts,* houses placed without or at the extremity or end of a town, the *o* in this case being for brevity omitted. Indeed the instances of its application are very numerous in our language.

"The way or reason that these insects became so designated, is pretty manifest, from the habits more particularly of the second species of this enumeration, or *Hæmorrhoidalis,* which being fully fed, its growth completed, in quitting its habitation in the stomach, and passing through the intestines, does usually hang for some days upon the margin of the fundament, beneath the tail, then falling to the earth and forming a chrysalis; and in this state would attract more particular notice and attention, occasioning often serious inconvenience and distress. So situated and observed, it was denoted the *Bout Worm* or *End Worm,* and by contraction *Bot Worm;* and afterwards, for want of better epithets, the appellation became extended to the fly produced by this worm, and we obtain *Bot Fly,* though it is obvious, as the fly never affects these situations, its application is improper, and has served to disguise and conceal the real origin of the name."

Clark describes the bots of the horse as follows:—

"OESTRUS. *Antennæ* with three articulations, the last globose with a bristle in front deeply sunk in the head. *Mouth,* a simple aperture without a trunk. *Palpi* two, of two articulations, last rounded, situated in a depression on each side the mouth. *Membrane* of the wings lax and puckered.

STOMACH BOTS.

" 1. *Equi. Oe. The Knee Bot, or great spotted Horse Bot.* Wings opaque white, with a golden tinge, a transverse black wave and two spots near the extremity; a minute black raised dot near the base of the wing. Abdomen reddish brown, with black spots and points. Legs red. *Female* with lengthened abdomen, curving underneath; *male* obtuse.

In meadows, laying its eggs or nits on the knees, mane, and sides of horses.

Egg white, oblong, pointed, the other extremity obtusely truncated, with a lid. *Larva* or *Grub* barrel-shaped, at one end tapering, obtuse at the other, covered with a thick skin, beset with a double row of prickles round each joint, alternately placed.

In the stomach of the horse, to which it adheres by two short black hooks, one each side the mouth.

The *Pupa* or *Chrysalis* oval, dark red, rough with prickly points, under dung.

" 2. *Hemorrhoidalis. Oe. The Lip or Fundament Bot.* Wings without spot, brown. Face white, antennæ in a black pit or depression. Body thinly covered with hair, greyish in the middle of the thorax and abdomen black shining, base of the latter white, and extremity red orange. Beneath grey, hairy. Legs pale red.

In meadows, laying its eggs on the lips of the horse.

Egg black, oblong with a petiolus or foot stalk.

Larva white, with spines or prickles like the former, but less and rounder.

In the stomach of the horse. *Puppa* red brown with small prickles round the segments.

* 3. *Veterinus. Oe. The Red, or Breast Bot.* Wings clear, unspotted. Body oblong, tapering, covered with reddish yellow hairs; sides of the thorax and base of the abdomen with white tufted hairs.

In meadows. *Larva* oblong, coral red, smooth joints, rounded, two last dark red.

In horses' stomachs."

My father has made some valuable observations on the bots of horses, and in a paper published in the first number of the *Edinburgh Veterinary Review*, which appeared in July, 1858, he says: "Bracy Clark has graphically described how the female fly deposits her eggs, covered by a glutinous secretion, on those parts of the skin which a horse can reach with his tongue. When the eggs are hatched the skin becomes irritable, and the horse bites and gnaws himself, the small active animal born adheres to the tongue, and fixes itself on the nearest and most convenient spot it can attain. Accordingly we find the larva or grub attached by its tough hooks to the cardiac end of the stomach, where the mucous membrane is covered by a thick cuticular structure. Sometimes we find them close to the pylorus and in the duodenum, and I have noticed them in the rectum. I remember, when a boy, in Essex, seeing the flies attack the farm-horses at plough during the hot summer days; and it is found that the perfect fly is soon destroyed by changes of weather, by cold and moisture. Bracy Clark says he has often seen the fly during the night time, and in cold weather, fold itself up, with the head and tail nearly in contact, and lying apparently in a torpid state, though in the middle of summer. It is the high temperature necessary to the fly's existence which may render bots far more abundant in warm climates, such as the Italian, than in England.

"The larvæ of the bots remain in the horse's stomach all winter, and in the ensuing summer, when the time for their exit arrives, they are from time to time seen firmly attached by their hooks to the horse's anus. Being of a dark colour, they are rarely observed on the fæces or ground, and even when I have had several young horses in my stable, I rarely could see bots unless adherent to the rectum and close to or upon the anus. The larva in this situation possesses little power of motion, and has a tough shell-like appearance, but exposure to atmospheric air seems very soon to excite it to move; it is, however, endowed with active locomotive power only for a short time, probably only for the day of its exit, so as to afford it means to attain a secure hiding-place in a bank or other favourable retreat. The adhering to the anus would seem to be a natural and habitual act, destined to allow time for the development of the faculty to creep. I have seen the grub on the floor of a stable moving towards the side so rapidly, and with such an outstretched appearance, that at first sight it could not be identified.

"The bot is next found in the form of chrysalis, the skin becoming shell-like, and retaining the shape and form of the grub as it issues from the horse's intestines, only acquiring a reddish-brown colour. The further metamorphosis in the state of chrysalis is completed by the eighteenth or nineteenth day. I allow one day of latitude, though I believe that there is a definite and constant period which, however, it is difficult to perceive, from the uncertainty of collecting all the larvæ in the same condition. The fly escapes from the tough brown shell at the narrow end representing the head of the bot, and it invariably issues—fully formed, active and powerful on wings and legs, and covered with down—at an early hour in the morning, varying with the time the sun rises, from three to five A.M. My plan for observing these points was to enclose the larvæ, as I removed them from the anus, into thin glass jars covered with gauze. Bracy Clark said that 'after remaining torpid in the state of chrysalis, *a few weeks*, the superfluous moisture being removed, and the parts of the future insect being hardened by drying, it bursts from its imprisonment, and the fly appears,' &c. I have always seen the fly born on the eighteenth or nineteenth day.

"The activity of the bots in my spontaneous vivaria was very great, and with a buzzing noise they moved about and then rested, and were especially vigorous and loud in their buzz as the day advanced. In a state of nature this is a provision to ensure the approximation of the sexes and fecundation of ova."

Clark declared that the bots were rather salutary than prejudicial in their effects on horses; but the view is untenable: and my father has afforded evidence, that in warm countries, and when horses are kept during the summer months at grass, so as to receive a large supply of the bots' eggs in the stomach, the parasites are prejudicial, and prevent the horses being got into full condition for active work. My father's experience is of such value to the practical man, that I hesitate not to quote his remarks at some length. He says:—"It would be important to establish in what localities or countries bots do, or do not, exist. Horses exposed on pasture in the summer months will most probably be attacked by the fly. This is certain in some countries where I have bought many horses, viz., in Italy, also in the south of England; but it is by no means so certain, I think, in other parts. I have purchased many English horses, chiefly from Yorkshire or further north, from breeders and farmers, &c., without discovering the bots, though I carefully sought for them, and I am led to believe they are far more rare north than in the south. In purchasing horses in the plains of Italy, it is a matter of certainty that their stomachs are lined with these parasites. I have therefore been under the most favourable circumstances to examine their influence on the condition of the animals purchased by myself annually in considerable numbers.

"I could not rely on the condition of one of the Italian horses taken up from grass at the end of summer in less than nine months or a year—such condition, I mean, as would fit them for any severe work. The young English horses have nourished themselves and become more muscular in far less time, and it must be remembered that the Italian horses were really good substantial nags, with no defect in their constitution. I do not, however, forget also that the English colts are reared under very different circumstances to the half-wild ones in the Maremme of Tuscany and Campagna of Rome, and elsewhere. The English farmer feeds with corn and hay, besides allowing his young stock plenty of good grass, whereas in Italy horses shift more for themselves, are not handled and fed, and have even an imperfect supply of grass on ill-cultivated pasture, and are exposed to the cold winds of winter or parching sun of July and August. There are, however, horses bred and managed in England in a manner as little calculated to promote their growth and condition or their owner's interests, as those of Southern Europe.

"There are, therefore, some circumstances which militate against the accuracy of the conclusions I may arrive at, notwithstanding extensive observation; but still I can furnish very strong proof in favour of the view that the bots in the stomach are not natural healthy stimuli, but prove detrimental to health. I gained valuable experience from one particular source, viz., in purchasing young horses every year from the late Count Gherardesca of Florence, who bred extensively on his estates in the Tuscan Maremme south of the city of Volterra, the lands sloping to the Mediterranean Sea. In autumn the three-year-old colts were housed in a large stable, standing separated from each other by bales. They were roughly groomed, chiefly fed on coarse hay, and were ridden and exercised, being slowly broken in. In this way they passed the winter, and their condition did not at all improve apparently. Large quantities of hay constantly kept before them, were eaten by these colts. It was from these that in the summer I made a selection, and they were poor, with thin crest and drooping abdomen, so that in mounting them the saddle slipped on to their shoulders. They voided large quantities of fæces with the coarse undigested hay, but their skins had a healthy appearance.

"After two days' walking journey to Florence, they were placed on good and well-regulated keep; and they invariably thrived so rapidly, that within two months they were in beautiful condition as riding-horses. Having been in the stable the preceding winter, spring, and summer, before sale, they lost the bots just before I obtained them; and, though at the time the question of bots in no way influenced me, it was after-experience which carried my mind to the epoch above alluded to. Accordingly, I afterwards purchased young horses from the same stock, but which had not been taken up into the stable, and I had a larger choice,—they seemed in better condition, and more muscular than their companions confined in the stable. To my disappointment and loss, the result was totally different from that expected. Of the first three thus bought, one was own brother to one I had had before, and another was a six-year-old horse well broken to ride, and had been constantly used by Count Gherardesca's factor, though he was taken up from the field to be ridden, and then let loose again. He was in fine health when purchased, but neither of the three gained condition during the winter after I bought them. Their legs swelled, they could not stand work, were weak and rough, and I lost time and money, simply, I believe, because these horses could not thrive with the accumulation of bots in their stomach. So far, the circumstances of these accidental experiments were most favourable to enable me to draw natural conclusions, as the horses purchased at different periods were much of the same age, indeed, in this respect, one of the last purchase had the advantage; they were of the same breed; the quality of food in either case was in no way calculated to make great difference in their condition, but the first lot had been housed until the bots had left the system not to enter it again, and in the other horses the œstri existed for the first eight or nine months that I had them in my possession.

"It was in the years 1850, 1851, and 1852 that I bought, at different intervals, many young horses from the pastures in the Roman States, and the part of Tuscany near Leghorn Some of these I kept long enough for observation, viz., from a few months to two years, and I procured bots in abundance, and observed the changes from larvæ to fly, and the peculiar habits of the latter."

No method of treatment is calculated to displace the bots, and a knowledge of their effects is valuable only to enable us to judge as to the prudence of exposing horses at grass certain seasons of the year and when bots are abundant. The safest rule to follow, I think, is to avoid the introduction of the parasites into the stomachs of horses by means which are so well suggested from the facts above adduced.

SOLVENT FUNCTION OF THE STOMACH.

In the single cavity of solipedes and of carnivora, as in the fourth stomach of ruminants, the semi-solid food is mixed with an acid secretion, and subjected to the influence of heat and moisture, in order to effect its solution. If the contents of the stomach are very solid, and producing much distension of the organ, the movements necessary to the admixture are checked, and the consequences of such impaction we have already considered. But if the food is moderate in quantity and of proper consistence, the gradual contraction of the stomach from left to right as the food descends into it, and to a certain extent from right to left, as the pylorus obstructs the passage of undigested food into the intestine, produces a double current and uniform intermingling of the food and secretions. Beaumont tells us, from his observations on Alexis St. Martin, who had a permanent opening in his stomach from a gunshot wound, that "the bolus of food, as it enters the cardia, turns to the left, passes the aperture, descends into the splenic extremity, and follows the great curvature towards the pyloric end. It then returns in the course of the smaller curvature, makes its appearance again at the aperture in its descent into the great curvature, to perform similar revolutions. These revolutions are completed in from one to three minutes." As the contents of the stomach are dissolved and diminish in quantity, the contractions at the left or cardiac end are scarcely perceptible, and it is from the point *c* (see Fig. 83) that they commence, and the food is moved towards the intestinal opening, or pylorus, through which the dissolved portion passes. Two or three minutes elapse before another peristaltic movement starts from *c*.

Secretions.—It is the mucous membrane lining the stomach

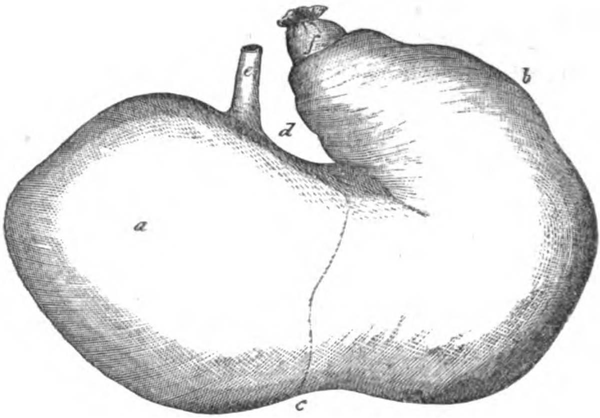

Fig. 83.

which yields the solvent fluid to be mixed, as above-mentioned, with the alimentary matters. In the horse the left half of the stomach is lined by a membrane which enjoys but very slight secreting power, and is protected by a thick, stratified, cuticular structure. In the right end the soft and actively secreting mucous coat is the same as we find in the stomachs of carnivora, or in the fourth gastric compartment of our domestic ruminants. In the empty stomach the mucous coat is thrown into ample folds, which are effaced as the organ is distended. In the horse, as we have before shown, even during distension, there are folds arranged spirally at the opening of the gullet.

On examining the structure of the mucous membrane, we find that it is reticulated, and may be compared to the membrane lining the reticulum, but in miniature. (See Fig. 84.) Into each compartment or space there are openings of glands or tubes, about $\frac{1}{380}$th of an inch in diameter. The eminences, including the polygonal interspaces, vary in shape in the

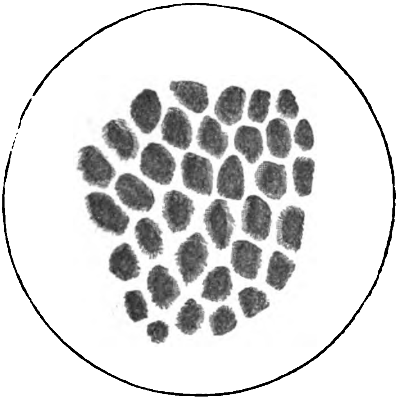

Fig. 84.—(DALTON.) Free surface of gastric mucous membrane, viewed from above; from pig's stomach, cardiac portion. Magnified 70 diameters.

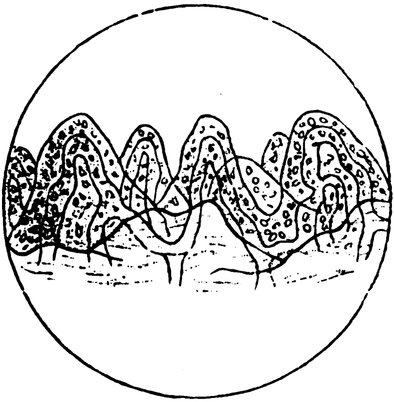

Fig. 85.—(DALTON.) Free surface of gastric mucous membrane, viewed in vertical section; from pig's stomach, pyloric portion. Magnified 420 diameters.

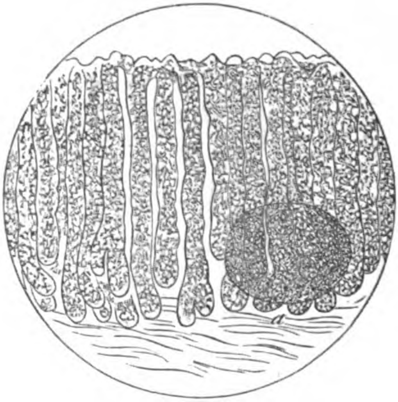

Fig. 86.—(Dalton.) Mucous membrane of pig's stomach, from pyloric portion; vertical section; showing gastric tubules, and, at *a*, a closed follicle. Magnified 70 diameters.

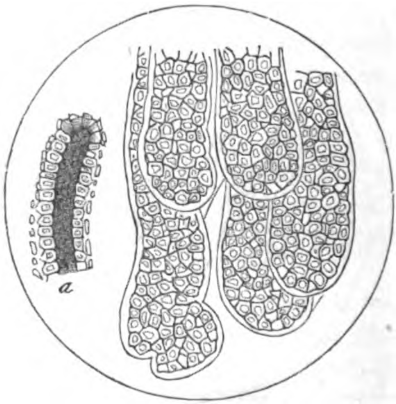

Fig. 87.—(Dalton.) Gastric tubules from pig's stomach, pyloric portion; showing their cœcal extremities. At *a*, a cylindrical cast of epithelium, pressed out from a tubule, showing the size of its size.

right end of the stomach, being conical in form and flattened from side to side, as seen at Fig. 85, and which are generally branched at their extremities. Two distinct varieties of gastric glands are found in the stomach of the lower animals. In the first variety the glands are lined throughout by columnar epithelium; they are placed at or near the pylorus, and their function seems to be the secretion of mucus; for the second variety cylindrical epithelium only occupies the upper part of the gland, the lower being filled with roundish oval secreting cells; they occupy the rest of the stomach, and they alone seem to secrete the gastric juice. (See Figs. 86, 87.)

There are also scattered over the membrane glands, called lenticular from the shape, which vary greatly in development in different subjects.

THE GASTRIC JUICE.

It is this secretion which is produced for the solution of food, and a certain turgescence or redness of the mucous membrane is characteristic of the state of hunger, and is increased as food enters the cavity. The sensation of hunger and turgescence of the membrane are relieved by the flow of gastric juice which is destined for digestion.

The properties of this secretion were first studied by Dr Beaumont, of the U. S. Army, on Alexis St. Martin, a Canadian boatman, who received a gunshot wound into the stomach, which established a permanent fistula. Dr Beaumont established that an acid fluid was secreted by the stomach whenever food entered the latter, and that it dissolved alimentary matters not only in the gastric cavity, but also in glass phials upon a sand bath, at a temperature of 100° Fahr. Since Dr Beaumont's observations, fistulæ of the stomach have been made artificially in animals, and the plan adopted is as follows:—

The dog is the animal generally chosen for the performance of this experiment; the very small risk of peritonitis following the operations on the abdomen, render this animal peculiarly well fitted for this purpose.

The animal to be experimented on is fed shortly before the operation, as the latter is very much facilitated by the stomach being in contact with the abdominal parietes. The dog having been placed on his back, an incision is made in the middle line, starting from the ensiform cartilage, and about two or three inches in length, the peritoneum is carefully divided; and the stomach, which is seen distended with food, is seized with the fingers; it is incised to the extent of an inch, and the incision is fixed to the wound in the abdo-

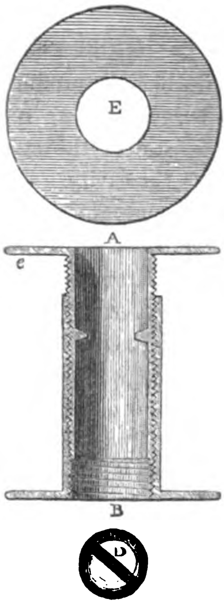

Fig 88.

minal wall by means of silver or iron wire sutures. The latter is then partially closed by sutures, so as to be of the same size as the incision in the walls of the stomach. If the operator wishes to collect the gastric juice immediately, he can at once introduce a silver tube; it is better, however, to allow the coats of the stomach to become adherent to the abdominal walls,—this generally takes place in a very few days. A drawing of the silver tube best adapted for introducing into the fistula, is shown at Fig. 88. It can be lengthened or shortened by turning the screw D; if introduced immediately after the operation, the tube is partially unscrewed, so as to allow for the swelling which will probably supervene. When this has subsided, the screw is again tightened, and the edges, *e*, of the tube come in contact with the mucous

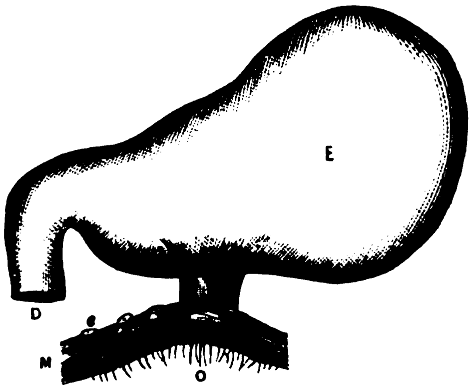

Fig. 89.

membrane of the stomach. The position of the tube in the stomach is shown by Fig. 89.

If the canula be removed, the fistulous aperture, which has become established, gradually closes, and the connections with the walls of the abdomen become absorbed. The subjoined Fig. indicates the union of the coats of the stomach with the abdominal walls in forming the fistula.

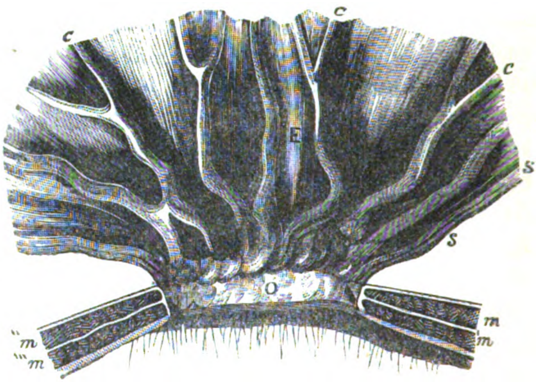

Fig. 90.

If it be desired to experiment on the gastric juice of a ruminant, the fistula must be established between the fourth stomach and the abdominal wall.

Numerous theories have been advanced in all times to endeavour to explain the action which the food undergoes in the stomach. Those which compared it to coction, fermentation, and combustion, for a time excited great attention, but as they were mere hypotheses, often framed to support the tenets of particular schools, they fell to the ground and were forgotten. Reaumur made the first step towards ascertaining the truth, and led the way for future observers, when he pointed out that, in animals possessing a membranous stomach, the triturating action which had been so much insisted on by Borelli, and the Florentine academicians, and which he had himself well studied in the graminivorous birds, is replaced by the action of a digestive fluid.

His ingenious experiments, soon followed by those of Spallanzani, showed that the gastric juice is the solvent of food in the stomach. These observers obtained gastric juice by causing birds to swallow portions of sponge attached to a string, and withdrawing them after a certain time; by expressing them they obtained a small quantity of gastric juice.

Spallanzani's experiments proved the solvent action of the gastric juice completely. He caused animals to swallow meat enclosed in metallic spheres, pierced with holes so as to allow the contact of the gastric juice; and, on withdrawing these spheres from the stomach, he found their contents partially or wholly digested.

During the period of fasting, the stomach is empty, and its mucous membrane is pale and covered with a grayish mucus; when food enters it, however, the capillaries become congested, and a liquid exudes like sweat, from the open mouths of the gastric follicles—this is the gastric juice. These phenomena, first described by Dr Beaumont, have been repeatedly observed since then in dogs with gastric fistulæ. The gastric juice is a clear and transparent liquid, of decidedly acid reaction. Its specific gravity is about 1003·3. If gently heated it possesses the property of gradually dissolving albuminoid substances, but if the heat be elevated to 160°, the action is entirely arrested; the reason of this we shall presently investigate. The gastric juice contains 99 per cent. of water, besides certain acids and salts, and a peculiar and very remarkable organic substance called pepsine; the chemical constitution of each of these substances we shall now shortly pass under review, examining the present doctrines as to their action on the constituents of food.

Many different opinions have been entertained as to the acids of the gastric juice. Vauquelin maintained the existence of phosphoric acid, Tiedemann and Gmelin of hydrochloric acid; Chevreul, Leuret, and Lassaigne, and more recently, Bernard and Barreswil, of free lactic acid, while Blondlot has strenuously maintained that the acidity of the gastric juice is due to acid phosphate of lime.

The experiments of Mr Bernard have undoubtedly gone far to prove the existence of free lactic acid in the stomach, and to disprove the presence of free hydrochloric acid; still the matter must be looked upon as far from settled.

The remarkable animal substance called pepsine, which we have mentioned as one of the constituents of gastric juice, is found besides in the mucus and coats of the stomach. It is conveniently prepared by macerating the coats of the stomach, first in water gently heated (between 80° and 100°), and then in cold water. On alcohol being added to the latter, a floculent precipitate of pepsine falls, which is soluble in cold water, and possesses most remarkable digestive properties. It is not prone to decompose, and 1 part in 60,000 parts of water will dissolve albuminoid substances, the action being increased on the addition of a few drops of dilute hydrochloric acid. This substance reddens litmus, and in its ultimate composition approaches the protein compounds, from which it differs in containing more nitrogen.* The salts of the gastric juice are chiefly chloride of sodium, potassium, and magnesium. Phosphate of lime is present in small quantities, and alkaline sulphates are absent. There are other saline ingredients which are only occasionally found.

If we now take into consideration which of the constitu-

* See BRINTON *On Food and its Digestion*, page 121.

cuts of the gastric juice probably acts on food, we shall arrive at the conclusion, that the digestive property is not dependent on the free acids alone, or on the animal principle pepsine alone, but is resident in both. Thus, if a certain quantity of gastric juice, in which some meat is being artificially digested, be neutralized with alkalies, the process is immediately arrested. On the other hand, gastric juice which has been boiled loses this property by the coagulation of pepsine. Gastric juice does not act on all the principles of food. Although helping, as we shall afterwards see, in the digestion of solid fats and starchy matter, it does not itself exert any important action on them; it is essentially the solvent of the albuminoid or nitrogenous constituents of food.

When muscular tissue is subjected to the action of the gastric juice, it swells up, becomes soft, and the transverse striæ or markings on the muscular fibres disappear. *Liquid albumen* is first precipitated in a floculent state by the gastric juice, the precipitate undergoing a process of solution afterwards. *Casein* also, when taken into the stomach, is immediately coagulated, the little solid masses thus formed in it gradually dissolving in the gastric juice, forming a homogenous and slightly opaque liquid. *Gluten*, when macerated in gastric juice, out of the body, has been observed to break up into molecular matter, which falls to the bottom of the vessel containing it. This change is probably only the first of a series which takes place in the body. *Gelatine* is easily dissolved in the stomach, and its solution does not solidify on cooling. Bones are also dissolved by the gastric juice.

Whatever the substances dissolved, they are reduced to a state of minute division, and form a substance possessing certain peculiar properties, and to which the name of peptone has been given. Reduced to the solid form by careful evaporation, peptone is a white or yellowish-white substance; almost tasteless and inodorous; very soluble in water; but insoluble in alcohol of eighty-three per cent. Its watery solution reddens litmus, and is precipitated by chlorine, tannic acid, and metallic salts; but it is unaffected by boiling, by acids, or by alkalies. With alkalies and bases it forms very soluble neutral compounds or salts. An aqueous solution of these is still less precipitable by reagents than one of peptone itself. Thus it is only thrown down by tannic acid, bichloride of mercury, and a mixture of the acetates of ammonia and lead: the acetate of lead, and the ferrocyanide of potassium, causing but a faint cloudiness; and even concentrated acids, nitrate of silver and alum, having no effect.*

The gastric juice dissolves, as we have seen, only the albuminoid constituents of food; it is therefore evident that a much greater proportion of these constituents is digested in the stomach of carnivorous than herbivorous animals. Hay contains only about 7 per cent. of albuminoid constituents, and it is these alone which are acted upon by the gastric juice in the stomach. The gastric juice helps, to a certain extent, the solution of solid animal fats, by dissolving the nitrogenous walls of the cells which contain the fat, and also the digestion of starch by dissolving the walls of the vegetable cells containing it. The gastric juice has, however, no action on the fatty and starchy constituents proper of the food.

It remains for us to examine the action which the gastric juice has on certain remedies taken into the stomach, and to consider the reasons why this fluid, which out of the body

* *On Food and its Digestion.* By Dr Brinton. Page 125.

has the property of dissolving albuminoid substances, does not during life destroy the coats of the organ which secretes it.

It appears that certain insoluble metallic salts are acted upon by the acids of the gastric juice, and reduced to a state of solution. By some it has been supposed that calomel, which is an insoluble chloride of mercury, is dissolved by the chlorides of the gastric juice. Iron, when taken into the stomach, is reduced to the state of oxide at the expense of the water contained in that organ. It is evident that this solvent action is dependent on the gastric juice, as it is most active during the period of digestion. Cyanide of mercury is a salt very easily decomposed by the gastric juice, and its poisonous properties seem to depend on the hydrocyanic acid thus set free; and Bernard has observed that symptoms of poisoning ensue most rapidly if it be taken during digestion. We have seen that, if an alkali be added to gastric juice out of the body, the property of digesting nitrogenous substances is destroyed. The same, however, does not happen in the body; for it is found that the alkali seems to act as a stimulus to the secretion of gastric juice.

John Hunter observed that, after death, the coats of the stomach often undergo a process of solution by the gastric juice; and for a long time physiologists were at a loss to explain the immunity which the stomach enjoys during life. It has now been shown that the stomach owes this property to the continually renewed epithelium of its mucus coat; and that it is not dependent simply on the vitality of the tissues, has been shown by some experiments of Claude Bernard, who, having introduced the hind-legs of a frog through a gastric fistula into the stomach of a dog, observed that they were digested whilst the frog was still living. Thus it is that, as science advances, many phenomena formerly considered to be vital (*i.e.*, phenomena occurring in living beings, which cannot be explained in the present state of our knowledge), are shown to be quite explicable by the ordinary laws which govern the animal economy.

Functional and Structural Diseases of the Stomach.

Abnormal Deviations in Size.

The accidental impaction of the gastric cavity which has been fully treated by us as occurring in all animals, may be regarded as predisposing to, and not produced by, diseases of the stomach. The latter organ adapts itself very remarkably to the function it is called upon to perform under a variety of circumstances, and the best illustration of this may be obtained by comparing the enormous stomach of the horse fed on boiled turnips and an excess of food generally, with the contracted viscus of the animal starved to death. I have not here to refer to deviations in size, which are consistent with the healthy state, and I may say that in the domestic animals there is little tendency either to wasting or increase in development of the coats of the stomach. If the whole body wastes, the stomach suffers also; but although Bidder and Schmidt have stated that the decrease in bulk and weight of the mucous membranes of the alimentary canal amounts in animals starved to death to about 31 per cent., it is, on the other hand, remarked by Dr Brinton, that there are appearances of a peculiar resistance to even this inclusive atrophy on the part of the stomach, as contrasted with the intestines.

Dilatation of the stomach due to bad management in horses, viz., which depends on bulky food given in great abundance, and all times, without regular intervals, is a condition which should be prevented. Fortunately we have few instances on record in which ulcers, cancer, or injury, are the causes of dilatation, and all our cases can be diagnosed by learning how animals are fed. When, from repeated distension, a chronic state of dilatation is established, there is a tendency to the impactions already referred to, which paralyse the stomach. Any hollow organ may be rendered incapable of contracting on its contents by over-repletion. Dr Brinton says:—"Just as the sudden application of a heavy weight to the end of a voluntary muscle not only elongates its fibres, but utterly exhausts them of all contractile power; or, just as the enormous distension of an occluded intestine soon exhausts and annihilates the writhing contractions by which its muscular coat at first strives to propel its contents past the obstacle, so it seems probable that a rapid dilatation of the stomach may destroy the operancy of its muscular fibres, not only putting them '*hors de combat*' by stretching, but suspending those nutritive changes which are necessary to their contractility, and are expressed by their contraction. How far each of these effects is 'physical' or 'vital,' it is of little use to inquire, for the antithesis is too clumsy to frame a dilemma, and too inaccurate even to probe the facts which it would obviously be unable to refute."

Treatment, therefore, consists in a well-regulated diet, which, so far as the domestic animals are concerned, will always prevent abnormal deviations in the size of the stomach.

Dyspepsia.

This term has not found its way into veterinary works. It is one I have employed to indicate an impaired digestion from arrest or diminution in secretion, or, in other words, "a difficult character of digestion unexplained by structural lesion." The stomach may not be the only organ affected, and it is probable that there are instances in which liver, pancreas, or intestinal glands are primarily at fault, but "why the symptoms of dyspepsia refer chiefly to the stomach it is not difficult to understand. The physiology of digestion affords us plausible grounds for presuming, that the details which distinguish this organ from the remainder of the alimentary canal—especially its shape, its size, its situation, its office, and the peculiarities of innervation associated with them—give it a kind of paramount importance; and render it, in the main, far more sensible to various disturbing agencies, and far more disposed to betray disturbance by abnormal phenomena (such as pain, vomiting, or flatulence) than any other segment of the digestive tube. So that even were purely intestinal dyspepsia much more frequent and important than it seems to be, the study of gastric dyspepsia would still be the best means of approaching its consideration. Apart from the frequent secondary involvement of the stomach in the intestinal variety, the symptomatology of dyspepsia of both kinds would be best studied from its most distinct and accessible side. In this respect, indeed, the functional derangements of the stomach and intestine do but parallel their structural diseases: in which we often find that lesions, otherwise precisely identical, are betrayed by much more distinct symptoms when located in the stomach than in the bowels; and that, in the latter situation, they are sometimes mistakenly referred to the stomach, owing to those secondary derangements of this organ which they are liable to excite."

The causes of dyspepsia in the lower animals are far less varied than the causes of a similar condition in the human subject. They may be classed under two heads: *Firstly,* Giving much food at rare intervals, or starving an animal for some time, and then allowing coarse aliment in considerable quantities; *Secondly,* Indigestible foods. I can specify numerous instances of great practical interest. Horses fall out of condition from hurriedly cramming their stomachs, and imperfectly masticating their oats. Over-work induces dyspepsia. Foals and calves die from being fed on copious draughts of cold milk, morning and night. Cattle are seized with a morbid appetite and dyspeptic symptoms on poor lands.

Symptoms.—In the horse a staring coat, dulness at work, emaciation, with a tucked-up appearance of the belly, are amongst the most apparent signs of dyspepsia. The frequent discharge of fetid flatus, the presence of undigested food in the fæces, and, especially, of uncrushed oats, &c., and the occasional appearance of griping pains, all indicate that the digestive organs are at fault. In cows we observe a diminished appetite, and a desire to pick up and swallow dirt, sand, lime, &c. The fæces are hard, scanty, and coated with mucus. The animal falls out of condition, and the secretion of milk is very poor and scanty. For the symptoms in sucking animals, see the description of diarrhœa. It is not uncommon to observe looseness of the bowels from imperfect action of the stomach. In ruminants and in carnivorous animals, frequent eructations, and even retching, are symptoms of the dyspeptic state.

Treatment.—Regulate the diet according to the animal. In severe cases give a purgative, and follow up by injections. Allow the most easily digested food in small quantities, rather frequently. When the appetite has failed in the horse, I have found that equal parts of bruised coriander seeds and common salt, given to the extent of about an ounce at each meal, is beneficial. The common salt may, in troublesome cases, be superseded by carbonate of soda, which stimulates the gastric secretion in a very remarkable manner. Do not try too many medicines, and avoid large doses, as the irritable and disordered stomach is apt to suffer considerably from injudicious drugging. Moderate exercise and fresh air facilitate treatment considerably; and grass feeding animals, in the spring or summer time, are often restored by grazing.

Gastritis, or Inflammation of the Stomach.

In any animal may this disease be observed, as the result of irritant poisons being swallowed, but in carnivora it occasionally presents itself as a primary disease without any such active exciting cause.

Many diseases have been confounded with this one, especially in our herbivorous quadrupeds, but in the latter it is extremely rare, and almost always connected with inflammation of the bowels. Mr Percival says, that though the malady comes rarely under the veterinarian's notice, it is not an uncommon disease, "for every practitioner who has been in the habit of inspecting the stomachs of horses after death, well knows that nothing is more common than to find the vascular gastric membrane reddened." It is, however, only by post-mortem examination that we can verify that an animal has been killed by an attack of gastritis; and as some confusion has arisen in naming diseases from an imperfect knowledge of cadaveric signs, I may mention, that frequently a somewhat brilliant red colour of the mucous membrane of the stomach is to be attributed to turgescence of the gastric glands, and there may be patches of a greyish hue, with appearance of tumefaction, and all this consistent with the most perfectly healthy state. It is only when there is free exudation between the coats, when there is marked ramified redness, with evident stagnation of blood, ecchymosis and erosions, that inflammation can be said to exist. Sometimes the mucous membrane is coated with false membranes. Sloughs or large gangrenous patches and perforations of various sizes are witnessed in cases of irritant poisoning.

The poison which has caused the inflammation is usually found in the stomach, or adhering to its coats.

The history of the case is often necessary for practical purposes, but the symptoms are characteristic in cases of poisoning. They consist in nausea, followed by vomiting in the smaller animals, and speedily attended by violent colic in all. The horse looks round to left flank, crouches, and cannot stand quiet or erect. Pulse becomes quick, and though strong at first, is soon feeble, irregular, or indistinct at the jaw. Thirst is sometimes intolerable; purging ensues, with violent straining, and the animal becomes very languid. The legs and ears are cold; partial sweats may break out over the body; the urine becomes high coloured and scanty. Symptoms of stupor or unconsciousness appear; the pupils are dilated, and the animal sinks paralytic, or with convulsive fits, the suffering from abdominal pains being, throughout the whole course of the case, most intense.

In the *Veterinarian's Vade-Mecum*, I have entered at considerable length into the history of all irritant poisons, whether animal, vegetable, or mineral, and with regard to the foregoing description of the symptoms, I may quote from Dr Brinton's admirable work on the *Diseases of the Stomach in Man*. The doctor says: "Of course, in the symptoms, as well as the lesions, produced by these agents, there is much that is too characteristic or specific of each poison to be included in any such brief outline. The concentration of the particular agent, its solubility, its affinity for water, its chemical action, its solvent effect on the tissues, its constitutional action after being absorbed into the blood, its attraction or determination to a particular part of the canal—can greatly modify the symptoms just summed up. Hence, quite apart from the results of an analysis, they generally justify a conjecture as to the poison by which they have been produced. The state of the mouth and œsophagus, the date of access of the pain, its intensity, the nature of the substances vomited, the amount and character of the purging, may thus assist our diagnosis. It is equally obvious, that even the more general or constitutional symptoms require a careful study; and can only be regarded as typical under certain limitations. Thus, the prostration which ends life is often produced by a concurrence of at least three causes: (1) the constitutional action of the poison; (2) the depth or extent of the lesion it has produced; and (3) the destruction of an organ essential to life—three causes, of which idiopathic gastritis, even if acute, would rarely afford more than the last and most chronic."

The causes of gastritis must be referred to more particularly before we can hope to establish any rules for treatment.

Animal Irritants.—A mixture of naphtha and fish oil has been known to produce acute gastritis in cattle. with symptoms of great pain, foaming at the mouth, &c. Cantharides given incautiously in large doses, and made into a ball, have caused inflammation of the stomach in the horse. Souse, used sometimes as a quack medicine for horses, or given to pigs, may prove poisonous, and kills by inducing inflammation of the stomach and nervous symptoms. Its action appears due to an animal principle, from the meat or fish steeped in brine, as well as to the irritant effects of common salt.

Mouldy bread, oils of tar and turpentine, savin in large doses, many of the ranunculaceæ and of the spurgeworts, creasote and aloes, in over-doses, are amongst the *vegetable irritants* which have been most frequently productive of gastritis.

Of the *metallic irritants*, arsenic, bi-chloride of mercury, calomel, salts of copper, and iron have most frequently induced gastric disease. In the dog, however, violent and persistent irritation of the stomach is caused most frequently by abuse in the administration of emetics—especially of the potassio-tartrate of antimony.

Sulphuric acid, nitric acid, oxalic acid, the caustic alkalies, ammonia and its carbonates, nitre, sulplates of soda and magnesia, common salt, phosphorus and preparations of iodine are amongst the *non-metallic irritants* most likely to occasion gastric inflammation in the domestic animals.

Treatment.—The causes of gastritis indicate that little benefit can be derived from the usual remedies employed in inflammatory disease, and blood-letting is always dangerous. The poison must be thrown out of the system, or its effects neutralized. Antidotes must be employed for each special case. Even simple water may be dangerous, either in increasing the potency of the irritant, as in cases of sulphuric acid poisoning, or hastening absorption, as in gastritis from various salts. Lime, white of egg, demulcents—such as linseed tea, &c.—are of great service in many instances. Counter-irritation, purgatives given with caution, injections, emetics in carnivora, are all means which are useful and require judgment in their use. Often, the relief of pain by opium, or the support afforded by a mild stimulant, may preserve life.

Gastritis in the dog has been specially noticed by all writers on the diseases of this animal, and special mention is made of the animal's disposition to lie on its belly against the cold floor; of an anxious expression, great thirst, violent fever, cold extremities, &c. I have repeatedly seen these symptoms relieved by warm baths, clysters, and minute doses of dilute prussic acid; but a far more characteristic disease is

Gastrorrhœa, or Catarrh of the Stomach in the Dog.

This malady usually arises from a severe attack of indigestion, and especially when a dog is exposed to cold and wet, though usually pampered and carefully housed.

Symptoms.—A hot nose, blood-shot eyes, and loss of appetite, are associated with efforts to vomit, which are usually ineffectual. Abdominal pain is sometimes severe, and there is obstinate constipation. In the course of twenty-four hours, the retching, which continues, is attended with the discharge of an abundant and dense mucus, often tinged with bile. The pulse becomes small, feeble, and very frequent; the bowels may have responded to the action of a dose of physic, but without relieving the gastric irritation, and straining accompanies the discharge of fæces. Blood is discharged both by the mouth and anus, and, unless soon relieved, the animal dies.

Warm baths, a mustard poultice over the abdomen, and the administration of dilute hydrocyanic acid, in doses of from two to three drops, given in water or a little wine, relieve the animal. In that stage of the disease, when considerable prostration is observed, I have seen great good from the occasional administration of wine and spirits of nitric ether.

Intestinal Digestion.

When the food has undergone such changes as occur within the true stomach, it is gradually forced through the pylorus, and subjected to further processes within the intestine.

Intestine.—The term is applied to that portion of the alimentary canal extending between the pylorus and anus, destined for the temporary retention of the chymous mass, so that its nutrient parts may be absorbed, whilst its more solid indigestible constituents are collected for excretion.

The intestine occupies by far the greatest part of the abdominal cavity, but varies in size and length in different domestic animals. It is always short in carnivorous animals, being four times the length of the body in the cat, whereas it attains extraordinary dimensions in herbivorous quadrupeds, measuring 27 times the length of the body in the sheep and goat, 20 times in the ox, 12 in the horse, 11 in the ass and mule, 15 in the dromedary, and again only 6 in the dog as a flesh-feeding animal.

Not only the attachments, but also the shape of the intestine, vary at different parts of its course, so that it has been deemed necessary to divide it, either arbitrarily or at natural demarcations. Thus we speak of the small and large intestine, the two being separated naturally by a marked change in direction, size, and conformation.

Small Intestine.—This, the smallest although longest, is also the first portion of the intestinal tube, extending from the pylorus to its sudden termination into the large intestine. In it the food is subjected to the modifying influence of important secretions, whereby its nutritive parts are fitted for absorption by the vessels which for this purpose are arranged in this portion of the intestinal track.

The small intestine has been divided into three parts: this classification is, however, purely conventional. Since it does not recognise anatomical differences for its basis, it might justly be presumed that this distinction of human anatomists exhibited traces of imperfection, even when applied to the frame of man. Such being the case, it is no matter of surprise that, in referring the distinction to the intestinal canal of animals, the incongruities of the system should be still more apparent.

Extending from the pylorus, the first portion is termed the duodenum, from its being considered as twelve fingers' breadth in length: it is, however, extended round to the left side of the spine, posteriorly to the anterior mesenteric artery. The middle or floating portion of gut takes the name of jejunum, and the third or cæcal portion is distinctively designated ileum.

The Ileum is, on the whole, the narrowest portion of the small intestine, but the thickest in its coats.

Having now specially to describe the structure of the small intestine, it may be taken as a whole, merely alluding to local peculiarities.

This portion of the alimentary canal has four coats, *i.e.*, peritoneal, muscular, cellular, and internal mucous.

The first, or peritoneal, has nothing of peculiar, beyond its enclosing a little triangular space all along the upper attached border of the gut. The looseness of the peritoneal folds attaching the small intestine is very marked: and Colin notes, that the mesentery is proportionately larger in young than in adult quadrupeds, so that the gradual shortening of this explains the spontaneous reduction of exomphalus or umbilical hernia in colts.

The second, or muscular, coat is mostly developed at the commencement of the duodenum and terminating portion of the ileum. It consists of white involuntary fibres, arranged so as to form an outer longitudinal layer and an inner circular one, both of which completely encircle the intestine.

The third, or cellular, coat is similar to that of the stomach, in being disposed in two layers, so as to connect the three coats together. It is especially condensed on the inner surface of the muscular coat, so as to take the appearance of a fibrous tunic attached to the mucous lining by loose cellular tissue.

The fourth, or mucous, coat is thin, having a velvety appearance, due to villi, peculiarly small in the intestines of the horse, but remarkably developed in other animals, especially carnivora and fishes. The villi may be seen by a pocket lens, on a well-washed piece of intestinal mucous membrane.

and between them are seen numerous foramina, which are the openings of tubular glands, known as the crypts of Lieberkuehn.

In addition to the tubular glands, by dissecting, from without, the muscular from the mucous coat, lining the commencement of the duodenum, we find clusters of vesicles similar to the vesicular structure of the salivary and pancreatic glands. These form distinct layers provided with ducts which open on the free surface of the membrane; and Dr Todd states that Brunner's glands, or, as he calls them, the *duodenal*, are more developed in the horse than in any other animal he has hitherto examined them in.

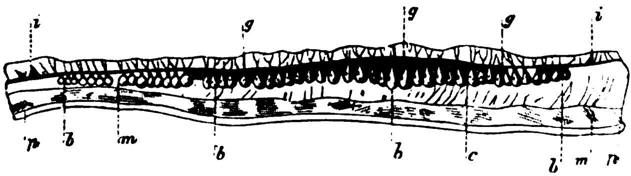

Fig. 91.—Portions of dog's intestine, showing the glands of Brunner, enlarged five times.—BERNARD.
i i, mucous lining of the intestine; *g g g*, glands of Brunner; *b b b*, glandular layer beneath the muscular coat; *m m*, muscular coat; *p p*, peritoneal coat; *c*, cellular tissue, which separates the glandular from the muscular layers.

We have next to treat of the solitary glands—glandulæ solitariæ—peculiar and rather scanty bodies, visible at various parts of the small intestine. These are vesicular, and without any opening when in the perfect state, surrounded by villous processes and Lieberkuehnian follicles. Some of the villi also project from the surface of the so-called glands, which are most apparent when distended with secretion.

About the second half of the jejunum, and along the whole of the ileum, we see longitudinal patches, varying from half an inch to even three inches in length, scattered all over, but more especially situated near the superior or attached border of the small intestine, which is contrary to the faulty description of some recent authors. These patches, distinguished as Peyer's glands or patches, also as Agminated glands—Glandulæ agminatæ seu aggregatæ—consist of an accumulation of small bodies, each resembling a glandula solitaria in miniature, being also destitute of a natural aperture. Colin (loc. cit.) states that they are first seen at a distance of about six feet and a half from the pylorus, and the least number of them he has ever counted has been 102, whilst the utmost has been 158.

The mucous membrane of the small intestine is thrown into folds at different parts, which are transverse, and scalloped near the pylorus, whilst in other parts they are mostly longitudinal; these are all temporary folds. There is no such arrangement as the valvulæ conniventes in the small intestines of the horse, though recent writers have described them. About five inches from the pylorus, at the superior border of the duodenum, is a semicircular fold, which, if elevated, admits of the finger being thrust behind it into the wide biliary duct. The opening of the pancreatic duct is also visible beneath this fold, but it is not so capacious as the one last mentioned.

Large Intestine.—The large intestine constitutes the terminating portion of the alimentary canal, being remarkably more developed in solipedes than in any other of our domestic quadrupeds. It occupies the greater part of the abdomen, and most of it is loose, whilst its shape and other peculiarities vary considerably at different points.

It is divided into three parts—cœcum, colon, and rectum—the precise extent of each being defined by special anatomical characters. (See Fig. 92.)

The structure of the large intestine does not vary essentially from that of the small, as it possesses the four

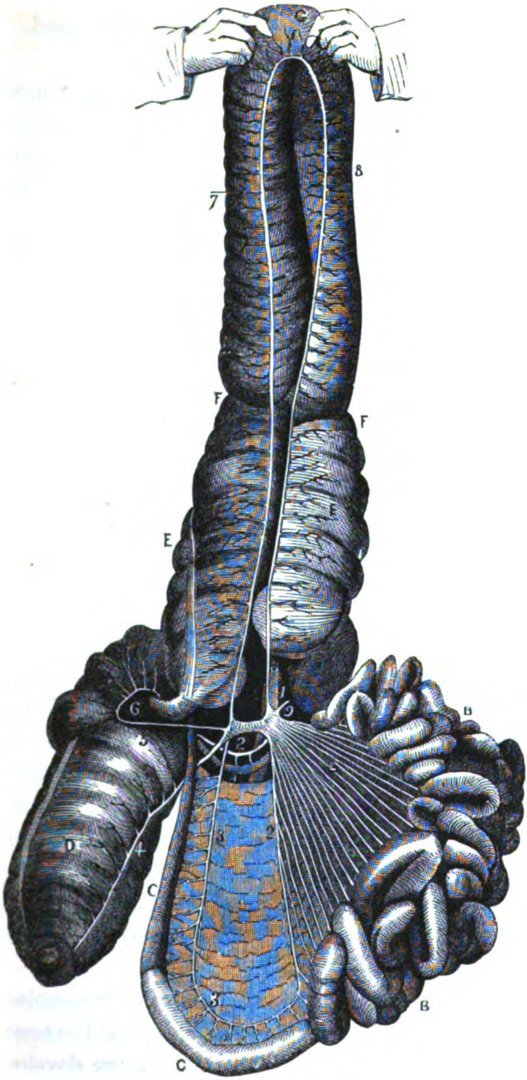

Fig. 92.

coats—*i. e.*, peritoneal, muscular, cellular, and internal mucous.

The peritoneal tunic forms an entire covering to the large intestine, with the exception of the superior surface of the transverse colon—which is in contact with the pancreas—and the terminating portion of the rectum. The bands by which it unites the intestine to other parts have been already described. In addition to the peritoneum forming an entire covering, at the attached margin of the flexures of the colon, it constitutes folds loaded with fat, varying in width in different parts, and clustered so as to have deserved the name of appendices epiploicæ.

The muscular coat of the large intestine is differently developed in various parts. Its fibres are of the plain variety, and arranged in two orders. The outer longitudinal set is scanty in some parts, but in others forms the longitudinal bands above alluded to. These are shorter than the actual length of the gut itself, so as effectually to pucker it. The number of longitudinal bands varies from one to four in the various parts of the gut, and the shape and breadth of the latter is not everywhere the same. The longitudinal fibres are abundant in the rectum, but they only form bands in the anterior two-thirds, as posteriorly to this they uniformly surround the intestine. The inner layer of fibres encircles the whole of the latter, being thickest towards the apex of the cæcum, as well as in the single colon and rectum: at the end of the latter the internal sphincter ani is formed by an accumulation of the circular fibres. The circular fibres of the colon are engaged in forming the ileo-colic valve, hereafter to be described.

The cellular coat of the large intestine resembles that of the small, only it is not so abundant, except at the terminating portion of the rectum, where it is much more developed.

The mucous lining of the large intestine is continuous anteriorly with that of the ileum, posteriorly with the common integument. It is thin, more or less coated with mucus, scantier in glands than in the small intestine, but the orifices of the Lieberkuehnian crypts are more apparent, owing to the surface here being destitute of villi. Saccular recesses, more or less capacious, exist in the membrane lining the large intestine. The difference in degree of vascularity gives rise to difference in the colour of the mucous coat in various portions of the gut: thus, that lining the cæcum is generally more deeply coloured than that of the colon, whilst the rectal mucous membrane is more vascular, and hence redder than the colic or cœcal one.

At the termination of the ileum is the ileo-colic or ileo-cœcal valve, which is constituted of two folds of mucous membrane, almost parallel to each other, and horizontal, leaving between them an elliptical orifice when partially drawn asunder. The folds consist of the circular fibres of the intestine, lined on the inner or ileac side by the villous membrane of the small, whilst on the cæcal and colic side they are covered by the mucous membrane proper to the large intestine. It is worthy of notice, that though muscular fibres partly enter into the construction of the valve, its efficiency is explicable on purely mechanical grounds, as proved by the fact, that it is competent in the dead body.

The anus is the outlet of the intestine, which is perfectly closed, except during the evacuation of feculent matters, and is made perceptible externally by the elevation of the tail. being situated in a space bounded superiorly by the sacrum and coccyx, laterally by the ischial tuberosities, and inferiorly by the urethra in the male and vulva in the female.

It is lined within by the mucous membrane of the rectum, which is loose and of a marked red colour. Its external covering is of common integument, destitute of hairs. Lying between the skin and mucous membrane are two circular muscles, whose office it is to keep the anus closed and prevent constant evacuation of fæces, whilst there are other muscular appendages situated externally to these, destined either to elevate or retract the anus; being evidently antagonistic to the sphincters.

The internal sphincter ani is in contact with the attached surface of the intestinal mucous membrane, and separated from the integument by the external one. It is constituted of the pale circular fibres of the gut, but towards its free edge certain coloured fibres are apparent on it.

The external sphincter is situated outside the internal one, and within the anal integument: it is circular, and composed of red fibres, attached superiorly under the first coccygeal bone, and inferiorly its fibres blend in the male subject in the accelerator urinæ and triangularis penis, and in the female with the constrictor vaginæ.

The levatores ani are two pale muscles, attached on each side of the first bones of the tail, and spreading downwards and forwards on to the rectum, form an attachment for the internal sphincter, and blending with the longitudinal fibres, so as to increase the thickness of the muscular coat of the rectum. The action of these muscles must be that of elevating the anus and shortening the rectum from before backwards.

The retractors proper to the anus are one on each side attached to the inner surface of the articular extremity of the ischium. Extending from before backwards, and rather upwards, they blend with the external sphincter. Their action is obviously that of retracting the anal opening.

In ruminants the intestine is not so capacious as in the horse, and a singular arrangement is noticed in them, as seen in the subjoined Fig. 93.

The small intestine, B B B, is attached to the free margin of a peritoneal fold, and within the latter—the large intestine or colon coils being only free at its blind head or cœcum, F, and at the end, H, or rectum.

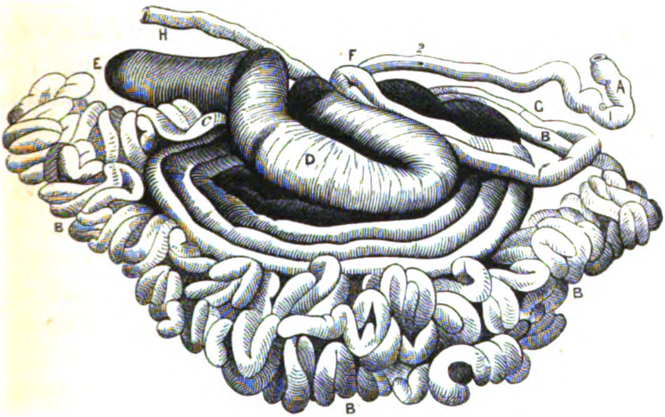

Fig. 93.

In the dog there is but slight difference in the size of the large and small intestine, and they are distinguished where they merge into each other by a very small cœcum.

The foregoing technical descriptions of the intestinal canal have appeared to me necessary, in order that many of the observations may be understood in treating of the functions and diseases of this region.

The mucous membrane with its numerous glands, yields an abundant secretion, which has been studied in the horse, with great care, by M. Colin.

OMENTUM.

The layers of membrane which attach the stomach intestine, liver, and spleen together, constitute, what is called by anatomists, the omentum. This is a very abundant expansion of serous membrane, loaded with fat, in cattle and sheep fed for the butcher, and known to the latter by the name of caul. It is the portion covering the intestine, and which is

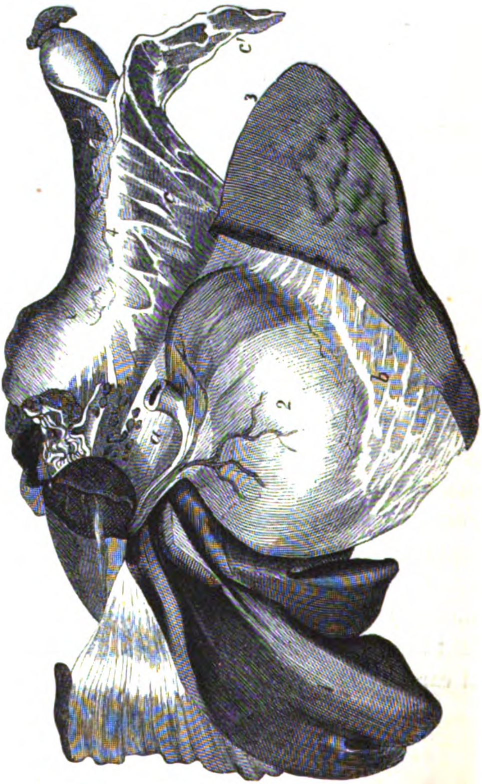

Fig. 94.

very delicate, with a reticulated aspect, in part due to streaks of fat that the latter name is applied to. In the annexed Fig. 94, two distinct folds are seen. The lesser, *a*, or gastro-hepatic omentum attaching the stomach to the liver, and the larger, *b*, *c*, or gastro-colic omentum, divided into the part attaching the stomach to the spleen or gastro-splenic omentum; *b*, and the part proceeding from the stomach to the colon; *c*, or gastro-colic omentum. The large and small omentum form with the stomach, duodenum, liver, and colon, a pouch or omental sac, which can only be penetrated close to the liver behind the small intestine, where there is an aperture called the foramen of Winslow.

The omentum, forming a sac into which the contents of the stomach drop when the latter organ is ruptured, has been rather strangely believed to be destined to retain the food, and prevent its entering the general peritoneal cavity in cases of ruptured stomach. This is evidently absurd, and Professor Dick has suggested, with more show of reason, that the abundant omentum of our domestic quadrupeds is "entirely for the purpose of facilitating the motion of the digestive organs, and that the difference which is found in regard to its size is owing to the peculiarities of the digestive apparatus in the different species of animals, where such variety of it is found." It no doubt extends the serous surface, and increases the amount of secretion.

To the practical man a knowledge of the disposition of the omentum, the construction of the omental sac, and the position of the foramen of Winslow, are of importance in connection with the history of herniæ, &c., which are observed in the domestic animals.

The Liver.

The liver, the largest gland in the body, is shown at Fig. 94, and its form in the ox is seen below (Fig. 95.)

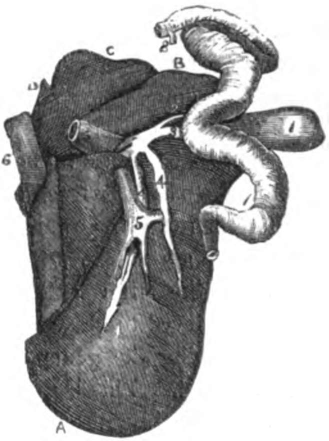

Fig. 95.

It is divided into several lobes, and receives through a large vein (the *vena porta*) the whole of the blood returning from the intestine towards the heart.

One important function is connected with the changes in the blood, enriched by the recent products of digestion, but the purpose it serves in connection with the changes of food in the alimentary canal is due to the gall or bile which it secretes.

The Bile.

Although this secretion is undoubtedly one of the most important in the body, and the means of obtaining it in a state of purity are greater than is the case with most of the other secretions, its chemical composition has only lately been satisfactorily investigated, and its physiology is still almost ignored. The bile is obtained in a state of purity from the gall-bladder of an animal recently killed, or by means of a biliary fistula from the living animals. The dog is usually selected for this operation, for the reasons we mentioned when speaking of gastric fistulæ, viz., the small risk of peritoneal inflammation. An incision three or four inches long, is made in the linea alba, commencing at the xyphoid cartilage, and the peritoneum having been carefully divided, the liver is raised, when the gall-bladder comes into view. This, seized with a pair of forceps, and drawn to the surface, the cystic and hepatic ducts are seen joining to form the common bile duct (ductus communis choledocus) which is easily seen entering the duodenum. Two ligatures are then passed around this duct, one being placed as near the gut as possible, the other near the origin of the duct. The portion between the two ligatures is cut out.

The gall-bladder is now fixed to the anterior part of the wound by means of metallic sutures, and then opened sufficiently to admit the little finger. The rest of the wound is closed by metallic sutures—the quilled suture is perhaps the best. Care must be taken to bring the wound in the muscles together before sewing up that of the skin. After the operation a wide roller is passed around the belly of the dog, a hole being made in it to allow the escape of the bile. If matters proceed satisfactorily, the wound in the abdominal wall heals, except where the opening in the gall-bladder becomes adherent. Through this all the bile secreted by the liver leaves the body, and may be collected by a suitable apparatus. The bile is a slightly viscid liquid, generally of a greenish colour, possessing an intensely bitter taste, and a somewhat fragrant odour. Its specific gravity is, according to Lehman, about 1·02. Its reaction is either neutral or very feebly alkaline. When it is filtered so as to separate mucus, it does not decompose, and can be kept for a long period of time.

The chemistry of bile was long involved in the greatest obscurity, as it is a fluid which, under the influence of reagents, is very easily decomposed, and many substances which are the products of such decomposition were considered as essential constituents of it. We mainly owe our knowledge of the composition of bile to the researches of Strecker.

The bile contains about 16 per cent. of solid constituents: these consist of resinous acids combined with soda, of colouring matter, of cholesterine. neutral fats, besides certain mineral matters.

Bile Acids.—If we examine the bile of the ox we shall find that it contains two very remarkable acids, the one crystallizable, the other non-crystallizable; to the first the name glykocholic acid is given; to the second that of taurocholic acid; these acids are found in the bile of most animals, though not of all. They are obtained by evaporating bile to dryness in a water bath, making an alcoholic extract, and then adding a large excess of ether. A bulky white precipitate falls, which consists of glykocholate and taurocholate of soda. This soon assumes a resinous appearance, and in a few hours crystals shoot up, these are glykocholate of soda, and the uncrystallizable portion consists of taurocholate of soda.

If the ether be poured off, the precipitates dissolved in water, and acetate of lead added, glykocholate of lead is precipitated; if the precipitate be now separated by filtration, and sub-acetate of lead (3 Pbo, C_4 H_3 O_3) added to the clear liquid which filters through, a white precipitate of taurocholate of lead falls. From the two lead salts, glykocholic and taurocholic acid can respectively be obtained, by suspending them in water, and passing a current of sulphuretted hydrogen through it. These two acids are found in the bile combined with soda.

Glykocholate of soda has the formula $Na\,O, C_{52}\,H_{42}\,NO_{11}$. If glykocholic acid be boiled with a dilute solution of potash, it is decomposed into cholic acid and glycine, hence its name.

Taurocholic acid contains sulphur, and has the composition $C_{52}\,H_{45}\,NS_2\,O_{14}$; its soda salt is not crystallizable.

The biliary acids of the dog differ from those of the ox, in that neither of them is precipitated by acetate of lead, whereas both are precipitated by sub-acetate of lead.

The pig's bile contains no crystallizable substance, the ether precipitate being entirely resinous in appearance.

The colouring matter of the bile, called biliverdine, has been little studied, and we do not even know approximatively its proportion in the bile. The bile of most of the carnivora has a yellow colour; that of the herbivora a green. There appear to be two varieties of colouring matter, viz., a brown and a green; the former seems to be converted into the latter, if the bile remains in the gall-bladder.

Cholesterine is a constant constituent of the bile, and it appears to be kept in solution by the taurocholates.

The mineral ingredients of bile are chloride of sodium, phosphate of soda, carbonate of soda, phosphate of lime, and magnesia.

Tests for Bile are two in number. The one consists in the action of nitric acid, which causes it to assume a variety of colours, viz., green, violet, red, and yellow; it is unsatisfactory, however, as it only proves the existence of bile colouring matter, which it causes to assume these varieties of colour. The other test, generally known by the name of Pettenkofer's test, is much more satisfactory, as it demonstrates the existence of one or both bile-acids. It consists in the addition of a drop or two of a solution of cane sugar to the liquid suspected to contain bile. Sulphuric acid is then added to the extent of about one-third of the portion of the liquid which is being tested. A violet and red tint is then gradually produced if bile be present.

The function of the bile in digestion is, as we have already said, still involved in the greatest obscurity. Some have considered that it is simply excrementitious. and have supported their opinion by the fact of animals with biliary fistulæ living for an almost indefinite period, although no bile reaches the intestine, provided the quantity of food supplied be sufficient.

The quantity of bile bears a certain proportion to the weight of the body in all animals, and is very much affected by the quantity of food taken.

Colin has drawn the following conclusions from his experiments in the horse. 1*stly*, That the biliary secretion is continuous, whether the animals are operated upon during the process of digestion, or have been fasting. 2*ndly*, That this secretion is not subject to the variable activity which is observed with regard to the salivary and pancreatic fluids. 3*rdly*, That this function is slowest when digestion is most disturbed, and animals grow weaker after the operation. 4*thly*, For three or four hours after a fistula has been made in the horse, the secretion amounts to 250 or 300 grammes, so that in twenty-four hours a horse would secrete about 6000 grammes, or twelve pounds weight. 5*thly*, The bile appears always to possess the same characters, the same degree of consistence, of fluidity, the same colour and reaction.

For every pound weight of the entire body, there is secreted in the dog 140 grains of bile, in the sheep 178. These respectively containing 5·712 grains, and 9·408 grains of bile solids. If we consider the quantity of bile secreted by the liver, we must come to the conclusion that, although perhaps not an essential, it still must play an important part in the function of digestion.

When bile is added to the matters dissolved by gastric juice, it stops the process of digestion, and exerting an antiseptic action, they may be kept for a long time without undergoing a further change; it, moreover, precipitates the albuminoid substances which have been dissolved. It appears likely that the bile, whose action is intermediate between gastric and intestinal digestion, arrests the former entirely, while it precipitates the alimentary matters on the coats of the intestine, there to be subjected to the action of other secretions. It probably facilitates the absorption of fat, as the fæces of dogs with biliary fistulæ generally contain fat, and it seems undoubtedly to exert an antiseptic action. and prevents decomposition of the intestinal contents, for in these dogs the excrements have a most repulsive odour.

The experiments of Bidder and Schmidt have shown that the bile is secreted in greatest abundance by the liver from twelve to fifteen hours after the introduction of food into the stomach; and the experiments of Dalton,* and others, show that it is discharged into the intestine in by far the largest quantity immediately after feeding, and within the first hour. Bernard supposes that the acidity of the chyme stimulates this discharge, for he found that on touching the opening of the ductus choledocus in the intestines, with a glass rod dipped in acetic acid, bile was immediately squirted into it. In its course through the intestines the bile is in great part absorbed, how and by what means is not, however, known, for it cannot be detected in the blood of the portal vein, or in the chyle.

* See DALTON'S *Treatise on Human Physiology*, p. 156.

THE PANCREAS.

This organ so much resembles the salivary glands in structure, that it has been termed the abdominal salivary gland. It is very irregular in form in different animals, and indeed there are several glandular masses, with separate

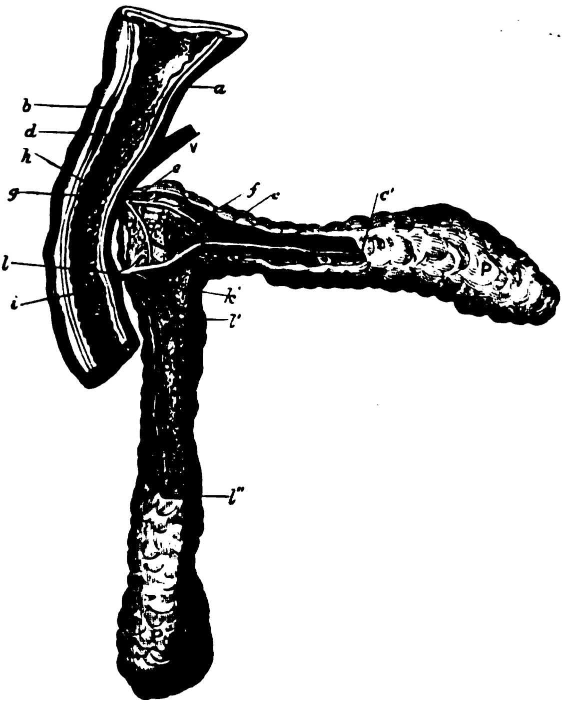

FIG. 96.—Pancreas and pancreatic ducts in the dog.—(BERNARD.) P P, Pancreas: a, pylorus; b, glands of Brunner; c c', large pancreatic duct; d, eminence formed by the duodenal glands; e, small pancreatic duct at its opening in the intestine; f, anastomosis not constant between the large and small pancreatic duct; g, orifice of the biliary duct; h, orifice of small, and i, of the large pancreatic duct; k', anastomosis of the large with the small duct.

ducts, in some animals grouped under the name pancreas. In the dog we observe the same simplicity in form as in the horse. (See Fig. 96.)

It is through this gland that the large vein, carrying the blood from the intestines to the liver—vena porta—passes. The aperture in the gland for this large vein is called the ring of the pancreas. The pancreas has two ducts, the large one *c c′*, fig. 96, and the smaller one *e*. This arrangement is seen in the cat as well as in the horse and dog. (See Fig. 97.)

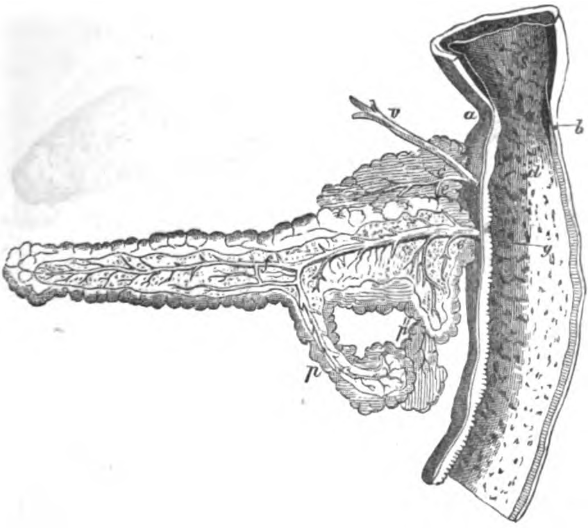

Fig. 97.—Pancreas and duodenum of the cat. *a*, Pylorus; *b*, glands of Brunner; *e*, descending branch of the inferior pancreatic duct; *f*, inferior pancreatic duct; *g*, opening into the intestine of the inferior pancreatic duct; *p p′ p″*, pancreas; pyloric portion of the stomach; *v*, biliary duct.

The pancreatic ducts enter the duodenum, into which the secretion is discharged close to, or in company with, the

Fig. 98.

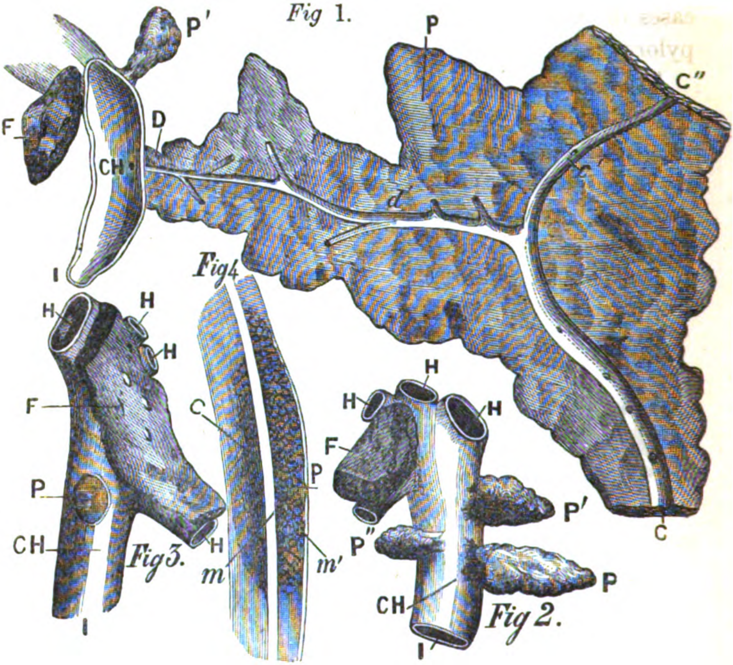

Fig. 1.—Supplementary pancreatic glands in the ox. P, large pancreas; C C' C", large pancreatic duct which opens in the intestine at C; *d'*, small pancreatic duct opening into the biliary duct at C H and D, and anastomosing with the large pancreatic duct *d'*; P', small supplementary pancreas opening in the biliary duct; C H, open biliary duct; intestinal extremity of the biliary duct; F, small portion of liver.

Fig. 2.—C H, Biliary duct in which three supplementary pancreatic ducts open, P P'P"; I, Intestinal extremity of the duct; H H H H, branches of the biliary duct at its opening in the intestine.

Fig. 3.—P, Pancreatic patch contained in the coats of the biliary duct C H; I, intestinal extremity of the duct, H H H, its divisions in the entrance to the liver; F, section of liver.

Fig. 4.—Section of the pancreatic patch of the preceding figure enlarged; P, section of the glandular tissue; C, internal surface of the biliary duct; *m m'*, thickness of the coats of the biliary duct.

biliary duct. In some animals, such as the rabbit, the distance between the two ducts is considerable, and in all such cases the pancreatic duct is the one most distant from the pylorus.

In the ox there is a special arrangement for the combination of the biliary and pancreatic ducts. Bernard has shown, by drawings which I here reproduce (see Fig. 98), how small portions of pancreas are attached or intimately blended with the biliary duct, and discharge a fluid to mix with the bile before the latter enters the intestine.

The subjoined Fig. 99 also indicates the biliary canal of a cow, the intestine and duct being laid open:—

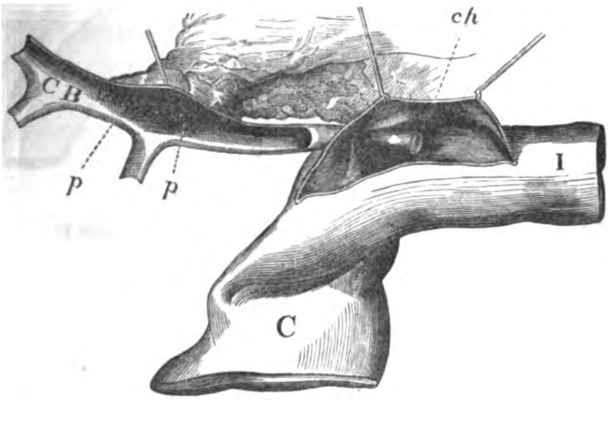

Fig. 99.—C B, biliary duct opened to show the small orifices p p, which constitute the apertures of the secondary pancreatic ducts; I, duodenum; C, rennet.

The Pancreatic Juice

Is a colourless, transparent, and slightly viscid liquid, of alkaline reaction, and coagulable by heat; in appearance, as in physiological character, it resembles saliva. Before discussing these properties, we shall, however, describe the operation for establishing a pancreatic fistula.

An incision having been made in the right hypochondrium (*i.e.*, right side) of a dog, below the ribs on one side, and parallel with the median line, the duodenum is seized and drawn out of the wound, together with the pancreas which is attached to it. The larger of the two pancreatic ducts which opens into the duodenum about half an inch below the common bile duct, is rapidly isolated from surrounding structures; and, having been opened, a small silver tube is introduced into it and fastened by a ligature, which is passed around it. The duodenum and pancreas are then returned to the abdomen, and the wound is sewed up, care being taken to leave the silver tube hanging out.

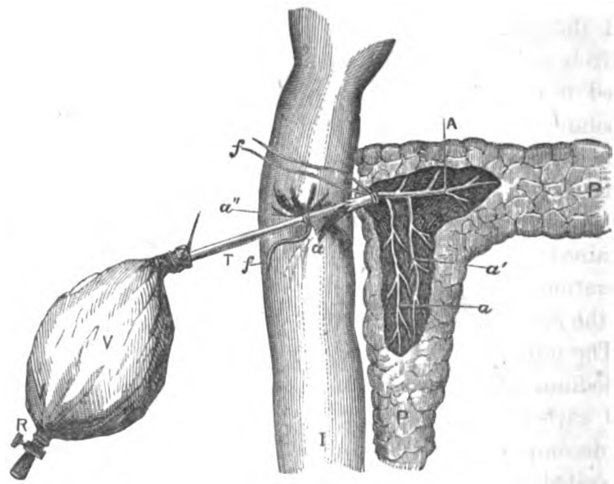

Fig. 100.—A, principal duct of the dog's pancreas; *a*, insertion of the pancreatic ducts into the intestines in which tube T is inserted; *a'*, lesser pancreatic duct; *a''*, ligature fixing the tube; *f f*, string which supports the ligatures; I, intestine; P P', pancreas; V, bladder to collect the secretion.

To the extremity of this is fastened a little gutta-percha bag with a stop-cock, so as to draw off the pancreatic juice when a sufficient quantity has collected.* It is quite impossible, however, to establish a permanent pancreatic fistula like a permanent gastric or hepatic fistula, for the tube falls out in the course of two or three days, and the wound healing up, the animal generally recovers. The pancreatic juice collected on the second and third day is generally abnormally liquid, and has a disagreeable odour.

Pancreatic juice contains water, salts, and a peculiar animal principle, to which the name of pancreatinine has been given. According to Bernard, it contains from 8 to 10 parts of solids, and from 90 to 92 parts of water in 100 parts.

The animal principle which it contains resembles albumen in being coagulated by heat; it is coagulated by nitric acid, and the coagulum is soluble in an excess of the acid; it is entirely precipitated by sulphate of magnesia. It is precipitated from pancreatic juice by alcohol, and the precipitate is soluble in water. The solution thus obtained possesses the properties of pancreatic juice. After having been exposed to the air for a short time, pancreatic juice is coloured red by chlorine, and the same takes place in pancreatic juice obtained by means of a fistula two or three days after the operation. This colour has been shown by Bernard to depend on the action of chlorine or pancreatinine.

The mineral constituents of pancreatic juice are chloride of sodium, alkaline and earthy phosphates, alkaline sulphates, and carbonate of lime. When the pancreatic juice begins to decompose, beautiful crystals of sulphate of lime are deposited.

The functions of the pancreatic secretion have of late years been satisfactorily studied by Bernard, and other able experi-

* See BERNARD, *Leçons de Physiologie*, p. 190.

menters. Their researches have shown that the pancreatic juice converts the starchy constituents of the food into sugar, and that it emulsionizes fatty matters, *i.e.*, it reduces them to a minute state of subdivision, holding them in suspension. The first of these properties it possesses in a much higher degree than the saliva, and the second seems almost peculiar to it. Whether it decomposes the fats which it emulsionizes, has not yet been satisfactorily made out.

This property of emulsionizing fat has been doubted by Berard and Colin, who extirpated the pancreas from four young dogs, two pigs, a goose, and a duck; they all grew and lived to be adults, and the conclusion arrived at by these distinguished physiologists is, that the pancreatic juice is not essential to the absorption of fatty matters.

Pappenheim and Purkinje, many years ago, arrived at the conclusion that the pancreas as well as the stomach secretes a substance capable of transforming protein matters into peptone. Corvisart's experiments confirm this, and this author thinks that the pancreatic juice is intended to act upon that part of the albuminoid substances which have left the stomach before being transformed into peptone. Keferstein and Hallwachs contest this, and believe that the effects described by Corvisart are due to putrefaction. Dr Brinton also finds the action of pancreatic juice on albumen very irregular. Corvisart considers that Keferstein and Hallwachs experimented with pancreatic juice secreted under abnormal circumstances, and the irregularity in action which Brinton has noticed, he explains on the fluid not being collected when the animal is in the act of digestion, the juice of the pancreas from the fasting animal having little or no power over coagulated albumen. Funke agrees with Corvisart, and, on the whole, the evidence yet afforded us preponderates in favour of a certain specific action of the pancreatic juice on albuminoid substances.

INTESTINAL SECRETIONS.

The glandular apparatus in the mucous membrane of the intestine yields an abundant secretion, which may readily be collected in a fold of intestine by placing a couple of pairs of clams at some distance from each other in the tube. As much as from 3 to 4 ounces of fluid may be obtained in half an hour in a couple of yards of small intestine. If intestinal digestion is stopped the quantity of secretion is small, but the amount is large if a solution of aloes or of sulphate of soda is introduced into the fold. Intestinal juice thus obtained is of a clear yellowish colour. Taste slightly salt and alkaline reaction. M. Lassaigne found that it contained—

Albumen	0·45
Chloride of sodium „ of potassium Phosphate and Carbonate of soda	1·45
Water . .	98·1

Its density is 1·010 at the temperature of 15° centigrade.

If the intestinal secretions are mixed with some oil, a soapy mixture is produced, and this is seen whether the oil be poured in the intestine during an experiment, or added to a quantity of the fluid outside the body. In canivorous animals this product of the mucous membrane is very scanty.

It is evident, then, that the acid material which passes from the stomach into the intestine is at once neutralized by the alkaline secretions it meets in the duodenum.

The glands of Brünner yield a considerable quantity of fluid which, mixed with the bile and pancreatic juice, tend to render the alimentary matters alkaline, to dissolve all soluble substances, and thus facilitate absorption. The alkalinity of the contents of the intestines increases near the cœcum, and certain principles in the food are digested, especially the starchy principles. It would appear, that when the gastric digestion is very active, the intestinal contents are less decidedly alkaline, but the alkalinity is very marked when the acid secretion within the stomach has been scanty, and digestion is chiefly carried on in the intestinal tube.

The fluidity of the contents of the small intestine is in part due to the abundant secretions which are mixed with the food, after it has passed through the stomach, but also to the rapid onward passage of indigestible matters which accumulate in the large intestine. The process of solution and dilution to which the alimentary matters are subjected in the small intestine, are very favourable to the absorption which we shall hereafter fully consider. The first portion of the large intestine or blind head of the colon—cœcum caput coli—is distended with very fluid contents, and in the horse this organ has been spoken of by slaughterers and others as a second stomach. It retains liquids which pass rapidly through the small intestine for some time, and they get gradually absorbed.

The solid mass, which moves slowly towards the anus becoming harder and drier, contains: 1stly, all indigestible materials, and especially in vegetable feeders, food protected by a cuticular envelope, and which may have escaped mastication; 2ndly, digestible materials which have escaped solution and absorption; 3rdly, epithelium and residue of secretions discharged in abundance by the mucous surface of the intestine and glands before-mentioned. Mr Sibson says:—

"The solid excrements consist of those portions of the food unfit for assimilation, consisting for the most part of woody fibre, as well as of other insoluble materials of the food that can only be removed from the system through this channel. The composition of the solid excrements of different kinds of animals varies to a still greater extent than that of the urine; moreover, the mechanical form of these substances materially influences their agricultural value, as it is on this circumstance that the facility with which they undergo decay chiefly depends, and consequently that regulates their fitness for particular purposes. The average composition of the solid excrements of our domestic animals may be thus stated:—

Approximate Composition of the Solid Excrements of the

	Horse.	Cow.	Sheep.	Pig.
Water	760	840	580	800
Organic matter, woody portions of food and other insoluble matter	210	136	360	170
Containing nitrogen, capable of yielding of ammonia	(6·10)	(3·6)	(9·02)	(·73)
Mineral substances, consisting of insoluble salts of food	30	25	60	30
Containing phosphoric acid	(3·48)	(2·25)	(6·2)	(4·5)
	1000	1000	1000	1000

The difference in the consistence of the solid excrement should not be overlooked. In the horse it should always be firm and in round balls or masses, moulded according to the shape of the folds of the intestine. In the cow it is softer, and cannot be rolled into the masses just mentioned, from the disposition of the intestine. Without entering into further particulars, I wish to point to the importance of not feeding a horse in such a way that its dung is soft and like that of a cow: but by regularity in feeding on corn and hay, with proper exercise and sufficient water, constipation need not be feared, and impactions are very rarely witnessed.

Intestinal Concretions.—Not only do we find indigestible materials accumulate in the intestine, but if any foreign object, such as a small pebble, a nail, &c., penetrates the large intestine, it acts as a nucleus around which materials of different kinds agglomerate, and concretions of large size are formed. Sometimes the food may clog, and adhere to the mucous membrane, constituting a stercoral concretion. I have seen a solid deposit of excrement perforated through its centre, so as to admit of the passage of fæces, but which clogged and incapacitated a considerable portion of the intestinal tube.

Occasionally a calculus forms in the stomach of the horse from the accumulation of calcareous salts—phosphates of ammonia and magnesia—around a piece of metal or other substance. The deposit is at first crystalline, and afterwards amorphous—the external surface, however, being smooth and polished. Mr Stanley, of Leamington, found two large calculi in the stomach of a horse, weighing respectively 4 and 5 lbs.; the latter being wedged at the opening of the duodenum, causing death.

The intestinal concretions have been classified according to their composition. Thus we have phosphatic calculi, oat-hair calculi or dust balls, and mixed calculi. These are distinct from the simple stercoral masses which consist alone of hardened fæces. Gurlt has classified the calculi according to their colour, but Professor Morton's classification is best.

The phosphatic calculi vary in size from a pea to a mass twenty pounds in weight. They have a smooth, polished external surface, and approach the spherical form. If several are formed together, they are flattened on their sides. A section proves the presence of a nucleus, around which stratified layers of earthy and animal matter exist. Girardin found in one—

Ammonio-phosphate of magnesia	48·00
Phosphate of lime	19·00
Water	14·00
Animal matter	·80
Soluble salts, &c.	6·60
Extractive matters	4·00
Fatty matter	7·00
Loss	·60
	100·00

In millers' horses the second form has been frequently found, and is composed almost entirely of the beard of the oat or barley firmly matted together, and disposed in concentric layers, with the admixture of mucous and some excrementitial materials. These are the dust balls or oat-hair concretions which sometimes attain great size.

The mixed calculi contain dung, phosphatic salts, mucous, oat hairs, and any indigestible or agglutinating material, which may surround any solid object which may accidentally float in the intestine.

An interesting case of calculus in the horse's intestine is reported by Mr Maclaren Kitching, in the first volume of the *Edinburgh Veterinary Review.* The calculus is in the New Veterinary College Museum. It is irregularly spherical and nodulated; two pounds nine ounces in weight, and five inches and a half in diameter. Its external characters are those of an ordinary oat-hair calculus, with a phosphatic one imbedded deeply in it. (See Fig. 101.)

The small calculus *a*, at the lower part, is of the mixed kind, and appears to have formed round a stone. This is a remarkable instance of the coalescence of phosphatic and oat-hair concretions.

a

Fig 101.

The non-scientific usually imagine that intestinal concretions are stones swallowed by animals. I can record a case in which a common marble was the cause of a dog's death. I was asked to examine a terrier dog last autumn, with the not uncommon declaration, that the animal must have been poisoned, as it had died so suddenly and in such violent pain. On opening the abdomen, I observed a solid spherical mass distending the duodenum about two inches from the pylorus, and it turned out that this was a marble which the animal had swallowed when with some children who were playing at marbles.

CHAPTER V.

DISEASES OF THE INTESTINE, LIVER, AND PANCREAS.

Intestinal parasites in the horse, ox, sheep, pig, and dog.—Constipation in foals.—Colic.—Causes, viz., physical and vital.—Symptoms.—Complicated varieties.—Post-mortem appearances.—Treatment.—The common practices condemned.—Mr Joseph Gamgee Senior's plan—Its certainty and safety.—Results.—Ruptured stomach.—Ruptured colon.—Ruptured rectum.—Volvulus or ileus.—Intussusception of the small and of the large intestine.—Mr Percivall on intussusception.—Pathological anatomy of the lesion.—Obstructions by tumours.—Ligatures of the intestine by pedunculated growths.—Enteritis.—Exudative enteritis.—Peritonitis.—Dysentery.—Enzootic dysentery.—Darn or wood evil.—Diarrhœa.—White scour in lambs and calves.—Dilatation of rectum.—Imperforate anus.—Fistula in ano.—Prolapsus ani.—Proctorrhœa.—Hæmorrhoids.—Hernia.—Umbilical—Inguinal—Scrotal—Ventral—Mesenteric.—Guttie in cattle—Phrenic and omental herniæ.—Diseases of the liver.—Jaundice.—Hæpatirrhœa.—Hepatitis.—Biliary calculi.—Parasitic diseases.—Pancreas.—Functional and structural disorders.—Pancreatic calculi.

INTESTINAL PARASITES.

THERE is a marked difference in our domestic animals as to the kinds of worm which give rise to unpleasant symptoms, and call for medical interference. In the horse, we rarely observe any form of tapeworm to be troublesome, and the parasites usually noticed are the bots when discharged in spring, the large round worm so often and very improperly called lumbricus, and which is the ascaris megalocephala, and the so-called needleworm, which is the strongylus armatus.

The forms of taenia observed in the horse are—taenia plicata, T. perfoliata, and T. mamillana.

Symptoms.—When parasites accumulate in large numbers in the horse, the digestive organs become disturbed, assimilation is imperfect; however rich and abundant the food, the animal does not thrive, and is hide-bound. This condition predisposes to various disorders, and is attended with occasional attacks of colic.

Treatment.—A brisk purge may sometimes suffice to clear the parasites out of the intestine, and restore the animal to health. In many instances further treatment is called for, and either of the following prescriptions may be used—

℞ Iron filings . . . . . 6 oz.

Common mass, sufficient to make 12 balls, one of which must be given every morning, and on the twelfth day a good dose of aloes, which will cause a copious discharge of worms. Or—

℞	Sulphur	12 oz.
	Arsenic	1 drachm.
	Bruised coriander seeds . .	6 oz.

Divide into twelve powders, and give one daily for twelve days. This is a very sure remedy in cases in which the ascaris megalocephala is abundant.

The ox is not very much tormented with parasites, and I can only repeat what I have said in my work on *Dairy Stock*, that "the strongylus radiatus and ascaris lumbricoides are amongst the most common round worms to be met with in the intestine of the ox. Ascarides abound in the small intestine of weakly calves, within a very short time after birth, and the system suffers very severely, as indicated by great emaciation; and when the animals are killed, the flesh has a peculiarly disagreeable, mawkish odour. The best remedy in these cases is iron, either in the form of iron filings or powdered sulphate of iron, given in treacle as an electuary. The worms are rapidly discharged, and the young animal acquires strength and condition. Cows are not often troubled with tapeworm, though two kinds—tænia expansa, and tænia denticulata are occasionally met with in their intestines. The only symptoms of their presence during life are the discharge of rings of the worms, attended by a little intestinal irritation. The best remedy is turpentine in mucilage, or thick linseed tea."

In the sheep, various species of strongylus, such as Str. cernuus and contortus, inhabit the intestine, but only one tapeworm is known—(*tænia expansa.*) Though little is known of tapeworm in the sheep in this country, nevertheless in some parts of the world this parasite is very troublesome, and destroys many lambs. If I am correctly informed, this is the case in Australia, where, after torrents of rain, portions of tapeworms are readily seen in large numbers on the washed soil. Thus existing as an enzootic affection, it is of great importance, as sheep affected with tapeworm pine and become emaciated, as well as predisposed to a number of other diseases which prove destructive. No properly devised means of cure has been suggested. Overstocked land appears to suffer most, and it may be necessary to reduce the number of sheep kept. All the advice that can be given is based on the well-known fact, that in proportion as you invigorate the systems of animals, they are less subject to parasitic disorders, so that sanitary precautions of a general nature are to be adopted. In individual cases, the best remedy is turpentine, given in drachm doses, in thick linseed tea, linseed oil, or gruel.

The pig is attacked by a large, round intestinal worm—(*echinorhynchus gigas*)—a parasite which propagates rapidly, and produces serious disturbance of the intestinal organs of young pigs. Ascarides and tæniæ are occasionally associated with the echinorhynchus, producing emaciation, weakness of the loins, and rigidity of the hind extremities. In the morning, and until feeding time, the pigs grunt and cry out incessantly, and have even a tendency to bite each other. The fæces become hard and dry, the skin tense, eyes sunken, and the visible mucous membranes are pallid. Debility increases, and the animals die from exhaustion.

Treatment consists, in the early stage, in the administration of a couple of croton beans in food. If by purgation the parasites are not removed, sulphur may be given freely. In a strong pig a quarter of an ounce of turpentine may be given in four ounces of linseed oil and a little gruel. Great care must be exercised not to kill the pig in administering draughts.*

Dogs are often troubled with worms, and most frequently with tænia cucumerina, tænia serrata, and with the round worm, ascaris marginata—the maw-worm; the latter very frequently requires to be expelled.

Some dogs with tapeworm are not much disturbed, and their condition is only suspected from the appearance of rings of the worm on the tail or excrement. There is, however, constipation, straining, and uneasiness in many instances. It is at all times desirable, especially on farms, to keep dogs clear of tapeworms.

The maw-worm is displaced readily, especially in young dogs, by means of the following electuary:—

Iron filings	1 oz.
Treacle	4 „

A teaspoonful morning and night to dogs.

Young dogs improve largely on the above treatment. A decoction of quassia or lime water may be used as an injection, with the effect of displacing the parasites. A brisk

* See *The Veterinarian's Vade-Mecum.*

aloetic or oleaginous purge has the same effect, but I prefer the iron treatment as the most efficacious and safe.

Tapeworm is displaced readily by kousso, oil of male fern, turpentine, areca nut, for which I subjoin prescriptions:—

℞ Areca nut . . . . ½ oz.
Conserve, as much as sufficient.

Divide into 12 balls, if for small dogs, and into eight if for large.

℞ Oil of male fern . . . 20 drops.
Made into pill with flour.

Constipation.

All animals are occasionally subject to costiveness. Some are predisposed to this condition, whereas others have rather an opposite tendency. It is more frequently a symptom of disease than meriting the name of a distinct affection, nevertheless, in all animals will loss of appetite, abdominal pain, and difficulty in voiding excrement supervene, if the regular peristaltic movement of the intestine and natural condition of the intestinal contents be interfered with. In dogs, this is a troublesome affection, often due to habits of cleanliness engendered; and it is extremely cruel to force an animal not to relieve its bowels, unless when it may please its master to turn it into a convenient place. It is cruel, at all events, if attention be not paid to frequently letting the animal at freedom.

Treatment.—Frequently by regularity and moderation in diet the disease is overcome. Mild laxatives may be occasionally employed, but brisk cathartics are only rarely called into requisition. Warm water injections and plenty of exercise are to be recommended.

Constipation is a troublesome, and, indeed, dangerous condition in newly-born foals. The meconium or excrement which accumulates in intra-uterine life becomes hard, and cannot be expelled, giving rise to colic and very urgent symptoms. Injections are to be relied on, especially if employed early.

COLIC.

Under this general term must be included a variety of conditions, all giving rise to abdominal pain. In the horse there is no more common or more frequently fatal affection than that which has received the names of spasmodic colic, flatulent colic, indigestion, gripes, inflammation, stoppage, and many more remarkable ones still.

The Germans have divided colic into the true and false kinds. The first being intestinal, and the second dependent on disorder of the liver, or urinary apparatus, as in cases of calculi, &c. We may define the true or intestinal colic to be a spasmodic affection of the intestine, never inflammatory, and not having a tendency to run on to inflammation, as most authors, teachers, and practitioners still erroneously believe, but due to some primary cause which interferes with the regular peristaltic movement of the intestine, and sometimes brought on by a combination of circumstances, the most trivial of which is not unfrequently regarded as the real cause of the disturbance.

Causes.—The great causes of colic are—overfeeding, bad and irregular feeding, over-work, and neglecting the first signs of any intestinal derangement, indicated by constipation, &c. With regard to over-feeding, it is certain that if horses are crammed simply because they have a voracious appetite, the intestines become over-loaded, and spasms soon appear. Some Scottish farmers give their horses between twenty and thirty lbs. of oats daily. Under the head 'bad feeding,' we might include the abominable boiled-meat system. Hard-worked horses in Scotland get mixtures of corn and sheelings,* with beans, pease-meal, and other stuff, which is called strong meat, and a very liberal feed is given three times a-day, or in turn millers' horses get the nose-bag put over their heads as often as they are stopped for any time, in delivering flour, &c. At night, notwithstanding the three ample feeds, a pailful of boiled turnips, barley, and bran, is given to each animal, besides an unlimited supply of hay. It is not astonishing, then, if our superb Clydesdales are destroyed in large numbers with attacks of spasmodic colic. Irregularity of feeding is very injurious, especially if coupled with over-work, and the days of the nose-bags were preceded by many deaths which are far from rare now-a-days also, and due to animals being fed well after many hours' starvation and hard work. Exhaustion, coupled with the causes just mentioned, induces colic. Not unfrequently an attack of colic may be due to an animal being feverish or disturbed from causes that are hidden and unknown. With such febrile disturbance, the intestinal secretions are scanty, and constipation produces the impaction of solid excrement in the large intestine, which is soon attended with severe abdominal pain. It is, therefore, not easy to define many causes which may indirectly tend to produce spasmodic colic. The usually mentioned causes are—a drink of cold water, or exposure to rain. These are often inert, or insufficient, and only help to disturb the balance of function.

The intestinal concretions described in the last chapter are often the causes of relapsing forms of colic, which are occasionally relieved by the evacuation of a calculus, or under the influence of a purge by the fæces passing by the obstruction. Parasites in the intestine also induce colic.

* English readers are informed that the sheeling is the thin substance containing the meal, and which by the last operation of grinding, is separated into two parts, viz., meal and meal-seeds.

In the ox colic is more rare than in the horse, but it is due to similar causes.

Irritant poisons in all animals induce symptoms of colic, and then the disease is often inflammatory.

Symptoms.—Indications of abdominal pain; pawing, shifting about, and crouching; the horse looks round at his flanks, sometimes attempts to bite himself; he lies down and turns on his belly, or rolls on his back, and often as the paroxysm is abating, he lies outstretched on his side as if to rest himself; he then rises, shakes himself, is no more in pain, and seeks food. When the animal is suffering, the pulse is frequent, the breathing accelerated and panting; the eyes are prominent and staring; there is an expression of anguish, and often great listlessness. All subsides—but shortly the symptoms return, often in an aggravated form. Sometimes the attacks diminish in violence, become fewer and far between, and the animal recovers; but under other circumstances the pain becomes continued, the pulse quick and hard; there is sympathetic derangement of the brain; the animal reels to and fro, lies down, obstinately turns on his back, relaxing the muscles of his hind limbs, the latter drop forwards so that the tense state of the belly may be relieved; the extremities are cold; there is twitching of the muscles; cold sweats bedew the body here and there; the lips are retracted, the teeth exposed, and the horse dies.

From first to last, animals affected with colic are costive—few and small balls of dung are occasionally passed. There is colic, with diarrhœa or looseness of the bowels, which occurs when the disease arises from eating diseased potatoes, not unfrequently given to farm-horses. Urine is scanty, if any be passed at all; and whenever there is a copious evacuation, it is considered a critical and favourable sign, and the horse is then often looked upon as cured.

In the horse the stomach may be so overloaded as to produce symptoms of vomiting, and even effectual regurgitation of food. Though usually a fatal sign, animals may recover notwithstanding rejection from the stomach.

A dangerous complication is tympanitis or distention of the intestine with gas. This constitutes that form of the disease called flatulent colic.

When the abdominal pain is continuous, organic lesion is generally to be suspected; and the case of colic may end in rupture of the intestine or of the diaphragm, intussusception and strangulation of the intestine. The often-dreaded inflammation is very rare, and usually due to irritants which have caused the colic, or which have been injudiciously given as medicine.

The duration of the disease is variable. The attack may be transitory, and last but an hour; it may be long-continued, and may extend over a day; and indeed a horse may be more or less in pain at intervals for two or three days in succession.

Post-mortem Appearances.—It is rare that animals die of simple colic without some complication; whenever they do, the intestine is found loaded—some obstruction is met with either in the shape of a calculus or fæcal matter. In some cases, one or more abnormal constrictions are visible on the gut, a condition obviously due to forced contraction of the intestinal muscular fibres. More frequently, in cases of death after colic, the large intestine—the colon especially—is ruptured, and the contents are thrown out into the cavity of the peritoneum. Sometimes the stomach itself is lacerated, more particularly along its great curvature.

Treatment.—In no disease so much as in spasmodic colic are the powers of nature and the scope of medicine so clearly exemplified. Because cases of colic not unfrequently recover under very different modes of treatment, persons are apt to attribute great curative powers to a variety of agents, of which it would be more appropriate to say, that they were not sufficiently injurious to prove fatal, and that recovery was effected in spite of them, rather than to allege that they have been the cause of the cure. For the preservation of life, nature is far from being wholly dependent on the resources of art, and it is only by availing of these according to a sound discrimination, that good can be effected in the majority of cases.

Oil of turpentine has long been the favourite medicine for the relief of spasmodic colic; but it is so powerful a stimulant, it so often tends to retard rather than to facilitate the evacuation of the bowels, that its administration is much more frequently followed by symptoms of inflammation and death than is any other mode of treatment.

This disease well illustrates the great rule, that no plan of treatment is so reasonable and so successful as that which aims at removing effects by directly attacking their causes, no practice so sound as that which follows in nature's steps, and avails of her resources to the utmost extent, as the best mode of overcoming unnatural conditions. This is the great basis of my father's plan, which he has strictly carried out for the last thirty years.

I have said that colicky pains are but a symptom, the cause of which is an overloaded state of the bowels, unable to relieve themselves: what more rational than to believe that, with the lightening of the load, the painful sense of its weight will be relieved?—that removal of the source of irritation will be attended with ease and comfort? Experience proves that such is the case; and there can be no question that by far the safest plan of treatment to be adopted in colic is to aim at evacuating the bowels; with a view to carrying out this principle in its fullest extent, aloes and enemata are the agents to be employed. Firstly, with reference to aloes; five drachms, as an average dose, should be administered in the early stage of an attack, and but two or three hours elapse, as a rule, before symptoms of decided relief are manifested. It is an error to suppose that because from 12 to 20 hours are required to purge a horse, therefore it is not until after that time that relief can be apparent. The length and very huge size of the horse's intestine oppose speedy evacuation, but the mucus membrane pours out a large quantity of fluid, which softens the impacted fæces, lubricates the delicate membrane of the gut, and thereby allays irritation and pain; and these effects are manifest a comparatively short time after the purgative has been administered. Many who have adopted this principle of treatment have objected to aloes, because said to be irritating, and preferred oil. But oleaginous purgatives are, in horses, of most uncertain operation; added to which, the objection urged against aloes is much too theoretical; experience is opposed to it, and I believe it would be impossible to support the objection with any well-authenticated statistical data. It is not unimportant to observe, that even surgeons and physicians of eminence have objected to purgatives in the treatment of spasmodic affections of the intestines, on the supposed ground of their irritating properties; but the experience of the majority has prescribed, and it is now all but unanimously admitted, that, under the circumstances mentioned, purgatives are depletives and sedatives, by virtue of their power to produce copious fluid evacuations, and remove sources of irritation.

The second class of remedies above referred to (enemata) should be employed from the very commencement. For this purpose the ordinary pewter syringe is frequently at hand —objectionable, however, on account of its weight and bulk, besides the force exerted with it in pushing fluids into the intestine. An excellent substitute, and one not liable to the same objection, is a bladder attached to a tube, such as represented in fig. 2. The tube is commonly made of wood—an objectionable material, because very subject to splitting in alternations of moisture and dryness, particularly so if the bore of the tube is of considerable size, as it should be to secure efficiency. A tinned copper tube is preferable, as combining lightness with strength; block-tin should have the further advantage of cheapness, though at the sacrifice of a no less important consideration—durability. A much more efficient instrument is the one represented in Fig. 1.

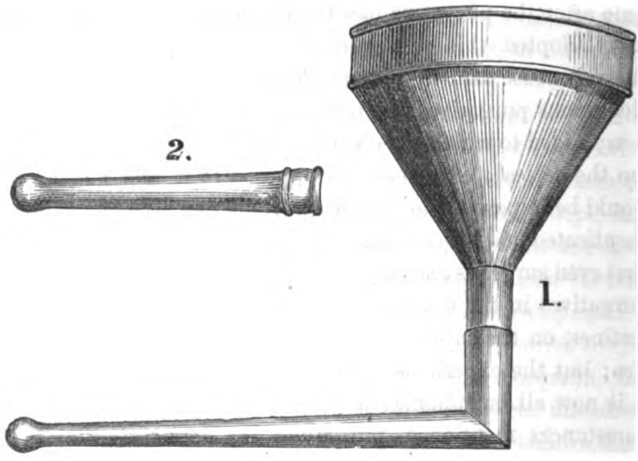

Fig. 102.

It consists of a straight metallic tube 12 inches long, tapered and rounded off at one end, bent at a right angle at the opposite extremity, which supports a broad funnel about 6 inches deep, and 7 in its greatest diameter. In using this instrument, its extremity requires to be oiled before introduction into the rectum; so soon as this is effected, the fluid—water, with a little oil, is preferable—is poured into the funnel. Experience proves, that no pumping force is required to inject fluid into the intestines, the effect of gravitation fulfilling the same purpose in a much more simple manner. As the fluid from the funnel gravitates into the rectum, bubbles of gas escape; the action of the gut, thus mildly stimulated, continues until, with the repetition of the process at intervals of a quarter of an hour, the required evacuation is induced, with its attendant relief. In farm-houses, or every other establishment where large numbers of horses are kept, an instrument like the one described should be kept: made of block tin, it is light, cheap, and very durable, qualifications which, conjoined as they are with the utmost simplicity and thorough effectiveness, render the contrivance one of the most useful in relieving disease.

My father first recognised the very great advantages of using a funnel of this description in giving injections to the horse, and has modified the form considerably from the first in use, so as to ensure, with small bulk, the most handy instrument for the operation.

It will be found, especially by young practitioners, that the urgent symptoms of colic alarm considerably all non-professional persons, and every suggestion is made, or numerous questions asked, which either induce persons to try remedies for the immediate suppression of signs of pain, or lead to troublesome interference on the part of persons who can do much mischief.

If proper confidence is reposed in the method of treatment by aloes and enemata, all that has to be done is to secure a loose box or shed, well-littered, where the animal can roll without danger.* It is not only wrong, but cruel, to persist in an animal standing, walking, or trotting, which is often done with the free use of the whip.

Great patience is required in treating severe cases of colic, and four or five hours may be spent before the symptoms appear to abate. With veterinarians, it should be a standing rule that, as the animal cannot be declared safe until its abdominal muscles relax, and evacuation both of fæces and urine is obtained, so should it not be left until such symptoms of relief are noticed.

Washing a little tepid water into the animal's mouth, or giving it a little nitre or spirits of nitric ether in water, can do no harm, and often palliates the intense thirst which the animal often experiences. Above all things, opiates and other stimulants or narcotics must be avoided. If cases of colic are neglected or improperly treated, the results which we are now about to consider are observed.

Ruptured Stomach.

I have alluded repeatedly to this lesion as occurring in the horse, from the obstacles to the act of vomiting which exist in this animal. The rupture involves the muscular coat first, and the mucous membrane which protrudes through the latter gives way also, and either the contents drop into the omental sac, or, from the close manner in which the abdominal organs are packed, by an effort of the abdominal muscles, rejection by the mouth occurs.

Symptoms.—A horse that has, by accident, got at a corn bin or sack of oats, eats to repletion, and is observed afterwards to breathe heavily, stagger, look round at his flanks,

* I have lost a horse by ruptured diaphragm, from not having a loose box to turn him into. The animal fixed its limbs against the stall post, and, in a struggle to extricate itself, injured itself fatally.

roll, and then suddenly to be seized with symptoms of vomiting, and food passes freely out at the nostrils. Exhaustion speedily ensues, and though the animal makes a violent effort not to fall, and even catches at the manger or stall post with his teeth, he nevertheless sinks to the ground not to rise again. Mr John Field, in referring to a case in which frequent retching was observed, says: "From this last symptom I inferred rupture of the stomach, although nothing had been seen to have been ejected, and on this account no medicine was given by the mouth." I have quoted, at page 153, from Mr John Field's *Records*, a case to show that vomiting might occur without rupture; and other cases might be brought forward to show that rupture is occasionally not indicated by rejection from the stomach. Mr Percivall says: "I remember the late Mr John Field observing to me one day, that he never had witnessed a case of ruptured stomach without vomiting occurring prior to death, which he thought very remarkable. The trooper, however, of my regiment, who glutted himself overnight, and died the following morning, did not exhibit this symptom." There is no doubt, however, that the rupture of the stomach is one of the conditions favourable to free exit of food through the cardiac orifice, and out by the mouth.—(See page 154.)

Though I have here referred to ruptured stomach as a result of colic, there are many circumstances under which it may be observed. Dupuy mentions a case due to a draught of water on a full stomach, and this is not an unfrequent cause; also blows, falls, and violent straining, which Mr Percivall has noticed in his *Hippopathology*.

Ruptured Colon.

As the stomach or other hollow organ, so may the intestine be paralysed by over-distention, and its muscular coat will thus give way, and with it the peritoneal covering and mucous lining of the tube.

The causes of such rupture are therefore over-distention, jerking movements of the animal, especially in trotting, and not attending to prompt evacuation.

Symptoms are not very distinct, and the rupture is usually recognised only on a post-mortem examination. The relief which occurs suddenly in an attack of spasmodic colic, coupled with the readiness with which water passes into the intestine, though all clysters have been violently ejected before, and all this followed by the animal acquiring rapidly a very anxious expression, sweating, and sinking fast, may indicate the organic lesion. It is doubtful how long an animal may live after the rupture has occurred. In some cases death is almost instantaneous, but if the immediate shock of the rupture is overcome, death may be delayed for hours, and perhaps days, but the animal evinces symptoms of peritonitis and severe fever in the latter instance, which prove the case to be hopeless. Such instances of prolonged life are doubtless very rare.

Ruptured Rectum.

Mr John Field records two cases of this singular lesion:—

"*May* 12*th*, 1837.—I was this day called to see a horse belonging to Mr S—. It was a case of protrusion of the intestines, their external coats being exposed through the anus. The parts protruding were the convoluted portion of the rectum, and the curvature of the colon; the *mesocolon* was ruptured, and, from the intestines being exposed on their peritoneal surfaces, it was certain that the rectum had ruptured. The horse was destroyed by injecting the jugular with a solution of nitre.

"*Examination.*—The rectum was found broken entirely off at the sacral attachment, and the piece so broken off had entered the remaining portion, and by the efforts of the horse had been gradually forced through the anus.

"The lining of the colon (that is, of the part extended) was much gorged, and quite black."

Mr Field also refers to a case in which a melanotic tumor caused obstruction and rupture of the rectum.

Volvulus.—Ileus.

Under these names diseases have been described affecting man and animals, and which consist in various forms of entanglement of the intestine, supervening in or giving rise to severe colic. I do not include under this head accidents which consist in the accidental intrusion into a natural or artificial opening of a portion of intestine—(see Hernia.) Very remarkable cases, however, occur, and I think I cannot better illustrate this than by quoting again from Mr Field's valuable *Records*. We there find—

"*May 3rd*, 1832.—A bay carriage-horse, belonging to General H—, was suddenly seized with pain and profuse sweating, without disturbance of the pulse.

"4 *o'clock*, P.M.—Slight tremor of the hind quarters—lies down much, but is not very uneasy.

"*Half-past* 7 *o'clock* P.M.—Pulse 54.

"10 *o'clock*, P.M.—Pulse frequent and full—more restless.

"*4th*.—Pulse 78, and wiry—much distention of the belly—membranes of their natural colour—has had no evacuation.

"12 *o'clock*.—Pulse 78, and feeble, but distinct—tongue livid—conjunctiva injected—respiration quiet—belly much distended. The horse died in the afternoon.

"*Examination*.—Two feet of the ileum, just before its termination in the cæcum, strangulated by a band of mesentery: it was much thickened, of a deep black colour, and easily lacerated.

"It is worthy of remark that this horse never lay upon his back, did not roll, nor attempt to sit upon his haunches, as is usual in cases of entanglement; the tongue and membranes also retained their natural appearance until nearly the last."

A singular instance is reported as follows by the same observer:—

"On the 16th November, 1829, I was called in to see a brown gelding, belonging to Mr J—, which was taken ill on the previous day. I found the following symptoms present: —viz. pulse 78, and feeble—respiration accelerated—tongue white, but not offensive—conjunctiva of natural hue, and not injected—partial sweats—horse restless, and very feeble—the introduction of the hand per anum occasioned great efforts to force it back again: the animal died in about six hours.

"*Examination.*—Stomach and small intestines healthy—villous coat of jejunum injected—the whole of the colon beyond its collateral attachment to the cæcum had turned on its short axis, whereby the same had become strangulated, and was one dark mass, an immense effusion of serum and blood being deposited between the villous and muscular coats —the peritoneal and villous coats were quite dark—the intestine contained black-coloured fæces and fluid blood: no other disease was present."

Volvulus must necessarily be an incurable lesion.

Intussusception.

This most remarkable lesion consists in the passage of one portion of intestine into another. Both the small and large intestines are subject to it, though most frequently the small

It occurs in all animals, and though almost invariably fatal, there have been instances of recovery. I have seen the accident only in the horse and dog, but notwithstanding the fixed position of the intestine in the ox, intussusception has been seen in the large intestine even of this animal.

Symptoms.—Severe colic, with total obstruction, rejection of enemata, and the persistence of pain. I remember attending a case in London in 1851, in which the horse stood obstinately for two days sitting on his haunches—at all times a very ominous sign—and looking round most anxiously to his flanks. This case proved to be one of intussusception of the cæcum.

Mr Percivall says:—"The only distinguishing symptoms I have been able to detect in such cases as volvulus or intussusception, are: instead of the animal lying down and rising continually, and pawing and stamping, and evincing all that restlessness he does in colic and enteritis, he generally manifests the greatest propensity to lie down; lying down and remaining down, only trying from time to time various new postures for relief, such as lying now upon his side, then rolling upon his back, and afterwards by stretching out his fore-legs, placing himself upon his belly, and from thence raising himself upon his hind-quarters like a dog, groaning all the while and casting many a dolorous look backwards at his belly. He will seldom rise of his own accord; but you may rouse him up; no sooner, however, is he up than he begins turning himself round, with his nose poking down, looking about for a fresh place to lie down upon. His pulse is not quick, but soft, and nowise thready or contracted."

Mr John Field, who is very practical in all his remarks, states the symptoms to be—

"Pain; restlessness, in some cases approaching to madness, unrestrainable; wandering about; rolling on the back;

sweating, in some cases profuse; crouching; sitting on the hind quarters, almost diagnostic; anxious countenance; frequent feeble pulse; belly at first of natural size, subsequently fuller, in some cases distended, dependant upon the locality of the intussusception; membranes in advanced stage, turgid, injected; mouth moist and clean, or furred and offensive; respiration accelerated; continued restlessness; rearing with fore-legs into manger; and standing upon that *point d'appui;* looking back from side to side; extremities cold; pain absent, tranquil; sighing or snorting; death. The sighing may exist in some cases, and not in others; and in some retching and vomiting."

In the dog and pig, vomiting, constipation, and violent abdominal pain, which persist or exhaust and destroy the animal, are characteristic of the lesion.

Pathological Anatomy of the Lesion.—The violent contraction of the intestine at a particular spot is attended with an active peristaltic movement of the portion of the canal in front of the rigid constriction. Thus the constricted portion is overlapped, and when a small portion is passed over by the moving gut, the intussusception increases rapidly. Mr Turner, veterinary surgeon at Montreal, reported a case in 1849, in which no less than sixteen feet four inches of the ileum had become invaginated. Mr Dunsford records an instance in which eighteen inches of the ileum had passed into the cæcum. When the lesion is observed in the large intestine, it is usually the cæcum that is invaginated; in the colon the whole of this vast pouch is imbedded in the latter.

When the invagination occurs, the mesentery must be partially torn, but a large fold is always carried in or covered over, and the blood-vessels going to and from the invaginated portions are thus pressed upon and obstructed. The venous circulation is at first chiefly retarded, and as a necessary result, the intruded gut becomes of a dark red, or black colour, tumefied, and even the seat of ulceration. Thus the invaginated intestine dies, and in the rare instances in which the peritoneal coat of the intestines adheres at the part where the invagination stops, the invaginated portion may slough and pass out so that the animal recovers. Such is an occasional though rare result in intussusception of the small intestine.

With invagination of the cæcum, as the colon is ample, and the blind pouch free, there is not the same tendency to compression of the blood-vessels, &c. Provided the ileo-colic opening is not closed, the animal may live, and in proof of which I subjoin a drawing taken at Alfort, from a subject

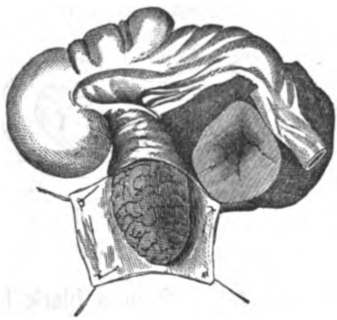

Fig. 103.

destroyed in perfect health, and at a great age, for purposes of dissection. The condition of the intestine was such as to assure us that the lesion was not recent, and the animal had perfectly recovered from its effects.

Treatment.—It has been suggested that the abdomen should be opened and the invagination overcome by a manual operation; but this is not safe or practicable in the horse. It has been done in the ox, and even in the human subject. If cases of colic are well treated at the commencement, intussusception is usually prevented.

Strangulation of the Intestine by Pedunculated Tumors, or Hypertrophied Appendices Epiploicæ.

Not a few cases have been recorded, in which the ileum has been found tied by the long neck or peduncle of a fatty tumour. The growth is always an enlarged epiploic appendix. I here reproduce a drawing from the first volume of the *Veterinarian.*

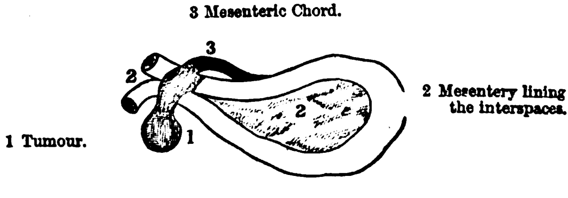

Fig. 104.

The specimen was taken from a black horse upwards of twenty years of age, which was suddenly seized with an attack of 'gripes.'

Mr Percivall, in describing the post-mortem examination, says: "Considerable serous effusion (about 3 or 4 gals.) into the abdominal cavity. About a foot in length of the ileum formed duplicature, strangulated, by being included and tightly strictured within a fold of an elongated portion of mesentery, from which grew by a neck, a fatty tumour, as large as the egg of a goose, and weighing six ounces. The portion of mesentery forming the neck or root of the tumour was, I found, simply twisted around the ileum."

Again I may quote from Mr Field's *Notes*, in which I find:—

"On the 12th January, 1824, a bay gelding was brought to the hospital, with symptoms as follow:—very frequent pulse—much uneasiness—sitting on the hind quarters—at times snorting severely—belly not full. He was bled immediately, and a mixture composed of ol. lini ℥xij, and ol. croton, gtt. ix, was given; the belly was stimulated, and clysters administered. At night the pulse was scarcely perceptible—the mouth was discoloured—the extremities had become cold, and the belly was beginning to distend. He shortly after died.

"Upon examination after death, twelve inches of the ileum were found strangulated by an elongation of the omentum, one of the epiploic glands being considerably enlarged, and forming part of the ligature; the entire portion of strangulated intestine was gangrenous; the intestines and peritoneum throughout were highly inflamed, and there was some blood effused into the belly."

In 1829, Mr Goodwin, then Veterinary Surgeon to the King, contributed a very interesting paper, with an excellent sketch, illustrating the lesion under consideration.

It is the most satisfactory illustration of the lesion yet published, and indicates how firmly the intestine may be tied by any structure which is long enough to wind round the convolutions; a circumstance due as much to the weight of the tumour as to the length of the peduncle.

The annexed engraving is a copy of the above-mentioned sketch:—

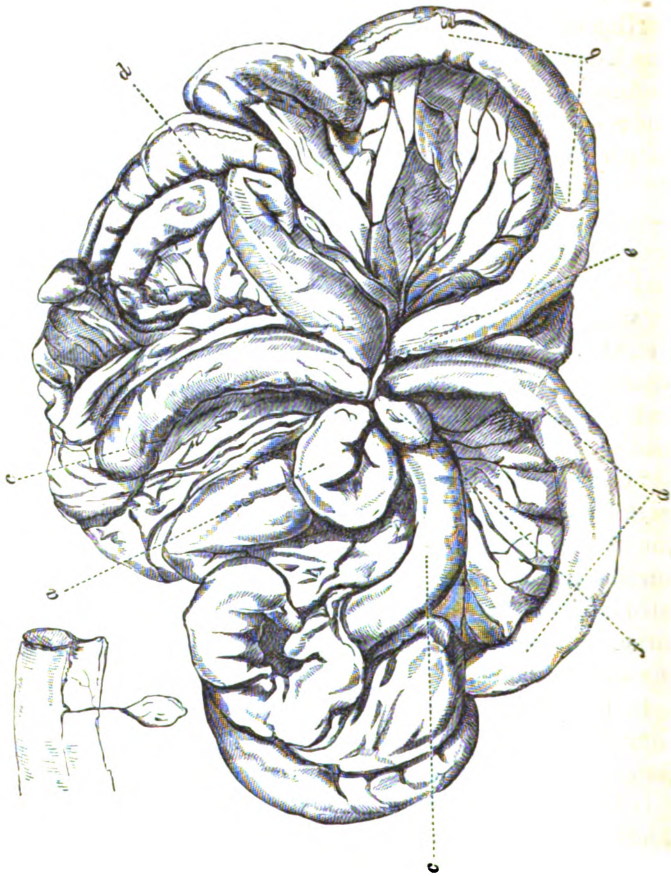

Fig. 105.

a.—The strangulated knuckle of intestines which, from stricture and obstructed circulation, had become green and gangrenous.

b.—The continuation of the portions of the ileum.

c c, d d.—Continuous portions of the same intestine (the ileum), also included within the stricture.

e.—The chord which formed the stricture.

f.—The fatty tumour hanging from the chord, which was in fact a hypertrophied epiploic appendix.

It is not easy to offer a satisfactory explanation of the origin of such tumours. The loose folds of mesentery at the attached margin of the intestine of the horse, which often contain an excessive accumulation of fat, become hytertrophied, and lead to the production of the growth, which drags the peritonæum, and becomes pedunculated.

Enteritis.—Inflammation of the Intestines.

As a general rule, when the intestinal tube is inflamed, the stomach is so also, and *vice versa.*

The horse is not very subject to inflammation of the intestine except as due to irritant poisons. The outer or peritoneal coat often becomes inflamed in cases of abdominal wounds, (see Peritonitis), but it is the mucous lining and muscular coat that are first and chiefly involved in true enteritis.

From the history I have given of colic, it will be observed that there are not sufficient grounds for the fears entertained when this disease is treated, lest it should terminate in intestinal inflammation. In fact, the substances which have been reputed irritant by some, and likely to excite inflammatory action, such as aloes and other purgatives, are really curative by producing a free secretion and relief of the congested vessels, whenever a cause is in operation giving rise to irritation and spasmodic pain in the bowels. But the poisons that I have mentioned as capable of inducing gastritis, are also those which induce inflammation of the intestine, and whether it be the pig poisoned with souse, or the horse and ox with arsenic, there are certain symptoms totally distinct from those of simple colic, which characterise the disease.

I wish, therefore, to be distinctly understood as regarding enteritis a very rare condition in the many cases believed to be inflammatory, which are usually attacks of spasmodic colic.

It is a morbid state, however, not unfrequently seen, especially as the result of poisoning in any of our domestic animals.

Symptoms.—In the horse the very general belief is, that more than usually severe colic, with persistent as well as violent pains, and the animal rolling on its back, &c., are the indications of an inflammatory attack, but these are certainly not usually the signs of true enteritis. In all our domestic animals symptoms of great constitutional irritation accompany and even precede any marked abdominal pain in enteritis. A small, frequent, hard pulse, rather strong in the early stages of the disease, but irregular and very indistinct in the latter, with irregular temperature of the body's surface, indicated by cold ears and extremities, &c., are amongst the leading general symptoms.

The visible mucous membranes are deeply congested, appetite lost, but thirst often considerable; there is usually constipation, though in many cases due to irritant poisoning, diarrhœa, and tenesmus are leading signs. The urine is scanty and high coloured. Colicky symptoms, not necessarily very severe, are observed, and there is great tenderness indicated in pressing the abdominal parietes. The animal's expression betokens persistent suffering, and danger of a fatal termination; the loins are rigid, belly tucked up, skin dry and tight on the surface of the body; the animal becomes listless, prostrate, lies down, and turns its eyes anxiously towards the flanks, and though it may attempt to rise, strength fails, and involuntary and apparently convulsive movements of the limbs are the last indications of a fast-fleeting life. The disease persists from twenty-four hours to a week, according to the severity of the attack. In favourable cases, about the third or fourth day, the free evacuation of urine, normal moisture of skin, regular defecation and comparative absence from pain, indicate the convalescent stage.

In cattle, the grinding of teeth, hot and dry mouth, tendency to tympanitis, and tenderness of the abdomen, with obstinate constipation in some cases, or very free and troublesome diarrhœa in others, constitute the leading features of the disorder.

In the pig there is great dulness, grunting, and other signs of uneasiness, besides a troublesome retching, and in the early stages a morbid appetite, which soon subsides. Ulceration of the intestines is not an unfrequent result of enteritis in this animal.

In the dog it is said that the signs of enteritis approach those of the dumb or paralytic form of rabies, but there are more severe symptoms of fever:—hot and dry nose, sharp and very frequent pulse, cold limbs, a dry skin, and arched back; tenderness over the region of the belly; and, as in all other animals, there is either obstinate costiveness or diarrhœa, according to the cause of the attack.

Post-mortem appearances.—These are unmistakeable, and it is no slight redness or turgescence of the large vessels, such as we find in fatal cases of simple colic, that may be regarded as characteristic cadaveric lesions of enteritis. The mucous coat is tumefied, of a very dark red colour, generally over a large extent of surface. The redness is first observed on the peritoneum, and, indeed, all the coats are involved, as indicated by the amount of exudation in their substance. I have seen, in a portion of intestine transmitted to me by a practitioner, the thickening attain nearly half-an-inch. I have seen not unfrequently a number of small ulcers in the small intestine of the dog, and the contents of the first portion of the canal especially of dark coffee colour, or tinged red, from blood extravasation.

Treatment.—Any irritant that may be present in the bowels must be removed by a purgative. In the horse, especially, no reliance is to be placed on the calomel and opium treatment in these cases. Copious draughts of linseed tea and enemata must follow a brisk aloetic purge. Should the purge be decidedly uncalled for by the symptoms, copious diluents must be had recourse to, and great benefit may be derived from counter-irritants, or hot fomentations to the abdomen.

In small animals, a warm bath, injections, and demulcents, such as mucilage or linseed tea, may be freely employed. In the event of poisoning, special antidotes have to be prescribed.

ENTERITIS EXUDATIVA.—*Entérite Couenneuse* OF THE FRENCH —*Croupartige Darmentzündung* OF THE GERMANS.

Under this name may be described a form of enteritis not uncommon amongst cattle, and which is characterized by the production of false membranes in the small intestine. It is sometimes acute, and at others chronic, commencing with symptoms similar to those of ordinary colic. Within a few days from the first symptoms, there is diarrhœa, and the fluid fœtid fæces contain shreds of lymph varying in length and thickness, but attaining sometimes the enormous dimension of twenty or thirty feet, and being often mistaken for worms. Usually, after the discharge of these membranes, the animals improve. Delafond* describes the symptoms as those of irritative fever, associated with slight colicky symptoms, which last for twelve or fifteen hours. The mouth is hot, muzzle dry, conjunctiva injected, respiration short and convulsive; pulse small, frequent, and soft; the vertebral column is very sensitive; belly tense, tender, and often tympanitic;

* *Receuil de Médecine Vétérinaire*, 1842, page 217.

the fæces at first hard and dry, become liquid and glary. These symptoms always increase in intensity until the fourth or fifth day, and so far the exudative enteritis differs in no respect from the simple inflammation of the intestine, but from the fifth to the sixth day, and rarely beyond the eighth in the exudative form, greyish false membranes are expelled, as already described. Recovery is generally prompt, after such expulsion.

Professor Lassaigne examined these membranes, and found that they were formed of a fibrino-albuminous matter, with mucous and alkaline or earthy salts.

The cases of '*moulten grease*' described by old authors, as observed in the horse and ox, are evidently cases of this singular affection. Indeed, I have seen shreds of loose, false membrane, discharged by the horse in cases of acute diarrhœa, and portions of such membrane have always been regarded as worms.

Treatment consists in an aloetic purge, or the use of sulphate of soda, sulphate of magnesia, or nitre, in doses of from 4 to 8 oz., repeated twice daily if the first two, or doses of one ounce of the last, at similar periods. Injections and sloppy gruel relieve and hasten convalescence.

PERITONITIS.

This disease consists in inflammation of the serous membrane which lines the cavity of the belly, and covers the organs contained within the latter.

Causes.—It is usually produced by wounds, and the greatest difference exists amongst our domestic animals as to the tendency to inflammation of the peritoneum. It is a very common cause of death from castration in the horse, and if any abdominal wound is inflicted in this animal, either in the performance of a surgical operation or by accident, death usually results in the course of four or five days. The ox and sheep are the least susceptible to it, and the pig and dog can also be exposed to the risk of abdominal operations more freely than the horse. As an idiopathic affection it is found in an acute and a chronic form. The peritoneum is involved in inflammation when any of the abdominal organs are affected with this disease, and sometimes independently.

Symptoms.—Tremors occasionally confined to the hind legs; appetite lost, though thirst sometimes great; pulse very frequent, hard, and wiry; respiration laboured and thoracic; nostrils dilated, with anxious expression of countenance; the animal looks round to its flank, and evinces colicky pains by pawing, crouching, &c. There is usually constipation, scanty discharge of urine. In most cases of traumatic peritonitis, the animal lies down about the third day, looks anxiously round to its flank, and dies usually within forty-eight hours from the time it first stretched itself on its side. I have seen these symptoms with abscess of the cord, in a colt after castration, and when I had amputated the cord above the seat of the abscess, the colt rose and appeared relieved, but sank a few hours after, the whole peritoneum being involved in inflammation.

Results.—Adhesion and sometimes effusion; more commonly death occurs when false membranes are found coating and fixing the intestine.

Treatment.—Purgatives, hot fomentations to the belly; Percival suggests a blister to the belly. Nitre may be given in the water the animal is allowed to drink. Injections should be perseveringly employed. Calomel and opium, aconite and other reputed antiphlogistics, have their advocates.

Dysentery—Colitis—Bloody Flux.

A very dangerous form of inflammation of the mucous membrane of the intestine, chiefly of the large, and attended with ulceration and hæmorrhage, receives the name of dysentery. It is a disease far more commonly seen in the ox than in the horse, and frequently observed in omnivorous and carnivorous animals. It is closely allied to severe forms of diarrhœa, though instances of the latter, such as the diarrhœa of suckling animals, are improperly termed dysentery, and believed to depend on inflammatory action. Dysentery is not unfrequently epizootic in different parts of the world, and may constitute one of the principal complications in a contagious fever, such as the steppe disease or contagious typhoid. In Great Britain it is chiefly seen as a sporadic affecting cows in ill-ventilated byres, &c.

Dysentery is observed in an acute and chronic form. Young and vigorous animals are most frequently affected with the first, and old worn-out animals with the last. The causes differ in the two cases, and active irritants or a blood poison produce the acute form, whereas the chronic is brought about by circumstances which lower the system or interfere with the function of some important emunctory, such as the skin or lungs. Bad food and exposure are powerful causes co-operating with others to induce this disorder. With regard to the horse, Mr Percivall says that the ordinary cause of dysentery is long sojourn in low, wet, marshy pastures, and that he once received a horse from Plumstead Marshes to treat, who was dysenteric, hidebound, lousy, and in a state of great debility.

I have witnessed this disease in the dog, especially in young animals tied to a dog kennel in some exposed situation, to watch a garden or house. In these cases there are general symptoms of fever, and fœtid black evacuations occur frequently, and are accompanied or succeeded by much hæmorrhage. There are griping pains, tucked-up appearance of the belly, and the animal's strength fails rapidly. I have observed that such cases are often fatal, and at all times difficult to treat. The abuse of tartar emetic, and exposure of animals after severe treatment with this drug, are also causes of dangerous forms of dysentery in the dog.

In the ox we find the symptoms as follows:—The acute form is attended with severe symptoms of general disturbance, often ushered in by shivering fits. The temperature of the body is very variable; the animal becomes hidebound and its coat stares; the back becomes slightly arched, and the loins are sensitive. The eyes are dull and occasionally the seat of discharge. The mouth is clammy, and the tongue furred and dirty-looking. The animal yawns and grunts, and at short intervals discharges a variable quantity of thin watery excrement and mucus, often tinged with blood. The straining is generally violent and distressing. The animal draws its limbs together, arches its back, extends its tail, and the anus appears sore and red. The urine discharged is often of a dark red colour. The amount of abdominal pain varies considerably; sometimes there is severe colic, and at others general tenderness. Gaseous distention of the paunch not uncommonly complicates the disease.

The constitutional symptoms are commonly those of a low typhoid disease. The animal is dull, emaciated, and suffers from thirst. An aphthous eruption in the mouth indicates the condition of the intestinal surface, where, in some cases, there are abscesses, and in others there is severe ulceration, whence blood is discharged. Unless by judicious treatment the symptoms are made to subside, they increase in severity, and in a fortnight from the commencement of the disease the animal dies. If the chronic type of the disease declares itself, the animal may linger on for a prolonged and indefinite period of time.

In the chronic cases the general symptoms are very severe, and faithfully enough pourtrayed by Youatt, who says: "The beast is sadly wasted—vermin accumulate on him—his teeth become loose—swellings appear under the jaw, and he dies from absolute exhaustion; or the dejections gradually change their character—blood mingles with the mucus—purulent matter succeeds to that—it is almost insupportably fetid—it is discharged involuntarily—gangrenous ulcers about the anus sometimes tell of the process that is going on within; and, at length, the eyes grow dim and sink in their orbits, the body is covered with cold perspiration, and the animal dies.

"In some cases the emaciation is frightful; the skin cleaves to the bones, and the animal has become a living skeleton; in others there have been swellings about the joints, spreading over the legs generally, occasionally ulcerated; and in all, the leading colour of the membranes, the rapid loss of strength, the stench of the excrement, and the unpleasant odour arising from the animal itself, announce the approach of death."

The post-mortem appearances of dysentery are:—Ready removal of the epithelium over the three first stomachs, which are usually pretty empty; the third may contain some solid food. The fourth stomach is the seat of reddish discoloration of its mucous membrane, which is occasionally œdematous, and at others the seat of exudation of lymph, which has been said to give to it the appearance of jelly. The small intestine, distended by fluid material, is occasionally injected, but often presenting no abnormal appearance. The cœcum, colon, and rectum are obviously inflamed. The mucous membrane red with abrasions or ulcerations, varying in extent, and sometimes perforating the intestine. In some cases abscesses exist in the submucous tissue. Ecchymoses, and even spots where sloughing is going on, are apparent in the large intestine.

Treatment.—In some acute cases of dysentery, advantage is said to have been derived from blood-letting. Greater reliance is to be placed in the use of mild aperients and emollient clysters. Calomel and opium, of each a scruple, given thrice daily for one or two days, has been attended with great benefit. The severe inflammatory symptoms having subsided, styptic and stimulating remedies, which act topically on the mucous membrane of the intestine, can be prescribed. Acetate of zinc, acetate of lead, and turpentine, all given in small doses rather frequently, and in large quantities of thin gruel and decoction of linseed, prove of service. Some veterinarians have obtained benefit from employing drachm doses of sulphate of copper. Alkalies and opium have been combined as follows for cases of dysentery in the cow:—

Solution of potash	1 oz.
Ipecacuanha wine	1 oz.
Powdered opium	1 dr.
Tincture of cantharides . . .	½ oz.

Mix and give in a quart of warm gruel.

Hertwig advise the administration of nitrate of silver in doses of eight or ten grains for the horse or ox, which may be given in about ten ounces of cold boiled water.

Chloride of lime, a drachm to the quart of water, proves beneficial; or the following prescription:—

Chlorinated lime	2 dr.
Tincture of arnica	2 dr.
Nitric ether	1 oz.

This may be repeated twice or thrice daily, being given in gruel.

Chalk, alone or combined with opium, has been much used, and with advantage when the acute symptoms are subdued. Other astringents, such as lime and catechu, have been employed; but, as a general rule, great care should be taken not to load the intestine with many medicines which are apt to irritate. Judicious diet is of great service in assisting an animal towards convalescence.

ENZOOTIC DYSENTERY.—WOOD EVIL.—MOOR ILL.—MELÆNA.—THE 'DARN' OF ABERDEENSHIRE.

From the peculiar discoloration of the urine, this disease has been regarded by some as chiefly implicating the kidneys, but it will be found in all well-marked instances that the bowels are primarily and principally affected. It is a disorder very widely diffused over Europe, and occurring on pastures, moors, or commons adjacent to woodland. The food these pastures afford may be rich or poor, but it always contains astringent plants in abundance, and at the period when the disease is most rife, viz., in the spring or early in the summer season, young shoots of oak or allied plants are greedily devoured, and produce the so-called wood evil. It is not, as I have elsewhere shown, due to any special poisonous plant, such as Lolium temulentum, or Anemone nemorosa, but to the astringent principles of many of the trees, &c., found in our woods. I have known cases to occur amongst young cattle in the spring, who greedily devoured the leaves of some oak trees that were felled adjoining a pasture on which the malady had never been seen.

Symptoms.—The animals become hidebound, costive, cannot urinate freely, secretion of milk stopped, and rumination is soon suspended. With loss of, or a morbid appetite, severe symptoms soon usher in, and a frequent hard pulse, which soon becomes weak, accelerated breathing, hot and dry mouth, yellowish-red colour of visible mucous membranes, great thirst, dulness and colicky pains, are characteristic of the disorder. The urine acquires a dark colour, and has a strong ammoniacal odour, it is tinged with blood, and any fæces that are evacuated are also coated with mucus and blood. Diarrhœa soon sets in as in ordinary cases of dysentery, with very offensive excrement, deeply tinged with blood. The animals moan, grind their teeth, and are stiff, with arched back though sensitive loins. Tympanitis, emaciation, coldness of the extremities, are all very manifest as death approaches. A fatal termination occurs usually about the second week, but in young well-fed cattle often much sooner. A return to health in fortunate cases is characterized by the gradual disappearance of all the symptoms, and a regular action of the bowels.

Special cases are characterized by the greater prominence of some symptoms, and occasionally the discharge of blood with the fæces is very abundant. Thus, in the *Veterinarian* for 1856, a gentleman, signing himself 'Caustic,' describes, under the head 'Melæna or Enterorrhœa in Cows,' some marked cases of moor ill or enzootic dysentery which occurred on a farm where the disease had been prevalent for three years, and the cows which 'Caustic' attended had been at grass about three weeks upon a peaty and, in some parts, badly drained field, and in the month of May. The following is the report of Case 1. The author says:—

"I was requested to attend a cow that had calved about three weeks. She had lived upon grass previous to the time of calving, was in fair condition, and quite well the previous evening. The following morning she gave but little milk and was purging. Upon my arrival, I found she had an exceedingly anxious countenance; the ears and horns were cold; the heart could be heard beating several yards off; the pulse at the jaw was exceedingly weak, numbering in the minute 74; the coat staring; the back arched; the skin tinged yellow; the rumen and omasum full. She voided frequently an immense quantity of liquid and coagulated blood, mixed with feculent matter of a dark brown colour; indications of vomiting showed themselves, and after several attempts, she succeeded in ejecting from the mouth matter similar to that passed *per anum*.

"In such a case as this, it was but too evident that what was to be done was to be done quickly; and having marked out my course, I immediately proceeded to put it into effect, which was first to throw several bucketfuls of cold water over her, then to cover her up with horse-rugs, and give the following draught:

℞ Ol. Lini, Ojss;
Pulv. Opii, ʒij;
Hydrargyri Chlorid., ʒss;
Pulv. Zingiberis, ʒij;
Ol. Juniperi, ʒiij. Misce.

This was followed in an hour and a half after, by—

Lini Oleum, Ojss, cum Terebinthinæ Oleum, ℥iv;

and small quantities of the latter were ordered to be administered several times during the day.

"At night I found her much better. A little dark, soft, offensive dung was being passed occasionally. After this, small doses of diffusible stimulants, combined with vegetable tonics, and a strict attention to diet, brought about a state of perfect convalescence in about nine days. This cow I had treated some months before for pleuro-pneumonia epizootica."

In the second case "the ears, horns, pulse, &c., were in the same condition as the first case. The action of the heart was so violent as to be heard at some distance, and at every beat it seemed to shake the whole frame. She purged an immense quantity of dark liquid, mixed with coagulated blood, &c., but she did not vomit." This cow died.

Of Case 3 'Caustic' says: "I was requested to see a cow belonging to my father; a remarkably large, good framed milking cow, five years old. She appeared well the previous evening; had been turned out to grass in the day time, and was tied up at night, being allowed good hay. I found her lying down, and I could scarcely get her to stand up for a moment. The ears and horns were cold; the pulse weak, 74 in number; the beat of the heart very loud; the first and third stomachs full and hard. She had not vomited, but had evacuated, with some difficulty, a little dark-coloured pitchy matter. I at once gave no hope of recovery, but being persuaded to try what I could do, I gave her a large dose of linseed oil with the oil of croton, combining a gentle stimulant, but she died five hours after I first saw her."

Post-mortem appearances.—The epithelium of the three first stomachs is readily detached, and the mucous membrane throughout the stomach and intestinal canal is of a dark red colour, infiltrated, and the seat of erosion. It is, however, in the large intestine that there are usually most marked signs of inflammation, ecchymoses, ulcers, &c.

Referring to the cadaveric lesions which occurred in Case 3, above-mentioned, 'Caustic' says:—

"The rumen and omasum I found filled to repletion with food. The true stomach, and the whole of the intestines, contained an immense quantity of matter similar to that I have before mentioned; and, strange and incredible as it may appear to those who have never witnessed it, I could pull from the intestines several feet of it without its breaking.

The mucous membrane was much inflamed, and had many dark patches resembling ulcers upon it, varying from the size of a sixpence to a crown piece. The liver was pale, and softened in texture."

Treatment.—A brisk purge is to be administered in the early stage. Injection of warm water must also be persevered with, and the animal must be allowed to drink as much as it wishes. The treatment by turpentine has many advocates. Saline or oleaginous purgatives have to be repeated two or three times in the majority of cases, and some advocate the solution of aloes, given to an adult ox or cow, in doses of seven or eight ounces. The hot-air bath and free ablution with cold water are to be recommended in this disease. If diarrhœa continues, the same treatment must be carried out as in common dysentery.

DIARRHŒA.

This is usually a symptom or consequence of disease rather than in itself a malady, and consists in the frequent discharge of liquid excrement without bleeding.

Causes.—There are three distinct kinds of diarrhœa. The first variety is dependent on some irritant which excites secretion, and the peristaltic movement of the intestine; the second is due to a blood-poison which nature attempts to eliminate by the intestinal mucous surface; and thirdly, there are cases of diarrhœa from derangement of the stomach, liver, and pancreas.

In the horse we find improper food, such as boiled roots and bran, potatoes, damp grass, and other similar causes, coupled with over-work and a special predisposition, produce the first form of diarrhœa. The second variety is observed in low types of influenza and other fevers; whereas the third is symptomatic of liver disorder.

Cattle are very subject to diarrhœa when placed on young soft pastures, and with sudden changes of diet. It is a symptom in epizootic diseases, such as pleuro-pneumonia and contagious typhoid, whereas it is seen in young animals of all kinds, when a dyspeptic state is induced from an artificial system of rearing, and the milk, unacted on by the gastric juice, passes into the intestine, and produces an active peristaltic movement and its expulsion.

Symptoms.—Frequent liquid evacuations, with discharge of flatus, considerable straining, scanty urinary secretion, impaired appetite, and occasional appearance of colicky symptoms. When an irritant is operating locally, the material which produces the disorder is usually to be detected in the excrement. If the stomach is inactive, alimentary matters, such as milk, pass unchanged: hence the name 'white scour' for diarrhœa in calves and lambs. There is always great fœtor, and a black condition of the fæces in blood diseases which give rise to diarrhœa. Sometimes preparations of iron, given with other astringents, occasion a peculiar form of diarrhœa, especially if a purgative is incautiously given to the animal receiving ferruginous tonics. The fæces are perfectly black, like ink, and very fetid. Such attacks are sometimes not easily checked. Should the pancreas not act, fatty matters are found in excess in the excrement.

Post-mortem appearances.—In the diarrhœa of young animals which proves so destructive amongst calves, and has been improperly designated gastro-enteritis and dysentery, there is no appearance of inflammation, and in the many cases I have examined, there were usually a peculiar pallor or indications of checked function in the fourth stomach and intestines. It is the mass of half-curdled milk in these organs, and the emaciated appearance of the tissues, which may be regarded as characteristic of diarrhœa in suckling quadrupeds. I have never seen thickening or exudations.

In adult animals the cadaveric lesions vary according to the immediate cause of the frequent alvine evacuations. Ramified redness or signs of determination of blood may be detected whenever an irritant operates locally, but this is often not more than the turgid condition of the intestinal mucous membrane when in active secretion. Disease of the liver, or of other parts of the digestive apparatus, may exist, as well as fluid and scanty contents in the intestine.

Treatment.—In all animals great advantage is experienced from the employment of warm water injections. It is true that purgative and medicated injections are frequently called for, but as a bland and useful aid to almost any kind of treatment, I must, in the first place, refer to warm water clysters.

Should any irritant be keeping up the diarrhœa, it should be expelled by means of purgatives, diminishing the food, and allowing the animal little to drink and little exercise. Purgatives must not be too much used in this complaint, and when the irritant substances supposed to exist in the bowels must have been expelled from the free action of a cathartic, it may be necessary to resort to the very opposite treatment of opiates and astringents.

In cattle, cases of simple diarrhœa are sometimes very difficult to treat, and unless the disease is simply due to a slight cause, such as a change of pasture, great benefit appears to have been derived, especially in the early stages of the disorder, from giving the following medicine:—

Calomel	1 dr.
Opium	1 dr.

In thick gruel, and repeated after forty-eight hours if the looseness is not checked.

In the horse we prefer a mild dose of cape aloes, but not to be repeated except at long intervals. A host of astringent preparations have been suggested. I here subjoin a few prescriptions for diarrhœa in the different domestic animals.

The following is a useful astringent for general purposes:—

Prepared chalk	1½ oz.
Catechu	2 dr.
Powdered opium	½ dr.
Powdered gentian	2 dr.
Water	10 oz.

This may be given in ale or gruel.

As a tonic astringent draught in cases of debility, and when the diarrhœa seems to be due to the animal's weakness, either of the following formulæ may be employed for the horse or ox:—

Tannic acid	½ dr.
Powdered gentian	1 oz.
Water	4 oz.

To be given in ale or gruel; or

Powdered angustura bark . .	1½ oz.
Sulphuric acid.	1½ oz.
Water	24 oz.

A wine-glassful of the above given three or four times daily in water.

Like purgatives, astringents may do harm if used in excess, and this I especially find in the diarrhœa of suckling animals. In these great benefit is derived from change of diet, or giving them a little milk frequently, and at the same time giving a tablespoonful of the common rennet such as is used in making cheese. The white of one egg in water or milk has a very desirable effect.

There are cases of chronic diarrhœa in horses and cattle that are benefited by mineral astringents, such as acetate of zinc or sulphate of copper. The latter is a very favourite remedy with some practitioners. When the fæces are very fetid, and the prostration very great, the following preparation may be tried:—

Chlorinated lime	2 dr.
Tincture of arnica . . .	2 dr.
Nitric ether	1 oz.

This may be given in cold water twice or thrice daily.

Alum whey is a very useful preparation, especially for small and weakly animals. It is prepared by boiling together for ten minutes half an ounce of alum and two quarts of milk; when strained a very useful agent is obtained, and may be given twice daily. Starch emulsion forms a very good material for clysters in diarrhœa, and thin wheaten flour gruel may be allowed to horses and cattle to drink.

Imperforate Anus.

This is a congenital malformation which is occasionally met with in all our domestic animals. I have seen a case in a bitch in which the anus appeared to be well formed, but closed by a continuous skin, and the fæces passed through the vagina. There was a congenital recto-vaginal fistula. More frequently a veterinary surgeon meets with cases in foals and calves in which symptoms of colic are very severe. On attempting to give injections, it is found that the fluid will not pass up, and at a short distance from the anus the rectum forms a pouch, and is not continuous with the alimentary canal. In other instances, the anus is closed, and the colon terminates in a cul-de-sac, there being no rectum at all. All these cases prove incurable, and are speedily fatal.

FISTULA IN ANO.

This troublesome affection has been only witnessed in the horse and ox. There are the so-called false fistulæ in ano, depending on disease of the pelvic bones; and the true fistula, which consists in a sinus formed beneath the anus on the side of the rectum, and in some instances opening into the latter; whereas in others it is blind, or terminating abruptly at the coats of the intestines. When there is a free opening from the rectum to the external surface the fistula is said to be complete, and when there is but one opening, and that cutaneous, the fistula is said to be a blind external one; whereas, in a few instances, though very rare in the lower animals, a blind internal fistula exists, that is to say, there is only an opening in the intestine communicating with the sinus. The false fistulæ in ano have always an external opening, and they may be detected by probing, when the grating of diseased bone is perceived.

The disease commences by the formation of an abscess in the angle between the rectum and ischium, and is usually due to injury. I have seen an instance in which the abscess extended along the side of the pelvis and destroyed the animal by pressure on the intestine, which induced obstruction. The pus descended through the inguinal ring, and produced inflammation on the inner surface of the thigh. I was called to this horse when too late to afford any relief, and after death about a gallon of pus was removed from the diffuse cold abscess. But in ordinary cases the abscess points, and discharges its contents through an opening close to the sphincter; and whereas the animal is very stiff during the development of the abscess, after it has burst the chief inconvenience arises from pains in the act of evacuating fæces, and at the same time the smearing of the tail and hind quarters with pus. A probe is necessary, as well as manual exploration of the rectum, to determine the nature of the fistula.

Treatment.—The only treatment consists in using the knife freely, dividing the sphincter ani, and then drawing the lips of the wound together. In the dog, especially, laxatives should be frequently administered whilst the animal is under treatment.

Dilatation of the Rectum.

I have witnessed in dogs subject to constipation, the accumulation of fæces in a dilated rectum to such an extent that all natural efforts failed to expel them. In the second volume of the *Edinburgh Veterinary Review*, at page 412, the following will be found:—"Adam observed in a six-year-old poodle and in an eight-year-old pointer, a very peculiar affection of the rectum. The appearances consisted in the dog attempting to void fæces, and straining violently, but without effect. The anus was observed protruded, and forming a round, hard swelling, and on examining the rectum with the oiled finger, a solid portion of excrement was found in it, which, in the one dog was fixed in a dilatation above, and in another below, the anus. From the existence of these pouches, fæces accumulated, grew hard, induced tenesmus, and the passage of other feculent matter was totally prevented. The treatment consists in allowing only soft food, no bones, giving oil occasionally, and removing the solid excrement by clysters."

As the abnormal dilatation favours the accumulation of excrement, I would suggest the use of astringents locally to diminish or overcome the deformity.

Prolapsus Ani—Exania.

This accident occurs in all domestic animals, and is seen, as Hertwig says, in three forms:—1stly, the rectum protrudes through the sphincter, and hangs behind the anus; 2ndly, the anus drops forward, and there is eversion of its mucous membrane; 3rdly, there may be only a portion of mucous membrance on one side protruding.

In the first form there is a decided eversion, and a red swollen intestine is observed to hang through the anus to the extent of an inch, five or six inches, or even a foot and a-half. There is great difficulty in replacing it, or pushing the finger through the opening. In the second form the eversion is deeper; and in the third, there is a chance of confusion with rectal polypi.

Causes.—Violent straining, especially in diarrhœa, tympanitis, or when worms produce great irritation. Prolapsus ani is not uncommon in cases of difficult labour, and is sometimes the result of back-raking, an operation which I am glad to have an opportunity of condemning. It is at best useless, and always dangerous. Exploration of the pelvic organs per rectum may be necessary, but the evacuation of the rectum by the hand is at all times superseded by injections.

Treatment.—The cause of the prolapsus must be overcome, whether it be diarrhœa, a fœtus in utero, or other removable agent. The rectum is replaced by the hand, and usually a strong dose of opium must be given to allay irritation. In cattle, any straining may be stopped by squeezing the back, or placing a surcingle round the body. Locally, warm water injections, and in some cases, injections of lead and opium lotion.

Returning the rectum is not always easy, and when the reduction has been effected the organ again protrudes. The local application of ice or an astringent wash, and the application of a truss, may be of some service. There are cases in which the protruded intestine has to be removed by freely amputating with the knife, and sewing the intestine to the margin of the anus by metallic sutures. Tubes and trusses have been made for the lower animals, but they are not readily applied, or of much practical utility when they can be placed conveniently.

HEMORRHOIDS.—PILES.

Most of our domestic animals are occasionally subject to tumours at the verge of the anus, and which consist in abnormal distention of the rectal or hemorrhoidal veins, or in a morbid development of skin or mucous membrane.

Symptoms.—In cattle, loss of appetite, suspended rumination, dulness, with stiffness of the hind extremities, and disinclination to move the hind limbs, both when standing or lying, are amongst the most marked signs of troublesome hemorrhoids. The tail is stiff and dry; fæces, tinged with blood, are found. The pulse is hard and full, secretion of milk checked, mouth hot, conjunctiva reddened, muzzle dry, anxious look and sunken eyes. The extremities and ears are cold, and the animal paws, yawns, and moans. Tumours of the mucous membrane are felt within the anus, which contain venous blood, and, on withdrawing the hand, it is found covered with blood. If the tumors are broken, coagula may be carried out with the hand, and the hemorrhoids disappear in ten or twelve hours, or severe symptoms occasionally result, with inflammation of the rectum, &c. A similar condition has been observed in sheep.

In the dog, hemorrhoids may be either within or outside the sphincter. They are very troublesome, but do not give rise to any febrile disturbance, and are connected with obstinate constipation.

Several veterinarians have recorded cases of hemorrhoids in the horse. Messrs Collins of the 16th Lancers* and Wells of Norwich† have recorded cases. A typical instance was contributed by Mr Holloway to the *Veterinarian* for 1856. The tumours were vascular, and discharged blood when the hardened excrement was voided with violent efforts.

Treatment consists in purgatives, cold water clysters, the use of food which will favour a relaxed state of the bowels, and opium suppositories.

HERNIA.

By hernia is meant the protrusion of any organ through an opening, whether natural or artificial. It is not necessary that the protruding viscus should find its way into, or form for itself a cavity, as in the case of hernia iridis, or protrusion of iris through the cornea. We commonly apply the term hernia to ruptures or displacements of portions of the intestinal tube, omentum, or other abdominal organ.

Herniæ are classified according to their position, as we shall see in describing the various kinds; but they are also distinguished into reducible and irreducible, and this depends on the circumstance whether the organ is capable of being replaced into its natural cavity or not. Both reducible and irreducible herniæ are apt to become strangulated, that is to say, the protruding organ may be constricted at the opening through which it has passed. Such strangulation is attended with great danger and very urgent symptoms, and may depend on three causes: firstly, Changes in the condition of the opening through which the organ passes; secondly, Descent of an additional portion of intestine or omentum into the hernial sac; and, thirdly, Change in the condition of the hernial contents, such as accumulation of fæces, congestion, &c.

* *Veterinarian*, 1849. † *Ibid.*, 1851.

So long as a hernia is not strangulated, the animal is but slightly inconvenienced by it, and internal ruptures are not recognised until producing obstruction to the course of the intestinal contents. Superficial herniæ are readily diagnosed by the character of the swelling, and the anatomical peculiarities of the lesion.

UMBILICAL HERNIA.—EXOMPHALOS.

This is not unfrequently congenital, and if not seen on the animal at birth, it usually occurs in the early periods of life, from the circumstance that the navel closes effectually in adult animals. Hertwig has seen it, however, in horses eight, ten, or twelve years old. It is most rarely seen in sheep and pigs, and consists in the protrusion of omentum or intestine through the umbilicus.

Symptoms.—It is the presence of a fluctuating tumour at the navel, varying much in size, and seen from the time of birth, or shortly after, that indicates exomphalos. We rarely have this hernia strangulated.

Treatment.—In some fortunate instances, the intestine is drawn into the abdomen as the animal grows, the mesentery being proportionately shorter in the adult as compared with the young animal. The only surgical interference of service consists in appropriate bandages, with a compress for the navel in very young animals, and, in severe cases of old standing, a pair of wooden clams must be placed tightly over the skin forming the hernial sac, whilst the animal is on its back, and the hernia is thoroughly reduced. A tight ligature round the neck of the hernial sac is often effectual.

INGUINAL HERNIA (Fig. 106.)

In stallions, and in young animals far more frequently than old, a fold of intestine passes into the inguinal canal, through

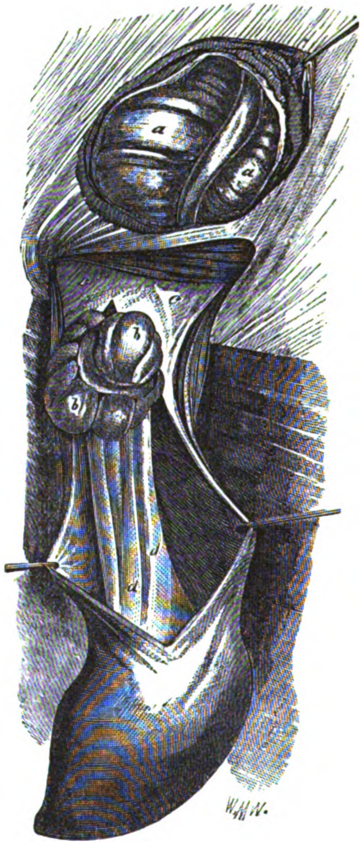

Fig. 106.—(GIRARD.)

INGUINAL HERNIA.—*a a*, portion of the colon continuous with *b b*, which is fixed in the inguinal canal; *c c* is the neck of the peritoneal sheath which is enlarged from the passage into it of the intestine; *d d*, tumefied portion of the spermatic cord.

which the spermatic duct passes from the testicle into the pelvis. It is an accident which continental veterinarians and practitioners in India meet with more frequently than we do in Great Britain, from the fact that stallions are not often used for working purposes in this country.

Symptoms.—Whenever a stallion is affected with symptoms of intestinal obstruction and severe colic, already noticed in describing the latter affection, it is the duty of the veterinary surgeon to cause a discharge of contents of the rectum by an injection, and then pass his hand into the intestine and feel the internal abdominal ring. The imprisoned intestine will easily be felt, should inguinal hernia exist. Retraction of the testicle on the side affected, cold sweats about the scrotum and thighs, looking anxiously round to the flank on the side affected, are all symptoms which aid in diagnosis.

Treatment.—By manipulation the incarcerated intestine is pushed back, and if not, the inguinal canal has to be opened by a small incision, and the reduction of the hernia affected through it.

Scrotal Hernia.

The inguinal canal soon becomes dilated in young animals, when intestine or omentum has passed into it. The scrotum then becomes the hernial sac, a circumstance which is not possible in man, from the complete separation between the peritoneal cavity and tunica vaginalis. As the two serous membranes remain continuous in the lower animals throughout the whole lifetime, part of the abdominal contents may pass into the cavity containing the testicle.

Symptoms.—In many cases, and especially in colts, calves, young pigs, &c., it is only when they are to be castrated that the lesion is discovered. The covered operation of castration has then to be performed. Fig. 107 shows the anatomical disposition of the parts. The hernia, especially in adult animals, may become strangulated from a violent strain, &c. Symptoms of severe colic and obstruction are noticed, as in cases of volvulus. The enlarged scrotum at once indicates the nature of the cause of suffering in these cases.

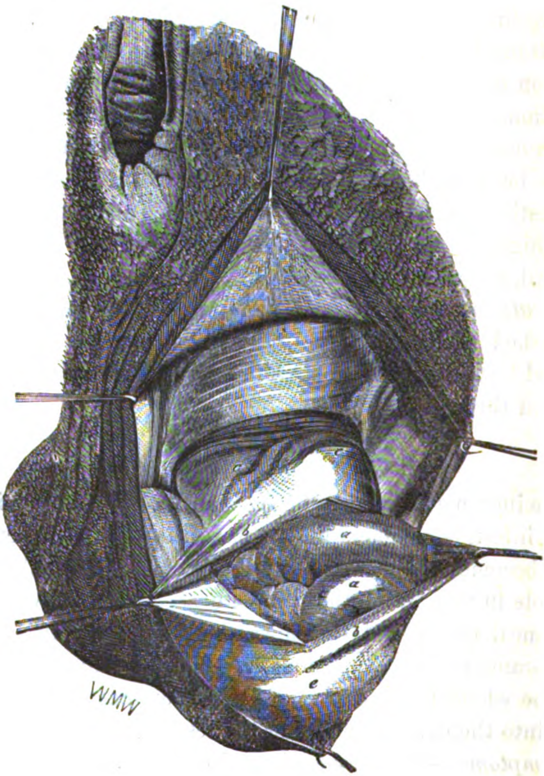

Fig. 107.—(GIRARD.)

SCROTAL HERNIA, showing at *a a* the fold of intestine in the scrotum; *c c* is the wall of the hernial sac; *e* represents the elevation of the tunical vaginalis produced by the testicle.

Treatment.—I must caution all, that when hernia is present drugs of any kind are very dangerous. An operation is indispensable, and in scrotal hernia the line of practice is to place the animal on its back, and by the taxis to return the intestine into the abdomen. When this is found impracticable, an operation has to be performed, which consists in dividing the constriction and castrating the animal by the covered operation.*

The first winter I was in Edinburgh, a remarkable case came under my observation. An aged gelding was seized with severe symptoms of colic, and a practitioner was called upon to treat it. He administered one of the antispasmodic draughts which I have before condemned. I happened to see the animal in pain, and, on examining it, found a scrotal hernia. In fact, I did not think the animal was a gelding until I had it cast, applied the taxis, relieved the animal, and saw that the horse was castrated.

Ventral Hernia.

This is an accident, which consists in the intestine protruding through an artificial opening in the abdominal walls, produced by violence. The size varies very greatly in different cases, and we rarely find that strangulation occurs. Ventral herniæ are rarely curable, except when recent; and I should recommend every practitioner called to an animal shortly after the accident, to cast at once, make a moderate incision into the hernial sac, and having pressed the intestine into the abdomen, introduce a number of strong metallic sutures through the muscular wound. Thus treated, the cases sometimes do well, however extensive the laceration may be. I do not advise compression, &c., as adhesion occurs between

* See the *Veterinarian's Vade-Mecum.* Second Edition

the intestine and hernial neck or sac, and a radical cure is afterwards impossible.

Mesenteric Hernia.

This is one of the internal lesions which cannot be distinguished from ordinary volvulus, intussusception, or other causes of strangulation of the intestine. After death it is found that a fold of intestine has accidentally slipped through a tear in the mesentery.

Gut-tie in Cattle.

This interesting lesion occurs in certain districts, and especially in countries where oxen are worked in the plough. It has been erroneously considered as a ligature of the intestine by the spermatic cord, which is left long in castrating, by pulling out the testicle after an incision in the scrotum.

The nature of the lesion has been well described by the German veterinarians. It consists in protrusion of intestine through a laceration of the peritoneum into a cul-de-sac between the remnant of the spermatic cord and the margin of the pelvis. It is indicated by severe abdominal pain, and is recognised at once by the practitioners who often meet with cases in the districts where it is observed.

Treatment.—It is possible to have a spontaneous cure by turning the animal sharply on its back, or suddenly elevating its hind quarters by causing it to leap off a step. If this fail, the hand must be passed up the rectum, and reduction effected by pushing with the palm upwards and forwards, so as to lift the imprisoned fold through the opening. In cases that resist even this method, an incision is made into the flank, and the intestine is withdrawn from confinement by passing the hand into the abdomen. The abdominal wound is then sewn up, and the cases do remarkably well.

Phrenic and Omental Hernia.

These are lesions due to violent efforts, and occurring during the struggles in attacks of colic, &c. The first consists in rupture of the diaphragm, and protrusion of the intestine into the thorax, and the other consists in passage of a fold of gut through the foramen of Winslow and the omental sac. They are incurable lesions. I shall hereafter have occasion to notice Ruptures of the Diaphragm.

Diseases of the Liver.

There are many diseases of the liver in the lower animals which are not recognised during life, and some that are symptomatic of constitutional disturbance. Thus, we find the livers of cattle slaughtered for human food frequently the seat of organic lesion, never suspected during life, and in other instances we have symptoms of general anæmia and dropsy, which, on a post-mortem examination, prove to have been connected with hepatic disease, though no sign during life would have indicated that this organ was more especially implicated. We have here to deal with disorders of the liver as a secreting organ, and at a future time we shall indicate some blood changes dependent on a disturbance in the blood-forming process carried on in the liver.

Jaundice.—Icterus.

It is rare to see attacks of jaundice in animals, except in dangerous fevers, such as distemper in the dog, or contagious typhoid in cattle. There are, it is true, some cases due to hepatic inertia, which may merit the simple name of jaundice, but commonly this must be regarded as a symptom.

The immediate cause of jaundice has given rise to considerable discussion. It is declared by some as probable that, even in a state of health, all the bile formed in the liver does not pass into the bile ducts, but that a portion of it enters the hepatic veins, along with the sugar; the quantity which thus enters, varying with the distribution of the blood in the gland, and with the relative degrees of pressure exerted by the contents of the veins, and of the minute bile ducts upon the secreting cells, being largest, when the pressure on the sides of the veins is least, and when that on the ducts is greatest. The biliary acids which thus enter the blood, or which are re-absorbed from the intestines, are supposed to undergo certain changes from oxydation, and may thus account for the large quantity of taurine which has been found in the healthy lung, and for the pigments which are naturally voided in the urine. When, however, anything interferes with these normal metamorphoses in the blood, as when this fluid becomes contaminated by the purulent infection, or by any other poison, it is supposed, that the complete metamorphosis of the colourless bile into urinary pigments is arrested, and that the intermediate substance, bile-pigment, is formed in the blood, so as to colour the various tissues and secretions.

Kühne has studied this question, and does not believe that the biliary acids are changed in the blood into bile-pigment, but shows that blood-pigment is changed into bile-pigment, under the influence of the biliary acids. By adopting the method of Hoppe, he was able to determine constantly the presence of the biliary acids in the urine of persons suffering from icterus, as well as in that of dogs whose biliary ducts had been tied. When dog's bile, or solution of the biliary acids, was injected into a vein, bile pigment and the salts were detected in the urine. Even in large quantities of healthy urine no biliary acids could be found.

Symptoms.—When jaundice occurs as an idiopathic malady, it is detected by the yellow colour of the visible mucous membranes and the skin. There is usually loss of appetite, a slimy furred tongue; dry, hard dung covered with mucus. The digestive organs are most disturbed, and the colouring principles of bile are discharged by the kidneys, as proved by the manner in which it tinges paper when dipped in the urine and dried. If jaundice is not relieved, the animal completely loses its appetite, becomes anæmic, its limbs are occasionally œdematous, and the temperature of the body becomes very low. These symptoms often continue, notwithstanding active measures being directed for their removal.

Post-mortem appearances.—In cases of jaundice which terminate fatally, the gall-ducts are found indurated or obstructed by gall-stones, hydatids, abscesses, or other enlargements which form on them.

The *treatment* of jaundice consists in the internal use of aloes and saline purgatives. After these, if jaundice continue, a dose of calomel may be given, but perhaps greater reliance can be placed in continuing with neutral salts, such as nitre and sulphate of soda, in two or four ounce doses daily. Turpentine in linseed tea, either alone or combined with aloes, has been recommended, besides the external use of rubefacients. Clysters prove of great service in the treatment of this disease.

Hyperæmia, or Congestion of the Liver.—Hæpatirrhœa.

Heat, good feeding, and inactivity, are great causes of hepatic derangement. In all animals, as in man, this is observed, though in the latter the use of alcoholic beverages, besides other circumstances incidental to a very artificial mode of living, favour materially congestion and other diseases of the liver.

The pampered horse is, however, subject to maladies of this organ to no small extent.

There are instances of liver disease in the horse of peculiarly insidious origin, and indicated by a state of obesity, pallor, and occasional yellowness of the mucous membranes, dulness, and very sleek skin, with occasional attacks of lameness in the off fore-leg. Pulse soft, rather weak and slow, numbering about 28 per minute.

Over-exertion or excessive repletion of the stomach, may give rise to colicky symptoms, or to more dangerous indications of internal hæmorrhage. The animal falls, rolls, sighs, and breathes heavily, looking round to the right side, and suffering from intense cold ears and limbs. The eyes are blanched, pupils dilated, anxious expression of countenance, pulse small, and very frequent. The animal is restive, and discharges a scanty quantity of high-coloured urine. Its breath is fœtid, tongue furred, and mouth clammy. In some cases the paroxysms are not so severe as to cause animals to faint, and a horse may stand propping himself up by the side of the stall, or if moved, has a staggering gait, and manifesting most of the above-mentioned symptoms.

Post-mortem appearances.—In the early stages the liver is not changed in form, but is bulky, of a uniform, or in some cases, irregular dark reddish-brown colour, and distended with blood. Not unfrequently in the horse we observe good specimens of 'nutmeg liver,' in which there is an appearance of congestion in patches within the tubules, and surrounded by grey, or lightish-brown liver tissue. This light colour is due to fatty degeneration of the cells, which are swollen, and compress the capillaries. When the disease is further advanced, there are patches of deep red colour, where some capillaries have given way, and the effused blood is in process of disintegration and absorption. Very fine crystals of hæmatine are obtained from these extravasations. Sometimes the liver is broken up in parts, and the finger lacerates its tissue on the slightest pressure. So long as the Glisson's capsule remains intact, the hæmorrhages are not fatal, but when, after a succession of paroxysms, a fatal bleeding supervenes, we find, in addition to the above post-mortem signs, an effusion of blood in the abdomen, a large rupture in the liver, and a pallid condition of the whole body. The heart is frequently the seat of fatty degeneration, and the deposits of fat over the body are very extensive.

Pathology.—It is probable that fatty degeneration of the heart and a languid circulation predispose to congestion of the liver. This organ, under the influence of heat, the rapid accumulation of fat, and unduly taxed by the rich food which the animal is allowed, is affected with hyperæmia, congestion, and fatty degeration, predisposing to hæmorrhage and ruptures such as we have described.

Treatment.—Hygienic rules should be obeyed as to food, exercise, and ventilation. Aloetic purgatives may be occasionally given. Bleeding should be avoided. It is during the paroxysms that we are often called upon to treat, but we can do little good except keep the animal quiet, give cold-water clysters, apply pounded ice and salt to the region of the liver, and dash cold water on the body. Mr John Field recommended the administration of the following—

Copaiba	1½ oz.
Linseed tea	12 „

This may be repeated.

The following may also be of great service—

Dilute sulphuric acid	4 oz.
Compound tincture of cinnamon .	4 „

One or two tablespoonfuls in a quart of water every three or four hours until the animal rallies. Preparations of ammonia and stimulants in general should be avoided. Sulphate of iron may be given in food when all severe symptoms have subsided, but should be continued in drachm doses only two or three days.

The disease is very refractory, and as the paroxysms increase in frequency and severity, the animal's life is in imminent danger.

HEPATITIS.

Röll very justly remarks, in his able work on Pathology, that this is a most rare disease affecting our domestic animals, and the cases that are diagnosed as hepatitis should in all probability be regarded as simple hyperæmia or congestion of the liver—indeed, the disease that we have last considered. The same author remarks that he has hitherto only seen a few instances of hepatitis in the horse. The inflamed portions of the liver were found of a yellowish or reddish-grey colour, very soft, and interspersed with yellowish points of suppuration. The hepatic parenchyma surrounding these spots were congested, and the peritoneal covering opaque. Mr John Field records a case of abscess in the liver, and says:—

"*September* 15*th*, 1823.—A bay gelding, belonging to Mr P——, died on the above day, and upon examining the body, it appeared that an abscess had formed in the right lobe of the liver, just under the peritoneal coat, at the anterior part of the organ: the coat under which the abscess formed adhered firmly to the diaphragm. The abscess contained 29 lbs. of thin brown pus. The animal had been ailing and wasting for a considerable time before, and was occasionally unfit for work. The first acute inflammatory symptoms took place about three weeks previous to his death: the pulse was not frequent, but the symptoms were all those of sub-acute inflammation of the pleura."

In another instance, on examining the liver, which was extremely high-coloured and in some parts tumid, there were found throughout its substance collections of pus, from the size of a pea to that of a hen's egg. These collections did not form at regular distances, but had more or less of the substance of the liver between them.

Metastatic abscesses, which are the result of a constitutional tendency to the production of pus in different parts of the body, are frequently seen in the liver, but we shall allude to this variety under the head Blood Diseases.

I have had occasion to examine livers both of the ox and horse, in which the peritoneal surface was considerably thickened, and consolidation of the substance of the gland had occurred to some depth. In some instances, and not rare in old cows, a circumscribed abscess has been discovered surrounded by dense layers of plastic lymph, having undergone a partial organization. Röll particularly notices these collections of pus in 'capsules with thick walls' (dickwandigen kapseln) which have resulted from an attack of hepatitis.

In hot countries, inflammation of the liver is said sometimes to assume an epizootic form, especially about the end of the summer. It is almost always connected with inflammation of other abdominal organs; after death the liver is found congested, of a greyish-red colour, and weighing from 40 to 50 pounds. In addition to ordinary symptoms, there is irritation of the skin. Lessona describes such an epizootic as having occurred in Italy, in 1827.

There is no animal declared to be more frequently affected with hepatitis than the dog, and probably because jaundice is frequently observed in this animal.

Symptoms.—As Janosch correctly states, there is no disease more difficult to recognise than hepatitis. It seldom occurs as an acute affection, and mostly in a chronic form. Animals affected with this disease are dull and listless; indicate no severe pain; respiration is not thoracic, but almost entirely abdominal; the skin is harsh, dry, and coat staring. The visible mucous membranes have a reddish-yellow colour, and the tongue is furred and dirty. Pulse is small and frequent, but irregular both as to number and character. In some instances it is remarkably slow. The fæces are hard, and often coated with mucus, and when the disease advances the symptoms of jaundice are most marked. In acute liver disease, from a check to the secretion of bile, the excrement becomes white, clayey, and very fetid. The febrile symptoms are sometimes severe, if the peritoneal coat is much implicated, and subside when the abdomen enlarges from effusion. Should dropsy thus result, the animal becomes emaciated, and dies within a few weeks.

Treatment.—I do not agree with the recommendation given by Mr Percivall to bleed repeatedly, abstracting, however, small quantities in this disease. Cathartics, and especially aloes, must be relied on, and followed up by frequent doses of nitre. The right side must be blistered, and, if acute symptoms are absent, the following may be prescribed:—

Hydrochlorate of ammonia . .	2 oz.
Sulphate of soda	8 oz.
Powdered linseed	4 oz.

Treacle as much as sufficient to make an electuary. A tablespoonful every two hours.

Parasitic Diseases of Liver.

The fluke—distoma hæpaticum—infests, to a very great extent, the liver of cattle and sheep. I shall enter into the history of this parasite when I refer to disorders of Nutrition, and in the description of Rot in Cattle and Sheep.

Echinococcus veterinorum, a hydatid, which may be found in any of the internal organs, also frequently infests the liver.

Biliary Calculi.

Gall-stones are very commonly met with in the ducts of the liver. They vary in size from a pin's head to a pigeon's egg. I have only seen one as large as the latter, and that from a horse. Sometimes a deposit forms on the inside of

Fig. 108.

the gall-ducts, especially when these have become dilated from the presence of flukes in them (see Fig. 108.) These casts of the gall-ducts are found by Dr Thudichum to be composed of cholocrome (colouring matter of bile) precipitated in a granular form.

It is chiefly in the ox that gall-stones are discovered, and they are made up of cholocreme, with cholic acid, phosphates, and carbonates of lime and magnesia.

Unpleasant symptoms only arise when the gall-stones are passed through the ducts and become fixed by the spasmodic action of the latter. The pain they induce is very severe, but the true cause of the suffering is never diagnosed in the lower animals. Jaundice, attended with pains at intervals, may turn our attention to the liver.

Aloetic purgatives must be given in such cases, besides the use of alkaline salts, phosphates, according to Dr Thudichum, and chloride of sodium.

Diseases of the Pancreas.

The pancreas is an organ doubtless often functionally disturbed, and the absence of its secretion impairs digestion, and gives rise to a form of diarrhœa in which fatty principles are in excess in the excrement.

Organic disease is not often discovered in this organ, but cancerous deposit, abscess, melanotic matter, &c., have been found in it.

Pancreatic Calculi, or small white concretions, varying in size from a millet seed to a common pea, are often found in large numbers in the pancreatic ducts of cattle after death, but I am not aware of any symptoms during life whereby their presence may be recognised.

CHAPTER VI.

ORGANS OF CIRCULATION.

Circulatory apparatus—The heart, its shape and position.—The pericardium, its structure.—Auricles and ventricles.—Valves of the heart.—Bone of the ox's heart.—Chordæ tendineæ.—Endocardium —Semilunar valves.—Eustachian valve. — Foramen ovale.—Muscular fibres of the heart.—Dr Pettigrew's researches.—Arteries, capillaries, and veins.—Action of the heart.—William Harvey.—Sounds of the heart.—Circulation in the blood-vessels.—The pulse.—Capacity of the arteries increased by subdivision.—Forces inducing the blood's flow.—Rapidity of the circulation. — Professor Hering's experiments.—Vierordt's conclusions.—Dr Dalton's diagram of the circulation.—General disturbance of the function.—The pulse.—Where felt, in the horse, ox, and smaller animals.—The pulse in disease.—Its varieties.—The pulse not sufficient to indicate the propriety of blood-letting.—A word of caution.—Heart disease. — General symptoms. — Palpitation, anæmic, dyspeptic, and nervous.—Rupture of the heart—Of the vena azygos.—Congenital malformation of the heart.—Ectopia cordis.—Pervious foramen ovale or cyanosis.—Hypertrophy of the heart.—Atrophy.—Dilatation.—Ossification of the heart.—Fatty degeneration.—Tumors of the heart.

THE principles which are dissolved in the process of digestion, and fitted for the purposes of nutrition, circulate throughout the system, modified or unmodified, in the blood. The blood-vessels, through which the vital fluid is propelled by a muscular organ, the heart, constitute the vascular or circulatory apparatus. From the heart the blood passes into channels, which, from being almost invariably empty immediately after death, were believed by the ancients to contain air; they are the arteries which subdivide into very minute vessels of hair-like fineness—the capillaries; the latter in their turn join or coalesce so as to form the veins, through which the blood passes back to the heart. Every animal may be compared to a sponge for its porosity, and is saturated by liquid blood, which runs a definite course in accordance with the disposition of vessels, and a propelling organ, the heart.

THE HEART.

Usually described as a hollow muscle or a saccular organ, provided with muscular walls, the heart is in reality a modification of the vessels at a definite spot, to ensure a regular action, whereby the blood is impelled in the circulatory apparatus. Its position is constant, just like the position of the stomach, liver, and other important viscera. It is somewhat regularly cone-shaped, with the base upwards, connected by blood-vessels with the spine, and the apex downwards and backwards. In man it is situated in the left side of the chest, but in quadrupeds it is as nearly as possible in the centre of the chest, though its impulse is felt on the left side from the rotatory movement of the organ in action. Thus lodged in the thorax, between the lungs, it is enclosed in a special sac—pericardium—which is continuous above with the large vessels, and attached below to the sternum or brisket. The sac is composed of a dense fibrous membrane, lined by a delicate serous tunic which is reflected over the heart. Its relation to the latter organ has been compared to the manner a double night-cap covers the head. The inner layer is firmly adherent to the heart, the outer layer to the fibrous sac, and there is an intervening space—pericardial cavity—in which a little liquid or vapour constantly exists. The serous membrane is smooth, and covered by delicate epithelial cells. (Fig. 109.)

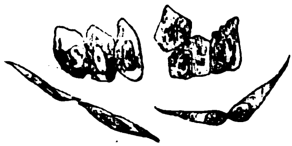

Fig. 109.—Tesselated epithelium from pericardium of sheep. Fusiform cells are shown, such as are constantly seen, especially in young animals.

On examining the heart when removed, with its large vessels, as seen in the annexed Figs. 110, 111, it is found divided

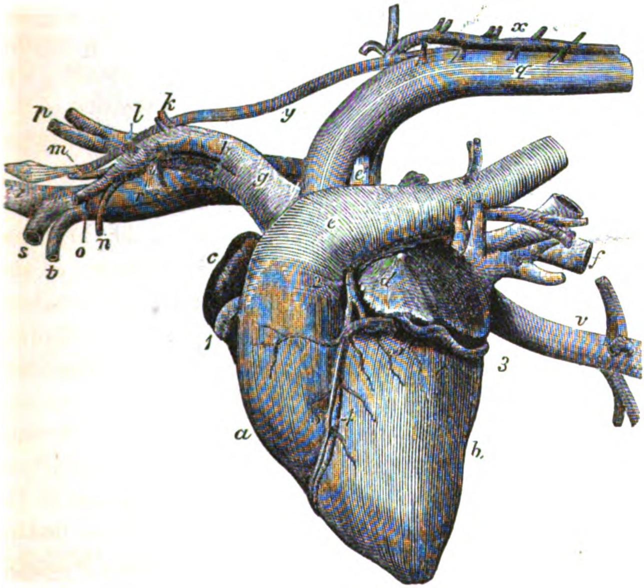

Fig. 110.—(CHAUVEAU.) The heart and principal vessels, seen from the left side; a, Right ventricle; b, left ventricle; c, right auricle; d, left auricle; e, pulmonary artery.

e′, ductus arteriosus obliterated; *f*, pulmonary veins; *g*, anterior aorta; *h*, left axillary artery; *i*, right axillary branch; *j*, origin of the dorsal artery; *k*, of the superior cervical; *l*, of the vertebral; *m*, of the inferio-cervical; *n*, of the internal thoracic; *o*, of the external thoracic; *p*, carotid arteries; *q*, posterior aorta; *r*, anterior vena cava; *s*, trunk of the axillary vein; *t*, of the internal thoracic vein; *u*, the dorso-cervical; *v*, posterior vena cava; *v′*, opening of the large hepatic and phrenic veins, *x*, azygos vein; *y*, thoracic duct; 1, right coronary artery; 2, left coronary artery; 3, auriculo-ventricular branch of the last; 4, its ventricular division; 5, cardiac vein.

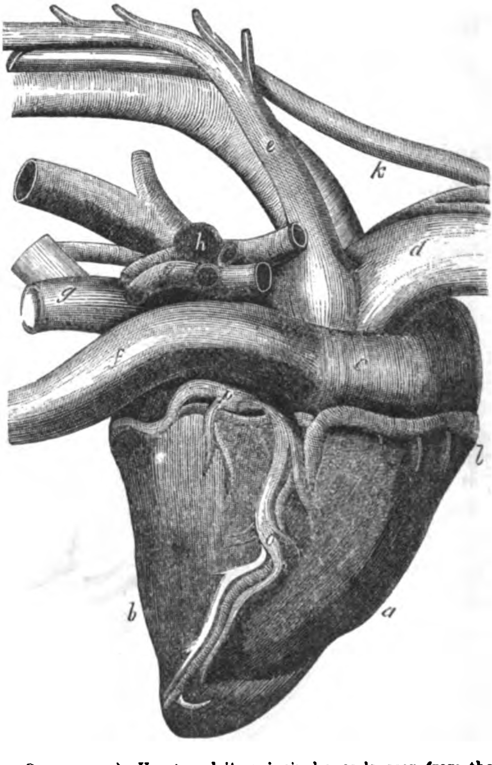

Fig. 111 —(Chauveau.) Heart and its principal vessels, seen from the right side. *a*, Right ventricle; *b*, left ventricle; *c*, right auricle; *d*, anterior vena cava; *e*, azygos vein; *f*, posterior vena cava; *g g*, pulmonary veins; *h h*, divisions of the pulmonary artery; *i*, posterior aorta; *j*, anterior aorta; *k*, thoracic duct; *l*, right coronary artery; *m*, its vertical or ventricular branch; *n*, its horizontal or auriculo-ventricular branch; *o*, ventricular branch of the coronary vein; *p*, auriculo-ventricular branch of the same.

into a right and left portion by a furrow, in which are the arteries and veins of the heart, and corresponding to the position of the external septum or dividing wall, which completely separates the right from the left cardiac cavities. The explanations to the above cuts will furnish the reader with the names of the parts represented, and it will be found that *c* and *d* are the right and left auricles, which are situated at the base of the heart, and separated by a circular furrow from the right and left ventricles, *a* and *b*.

The auricles, so called from the projection on which the letter *d* is marked in Fig. 110, and which has been compared to the flapping ears of a dog, receive the blood from the veins, and constitute the venous portion of the heart, whereas the ventricular section is also termed the arterial, from its connection with the pulmonary artery and aorta.

If a section of the heart is examined, it is found that the auricles and ventricles communicate freely, and the auriculo-ventricular openings are provided in the left side with a two-flapped valve, which has been compared to a bishop's mitre, hence termed *mitral*, and in the right side the valve is three-flapped or tricuspid. The flaps which form these valves are connected with a tendinous ring between the auricles and ventricles. This ring is partly cartilaginous in the horse, and in the ox it contains bone.

Fig. 112.—(LEYH.) Bone of the ox's heart, natural size. *a*, The anterior angle; *b b*, the posterior angles; *c*, the upper border; *d*, the lower border; *e*, the posterior border; *f*, the right surface.

Each flap of the auriculo-ventricular valves is provided with tendinous cords—chordæ tendineæ—which are attached to the free margin and under surface, so as to keep the valves tense when closed, a condition which is produced by the shortening of muscular pillars—musculi papillares—with which the tendinous chords are connected. The inner surface of the heart is covered by a serous membrane—endocardium, which is smooth and glistening, being firmly adherent to the muscular structure of the organ.

The arterial openings, both on the right and left side, are provided with three-flapped semilunar valves, to prevent the regurgitation of blood. The veins opening into the auricles are not capable of closure, but the posterior vena cava has an imperfect flap—eustachian valve—at its aperture. There is one more point that I must particularly notice in the construction of the heart. In fœtal life the two auricles communicate by an opening—foramen ovale—which becomes closed immediately after the animal's birth. Its position can be seen in the heart of the oldest animals from a depression and circular fold which constitute the remnant or vestigium foraminis ovalis.

It is important to inquire into the arrangement of the muscular fibres, whereby the peculiar rythmic action of the heart for the propulsion of blood is produced. Until recently the subject was involved in much mystery, but a distinguished student of the Edinburgh University—Dr Pettigrew—has satisfactorily explained it, and was called upon, in 1860, to deliver the Croonian Lecture at the Royal Society of London. I may be permitted to quote from the abstract of the lecture published in the Royal Society's *Proceedings:*—

"The Lecturer began by referring to the descriptions of the arrangement of the ventricular fibres of the heart given by previous inquirers, more especially Lower, Senac, Wolff, Gerdy, Duncan, and Reid; he then proceeded to give an account of the results of his own investigations, which had been conducted on the hearts of the sheep, calf, deer, ox, horse, &c., all of which, he observed, bear a perfect resemblance to the human heart.* In order, as much as possible, to evercome the difficulties of the subject, he availed himself of drawings, explanatory diagrams, and models illustrating the course and relation of the fibres, To these last, however, he observed, he attached no special importance, further than that they were useful vehicles of communication; and it was to the dissections themselves, some of which were before the Society, that he looked for a corroboration of the statements he advanced.

"Commencing with the left ventricle, which he believes to be the typical one, the Lecturer stated that, by exercising a little care, he had been enabled to unwind, as it were, its muscular substance, and so to separate its walls into several layers,† each of which is characterised by a difference in direction. Seven layers, at least, can be readily shown by dissection: but he believes they are in reality nine; viz., four external, the fifth or central, and four internal. He explained how the external fibres are continuous with the internal fibres at the apex, as was known to Lower,‡ Gerdy,§ and others, and how the fibres constituting the several external layers are continuous with corresponding internal layers likewise at the base;‖ a fact to which the Lecturer drew particular attention, as being contrary to the generally received opinion, which is to the effect that the fibres at the base are non-continuous, and arise from the auriculo-ventricular ten-

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* Dr Pettigrew's researches include also the arrangement of the fibres in the ventricles of the bird, reptile, and fish.

† Senac (*Traite de la Structure du Cœur*, &c., [Paris, 1749], planche 8), figures four layers; and Searle (*Cyc. of Anat. and Phys.*, art. "Heart," speaks of three.

‡ *Tractatus de Corde*, &c. London, 1669.

§ *Recherches, Discussions et Propositions d'Anatomie, Physiologie*, &c. Paris, 1836.

‖ The late Dr Duncan, jun., of Edinburgh, was aware of the fibres forming loops at the base, but seems to have had no knowledge of the continuity being occasioned by the union of corresponding *external* and *internal* layers, or that these basal loops were prolongations of like loops formed by similar corresponding external and internal layers at the apex—a point which the Lecturer believes he is the first to establish.

dinous rings, which, as he showed by numerous dissections, is not the case.

"Coming next to the question of the direction of the fibres, he showed how there is a gradational sequence in the direction of the fibres constituting the several layers. Thus the fibres of the first layer are more vertical in direction than those of the second, the second than those of the third, the third than those of the fourth, and the fourth than those of the fifth, the fibres constituting which layer are transverse, and run at nearly right angles to those of the first layer. Passing the fifth layer, which occupies the centre of the ventricular wall, and forms the boundary between the external and internal layers, the order of things is reversed, and the remaining layers, viz., six, seven, eight, and nine, gradually return to the vertical in an opposite direction, and in an inverse order. This remarkable change in the direction of the external and internal fibres, which had in part been figured by Senac, and imperfectly described by Reid,* as well as other detached and important facts ascertained by himself and others—such as the continuity of the fibres at the apex and base, already adverted to—he suggested might be accounted for by the law of the double conical spiral, which he proceeded forthwith to explain.

"The expression of the law, as he conceives it, with reference to the arrangement of the fibres in the ventricle, is briefly the following. By a simple process of *in*volution and *e*volution, the external fibres become *internal* at the apex, and *external* again at the base; so that whether the fibres be traced from without inwards, or from within outwards, they always return to points not wide apart from those from whence they started. In order to illustrate the principle of the double conical spiral in the above sense, he took a sheet of net, through which parallel threads of coloured wool, representing the individual fibres, were drawn at intervals; and laying it out on the table before him, with the threads placed horizontally, seized it by the right-hand off corner, and rolled it in upon itself (*i. e.* towards his own body) seven turns, so as to produce a cone whose walls consisted of nine layers.†

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* *Cyc. of Anat. and Phys.*, art. "Heart." London, 1839.

† A sheet of paper with parallel lines drawn upon it will answer the purpose equally well, except that its non-transparency precludes our seeing the external and internal spirals rolled the one within the other when the sheet is fashioned into a cone and held against the light, as the Lecturer recom-

On gradually unwinding the walls of the cone thus fashioned (which is tantamount to undoing the spirals), so as to imitate the removal of consecutive layers from the walls of the ventricle, he finds that the gradation in the direction of the several layers just specified is distinctly marked; and that these layers, as was exhibited in various dissections, find a counterpart in the ventricle itself. Thus (the heart being supposed to be placed upright on its apex) in the first external layer the threads are seen running from base to apex, and from left to right,* almost vertically; in the second layer they are slightly oblique; this obliquity increases in the third, and still more in the succeeding layer, till in the fifth or central one the direction of the threads becomes transverse. After passing the central layer, the direction of the threads (as of the fibres) is reversed; in the sixth layer they begin to turn from *right* to *left*, with a certain inclination *upwards;* and in succeeding layers gradually become more and more vertical, until the innermost, or ninth, is reached, in which they become as vertical as in the first, but are curved in an opposite direction.

"As a necessary consequence of this arrangement of the fibres, the Lecturer showed that when the layers are in apposition, as they exist in the undissected ventricle, the first external layer and the last internal cross each other with a slight deviation from the vertical, as in the letter X; while in the succeeding external and internal layers, until the fifth or central one, which is transverse, is reached, they cross at successively wider vertical angles, as may be represented by an $\bowtie$ placed horizontally.

"Holding the cone, prepared as described, against the light, the Lecturer then showed how, by the rolling process, a double system of conical spirals, similar to those found in the left ventricle, had been produced—the one an external left-handed down system, running from base to apex, and corresponding with the external layers; the other an internal right-handed up system, running from apex to base, and corresponding with the internal fibres; and how, seeing the opposite systems are the result of different portions of the same threads being rolled in different directions (the one within the other), the spirals are consequently continuous at the apex.

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mends. The sheets should be twice as long as they are broad; and the lines or threads should run in the direction of the length.

* That is, in the direction from the left hand to the right of the observer.

Arteries, Capillaries, and Veins.

When the ventricles of the heart close on the blood which they contain, the fluid is pushed into the arterial system. The arteries are elastic tubes, with walls of sufficient firmness and thickness to prevent collapse when the blood flows out of them. As the vessels ramify they diminish in size, thickness, and elasticity, acquiring, on the other hand, greater contractile power. The branching occurs in a variety of ways: frequently by bifurcation; at other times a main trunk gives off small branches at acute or right angles, and, in some instances, vessels split up suddenly into several or many small branches. This is seen with the mesenteric arteries. Without entering into the minute anatomy of the blood-vessels, I may mention that the elasticity of the larger arteries is due to elastic tissue, (see Figs. 113, 114);

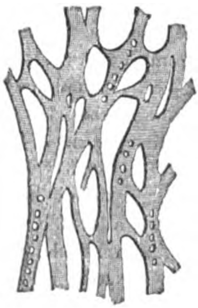


Fig. 113. (Kölliker.)—Elastic network from the tunica media of the pulmonary artery of the horse, with holes in the fibres. Magnified 350 times.

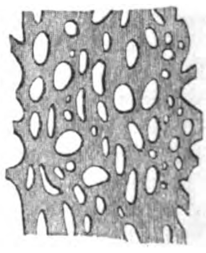


Fig. 114. Kölliker.)—Elastic membrane from tunica media of the carotid of the horse. Magnified 350 times.

whereas their contractility is due to plain contractile fibres described by Kölliker.

The capillaries are composed of exceedingly delicate transparent membrane, on which nuclei are observed, and, as

Kölliker says, they "appear to become transformed into the larger vessels by the super-addition of layers, both on their inner and outer sides; their own coat, meanwhile, coalescing with these, and being, perhaps, continued into the fibrous layer of the tunica interna."

The veins differ from arteries in having less elastic material in their coats. They are tougher, and in some parts are provided with an abundant muscular coat. Veins are provided with valves, which are very numerous, where gravitation is opposed to the blood's flow, as in the veins of the limbs. The valves are composed of folds from the middle and inner venous tunics.

Action of the Heart.

The action of the heart is progressive, and consists first in the contraction of the auricles for the propulsion of blood into the ventricles. The auricles dilate, and the ventricles contract; there is, then, a pause in the heart's action. At the time that the ventricles contract, the impulse of the heart is felt against the left side. This is due to a complete movement of the heart, and a rolling from right to left, in accordance with the arrangement of the muscular fibres, though the ventricles also elongate, as shown by William Harvey. In describing the action of the heart, this illustrious observer says:—"First of all the auricle contracts, and in the course of its contraction throws the blood (which it contains in ample quantity as the head of the veins, the storehouse and cistern of the blood) into the ventricle, which being filled, the heart raises itself straightway, makes all its fibres tense, contracts the ventricles, and performs a beat, by which beat it immediately sends the blood supplied to it by the auricle, into the arteries; the right ventricle sending its charge into the lungs by the vessel which is called vena arteriosa, but which, in structure and function, and all things else, is an artery; the left ventricle sending its charge into the aorta, and through this by the arteries to the body at large.

"These two motions, one of the ventricles, another of the auricles, take place consecutively, but in such a manner that there is a kind of harmony or rhythm preserved between them, the two concurring in such wise that but one motion is apparent, especially in the warmer-blooded animals, in which the movements in question are rapid. Nor is this for any other reason than it is in a piece of machinery, in which, though one wheel gives motion to another, yet all the wheels seem to move simultaneously; or in that mechanical contrivance which is adapted to fire-arms, where the trigger being touched, down comes the flint, strikes against the steel, elicits a spark, which falling among the powder, it is ignited, upon which the flame extends, enters the barrel, causes the explosion, propels the ball, and the mark is attained; all of which incidents, by reason of the celerity with which they happen, seem to take place in the twinkling of an eye."

When the ventricle contracts, the blood strikes against the auriculo-ventricular valves, which close upon the volume of blood which is then entering the auricles. This is associated with a sound—the first heart sound distinguished by its longer duration, and softness, from a sharp second sound which occurs when the blood regurgitates in the pulmonary artery and aorta, so as forcibly to close the semilunar valves. Dr Leared has published a thesis on this subject, in which he declares that all sounds formed in connection with the circulation are produced by and in the blood itself, and their mechanism is the same. The first sound coincides with the contraction of the ventricles, and is caused as follows:—"Blood having been forcibly driven from the ventricles into the aorta and pulmonary artery, comes into forcible contact with blood in these vessels, which, supported by the semilunar valves, had attained a state of momentary repose. The impact between this fluid in motion, and that in a state of rest, gives rise to the sound. . . . . The second sound occurs during diastole, and in its mechanism closely resembles the first. The blood having been driven with much force into the aorta and pulmonary artery, a portion of it recoils, but is checked in its rapid descent towards the heart by the semilunar valves. The sound is caused by the concussion thus induced, the force of which is, however, by no means sustained by the valves alone, for they are thoroughly supported by the ventricles and their contents. This is obvious, since there can be no approach to a vacuum in the heart. The valves are regarded as separating media, which do not themselves sustain the force of the descending blood."

During contraction the heart becomes firm, like any other muscle in the body; it also elongates, and rotates on its own axis from left to right. It is the protrusion or elongation of the heart, coupled with the turn to the left, which causes the impulse or thrust against the side of the chest.

The sounds of the heart and impulse are observed to recur with the greatest regularity, and are termed rythmic. There is a period of rest between each complete action of the heart, —a pause which occupies nearly one-fourth the time that the heart requires to complete its contractions and movement. Thus the heart, which is supposed never to rest, from the birth of an animal to its death, is during a certain period inactive, and its structure rests after each effort.

Circulation in the Blood-vessels.

The arteries recoil to a certain extent on the blood, which is propelled into them by the heart. They are dilated and rendered tense when filled, but in virtue of their elasticity, their calibre is soon restored, and the muscular coat also regulates the capacity of the vessels, in accordance with the flow of the blood. There is no active rythmic propelling force in the arterial system. The blood advances in an uninterrupted column, as there is no void in the circulatory apparatus, and the jerk produced by the powerful heart is felt at every beat in the smallest arteries. This is the pulse.

By the subdivision of the arteries, the capacity of the arterial system increases, and this exerts a similar influence on the current of blood to that observed by the widening of a river on the current of water. It equalizes and retards it. It has been estimated by Volkmann that the blood circulated in the carotid arteries of horses, calves, and dogs, at the rate of 12 inches in a second.

The arteries usually run in protected situations, and the larger ones cannot be felt in order to determine the state of the pulse. Middle-sized superficial vessels running over bones are therefore selected, as we shall presently see.

Pulsation is lost in the capillary system, and here the flow onwards towards the veins is due to the constant pressure from behind—*vis a tergo*—which the column of blood exerts. Doubtless, capillary attraction exerts some influence in these hair-like tubes, to ensure an equable distribution of blood, but the wisdom of creative design is admirably exemplified by the vast mass of blood enclosed within the very delicate capillaries being pressed forwards by liquid pressure, and not subjected to the sudden jerks of a pumping heart. In weak animals that have been starved for some time, pulsation is perceptible in the smallest arteries and in the capillary system. This may be seen in frogs, mice, and bats, whose transparent structures favour microscopic examination. In them we observe minute vessels, about $\frac{1}{2000}$th of an inch in diameter, with single rows of blood-particles flowing in the centre of a stream of colourless, transparent blood-liquid—liquor sanguinis. The current is tardy near the walls of the vessels, and rapid in the middle. It has been estimated that blood advances in the capillaries at the rate of nearly two inches per minute.

By the coalescence of the capillaries veins are formed in which the pulsations are wanting; the flow is more equal and less rapid than in the arteries; more rapid and less equal than in the capillaries. The pressure from behind still pushes on the column of blood, which is supported in its progress from bearing against the current of the circulation by the valves. Any pressure on the veins which is especially active during the contraction of muscles favours the onward flow, and in the vicinity of the chest, where the veins are held rigid and open by surrounding membranes or fasciæ, the aspiratory force exerted by the opening of the chest tends to suck the blood towards the heart. One method of witnessing this suction power is by opening the veins of the neck low down; a gurgling sound succeeds the infliction of the wound, and, instead of blood flowing, air is drawn in, and destroys the animal. This is a caution against approaching too near the chest in the practice of venesection.

The forces which are in exercise to produce a regular flow of blood are, therefore:—

1. Contraction of the heart.
2. *Vis a tergo.*
3. Capillary attraction affecting the circulation locally.
4. Muscular exertion.
5. Aspiratory force, or *vis a fronte.*

Support by the valves, so as to prevent regurgitation, and the regulating force exerted by the elastic and contractile coats of the arteries, are also influences which favour the blood's circulation.

I cannot pass over this subject without noticing the fact, that the vitality of tissues is essential to the circulation. When life is impaired stagnation at once results, and the blood in contact with the impaired structures coagulates. This simple fact explains, as M. Lister has satisfactorily proved, the stagnation and changes in the blood and vascular apparatus observed in inflammation.

The flow of blood is, as we have already shown, constant and rapid. It is kept up by a variable number of propelling efforts of the heart in different animals. Thus this organ beats,—

In the horse, . .	from	32 to 38	times in	a minute.
„ ass, . .	„	45 to 48	„	„
„ ox, . . .	„	40 to 50	„	„
„ sheep and goat,	„	70 to 80	„	„
„ pig, . . .	„	70 to 80	„	„
„ dog, . .	„	90 to 100	„	„
„ cat, . .	„	120 to 140	„	„

To Hering, professor in the veterinary school of Stuttgart, is due the merit of ascertaining by experiment the rapidity with which blood flows in all warm-blooded creatures. Ferrocyanide of potassium was injected by him into one jugular vein of a horse, and blood received from the opposite vein and tested. Hering determined that the round of the circulation had been completed by the solution in from 25 to 30 seconds. Vierordt has repeated these experiments, and estimates the rapidity of the blood's flow, as follows:—

In the horse the blood	flows	round the body in	28·8	seconds.
„ dog	„	„	15·22	„
„ goat	„	„	12·86	„
„ rabbit	„	„	6·91	„

In young animals the circulation is more swift, and it appears to be quicker in the female than the male. According to Vierordt, the average rapidity of the blood's flow in any warm-blooded animal is measured by the time required for from 26 to 28 beats of the pulse in that animal. As we have before mentioned, the circulation is most rapid in the arteries, and slowest in the capillary system.

I have here borrowed from Dr Dalton a diagram of the circulation, which he correctly says is not a simple process, but made up of many different circulations, going on simultaneously in different organs. He says:—"It has been customary to illustrate it, in diagram, by a double circle, or figure of 8, of which the upper arc is used to indicate the pulmonary, the lower the general circulation. This, however, gives but a very imperfect idea of the entire circulation, as it really takes place. It would be much more accurately represented by such a diagram as that given in Fig. 115, in which its variations in different parts of the body are indicated in such a manner as to show, in some degree, the complicated character of its phenomena. The circulation is modified in these different parts, not only in its mechanism, but also in its rapidity and quantity, and in the nutritive functions performed by the blood. In one part, it stimulates the nervous centres and the organs of special sense; in others it supplies the fluid secretions, or the ingredients of the solid tissues. One portion, in passing through the digestive apparatus, absorbs the materials requisite for the nourishment of the body; another, in circulating through the lungs, exhales the carbonic acid which it has accumulated elsewhere, and absorbs the oxygen, which is afterwards transported to distant tissues by the current of arterial blood. The phenomena of the circulation are even liable, as we have already seen, to periodical variations in the same organ; increasing or diminishing in intensity

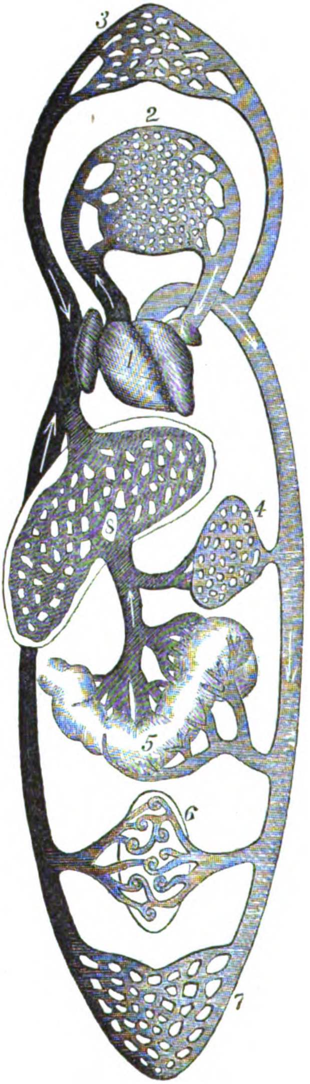


Fig. 115. Diagram of the circulation. 1, Heart; 2, Lungs, 3, Head and upper extremities; 4, Spleen; 5, Intestines; 6, Kidney; 7 Lower extremities; 8, Liver.

with the condition of rest or activity of the whole body, or of the particular organ which is the subject of observation."

General Disturbance of the Circulation.

From the universal distribution of blood over the system, and the manner in which movement, respiration, secretion, and absorption must influence the current of blood, it is evident that there are physical reasons for very frequent and sudden changes in the condition of the circulation. Exertion, the different positions the body may be placed in, feeding, influence the blood's flow; but the heart and even blood-vessels are affected by causes which operate through the nervous system. Any disease of important organs, and capable of giving rise to constitutional disturbance, at once affects the state of the circulation. The current may be retarded or accelerated, and this both locally and generally. So readily and certainly does the blood's flow indicate the normal or abnormal state of an animal, that it is universally regarded as one great criterion to test the degree of deviations from health, and watch the progress of disease.

The pulse is produced, as we have already shown, by the propulsion of blood into the arteries. These vessels become distended, elongate, and are, to a certain extent, raised by the jerk transmitted with every heart-beat. It must be remembered that there can be no pulse without contraction of the heart, and the number of pulsations per minute may be determined alike in all parts of the circulatory system. It is true that in distant arteries of limbs, head, &c., there is a perceptible lapse of time after the contraction of the heart, which is required for the transmission of the blood-wave. But, though we can determine the number of pulsations by feeling the heart or arteries, the character of the pulse, which is so sure a guide in determining the state of a patient, can only be ascertained from the arterial system. Thus, in a case of extreme debility, in the so-called bloodless or anæmic state, the heart contracts with great force, its impulse is violent, whereas the pulse at a distance is almost and perhaps quite imperceptible.

In the horse, the pulse is usually felt at the jaw; the submaxillary artery passes along the inside of the latter to the part where the thick cheek muscle is felt, and here it turns round the lower margin of the bone to be distributed on the side of the face. By placing the thumb obliquely on the lower and fore-part of the cheek, and passing the fore and middle fingers on the inside of the jaw, a rolling cord is felt, which, if slightly pressed upon, is found to pulsate. The number and character of pulsations may be well felt there. But the horse is apt to move his jaws, and may be masticating. It is then necessary to select another artery, such as the brachial, which is felt on the inside of the elbow joint, from the front. The temporal artery felt near the articulation or the jaw is also favourably exposed for the purpose. The metatarsal artery, below and inside the hock, and the plantar arteries, are felt in local disease, to determine the existence of throbbing, &c.

In the ox, the pulse is also felt from the facial artery and the brachial. The latter is more easily touched in this animal than in the horse. It will be often found that a cow will be most quiet, if the person desiring to feel the pulse will walk up to the near side, and put his arm over the neck to feel the right facial artery. The left hand may be used to steady the head by holding one of the horns.

When a cow is lying, it is frequently convenient to feel the pulse from the metacarpal arteries, just in a line with the cleft of the fore-feet, and over the fetlock. The right or left leg will always be found projecting outwards, and exposed most favourably for the purpose of feeling the pulse. It is important not to disturb sick animals, and often they are unable to rise, so that the artery above the fetlock is of service to the practitioner.

In both horse and ox it is occasionally necessary for the veterinary surgeon to feel the pulsation of the large abdominal aorta and the iliac arteries. This can only be accomplished by passing the hand up the rectum, and in diseases of the arteries of the hind-limbs remarkable deviations in calibre, and irregularity in the blood's flow, are thus discovered.

In all the smaller animals the artery of the thigh is the most convenient to feel the pulse. On the inside of the thigh there is not much hair, and if the extended fingers are placed across the thigh-bone, which is easily felt, the artery may be readily pressed against it, and the number and character of the pulsations determined.

Great pressure is not needed, and indeed is not favourable in determining the state of the pulse. It is by well-regulated bearing, especially where the artery is crossing a bone, that useful indications are obtained.

Number of Pulsations and Modifications in the Character of the Pulse, according to Species, Age, Sex, Temperament, &c.

There is some difference in the character of pulsations in different animals. In the horse the pulse is full and distinct. In the ass it is smaller, and with greater tendency to irregularity. In the ox the artery rolls tensely under the finger, and the pulsations are long, equal, and soft. In the sheep the pulse is active, small, and wiry; in the pig, tense and hard; in the dog and cat, firm and wiry. It must be understood that, relatively to each other, animals differ as above stated and there is a characteristic pulse as much as distinctive peculiarities in the respiration, &c.

It is of great moment to the practical man to be acqnainted with the variations in the pulse according to age, and further observations are called for on the subject. In man it has been determined that the pulse is more frequent in old age than adultism; but Delafond has confirmed Rigot's observations on this point, and finds that the pulsations are less frequent in old animals. The following table includes the results of observations by Rigot, Minot, and Delafond.

Species.	Mean Number of Pulsations per minute.					
	Adultism.		Youth.		Old age.	
Horse, . .	From	36—40	From	60—72	From	32—38
Ass and Mule,	„	46—50	„	65—75	„	55—60
Ox, . .	„	45—50	„	60—70	„	40—45
Sheep and Goat,	„	70—80	„	85—95	„	55—60
Pig, . .	„	70—80	„	100—110	„	55—60
Dog, . .	„	90—100	„	110—120	„	60—70
Cat, . .	„	120—140	„	120—140	„	100—120

For the horse and ox Kreutzer furnishes us with the following result of his observations:—

Horse.		Ox.	
At birth, . .	100—120	At birth, . .	92—132
14 days old, .	80—96	4—5 days old, .	100—120
3 months old, .	68—76	14 „ „ .	68
6 „ „ .	64—72	4—6 weeks old,	64
1 year old, .	48—56	½ to 1 year old, .	56—68
2 „ „ . .	40—48	Young cow, .	46
3 „ „ . .	38—48	Four-year-old oxen,	40
4 „ „ . .	38—50		
Aged, . .	32—40		

There is no material difference between male and female as to the pulse, but during parturition it is both more frequent and more full than at other periods in all animals. Delafond says, that in the mare and cow the ordinary number of pulsations increases, on an average, four or five beats every month after the sixth of utero-gestation, and the artery is tense, full, and rolls under the finger.

It is evident that temperament must affect the pulse in a marked degree, and great contrasts are offered by the full bounding pulse of the horse with a sanguineous temperament, as contrasted with the slow, feeble, and small pulsations in the lymphatic variety.

Size does not affect the pulse to the extent that might have been anticipated. In comparing the pulse of a pony with that of a cart-horse, it is evident that in the first it is more frequent and small. If we compare animals of different species, then it is a very marked feature, that in proportion to diminution in size the frequency of the pulse is increased.

The veterinary practitioner cannot fail to observe a decided contrast between animals enjoying fresh air and liberty to those that are confined in hot and badly ventilated stables. If I have stated, that the pulse of the ox numbers usually from 45 to 50, it will be found that in town byres the average is often between 60 and 70, and I believe I never witnessed it below 55 in London dairies. Great allowance should therefore be made in examining patients for the circumstances under which they live. Heat always increases the frequency of the pulse, and this is perceived in the open air on a hot summer's day, or in a confined apartment.

The approach of a storm is readily felt by animals, and horsemen are well acquainted with the repugnance which horses manifest to face tempestuous weather. The atmosphere is charged with much electricity, and its effects are observed by a frequent pulse and accelerated breathing in animals who are not sheltered.

The Pulse in Disease.

The pulse is modified by disease as to frequency, strength, and regularity. There are special expressions adopted by pathologists, and which have a fixed meaning. Thus, a *slow* pulse is one in which the beats per minute are below the normal standard, and a *frequent* pulse is the very reverse. Often confounded with the term *frequent* is the adjective *quick*. A quick pulse is one with a sharp, decisive stroke, though usually frequent as well. A *tardy* pulse—*pouls lent* of the French—is one opposed to the quick pulse, in which the pulsation moves slowly under the finger, and at long intervals. It is met with in cerebral affections in the horse.

The pulse is full and strong when it strikes with force against the finger. It is feeble, indistinct, and sometimes imperceptible where it is usually felt in opposite conditions. A strong pulse may be corded and incompressible, viz., the artery not easily effaced, or the current within it readily stopped by pressure with the finger. An oppressed pulse is one in which fulness of the artery is associated with a somewhat imperfect but active jerk, as if the blood-wave could be indistinctly felt with the distended state of the vascular system. When a pulse is small, yet strong, it is called *hard* or *wiry*. A soft pulse is when the artery is full and pulse small. A pulse is termed irregular when several pulsations succeeding each other rapidly are followed by a long interval, and the number of frequent pulsations are variable. There is a marked difference in the strength of different pulsations under these circumstances. An intermittent pulse is one in which there is regularity in the intervals between a constant number of frequent pulsations.

The pulse is said to be rising when, from being small and frequent, it increases in strength, and often diminishes in frequency. It is a *running-down pulse* when it becomes very frequent, and more and more indistinct.

I need not enter into the explanation of many other terms applied to the pulse, but have to state that a full and strong pulse is characteristic of health, plethora, and when beyond the normal standard, inflammation. I must distinctly state, however, that the pulse alone is not a criterion of the presence of inflammation, and when the late Mr Sewell used to say, that when a horse's pulse rose above 45, in any case, it was a sign of inflammatory action, and called for bleeding, it was in accordance with the doctrine of the Broussais school, "ubi stimulus ubi fluxus," which has proved so destructive to life in man and animals. In the works on veterinary medicine, up to the present day, the dangerous recommendation of bleeding, when the pulse is strong, because inflammation is running high, may be met at every page. In accordance with more enlightened pathological views, efforts must now be turned towards abolishing such ancient and dangerous methods of practice. It must not be forgotten, that to save blood and not to draw blood is usually equivalent to saving an animal's life. The cases are extremely rare in which the abstraction of blood is of any moment; and to the non-professional reader we say, do not tamper with dangerous remedies: to the professional reader, as well, I have now to say that the pulse alone can not indicate when bleeding may be advisable. The belief that the frequency of the pulse necessarily indicates inflammation is still a professional opinion fatal to scores of human lives in Southern Europe; and where I have found it most—in Piedmont—horses and cattle share the same fate as consumptive patients, whose palpitating hearts, labouring to act on a scanty supply of blood, soon cease to act, from the resolute importunity of the phlebotomist.

The feeble pulse indicates debility, and the bloodless state, and an oppressed pulse is usually found in pulmonary affections of an inflammatory type. The wiry pulse is generally indicative of disease of the serous membranes, whereas the intermittent and irregular form of pulse are associated with special disorders, usually attended with danger to life.

Venous pulse.—This phenomenon is observed with great facility in the jugular veins of animals. In some cases it is not incompatible with health, whereas in others it is a valuable symptom of disease. The jugular or neck veins of an ox are observed to pulsate or to fill at every heart-beat, when the animal is lying and ruminating. In some instances an appearance of venous pulse is produced by the pulsation of the carotid artery producing the jerk in the jugular vein, but at others the venous pulse is the result of the vein filling when the ventricles of the heart contract, and the auriculo-ventricular valves close suddenly. Delafond is unquestionably in error when he says that the venous pulse is due to regurgitation of blood in the anterior vena cava, and the jugular veins, *when the right auricle contracts.* He remarks that he has observed the phenomenon on animals lying for a long time during the performance of painful operations. It is doubtful if, even in cases of heart disease, in which the pulsation of the neck veins is so manifest, there be any reflux of blood. I believe not, and that the slow and embarrassed action of the ventricle induces the momentary check to the blood's flow in the veins whereby these fill with a jerk from above. The reflux of blood, as far up as the venous pulse is perceived, is impossible.

SIGNS OF DISEASE OFFERED BY THE CAPILLARY CIRCULATION.

These are simple, connected with the appearance of vascular parts uncovered by hair or a thick cuticle, and in which any modifications of the vascular apparatus may be at once witnessed. Redness of the conjunctiva and nasal membrane is frequently a sign of plethora, fever, or inflammatory disease. The redness is *ramified*, or dependent on a gorged state of the blood-vessels, but in some instances the blood becomes diseased, and transudes through the capillaries, so that instead of a uniform ramified redness, red spots produced by extravasated blood are produced. These blood-spots—petechiæ—are very unfavourable signs of severe general disorders.

DISEASES OF THE HEART.

Treatises on veterinary medicine, British or foreign, are singularly scanty in information on this important subject.

Leblanc remarks, that after having denied the existence of heart disease in animals, practitioners have admitted that they are, after all, not rare, but have doubted the possibility of diagnosing them. I think, with Leblanc, that though the diagnosis cannot be declared easy, the diseases are nevertheless so characteristic as to leave little doubt as to their nature, when observed by an intelligent practitioner. The diagnosis of heart disease will always call for correct anatomical and physiological knowledge, and careful observation. There are forms which the veterinarian will not easily distinguish, especially as he can never hope to attain that proficiency in auscultating the diseased heart which the human physician can acquire. Heart disease in man is not only common, but the heart is so exposed, and the region it occupies in the chest is so accessible for the purposes of percussion and auscultation, that very slight variations in position, size, &c., can be determined with the greatest accuracy. This cannot be accomplished in the horse. The ponderous shoulders close upon the keel-shaped thorax to such an extent as to prevent our carefully distinguishing the heart-sounds at different parts, and totally precluding any investigation as to the space filled by the organ, however much enlarged it may be. I not only believe, however, with Leblanc, that we can attain to such a degree of proficiency as to determine the presence of any disease of the heart with as much precision as that of any other organ, especially in the horse; but I think we can accomplish more in the diagnosis of heart affections than even in diseases of the liver, pancreas, &c. The diseases of all the internal organs in animals have been very imperfectly recognised. How few of our practitioners would like to stake their reputation on the recognition of hydrothorax! I do not forget the advice I received in the lecture-room when a student, to carry a small trochar and canula in the pocket, to pierce, in the absence of on-lookers, the intercostal space, in any doubtful instance, and thus make sure of diagnosing a condition for which characteristic signs were wanting. I have since learned, that though hydrothorax is one of the diseases easily recognised, it is certainly not more readily diagnosed than cardiac disorders. Indeed, I remember, when a college student, having had the advantage of practising auscultation a little in hospitals, diagnosing effusion in the pericardium which had been ignored. The animal died, and the accuracy of the diagnosis was demonstrated by post-mortem examination.

General Symptoms of Diseases of the Heart.—The acute affections, such as pericarditis, or endocarditis, are associated with very intense fever, and very commonly with a fever of a peculiar type, such as rheumatism or influenza. Precision in this diagnosis, though important, is very rarely called for, as the diseases yield to general antiphlogistic treatment, and are very commonly curable.

Some fatal heart complaints or injuries are remarkable for the absence of any general symptoms. This is particularly the case in cattle not used for severe exertion of any description, and in which a slight interference with the circulation may not affect the general health.

Frequently have cases been recorded of oxen falling dead, and having a knitting needle or wire lodged in the chest and piercing the pericardium and heart. The old adhesions prove, in such cases, that the instrument of death has been long creeping to the vital organ, and for some time so placed as necessarily to interfere with its rythmic action. It is the sudden death without any appreciable cause that leads us to suspect, before performing a post-mortem examination, that the heart is injured or affected.

Chronic heart disease, which gives rise to some inconvenience, varying in degree according to the importance of the lesion, is indicated by symptoms regarding which I have to offer some observations. Dyspnœa is a very prominent sign in many cases, and which leads to confusion so as to cause animals affected with interference to the organs of circulation to be treated for a different acute malady of the chest. An animal free from any acute symptoms except a loss of appetite, if perchance oppressed by exertion, will, when galloped, trotted, or even walked far, and especially up-hill, indicate great difficulty in breathing, and is in fact condemned as thick-winded. When such dyspnœa is unassociated with cough, and is seen in an animal in good condition which is subject to cold extremities, venous regurgitation in the neck on exertion, and other symptoms hereafter noticed it is usually connected with dilatation of the right auricle, or insufficiency of the mitral valve.

Vertigo is another symptom indicating a more severe form of organic lesion. A horse is for some time known to be unsound, or rather very incapable for any severe exertion. He is suddenly seized with symptoms of megrims when being driven, and on careful examination no pressure on the veins of the neck by the collar is found to have produced such an effect. The attacks recur, and the animal has to be thrown off work. He suddenly reels to and fro in the stable, and falls back or sinks to the ground as if shot, recovering himself when in the recumbent posture, and becomes unfit for work of any kind. Such a form of staggers is invariably due to interference with the heart's action by organic disease. It must not be confounded with coma or sleepy staggers, nor with stomach staggers, or ordinary attacks of megrims.

Irregularity and frequency of the pulse is another of the general symptoms, which, though observed in fevers, &c., is commonly the first characteristic sign which leads to a local examination of the heart.

Habitual coldness of the ears and extremities, indicating a languid circulation, is a very useful sign.

Œdema first occurring in the hind legs, then in the fore, and lastly in the chest and belly, is a useful symptom characteristic in some heart affections.

However active and nervous an animal may naturally be, if seized with cardiac disease, a change occurs, and there is a tendency to obesity, dulness, inactivity, and, in the majority of instances, a chance of some sudden and irremediable interference with the propulsion of blood, hence instantaneous death.

Indeed it were well if the pulse was more frequently felt than it is, by applying the hand over the region of the heart; and I may here quote Dr Wardrop's remarks. He says:—"That disturbances in the heart's functions are very common there is surely no need of any other evidence than a knowledge of the numerous changes which take place in the arterial pulse, such changes always indicating some corresponding alteration in the movements of the heart. It is, therefore, remarkable that while the attention of most pathological inquirers has been assiduously directed to the detection of changes in the arterial pulse when investigating every disease of the body, yet they have seldom deemed it necessary to examine into the condition of the heart itself, although they must be aware at the same time that the arterial pulse is felt for no other purpose than to acquire information on the state of the central organ of the circulation. Indeed, I have a strong conviction that the habit of examining the state of the arterial pulse in place of the beats of the heart has been a fruitful source of error in the practice of medicine; and it may not be unworthy of notice here, as a curious fact, that the Chinese, of whose progress in medical science we know so little, when exploring the condition of a patient, place the hand or ear on the region of the heart instead of feeling the radial pulse."

Palpitation of the Heart.

There are several forms of palpitation connected with different morbid states. The first and most common is witnessed in anæmia. I have often drawn the attention of my students to this sign, neglected by veterinarians in this country, and which has often led to errors in diagnosis and prognosis. Anæmic palpitation is associated with *blood-sounds*, heard in the vicinity of the heart, large arteries, and veins. They vary with the condition of the blood, and are dependent on the quality of the latter. Physicians have termed "anæmic murmurs," the peculiar sounds heard most distinctly in the lower animals, and due to the churning sustained by the blood in passing through channels of varying size, as it traverses the heart. There is a venous blood-sound heard by applying the ear over the jugular veins at the root of the neck in anæmia. It is a continuous hum, to which the French have applied the term of "bruit de diable." It is extremely difficult to distinguish a blood-sound in the horse from a valvular murmur, because we cannot conveniently compare the heart-sounds at different parts. In man there are great facilities for such distinctions. It is, however, important to be as accurate as possible, as valvular murmurs indicate organic disease of the heart, and valvular insufficiency. Daily observations, and comparing the sounds as heard at different parts, from above downwards, will often prove satisfactory.

Anæmic palpitation of the heart is of course cured by the tonic treatment, liberal diet, &c., which are prescribed for the general treatment of the bloodless state. The organs of circulation must not be over-taxed by much exertion.

In man, there is a form of palpitation termed dyspeptic, and due to stomach derangement. This is, so far as I am aware, unknown in the lower animals.

The third and last form of palpitation has most singularly been mistaken for spasm of the diaphragm.

Mr Percivall, in his *Hippo-Pathology*, says:—"If I mistake not, our attention was first called to this subject by the celebrated Nimrod, the late Mr Apperley. In his admirable 'Letters on Condition,' so long ago as the year 1825, he remarks, while discoursing of treatment after a hard and long run,—'When a horse is very much exhausted after a long race with hounds, a noise will sometimes be heard to proceed from his inside, which is often erroneously supposed to be the beating of his heart, *whereas it proceeds from the excessive motion of the abdominal muscles.*' This interpretation of the 'noise' was shortly afterwards disputed by Mr Smith, of Woodhouse, who ascribed it *to the heart.* In a subsequent letter, however, Mr Apperley, having in the interval met with another case, argues that the noise, from the situation in which it is heard, cannot possibly proceed from the heart, unless, indeed, as he adds, 'the heart lay where it should not lie:' but—repeating his former opinion—is caused by 'a convulsive action of the abdominal muscles.'

"In 1831, Mr Castley, with his mind directed to the subject by the foregoing observations of Mr Apperley, sent a paper to the *Veterinarian,* wherein, although he had never seen but one 'well-marked instance of it,' he appears to have hit upon the true explication of the phenomenon; which is, that the 'noise in the inside' is owing to 'spasmodic affection of the diaphragm.' In Mr Castley's case, the prominent symptom was 'a convulsive motion or jerking of the whole body, accompanied by a dull thumping noise, audible at several yards distance, and evidently proceeding from his inside. The beats appeared to be about forty a minute. On placing my hand over the heart, the action of that organ could be felt but very indistinctly: the beating evidently came from behind the heart, and was plainly to be felt in the direction of the diaphragm. Again, placing my hand upon the abdominal muscles, the jerks appeared to come from before backwards. There was no pulsation to be felt at the submaxillary artery.'

"Mr Brown, V.S., Melton Mowbray, in 1833, published three 'well-marked cases' of it. The first was that of a young mare taken up from grass and driven slowly thirty-five miles in one day, with a stomach filled with three pecks of oats. The second, that of a horse who 'had been living in a state of rest for some time, and was forced to sudden and violent exertion with his stomach full of grass.' The third had not undergone any exertion, save that of 'rolling and pawing' from an attack of gripes. Mr Brown referred them all to 'spasmodic action of the diaphragm.'

"To Mr Sinclair,* V.S., Morpeth, spasms of the diaphragm occurred in a case of trismus. 'There was a loud beating in the region of the diaphragm, which could be heard at a distance of ten yards, and not synchronous with the pulse.' It was 'accompanied with distressing cough and profuse perspiration.' The case did well, treated by opium and digitalis, and keeping the bowels open.

"Mr Tombs,† V.S., Pershore, saw a five-year-old mare, who for some days had been out at grass, that became suddenly seized with quick and laborious respiration, quick pulse, and shivering, which symptoms were treated by venesection and an aperient. 'In the evening, violent palpitations of the diaphragm came on, which was discovered by a tremendous and loud noise inside the ribs, as though a man was in the thorax beating the ribs with a hammer: the noise proceeded principally from the left side, midway between the spine of the back and the ninth rib. Pulse almost imperceptible.' Venesection and opium, and stimulating liniment to the side and extremities, with aperients, perfectly cured the case.

"Mr Gutteridge,‡ V.S., Carmarthen, was called to a mare who, on her arrival in the Gloucester mail, showed great uneasiness, frequently attempting to stale; pulse 90; 'and there was a violent beating on the near side, which could be heard at a considerable distance. Her side was much convulsed; and, on placing my hand over her heart, its action

* *The Veterinarian*, for 1835. † *Ibid.*, 1835. ‡ *Ibid.*, 1836.

could not be clearly felt. Venesection—which it became necessary to repeat—aperient medicines and opiates, recovered her."

I have witnessed cases of spasm of the diaphragm, which may be called by the well-known name applied to them in human subject—hiccough. I have seen this condition as the result of poisoning with the veratrum album, and in one case of over-repletion of the stomach, with vomiting, which recovered. The spasm of the diaphragm was violent, all the symptoms of hiccough were well-marked, but no such sounds as practitioners have believed to depend on such spasm were ever witnessed. On the other hand, I have seen several cases of marked nervous palpitation of the heart, in which the sounds could be heard at a great distance from the affected animal, and have satisfied myself that the heart alone was the organ implicated. Leblanc, the best authority on this subject, holds the same opinion, and disputes the opinion held by Delafond and Goubaux in accordance with the views of the veterinarians quoted by Mr Percivall. Leblanc draws attention to three singular cases recorded in 1830 by Coulbeaux, veterinary surgeon at Melun. After alluding to certain accessory symptoms, such as elevated temperature of the body, redness of the visible mucous membranes, and tumultuous breathing, he says, "The respiratory movements were interrupted by a violent elevation of the flanks, circumscribed towards the upper region, and so intense as to be appreciated with the hand as well as by the eye. This lifting of the flank, which is limited in extent to a few square inches of surface precisely at the hollow of this region, is perfectly isochronous with the heart-beats." In the second case Coulbeaux found "no cough, breathing not accelerated, but interrupted by a lifting of the flanks, equal on either side, and perfectly isochronous with the pulsation of the submaxillary artery.

The beats of the heart were not very appreciable, although the ear was applied to the left side, but, on the contrary, they were most marked (très sensibles) on applying the ear to either flank." In the third case, when the hand was placed with its back to the ribs, behind the left elbow, the heart's impulse could not be felt, and the sounds were indistinct; but on applying the ear to the flank, the sounds are heard to be near, as the heart had been carried upwards and backwards. After a little exercise the lifting of the flanks is observed, and a sort of impulse isochronous with the heart's action.

Levrat records a case which occurred in a mare fifteen years of age. The following symptoms were observed:—A jerk of the whole body, produced by the extraordinary force of the impulse of the heart, as the organ strikes the dorso-costal region, towards the upper part of the first false ribs. The impulse is very distinct, and does not seem to be due to any tumour interposed between the heart and ribs; its force is such as to cause a general shake of the body, which may be observed at a great distance. These heart-beats are very regular, fifty per minute, and heterochronous with the pulsations of the submaxillary artery, which are also fifty in number. The artery is softened; the pulse regular; the breathing is peculiar. On approaching the ear to the external nares, the animal is heard to make successively three inspirations, which coincide with the heart-beats; each of these inspirations is followed by an expiration, so feeble and short that columns of air cannot be felt; the fourth inspiration is followed by strong and prolonged expiration, which lasts during three heart-beats. Thus the respiration continued.

Three cases observed at the Lyons Veterinary School were characterised by very violent impulse of the heart. The palpitations were not only perceptible by a violent shaking of the body, but also by a sound which could not be mistaken. All other functions were regular, and the animals recovered within eight days.

Leblanc says that he could add the histories of at least twenty cases similar to those above recorded. He says that his observations authorize him to state that the symptoms are not due to organic lesion, although he never had an opportunity of performing a post-mortem examination in such a case. The animals all recovered. He is nevertheless disposed to believe that the remarkable abdominal pulsations, in the absence of any violent heart-beats, might depend on something more than mere nervousness, and due, perhaps, to a temporary obstacle to the circulation in the posterior aorta. It is difficult to understand that a simple nervous phenomenon should last eight days or more, with equal intensity during the whole time. The palpitations, which occur suddenly as the result of active emotions, especially in the dog, are ephemeral.

Many veterinarians have been alarmed at the symptoms. They appear suddenly; and disappear with as little warning, and usually all other functions remain undisturbed, if we except the respiratory act, slightly modified from its intimate connection with the circulation. Levrat and others have noticed that the peculiar sounds were apparently not rythmic, with arterial pulsation, but the number was constantly the same, whenever any careful observations were recorded. It is not a little remarkable that similar cases have not been observed in cattle. Leblanc has witnessed them in the dog.

Treatment.—Rest, and a mild aperient, at the same time avoiding any cause of excitement to the animal, is attended with a disappearance of the symptoms. Digitalis is the remedy recommended as a specific in all such cases. It is given in doses from 10 to 30 grains daily to the horse, for five or six days. In the dog from one to three grains may be prescribed, at similar intervals. Leblanc suggests the propriety of very small doses, cautiously administered.

In a practical point of view, the results of sudden efforts of the heart, and which are by no means unfrequent, especially in this country, where willing horses are pushed beyond their strength, are next in importance.

Ruptures of the Heart and of the Vessels in its Vicinity.

Without change in structure, the heart or great vessels burst under the influence of undue exertion or violent concussion. In man, from fatty degeneration, the substance of the heart gradually gives way, but in the horse this form of rupture is rarely seen. The most common seat of rupture I have observed, and which occasionally proves the source of death in a hard-contested race, or in a cart-horse drawing a very heavy load up-hill, is laceration of the aorta from its connexion with the left ventricle. The tendinous ring around the semilunar valves snaps, hæmorrhage ensues, and the animal dies. I have witnessed this accident in active Clydesdale horses, in which the heart presented no organic lesion whatever.

The next form of rupture is one which my brother has described fully in his work on *Researches in Pathological Anatomy and Clinical Surgery*. They are ruptures, the result of violence, and occurring from falls. blows, or sudden jerks. My brother says:—

"The mechanism of these traumatic heart ruptures deserves consideration. With a view to explain it, Dr John Davy instituted a series of seventeen experiments (Op. cit. p. 452-3) on the dead bodies of men and animals, by tying the various great vessels in the neighbourhood of the heart, and forcibly injecting fluid into it. He summed up: 'The results of these experiments, in the way of illustration, as applied to the case with a view to which they were instituted, are in no wise clear and satisfactory. Considering them generally, they are perhaps less uniform than might have been expected, and hardly favourable to any general conclusion being deduced from them, excepting indeed the following: 1stly, That the power of resistance possessed by the heart and large vessels, independent of any vital properties of endurance peculiar to them, is enormous; and, 2ndly, That there is much variation in point of strength in the same parts in different instances.' Not much more conclusive, though certainly free from the objection which always attaches to experiments upon dead animals performed with a view to illustrate occurrences in living ones, were the experiments of Chaussier (Portal's *Memoria* cit.) He found that when the trunk of the aorta is ligatured in an animal, the left auricle and ventricle burst; but if the ligature be applied to the trunk of the pulmonary artery, the right ventricle and auricle dilate considerably, the contractions of the heart redouble, but its walls do not rupture.' Admitting the fact, its bearing is doubtful, if any. The causes which commonly produce traumatic ruptures of the heart, cannot operate so as to occlude the great arterial trunks, particularly the aortic; and if they did, rupture of the heart should more frequently be noted in the left side, whereas the reverse is in fact the case.

"More to the point is a very interesting observation by my brother John. While prosecuting his investigations in comparative pathology in the slaughter-houses of Ferrara, in the spring of last year, his attention was particularly attracted by several cases of rupture of the vena azygos, which he associated with the manner in which the animals were killed— division of the spinal cord by thrusting a knife into the interspace between the first and second cervical vertebræ. He first observed, as the thorax was opened, circumscribed clots, between the pleura and vertebræ, covering the azygos vein; the blood sometimes trickling down beneath the serous membrane. On dissection, jagged ruptures of the blood-vessel were discovered. His friends, Professors Maffei and Bàlboni, having sought from him an explanation of the fact, he suggested (to my judgment very plausibly), that the instant the animals are pithed, the walls and contents of the thorax are paralyzed, the heart becomes an inert bag filled with fluid, the jerk of which, as the animal falls, causes rupture of the containing vessel at its weakest part; and this is, in truth, the vena azygos, whose walls are thin, and only protected externally by the pleura. At my brother's suggestion, Professor Maffei instituted a series of observations to determine the frequency of the lesion under consideration; and with his customary courtesy and exactness thus communicated the result: 'From the 1st of June 1854, to this date (28th May 1855) 3095 oxen and cows were killed in our public slaughter-houses; I have met with the rupture of the azygos in fifty-seven of these animals; these ruptures occur in various parts of the said vein; at times where the intercostals join it, and at other where the vein curves round to empty itself into the anterior vena cava. Such lacerations seem to occur about the same number of times in either of these situations: they bear the character of regular tears, inducing an effusion of blood between the laminæ of the mediastinum, or beneath the parietal pleura. Sometimes the vital fluid flows into the thorax itself.'

"Taking these facts into consideration in connection with those recorded in the appended tabular exposition of cases, the mechanism of these lesions seems to admit of twofold explanation. 1stly, In the case of a person falling from a height on to his head or feet, it is presumable that the heart, losing for a moment its tonicity, may be preternaturally disposed to rupture at its weakest part, in consequence of the jerk of the contained fluid. 2ndly, We have to consider the ruptures which are occasioned by the application of direct violence to the chest wall. A girl was suddenly killed by the passage of a cart-wheel over her body. The heart was literally smashed, as the liver so commonly is in the crush of a man between the buffers of two railway carriages. It is particularly worthy of notice, though readily explicable on account of the elasticity of the tissues composing the chest-wall, that they had scarcely suffered any injury. There can be no doubt that, in a minor degree, some blows on the chest may produce rupture of the heart by a mechanism similar to the preceding. Ollivier (*Mem.*, cit.) believes that the passage of a wheel over the chest may sometimes occasion rupture of the heart by compressing the pulmonary artery, and opposing an obstacle to the flow of blood, to overcome which the heart acts with redoubled vigour, and consequently cracks."

My brother, moreover, mentions that "Extensive research in the records of veterinary medicine and surgery, for cases in animals similar to those above recorded in man, has resulted in the discovery of only one, which fell under the notice of Mr Parker of Birmingham.* 'My attendance,' he says, 'was requested to a pony which, running away with a gig down a hill, had, with his right shoulder, struck violently against the wheel of a cart. He

* *Veterinarian*, May, 1855, p. 268–9. My brother says:—"My quotation is not literal, but a condensation of Mr Parker's report, with some additional information in point, which this gentleman has kindly communicated to me, in reply to inquiries addressed to him, at my suggestion, by Professor Simmonds."

reared up and then fell; from this position he could not move, neither could he stand when lifted on his legs. I found him lying on left side, apparently free from pain, presenting the following symptoms: respiration very quick, but not laborious; pulse 55, and weak; visible mucous membranes pallid, especially the buccal. Presently expression of eye became haggard, breathing rather laborious, pulse more frequent and feeble. He was killed about an hour after the accident, at the entreaty of an officer of the Animals' Friend Society. P.m., abdominal viscera healthy; pericardium ruptured on right side, contained a quantity of coagulated blood; a clot of blood affixed to base of right auricle, which was here separated from the ventricle; the muscular structure was evidently ruptured to the extent of almost an inch. Ribs and investing muscles uninjured.' "

Congenital Malformations of the Heart.—Ectopia Cordis.

This condition is one observed chiefly in calves, and the most common form consists in the heart being situated outside the chest, and communicating simply by the large vessels which attach it with the interior of the body. The fissure through which the vessels thus communicate with the heart is in the sternum. Professor Hering has published interesting cases of this description, and made important observations on the heart's action under such favourable opportunities. The displacement may consist in the heart being pushed up at the root of the neck, or, lastly, in the organ descending on the abdomen. All the animals in which it has been observed have died within a short time after birth.

A malformation of the pericardium and walls of the chest occasionally brings the heart in view though in its natural cavity. Such a condition has been witnessed in man as well as in the lower animals There are infinite varieties of arrest of development, but the most interesting to the practitioner is that of

PERVIOUS FORAMEN OVALE—CYANOSIS.

I have mentioned at page 326, that in fœtal life the two auricles of the heart communicate by an oval opening. This causes an admixture of the blood, returning from the system with that returning from the lungs. After birth, the opening is perfectly closed, and, if it remains open, the purified blood from the lungs in the left auricle becomes contaminated by blood which has been the round of the system, and returns of a dark colour to the right auricle. The consequence is, that venous blood circulates through the arteries, so that the visible mucous membranes are blue, the development of animal heat imperfect, and, in fact, all the functions of the body imperfectly carried on. From the blueness of the skin and visible mucous membranes, this affection has received the name of Cyanosis, or the blue disease.

As pervious foramen ovale can only be a congenital state, it is observed in young animals. It may prove fatal to them at an early period of life, or, from their puny, sickly aspect, their owners may, though in ignorance of the real nature of the cause, resolve to destroy them.

It may not be recognised until animals are handled in breaking or training; but the difficult breathing, the oppression resulting from even moderate exertion, with marked embarrassment in the functions of circulation, will turn the attention of an observer to the heart. Auscultation reveals an abnormal sound, which not unfrequently consists in the murmur heard in anæmic patients, and due chiefly to the condition of the animal.

It would appear that it is possible to have the foramen ovale re-opened in the human subject. I am not aware of a single observation of this description in the lower animals. Dr Wardrop says, in his learned work, *On the Diseases of the Heart:*—"The membrane which covers the foramen ovale is sometimes as thin as a spider's web, or it resembles a piece of lace. At other times it is found re-opened in such a manner as to permit an intermixture of the venous and arterial blood. This condition of the foramen ovale was first described by Abernethy, but little notice has been taken of it by subsequent pathologists, though its accuracy is corroborated by morbid preparations in every museum. 'Having formerly been much surprised to find the heart so little affected when the lungs were greatly diseased, and observing in one or two instances, that the foramen ovale was open, I was led to pay more particular attention to the state of that part, and I have found this to be almost a constant occurrence in those subjects where pulmonary consumption had for some time existed previous to the person's decease. I took notice of this circumstance thirteen times in the course of one year, and, in several instances, the aperture was sufficiently large to admit of a finger being passed through it. Now, as the *septum auriculum* is almost constantly perfect in subjects whose lungs are healthy, I cannot but conclude that the renewal of the foramen ovale is the effect of disease—nor will the opinion appear, on reflection, improbable; for the opening becomes closed by the membranous fold growing from one edge of it till it overlaps the other; and their smooth surfaces being kept in close contact by the pressure of the blood in the left auricle, they grow gradually together. But should there be a deficiency of blood in the left auricle, and a redundance in the right, the pressure of the latter on this membranous partition will so stretch and irritate the uniting medium as to occasion its removal, and thus a renewal of the communication between the auricles will take place.'"

Hypertrophy of the Heart.

Increase in the size of the heart and in the thickness of the walls of some of its cavities, has been long since observed by veterinarians. Recorded cases have not been always satisfactorily described, and the first author who has furnished us with a concise history of the lesion is M. U. Leblanc. By careful comparison of hearts affected with different forms of hypertrophy and healthy hearts, he finds that there are three distinct varieties of the lesion. The first is that in which the walls of one or more cavities are thickened without change in the capacity of the cavities: this is the *simple hypertrophy.* In the second, the walls of one or more cavities of the heart are hypertrophied, and the cavities enlarged: this is *eccentric hypertrophy,* which Corvisart has called *active aneurism* of the heart, in the human subject In the third form, hypertrophy of the walls and diminution in size of the cavities coexist: this is the *concentric hypertrophy.* Hypertrophy of the heart is usually associated with other diseases, and especially with pulmonary lesions.

The origin of this disease depends on some obstruction to the circulation, or cause which induces increased activity of the heart. Leblanc believes that chronic inflammatory disease of the serous membranes, covering or lining the heart, may induce hypertrophy, and he notices also the obstructions to the flow of blood by constriction of vessels and of the apertures between the different cavities of the heart.

Symptoms.—In simple hypertrophy the action of the heart is stronger than usual, though the impulse is not so sharp, and is felt lower than usual. This condition is found to persist. The sounds of the heart are more intense, though indistinct, provided that the cavities are not diminished in size. A metallic bruit is often heard most distinctly near the seat of the hypertrophy. Leblanc says that there may be very energetic impulse on the right side of the chest due to an eccentric hypertrophy of the right side of the heart. He has also noticed at the same time another coincidence, which is a very manifest murmur, probably produced by the shock between the columns of blood and semi-lunar valves, which he calls *bruit de claque*. The impulse of the heart in cases of hypertrophy is sometimes visible on looking from a distance at the region of the heart. Leblanc has also met with reduplication of the second sound, a symptom which indicates irregular muscular action. On the subject of the reduplication of the heart's sounds, Dr Barclay says, in his admirable *Manual of Medical Diagnosis*, at page 383:—"Reduplication, like intermission, suggests some imperfection in the relation of nervous force and muscular contraction, in so far as one serves to regulate the other: but while we are able to draw a distinction between intermission and irregularity, as indications of disease, we are not able to lay down the same certain rules in reduplication. We may be very confident that when both sounds are reduplicated there is some form of disease present: reduplication of the second sound is very often caused by imperfect closure of the auriculo-ventricular aperture on one side, which causes the systole of one ventricle to terminate more quickly than the other; but it is also heard, like intermission, in what we call merè functional disturbance. It will be readily understood that when either sound becomes prolonged by the presence of a murmur, the reduplication is lost in the continuous bruit. It is wise in practice to restrict the term reduplication to cases in which no bruit is detected; for example, when there is a slight diastolic aortic murmur, the second sound of the heart, formed at the pulmonic valves, may be heard quite distinct and separate from the aortic bruit, which replaces the second sound there; but the two do not consist of a reduplicated second sound, but of the sound and the bruit, which are heard separately, the one short and terminating at its usual time, the other prolonged."

Percussion enables us to determine the extent to which the heart is enlarged, as its position is indicated by dulness, which is, of course, detected over a wider surface as the heart increases in size. It is not easy to be very accurate in determining the extent of general enlargement the heart has suffered in the horse. This is more readily accomplished in the dog, but in none of our animals so satisfactorily as in man, in whom an expert physician will mark with a pen precisely the limits to which the heart has extended beyond the natural space it should occupy in the thorax.

In simple hypertrophy the pulse is often regular, full, and strong. It is small and feeble in the rare cases of hypertrophy which are classified under the third head mentioned above, of concentric hypertrophies.

Hypertrophy of the heart is a malady which progresses slowly, though it soon prevents an animal performing any hard work, and being used for fast riding or driving. It predisposes to other maladies, such as pulmonary congestion, active hæmorrhage, &c.

Treatment.—Judicious management, so far as moderating diet, restricting the amount of work, and allowing ample periods of rest, includes most of what can be done to relieve an animal suffering from hypertrophy of the heart. Leblanc states that hypertrophy of the heart is frequently met with in broken-winded horses, and he has observed the best effects in these from the daily administration of small doses of arsenic. I can confirm this statement.

Atrophy of the Heart.

The diminution in thickness of the muscular walls of one or more cavities of the heart is certainly not unfrequent in the horse. The size of the cavities is usually increased, and very rarely do these remain of their normal capacity under such circumstances. From my own observation, the right side is more frequently atrophied than the left, and the auricle oftener than the ventricle.

Symptoms.—Animals are dull, not inclined to eat or work; pulse feeble, indistinct at the jaw, and often irregular. The sounds of the heart are feeble and indistinct, sometimes modified by complications, such as valvular disease. There is often a marked venous pulse; coldness of the extremities, and other symptoms noticed under the head Dilatation of the Heart. Treatment is of no avail.

Dilatation of the Heart.

I have witnessed three well-marked cases of dilatation of the right side, and all within last year and this. They all presented the same features as to history, &c., and may be grouped together.

1stly, The animals had all been owned by the persons consulting me for periods varying from four to six months.

2ndly, During that time complaints were constant regarding the animals' inability to work. Two of the animals—one a clever little chestnut mare, and the other a good bay carriage horse—were naturally active useful animals, but were rendered unfit for work by the cardiac disorder.

3rdly, The leading symptoms noticed by the owners and grooms in the three cases were, difficulty of breathing on the slightest exertion, no appetite, coldness of the extremities.

In one, the owner had observed a "trickling of the blood in the veins of the neck"—*venous pulse*. In another two, fainting fits in rapid succession following a partial attack whilst the horse was in harness, led to my being consulted. In the third I was called after the animal had had "*a fit of staggers.*"

4thly, In all three cases the animals had been treated for supposed disorders of the lungs, though no cough or other symptoms except those above-noticed had been observed.

5thly, I found no difficulty in diagnosing either of the cases, notwithstanding that the true nature of the disease had not been recognised during the many weeks that the animals had been under treatment. The symptoms were:—Small, feeble, irregular pulse; in one case indistinct at the jaw. Marked venous pulse, especially after a little exertion. Coldness of the extremities, especially of the hind ones, which had a tendency to œdema. In two cases the disease had so far advanced, that shortly after my seeing them, œdema set in below the chest and belly. Heart's action embarrassed, and impulse tremulous. Sounds not much altered, but the first somewhat modified.

6thly, *Results.*—The chestnut mare I purchased to show the case to my class, and dissect the animal; but as the malady had not advanced very far, we tested the effect of a little slow work, and she was used for a few days in a light cart. The individual who undertook to drive her for me was so pleased with the mare that, in the presence of my students, he offered me £16 for her. I assured him that she would drop down and die some early day, and probably when at work. I moreover told him that the animal must be dissected. On the next day, at about one o'clock P.M., I was suddenly called to perform the post-mortem examination. The mare had been put in harness and walked up a somewhat steep hill, at the top of which she reeled to and fro, and sank to rise no more.

In the second case the horse was sold to some horse-coper for £6, and I lost sight of him. The third is still under observation for the benefit of our students, and will in due time be destroyed for dissection.

The post-mortem appearances in the chestnut horse indicated enormous dilatation, with atrophy of right side of the heart. The tricuspid valve was insufficient. The muscular structure of the heart had undergone slight fatty degeneration.

These interesting cases are of moment to the veterinarian in indicating the possibility of diagnosis by a correct appreciation of symptoms. They will be found to correspond in many points with the following cases which I quote from Mr Percivall's *Hippo-Pathology*:—"Mr Pritchard was requested to examine a six-year-old mare, on account of falling away in flesh. He found her poor and lean on the rib, with belly large, and coat unhealthy; although she had been for several weeks in good pasture, where she, otherwise, appeared tolerably well and lively. Pulse 84, rather hard and irregular. The impulse of the heart indicated a change in its structure, by a loud and sonorous stroke, recognised on the right side of the chest nearly as forcibly as on the left. Its beating was regular; but an unnatural rhythm, a throbbing palpitation, accompanied the stroke. The blood in the jugular veins met with considerable impediment. The regurgitation observed in these vessels at the bottom of the neck, slight in horses in health, was in this mare considerable, and extended up the neck even to the head. The belly and legs were slightly œdematous. At length, diarrhœa attacked her, and carried her off. The pericardium was thinner and more capacious than ordinary. The heart appeared unusually large and flabby; lymph was effused into the cellular substance around its base; the right auricle was very much enlarged, being three times the size of the left, and its walls thin; the right ventricle was dilated, but not at all in proportion with the auricle; the left auricle was not dilated, but the left ventricle was much enlarged, and its walls, especially at the extreme of the apex, so thin that Mr Pritchard felt a little astonished that it could have contracted without rupture, for it was not more than one eighth of an inch in thickness. The heart weighed ten pounds, and measured in circumference, at the base, two feet seven inches. The lungs were perfectly healthy. Mucous lining of the bowels tumid from serous engorgement. Absorbents of the large intestines loaded with red-yellow lymph; but near to the receptaculum chyli, with blood. The thoracic duct contained principally blood, but was not much dilated. The liver was in a state of sanguineous engorgement, weighing nearly thirty pounds. There was extravasation of blood into the parenchyma.

A most extraordinary case of dilatation or aneurism of the left ventricle of the heart, is related in vol. xiv. of the *Veterinarian*, by Mr Harrison, V.S., Southport. The subject was a cart-mare, nine years old, who, from her youth, had been in the habit of drawing heavy loads, on which occasions her spirit seemed to exceed her strength, though she had always maintained her health, notwithstanding that, for some months before her death, she had not thriven as heretofore. Though apparently quite well, for the first time in her life, after a hard day's ploughing, she refused her food, and appeared very weak, for which she was bled, which made her still weaker. When Mr Harrison first saw her she was scarcely able to stand, and, while he was in the act of feeling her pulse, she staggered and fell. The pulse, after she was down was very small and weak, and it was not, with any accuracy, to be counted. She became comatose, with her respiration nearly suppressed, as though she were dead. When she came to, the breathing was shorter and quicker than natural. Mr Harrison had her destroyed. The stomach was found in a state of *collapse;* but her disease was in the heart. 'The left ventricle proved in such a state of dilatation that it almost filled the left cavity of the chest, usually occupied by the lung, but which latter had gradually become absorbed, to accommodate itself to the increased size of the ventricle, and this absorption had proceeded so far that the lung did not exceed the size of the breadth of one's hand, and this remnant was situated at the most posterior and superior part of the chest. The brain was perfectly healthy.'"

OSSIFICATION OF THE HEART.

This singular lesion has been observed several times, and I am acquainted with two admirable specimens. One is in the London Veterinary College museum, and the other at Alfort. The ossification has evidently extended into the substance of the ventricles, and appears to me to consist in calcification of the areolar tissue, probably associated with fatty degeneration, and removal of a very large portion of the true muscular fibre. It is difficult to understand how the circulation could have been carried on. Mr Percivall says:—" Mr Henderson, V.S., London, has in his museum* a remarkably fine specimen of this disease. The parietes of the right auricle are converted into osseous substance, rendering that cavity but a passive receptacle for the blood: the current must have continued without any, or with hardly any, fresh impulse into

* Now at the Royal College of Veterinary Surgeons in Red Lion Square.

the ventricle. All that Mr Henderson knows about the case is, that the horse from which the heart was taken dropped down dead, in an emaciated condition, in a dust-cart.

"A case of ossification of the right auricle is reported in the *Récueil de Méd. Vet.* for Sept. 1840. It occurred to Mr Barthelemy. The horse, small in stature and weak in appearance, worked in a public carriage, but only for five months, before he was found incapable, though only five years old. He had no cough, though it was found that his respiration and pulse were much quicker than in health, and that the slightest exercise proved sufficient to put him out of breath; though even then the motions of his flanks were but increased in number, without being rendered irregular. At length he was sent into the infirmary, and died there on the sixth day, with symptoms of pneumonia in both sides. There were found abscesses and vomicæ in the lungs, with hepatization and grey tubercle, quite sufficient to account for death. But the heart also was diseased. It was so voluminous as nearly to fill the entire cavity of the pericardium; and its left auricle was ossified, and strongly adherent to the pericardium by white fibrous bands. It was double its natural size, and its ossified walls proved more than one-third of an inch in thickness. The auricular septum was sound, and the auriculo-ventricular valves had not a spot of ossification. The ventricles were not sensibly enlarged."

Fatty Degeneration of the Heart.

This disease, so common in the human subject, is not frequently seen in the lower animals. In a state of obesity the heart of oxen especially is surrounded with large masses of fat, which penetrate its structure to a certain extent. But, in addition to fatty tissue, deposited around the heart, the muscular structure gives way, and fibres are observed broken up and replaced by innumerable oil-globules. I have, however, shown that in a case of dilatation the heart was fatty, so that, apart from the tendency to obesity in some cases, and of premature decay in others, when various tissues are disposed to undergo fatty transformation, the heart is implicated by a similar retrograde change.

The symptoms are those of dilatation already given, and treatment is of no avail.

Amongst the cardiac affections of a chronic nature, and which are rarely diagnosed during life, we must class—

TUMOURS OF THE HEART.

There is a great variety of cardiac tumours. Those that I have more frequently witnessed are—1. Parasitic growths, either internally situated or attached to the apex of the heart. 2. Melanotic tumours in the substance of the heart. 3. Fibrinous tumours, or cardiac polypi, properly so called. 4. Vascular tumours. 5. Cancer.

It is evident that the importance of these organic disorders varies as much from the position of the growth as from its size and tendency to interfere with the heart's action. The presence of a small obstruction within the heart is calculated to endanger an animal's life far more than an external tumour. Thus, a polypus forming within the auricle may drop on the corresponding auriculo-ventricular opening and arrest the blood's flow. It is remarkable that, as shown by case 2, reported below, a large polypus may have its pedicle in the auricle, and continue growing in the ventricle to the extent of filling the latter, and yet the animal died suddenly *without having previously shown signs of ill health.* I have here to repeat that the temperament, habits, and manner of keeping cows tied up in a stall, lead to the observation of cases in these animals which would give rise to symptoms at a comparatively early period in the hard-worked horse.

With regard to external tumours, their weight is sometimes very great, and, when connected with the apex, may attain a size far exceeding that of the heart itself, without inducing very serious symptoms. This is not the case when the deposits invade the base of the heart, where they obstruct the vessels and arrest the circulation. If the veins are chiefly implicated, dropsical effusions, with symptoms of debility, palpitating heart, and coldness of the extremities, &c., are observed. If the arteries become constricted, the imperfect flow of blood soon leads to great prostration and hectic, the animal lingering on to die in a state of great emaciation.

The tumours examined, and which are connected with the exterior of the heart, originate in the substance of, or immediately beneath the pericardium, which yields, and is continuous in all cases I have examined with the envelope of the growth. The tumours are usually unattached to the parietal layer of the pericardium, and lie free in the pericardial sac.

The tumours are often multiple, and this is chiefly the case in cancer and melanosis.

1. With regard to the parasitic growths, I have examined in Bologna a polypus containing as its nucleus a cyst, within which were admirable specimens of *echinococcus veterinorum.* Another remarkable specimen, preserved in the museum in that city, consists in a large mass of cysts hanging from the apex of the heart of an ox. These are cysts of the same parasite. *Cysticercus tenuicollis* has been met with in the pericardial cavity; *cysticercus cellulosæ,* in the substance of the heart of the pig; and *dochmius trigonocephalus* in the cavities of the heart of a dog.

2. I have seen several instances of melanosis implicating the heart, but only recognised after death.

3. In referring to cardiac polypi, I may draw attention to a paper by my brother, Mr Arthur Gamgee, published in the second volume of the *Edinburgh Veterinary Review*, p. 30, in which a specimen is described as follows:—

"CASE I.—*Tumour occurring in the left Auricle of the Heart of a Cow.*—The morbid specimen, of which a drawing is appended, was brought to the New Veterinary College from the Edinburgh slaughter-houses. The heart had, by the man who had killed the animal, been at once recognised as presenting an abnormal appearance; no account was, however, forthcoming of the state of the beast during life. The heart weighed 5 lbs., and with the exception of very great distention of the left auricle, appeared quite healthy. The left auricle had been cut before it was brought to us, and from the opening a fibrinous mass protruded. The left ventricle was first opened by a longitudinal incision along the septum ventriculorum, both on the anterior and posterior surface.

"*Description.*—On examining the auricle through the auriculo-ventricular opening, it is found distended by a tumour, which so thoroughly obstructs the opening as to render it a matter of mystery how blood could pass through the pulmonary veins into the ventricle. On making an incision from right to left along the upper surface of the auricle from the body to the auricular appendage, the tumour is observed to fill the whole extent of the cavity, to the right side of which it is attached by a broad base. On drawing out the tumour from the auricle by turning it on its base from left to right, it is exposed in the position shown in Fig. 116.

"Around the tumour shreds of blood-clot exist, but the mass itself has a pinkish-yellow colour, rather nodulated on the surface, which is smooth, with the exception of a considerable patch of gritty roughness and greyish-yellow colour; at the lower surface, the shape of the tumour exactly repre-

Fig. 116. Cardiac polypus. *a*, Fibrous tissue of peduncle; *b*, Lymph corpuscles; *c*, Elongated cells.

sents that of the distended auricle, and on superficial examination of its pedicle, it appears to have an extensive attachment to the wall of the auricle, the endocardium seeming to extend over the mass. The tumour has a decidedly elastic feel, and in some parts the recoil on pressure is such as almost to resemble fluctuation.

"Before proceeding with the description of the internal aspect and structure of the tumour, I must mention that the auricle appears healthy throughout, and its lining membrane smooth, except approaching the mitral valve, the flaps of which have a shrunken appearance, and a decidedly uneven upper surface. The left flap is perforated in its centre by five holes, the membrane of the flap, especially around one of these, being decidedly attenuated. Another hole, considerably to the right, is much larger and jagged. The right flap is thickened in some parts, attenuated in others like the left, but only perforated by a few minute holes near its free edge. The chordæ tendineæ are healthy, the papillary muscles well developed, the ventricle presenting no morbid characters. In order to examine the structure of the tumour, a clean section was made through its middle, dividing it and its pedicle very nearly in half. The feel imparted by the knife resembled that of cutting through soft cheese, with the exception of the peduncle, which was tough and fibrous. Each cut surface showed the bluish-red structure of the peduncle, ramifying from its base into the tumour, extending from right to left, but sending out broad processes into a stratified mass of pinkish-yellow fibrine, the outer layer of which circumscribing the whole, appeared the toughest. This fibrine exactly resembled that found in the sac of an old aneurism. No juice could be squeezed from the cut surfaces.

"*Measurement of Tumour.*—Greatest length is in transverse direction, *i. e.*, at right angles to the pedicle, 4¾ inches; from the centre of the pedicle to the highest point on the surface, 2½ inches; pedicle, from base to the uppermost ramification, 1⅝ inches. In front of the pedicle is a small flattened tumour, about 1 inch in length, and ½ inch in width, possessing the same physical aspect as the other, without gritty deposit, and firmly attached by a very slender and long peduncle.

"*Microscopic Examination.*—On examining the connections of the pedicle and the layers of fibrine surrounding it, there is evidently a gradual transition of structure from the tough fibrous and vascular peduncle to the cheesy granular and exsanguine fibrinous deposit. On examination with the microscope, the peduncle is seen composed of fibrous tissue, and interspersed are elongating lymph-corpuscles (*a*, Fig. 116.) Towards the processes of this fibrous deposit, the tissue is more imperfectly organized; fibroplastic cells (*c*) are more numerous, and as we extend from the centre these in their turn give way to the unchanged lymph corpuscles (*b*) and molecular matter constituting each compact layer. In some parts towards the surface of the tumour, the molecular matter almost entirely constitutes the layers; in others the lymph cells are very abundant. The gritty deposit on the surface effervesced on the addition of hydrochloric acid, and some phosphatic crystals (though few in number) were seen.

"CASE II.—*Cardiac Polypus firmly adherent to the Internal Wall of the Right Auricle.* (This is the description of specimen 2510 in the musuem of the University of Bologna.)

"Professor Allessandrini says of this tumour, that it occurred in an ox, nine years old, that died suddenly, and which previously had shown no signs of ill-health. A vertical section of the heart being made from the base to the

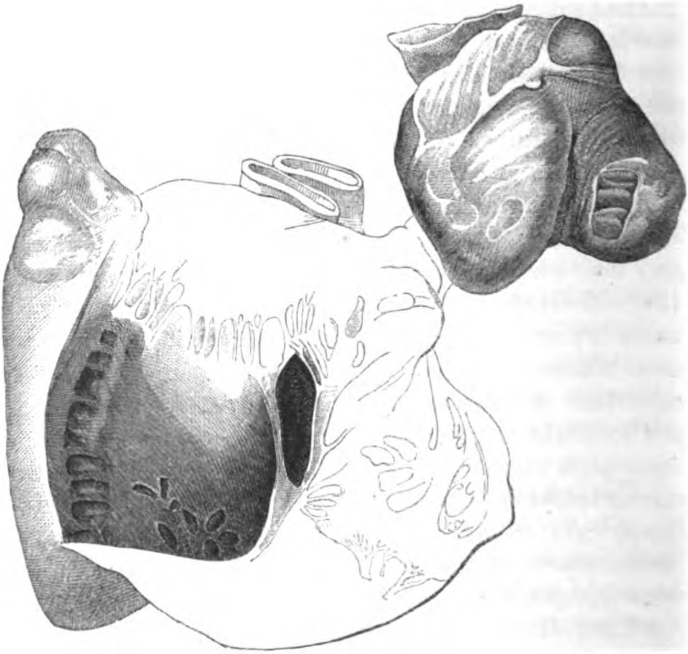


Fig. 117. Cardiac polypus.

apex, exposing all the right ventricle and part of the right auricle, a polypus comes into view, exactly resembling in form and consistence those found on mucous surfaces, in the uterus, vagina, and the nares. This polypus (Fig. 117) is attached by a rather slender pedicle, to the internal walls of the right auricle next the appendix, and nearly fills the cavity of the right ventricle, dragging down the wall of the auricle, to which it is attached, to the level of the ring of the tricuspid valve. The polypus is of a somewhat circular shape, and its dimensions before immersion in spirit were as follows:—

Greatest circumference from one side of pedicle to the other, going over the largest part of tumour . . .	13·39 inches.
Circumference of pedicle . . .	2·44 „
Circumference at the thickest part of tumour	9·17 „
Greatest length	5·39 „
Greatest width in the centre . . .	3·93 „

"This polypus was very firm, elastic, and almost appeared to contain fluid; none was, however, found on section. Polypi that have reached so advanced a period of organization are of extreme rarity, and my search for cases of them in periodicals and in works on diseases of the heart, has been very unproductive."

In the sixteenth volume of the *Veterinarian*, Mr Kay, of Pontefract, describes a singular case which occurred in a quey thirteen months old, and in which, from the irregularity of the blood's flow, Mr Kay suspected disease of the heart. The animal lived several days, and, after death, a polypus was found adhering to the wall of the right auricle, and another existed in the right ventricle. The latter, also adherent to the wall, weighed from five to six ounces. The remarkable feature of this case is, that two calves, about the same age and out of the same cow, had died in previous years, exhibiting the same symptoms before death.

Mr Shenton describes a case of polypus cordis in an old cow, in which the tumour grew from the septum. It is probable that not a few cases of heart disease owe their origin to rheumatism, and a valuable case in favour of this view is also recorded by Mr Shenton, in the twenty-fifth volume of the *Veterinarian.* A filly suffered from lameness, for which Mr Shenton's advice was sought. A month elapsed before a second visit, when the animal was found emaciated, still lame, and Mr Shenton considered it a case of rheumatism. Venous pulse was discerned, and obstruction to the free course of blood through the right side of the heart suspected. A fortnight afterwards the filly was found dead in her box, and a tumour was discovered in the free wall of the right ventricle. The only other lesion consisted in enlargement of two or three mesenteric glands.

The above cases evidently belong to a class that chiefly affect cattle, and are not often recognised during life. The tumours owe their origin, probably, as my brother states, to the organization of plastic matter thrown out in endocarditis, as well as to the deposition of fibrine from the blood in layers around such primary deposit.

4. Fig. 118 represents a vascular tumour springing from the right ventricle of a horse, and which I had an opportunity of drawing from a specimen in the museum at the Turin veterinary school. Like other tumours of the heart, its presence was not diagnosed during the life of the animal.

It was chiefly composed of venous varicosities with coagula which had accumulated in sacular recesses. The

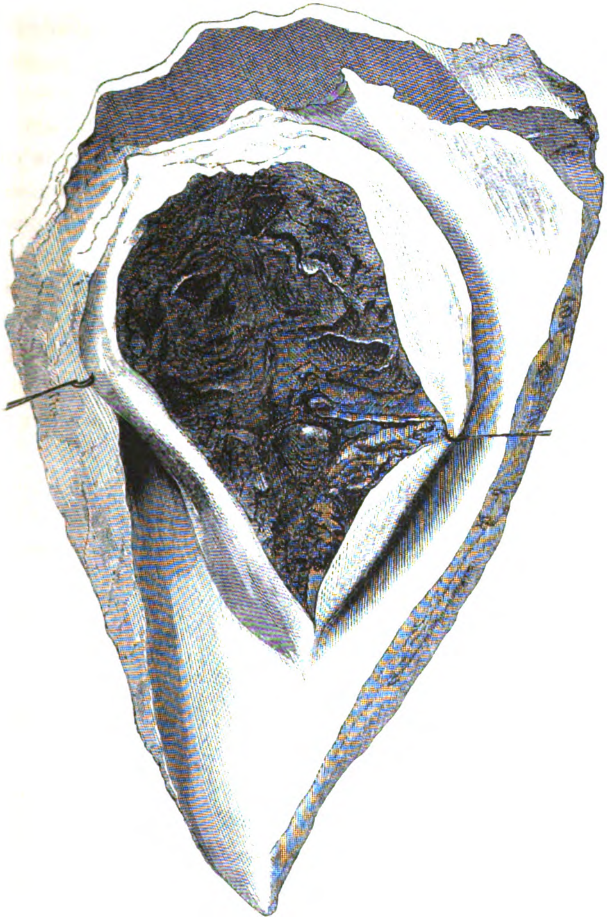


Fig. 118. Vascular tumour in heart of horse

endocardium on the surface of the growth was smooth and free from any change in structure. The growth was diffuse and tapered, as may be seen by the drawing, towards the apex of the heart.

5. *Cancerous growths.*—The heart is usually involved in cancerous disease only when the constitution fails in cancer of other organs. The deposits are, therefore, secondary; though instances are not wanting of cardiac tumours, probably malignant and unconnected with cancer in other organs. Cancer of the heart obeys the same laws of development as cancer elsewhere. It arises in a circumscribed spot and spreads in every direction, usually towards the base, and invading not only the tissues around the heart and vessels, but destroying the walls of the first and coats of the second by progressive infiltration.

CHAPTER VII.

ORGANS OF CIRCULATION.

Acute diseases of the heart.—Carditis.—Pericarditis.—Delafond, Leblanc, and Dr Barclay on its diagnosis.—Cases recorded by Mr Barrell and Mr Litt.—Endocarditis.—Cases in cows recorded by Mr Gowing.—Endocarditis in the dog.—Foreign bodies in the heart.—Observations by Camoin and Boizy.—In the horse, ox, and other animals.—Diseases of the arteries.—Arteritis.—Embolism.—Meaning of the term.—Letter from Mr John Barlow to Dr Gairdner.—Case.—Mysterious forms of lameness.—Errors of Diagnosis.—A contrast.—Aneurism.—Virchow on its production.—Atheroma.—Parasitic disease of the mesenteric arteries—A disease peculiar to aged horses.—Observations in the Vienna School.—Injuries to the arteries.—Diseases of the veins.—Venous hæmorrhage.—Phlebitis.—Idiopathic and traumatic—Adhesive and suppurative.—Fistula.—Causes of obstructed veins—External, especially in harness horses—Internal, chiefly as the result of phlebitis.—Symptoms.—Megrims.—Varicosity—Local—General.—Phlebolites.—Professor Simond's case.—Dr John Reid's observations.—Diseases of the capillaries.—Active and passive bleeding.

CARDITIS—INFLAMMATION OF THE HEART.—Under the general title 'Inflammation of the heart,' all inflammatory diseases of the central organ of circulation have been classified. But when we consider that any part inflamed is inactive, it is evident that only certain structures of this vital viscus must at any time be involved. In fact, there cannot be a *bona fide* case of carditis; that is to say, one in which the muscular structure is throughout its whole substance involved in the process of active inflammation. Leblanc refers to the frequent observation of true carditis, and then says that the best circumstances to observe its lesions are immediately around the seat of any injury to the heart, or when an abscess develops in the walls, and lastly, when other alterations take place, such as deposits of lymph, &c. But the very vagueness of the symptoms furnished by Leblanc, indicate that he is not acquainted with a primary inflammatory disease involving the heart's substance. The very circumstance that his cases of carditis are declared by him as by no means incurable, prove that the heart is exempt from such a disease.

PERICARDITIS.

The serous covering of the heart is liable to inflammation more frequently than other heart structures. Pericarditis is seen with equal frequency in all our domestic animals. It occurs often as a primary or idiopathic disease, and, at other times, it is a complication in constitutional and contagious disorders. Its characteristic lesions are seen in pleuro-pneumonia in cattle, in influenza in the horse, and in rheumatism. Its causes are numerous, and usually allied to those which induce acute diseases of the respiratory organs. Damp, cold, alternations of temperature, are all favourable to its development.

The symptoms of pericarditis are often obscure, and it is not to be wondered at, when we consider how little the region of the heart is exposed in the lower animals for auscultation. The heavy shoulder, firmly applied on either side of the keel-shaped thorax, precludes any very accurate observations such as the human physician has opportunities of making. If veterinary works are consulted on this subject, it will be found that the information they furnish is very limited. I have, in several instances, succeeded in diagnosing the presence of pericarditis in the horse, and proving the correctness of my diagnosis by post-mortem examination. The symptoms are general and local. The general symptoms consist in severe irritative fever, with a frequent, wiry, and often irregular pulse. The animal stands with a sunken head and peculiarly anxious expression, indicative of considerable suffering; the eyes are fixed, nostrils dilated, breathing is laboured, and, indeed, the dyspnœa is regarded by Delafond as one of the characteristic symptoms, being attended by an action of the flank not unlike that of broken wind, and with a deep depression along the margin of the costal cartilages. Pressure on the left side, and smart percussion, induces pain in the early stages. The limbs are cold, and often having a tendency to become œdematous; effusions may occur in other parts, such as within the pleura, beneath the chest, in the sheath, &c. The animal wastes rapidly, and indicates a tendency to speedy dissolution.

The local symptoms, so far as they can be traced, are similar to those observed in man. Friction-sound is often unmistakeably heard, and Delafond has referred to the facility with which it may be often detected, and that it coincides, in the majority of instances, with the first sound of the heart. Leblanc says the friction-sounds must be distinguished from those due to pleural disease, and this can readily be done from their concomitance in the latter case with the respiratory movements. Leblanc also notices the dulness detected by percussion over the cardiac region. If we compare what Delafond, Leblanc, and others have said on the diagnosis of pericarditis in the lower animals, with that written on the subject by human physicians, we cannot fail to notice the closest similarity. Dr Barclay says:—" If, on examination of the heart, pericardial friction be made out, there can be no doubt that pericarditis exists: other indications of inflammatory action will not be wanting, but here there is less need for the evidence of correlative symptoms than in other cases. When friction-sound is absent, it may be annulled either by the presence of fluid, or by universal adhesion; in either case, the general symptoms must be decided before we can be warranted in pronouncing such a diagnosis. Along with these, not in opposition to them, we shall find in the former very extended dulness, especially in an upward direction, and, as usually described, assuming somewhat of a pear-shaped form; undulatory movement may sometimes be visible over the præcordial space, while the heart's action is excited, laboured, or irregular, and the apex-beat somewhat elevated; the ordinary sounds of the heart are distant and indistinct over the position of percussion dulness, becoming louder and more natural above the space occupied by the fluid; tenderness over the præcordial space, pain, and dyspnœa, and great distress from any sudden movement, are also met with in such cases. On the other hand, when the surfaces are agglutinated together, the evidence is more obscure; perhaps the most important points, when taken in connection with the general symptoms, are persistently perverted rhythm with nothing else to account for it, and a certain degree of obscurity of sounds, accompanied by increased and excited action. When, along with these, there are also præcordial pain, distress or anxiety, and dyspnœa, the diagnosis may be pretty certain in a case of acute rheumatism or severe pleurisy, where pericarditis is to be looked for, but can never be relied on when there is nothing else to guide us to it.

"In the early stage, excited action, altered rhythm, and creaking noise before friction is established, should prepare us for its appearance, especially if pain occur in the course of rheumatism, pleurisy, or albuminuria. In the latter disease, the plastic exudation is generally much less, the tendency to pour out fluid much greater.

"In the course of pericarditis we must be prepared for the occurrence of pleurisy, and in inflammation of the pleura for its attacking the pericardium. When the friction occurs in the immediate vicinity of the heart, it may be difficult to say by which membrane the sound is produced; because even when the breath is held, the impulse of the heart may cause pleuritic friction."

The causes, some of the symptoms, and the post-mortem lesions of pericarditis are well shown in the following account of a case of chronic pericarditis in a colt. It was communicated by Mr Barrell of Keynsham, to the *Veterinary Record*, in 1848. Writing on the 17th November, 1847, Mr Barrell says:—"Being this morning called to see a filly affected with 'surfeit,' my attention was directed to a colt then lying dead in the yard. On making some inquiries respecting it, the coachman informed me that he died suddenly on the previous evening. The history of the case was given by him as follows:—

"The colt was eighteen months old, thorough bred, and castrated last spring. He had been kept in a loose box on corn from the time of weaning till the last week in August, when both he and the filly were turned into a meadow, which was in a cold damp situation, and the grass rather scanty; consequently they became greatly impoverished. There they were allowed to remain till last week, when they were found, to use my informant's own words, 'breaking out from head to foot, and hide-bound.' On this account they were housed, and pretty liberally dieted; the owner considering that this change of living would make them all right again. The colt fed well, and not the least illness was observed up to the time of his death, except a slight swelling of the belly and sheath; in fact, he was in better condition than his companion. On the coachman's going to him last evening he found him lying down, and on causing him to rise, the breathing became very laboured for a few minutes, when he suddenly fell, and died instantaneously.

"I availed myself of this opportunity of making a post-mortem examination. The appearances presented were—belly and sheath œdematous. On laying open the cavity of the abdomen, a large quantity of serous fluid escaped. The viscera of the abdomen had a healthy appearance, except the liver, which was considerably enlarged, softened, and of a dark colour. The mesenteric glands were of the usual size, and the lacteals also. On opening the thorax I was astonished at the enormously distended state of the pericardial sac, on making a section of which about six quarts of yellow turbid serous fluid escaped, in which floated several large flocculi of lymph. The pleuræ and lungs were slightly inflamed, and many patches of ecchymosis were visible on the pleura pulmonalis and p. costalis. The heart, &c., I have forwarded you, therefore it is unnecessary for me to give any description of these parts. This case is interesting, more especially so on account of the absence of the usual premonitory symptoms of this disease."

The editor of the *Veterinary Record* added in a note, that "the lesions were doubtlessly the result of an attack of pericarditis, which had become chronic. Such cases are comparatively rare. The amount of fibrine thrown out over the heart was considerable, the false membrane being in places full half-an-inch in thickness. The substance of the heart was softened, but the lining membrane of the organ was unaffected. The pericardial sac itself was as extensively diseased as the membrane investing the heart. Such an effusion of lymph must necessarily have interfered with the functions of this all-important organ; but it would seem that the progress of disease had been most insidious."

I shall have to allude further on to cases in which sharp-pointed objects injure the pericardium and heart, but an instance, published by Mr Litt of Shrewsbury, in the *Veterinary Record* for 1845, merits being reprinted here. He says:—

"On the 21st ult. I was called upon to visit a yearling bullock that had on the previous day evinced, for the first time, symptoms of illness. The animal, which was in good condition, obstinately refused his food, and looked slightly dejected; but, beyond this, and a slight degree of constipation of the bowels, there was nothing to distinguish his case from one of ordinary fever, *with the exception of the peculiar state of his pulse*, which was exceedingly full and rapid, something like 140 per minute; indeed, the pulsations were so quick, that, notwithstanding their full and distinct character, I had much difficulty in counting them. This circumstance, and the peculiar sound perceptible on auscultation at the sides, led me to the supposition of extensive disease of the heart, but of what particular character I was at a loss to determine. Having stated thus much to my employer, and further given an unfavourable prognosis, I set about the treatment as follows:—I commenced by the abstraction of blood to the amount of about eight pounds, and administered a strong purgative drench, which, having operated freely in the course of the night, seemed to afford considerable relief, for on the 22nd he was decidedly better, and ate tolerably well, although there was but little alteration in the state of his pulse. I ordered him to have the following drench night and morning:—

℞ Ext. bellad.
Ant. pot. tart. . . . ā ā ʒj.
Potass. nitrat. . . ʒvj.
Magnes. sulph. . . ℥iv.—M.

"On the 23rd he was very much worse, and seemed to be in some pain, which, however, subsided on a second bleeding, though his appetite never returned. The medicine was persevered in, without the slightest beneficial effect, until the evening of the 26th, when death put an end to his sufferings.

"Feeling some degree of interest in the case, I rode over on the following day, and made a post-mortem examination. The abdominal viscera were perfectly healthy, but on laying open his chest an immense mass of disease presented itself. The lungs were inflamed in places, not, however, to any extent; but the pericardium was extraordinarily diseased. It was not only much thickened and inflamed, as you will perceive by the specimen sent you, but was also completely enveloped in a thick coat of coagulated lymph-like substance, from which large flakes of the same material were floating loosely in the chest. Having removed the pericardium and its contents apart from the chest, a more minute examination detected a slight opening through the sac, and a corresponding one in the substance of the heart itself, extending about half-way through the wall of the left ventricle, as will be perceptible should the specimen be still sufficiently perfect. The membrane of the heart itself was much diseased over its entire surface, and there was also an inordinate quantity of the *liquor pericardii*. Thinking the case curious, I brought away that portion of heart and sac containing the punctures, and which I trust is now in your possession: had I then thought of sending it to the Association, I should have taken the whole organ. As the animal's skin had been removed before my arrival, I had no opportunity of examining it; but I found a distinct mark, in fact a long-healed cicatrice, on the anterior portion of the left *pleura costalis*.

"The conclusion at which I arrived respecting the case was, that some time, probably months ago, the side had been punctured by some sharp instrument, and the heart wounded to the extent shown, and that the efforts of nature had never been sufficient to close and heal up the injury: unhealthy inflammation was the consequence, and the result of all, the mass of disease I have attempted to describe. The case is also interesting as being another proof how long the most serious disease of a most important organ may be going on without in any way interfering with an animal's apparent well-doing—a circumstance of great importance to the veterinary surgeon."

Leblanc has described with great precision the lesions of pericarditis, the congestion characteristic of the early stages, the opacity of the serous membrane, its thickening, and the formation of false membranes. The two surfaces of this serous membrane may adhere throughout their whole extent, and the heart's action be permanently impaired.

Treatment.—Pericarditis is not an incurable disease. It is often fatal in a very short time, not lasting more than from five to eight days, but many cases recover. The method of treatment varies according to the circumstances under which it is developed. It may be necessary to treat an animal for an attack of rheumatism or influenza, of which the pericarditis is but a complication. If developed as a specific disease, active antiphlogistic measures must be adopted at first. Bleeding may be resorted to in the earliest stage, though its importance is not, in my estimation, so great as the administration of an active cathartic. A large mustard poultice may be applied on the chest, and salines administered at intervals. Sedatives have been strongly recommended, and, amongst others, digitalis. The following prescription is one amongst many forms in which this remedy has been administered:—

Acetate of lead, . . . ʒij.
Powdered leaves of digitalis, . ʒij.
Powdered liquorice root, . ℥ij.
Powdered marsh mallow root, ℥j.

Add sufficient water to make an electuary. The fourth part to be administered every three hours to horse or ox. In the pig and dog antimonials are to be recommended. The extremities must be hand-rubbed and bandaged, the body covered with warm clothing, and any of the large herbivora may be allowed cold water *ad libitum*, containing about an ounce of nitre to the pailful.

ENDOCARDITIS.

Inflammation of the inner lining of the heart is a very common complication in rheumatic disease. It is indeed a specific lesion of this peculiar fever, and Dr Richardson considered that when, after injecting lactic acid in solution in the peritoneum, he discovered the appearances of endocarditis, that he had produced the characteristic lesion of rheumatism. Endocarditis is a very acute and dangerous disease. It is, perhaps, more dangerous from the results to be feared than from its tendency to kill in its acute stage, though this is not an unfrequent occurrence.

The causes of endocarditis are very similar to those of pericarditis, and must often be grouped with those of rheumatism. A constitutional tendency appears in animals as in man to influence the production of this disease.

Symptoms.—The general symptoms of irritative or rheumatic fever are attended with very marked local symptoms of heart disease. There is very decided interference with the action of the heart, and its contractions are energetic, vibratory, and often irregular. The pulse is unequal in its beats, and often intermittent, and there is a marked contrast

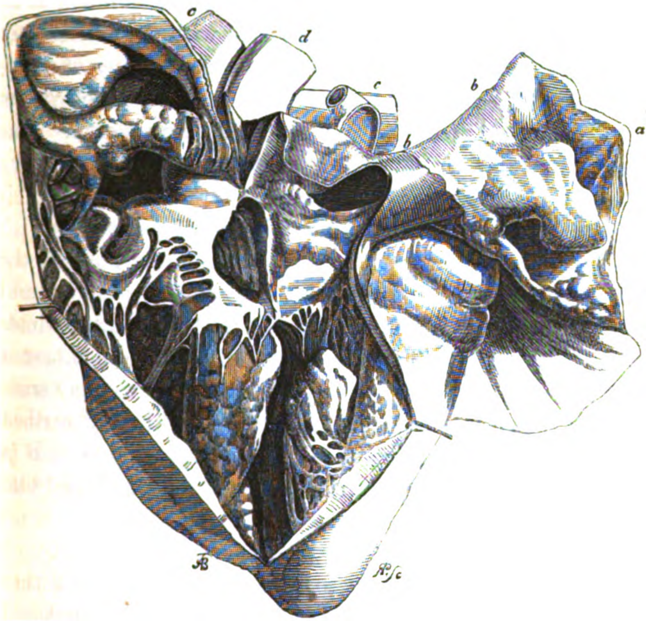


Fig. 119.—Thickening of the Endocardium as the result of inflammation.

between the violent heart-beats and the smallness of the pulse: Leblanc says that this sign is very important in distinguishing endocarditis from pericarditis. This author notices specially a loud metallic tinkling in connection with endocarditis, as well as a *bruit de souffle* or bellows-murmur. A marked venous pulse is seen in this disease, as much as in other acute cardiac affections, interfering with the efficiency of the auriculo-ventricular valves. In the early stages of endocarditis the breathing is not very laboured; but if the valves become much impaired, the dyspnœa is very severe. The usual result of a violent attack of endocarditis is shrinking of, and the formation of vegetations on, the auriculo-ventricular valves, with narrowing of the openings with which these valves are connected. Sometimes the whole of the endocardium is thickened, and the seat of deposit in and beneath its structure, as seen in Fig. 119. At other times the inflammation is limited to a part where false membranes and pus may form. It is to endocarditis that we may trace some of the enormous cardiac polypi which I have described in the chapter preceding this one. A remarkable case is recorded by Mr Gowing, in the *Veterinary Record* for 1848. He says:—

"Unfortunately, the history of the first case is brief, as I was not called professionally to attend it. All I could gather from the proprietor was, that the animal had been purchased by him about five months since. She was of the short-horn breed, and had calved a few days previous to purchase. When in possession of her owner three or four days, the milk was perceived to assume a peculiar red appearance, as if blood had been mingled with it; and this continued till the animal died. At this time she fed well, and was improving in condition, and it was anticipated the milk would resume its natural state, and likewise increase in quantity; instead of which it diminished, the appetite became impaired, and the animal was observed by the dairyman suddenly to fall down. She was raised, and the body and extremities rubbed, and she apparently recovered, remaining seemingly in health for the period of five or six weeks, when she again as suddenly fell. Being raised, and the same means adopted as at first, she soon after again recovered; but she now lost flesh rapidly, and although the owner resorted to the aid of medicines, it was evident she was fast sinking: he therefore determined to sell her in the state she was, rather than to incur any further expense. On going into the cow-house on Thursday morning last, he perceived the animal was again down; but remembering she had fallen twice before, he took little notice of it: on a closer examination, however, she was found to be dead.

"*Morbid Changes in the Heart.*—The organ, viewed externally, presented the left auricle prominent, and of a rounded form. The heart itself was somewhat elongated, and smaller than natural. On making a section of the auricle just at its base, a solid mass of matter, of a dark colour, and as large as a man's fist, was perceived, filling up the cavity, and also passing into the auriculo-ventricular opening, adhering slightly to the bicuspid valve. Superiorly, a portion of it had entered two of the pulmonary veins. On its upper and outer part a cup-like cavity existed, which evidently had contained pus. The mass itself was adherent only to the supero-external part of the auricle, and thus a passage was formed for the blood from the pulmonary veins into the auricle, the muscular walls of which were much dilated and attenuated.

"Examining the points of attachment, the nature of the abnormal deposit was disclosed, and also the causes that must have been in operation to produce it. The serous lining membrane had evidently been intensely inflamed, and depositions of lymph, which had become organized, had taken place, giving rise to a considerable thickening of this membrane. Layer after layer of fibrine had become separated from the blood as it passed over this diseased membrane, and thus the mass was gradually formed. Through the continuation of the inflammatory action the pus was secreted, which filled up the cup-like cavity, the walls of which had been formed by the separated fibrine, as already described.

"The great peculiarity of this case is, the existence of inflammation in one part only of the lining membrane of the auricle. It is also singular that this diseased action is more commonly met with on the left side of the heart than on the right. The sudden and repeated falling down of the animal will be, of course, referred to an unequal or irregular supply of arterial blood to the brain.

"The case of abscess in the walls of the heart of a cow is even less interesting than that I have recorded, as, during life, the only symptom indicative of diseased action going on was, the animal's always turning to one side when moved or caused to progress. This would rather have awakened a suspicion of the brain being implicated. She, however, died suddenly, when the last-named organ was found to be perfectly normal; but an abscess existed in the muscular structure of the heart, containing more than a tea-cupful of pus."

In the dog I have seen acute endocarditis frequently supervening during an attack of rheumatism. The animal becomes very helpless, suffers intense pain, cannot be moved from its bed without crying out, and manifests considerable dyspnœa. A very marked bellows-murmur may be heard. Endocarditis is regarded by some as a very common disease in the dog. Its results, viz., chronic valvular disease, are not uncommon, and characterised by loss of activity, dyspnœa, and signs of cardiac embarrassment on the least exertion.

Treatment.—The treatment of rheumatic fever and rheumatic endocarditis, are one and the same. Evacuants, sedatives, and salines are the remedies to be employed. From ten to twenty drops of tincture of aconite, or half-drachm doses of digitalis, may be given with four ounces of liquor ammoniæ acetatis, in a quart of water, morning and night, to the large herbivora. To the dog, two or three drops of tincture of aconite, or hydrocyanic acid, with a table-spoonful of liquor ammonia acetatis, in a wine-glassful of water, may be given at similar intervals. Mustard poultices and active blisters will relieve. If the dyspnœa and embarrassment of the heart's action continue long, organic lesions of the valves may be declared to exist, which will for ever incapacitate an animal for work. I do not agree with Leblanc, who says:—"It is very rare when the first symptoms do not appear very promptly, and in the course of three or four days, that the disease does not last several months. It is under these circumstances that we must not leave the animal to nature. Sinapisms, blisters, setons, moderate diet on soft food, are to be employed." My advice is the reverse, as I never knew an animal recover so as to work well and with comfort to itself, unless the acute symptoms of endocarditis had been fairly subdued, and no organic trace of the disease left.

Foreign Bodies injuring the Heart.

Very many cases are recorded of sharp-pointed objects in the shape of bits of wire, knitting-needles, nails, pins, &c., passing from the second stomach through the diaphragm to the heart, and producing symptoms of pericarditis. There are certain countries in which cows are very frequently attacked thus, and entirely from the manner in which they are kept, and the many opportunities offered for the animals to pick up objects which their female attendants use, and are apt to throw about. In Britain these accidents are common; but I think, on the whole, less frequent than in Italy, Switzerland, or France. In the archives of the University of Bologna, many cases are recorded, and which have been communicated by veterinary surgeons in the neighbourhood.*

* In 1859 I consulted many authorities with a view to draw up a list of cases for my friend, Mr Jardine Murray. Very many more are to be found scattered in periodicals, but the most important are, perhaps, included in the following notes:—

Frei found a knitting-needle penetrating the pericardium of a cow, to the extent of half-an-inch.—CANSTATT'S *Jahresbericht über die Leistungen in der Thierheilkunde*, 1851, p. 40.

Fischer found a nail transfixing the reticulum and heart of a cow, which had died after a short illness.—*Ibid.*, p. 40.

A piece of iron wire, two inches long, was found in lymph connecting the reticulum, pericardium, and heart in a cow, which had, for some period, suffered from constant cough, but had eaten heartily till the day before death.—*Archiv für Thierheilkunde, von der Gesselschaft Schweizericher Thierärzte.* Neue Folge, 8 Band, p. 25.

A case in which similar appearances were discovered, but in which the foreign body had disappeared, is related by Brennwald.—*Ibid.*, 1850, p. 62.

In a like case, Mauer found a piece of wire in the wall of the left ventricle.—*Ibid.*, p. 25.

Von Sindenberg gives the case of a cow in which a plank-nail, four inches long, surrounded by pus, was found to transfix the reticulum, diaphragm, and heart, which were agglutinated by lymph.—*Magasin für die gesammte Thierheilkunde.* Herausgegeben von Dr E. F. GURLT und Dr C. H. HERTWIG, Berlin, p. 190.

Von Eckerdorf cites a case in which the reticulum and diaphragm were found transfixed by half a roofing-nail (Schindelnagel).—*Ibid.*, p. 417.

Körber found a needle penetrating the adherent pericardium and left side of the heart of a cow.—*Ibid.*, 1850, p. 398.

In the same journal (1847, p. 147), Schöle describes three analogous cases. In the first, the reticulum was adherent to the diaphragm, through which there was a small fistulous opening. The foreign body

It is difficult to furnish a complete history of accidents which have been, on the whole, but imperfectly observed. I cannot do better, I think, than reproduce abstracts of two of the best papers on the subject, though abundant materials

was not discovered, having probably again found its way into the second stomach. In the second, the pericardium was enormously distended, and a hair-pin transfixed the heart, pericardium, and reticulum. In the third, a sewing-needle was found transfixing the reticulum and diaphragm, injuring the pericardium at its apex.

Zimmermann observed three cases of traumatic disease of the heart as the result of penetration of its walls by sharp bodies.—*Thierärzliche Zeitung*. Herausgegeben von den LEHRERN der grossherz. Badishen Thierarzneischule Red. C. A. FUCHS). 4 Jahrgang, Carlsruhe, p. 21.

Werner gave a case in which a table-knife, 7½ inches in length, passed from the reticulum to the left ventricle of the heart, penetrating its substance to the depth of two lines.—*Centralarchiv für die gesammte Veterinärmedicin und die Veterinärärzlichen Standes- und Vereinsangelegenheiten*. Herausgegeben von Dr J. M. KREUTZER, Prof. in München, 1848, p. 165.

Franzisci relates a case of emphysema extending over the whole body from a ramrod, 14 inches long, having passed through the diaphragm, and wounded the under surface of the left lung and thoracic walls.—*Thierärzliche Wochenblatt*, redigirt von Niklas, Landgerichtsthierarzte im Neu-Ulm. 1 Jahrgang, 1848, p. 29.

Rainard says that needles frequently pass from the œsophagus to the heart, and in some cases sticking in the substance of the heart, and in others remaining free in the pericardium. He describes a case in which it is probable that the needle passed through the vena cava into the substance of the heart.—*Journal de Médecine Vétérinaire de Lyons*, 1849, p. 425.

Murray records a case in which a headless brass pin, three inches in length, had transfixed the pericardium and left ventricle, causing death. *The Veterinary Record and Transactions of the Veterinary Medical Association for* 1849, p. 244.

Several other such cases are alluded to in the *Dictionaire de Médecine, de Chirurgie, et d' Hygiène Vétérinaires*, par M. HURTEL D'ABOVAL. Tome 1°, p. 578, et seq. Article "Corps étrangers."

are scattered through the pages of veterinary journals in the shape of individual cases. The first is entitled—

FOREIGN BODY IN THE LEFT AURICLE OF THE HEART.—The subject of this paper was an eight-year-old cow, in good condition. M. Camoin's advice was solicited in consequence of her having been unwell for eight days previously. He found her lying on her right side, with the head turned upon the shoulder, eyes half-closed, muzzle dry and cold, mucous membranes pale, and pulse small, frequent and intermittent. The respiration was short, slow, and abdominal, and the temperature of the body reduced. The animal having been raised with difficulty, was immediately seized with rigors, which gave way to dry hand-rubbing. Next an eructation took place, of gas having a most repulsive odour, as of decomposing animal matters. There was slight œdema on the middle of the belly, and round the muzzle. There was general stiffness and difficulty in motion. After walking a few paces, the pulse became fuller, accelerated, no longer intermittent, but very irregular. Inspiration short and catching, expiration full and prolonged. Auscultation detected a very distinct *bruit de souffle*, and loud beating of the heart without regularity in the time of systole and diastole. The veins of the neck and head were engorged. The general condition of the animal was anæmic, it was slightly hoven, and constipated. Some appetite remained, and the thirst was remarkable.

Disease of the heart was diagnosed, and at the request of the owner the cow was subjected to treatment, without, however, preventing a gradual aggravation of the symptoms. On the fourth day of M. Camoin's attendance, the animal was extremely anxious, the head was frequently turned toward the region of the heart. The open mouth showed pallid mucous membranes, sometimes there was grinding of the teeth, the eyes were glazed and turned backwards in their orbits, and there were constant uneasy attempts to raise the fore-part of the body. The body generally was cold, the mucous membranes infiltrated, and the dependent parts of the body œdematous. There was great weakness, loss of appetite, considerable hoven, imperceptible pulse, short and feeble but stertorous respiration, and loss of sensibility. The animal died the same day in slight convulsions.

The post-mortem examination made immediately after death exhibited the intestines distended with gas of an odour like that of the eructations. Their internal coat and contents were of a dull leaden colour, while in the small intestines was likewise met a chocolate-coloured liquor formed of blood mixed with intestinal juice. The abomasum contained a similar fluid mixed with alimentary matters. The reticulum and omasum contained about 2½ lbs. of clotted blood, of a deep brown colour, and which showed no signs of having undergone any digestive change. None of the abdominal viscera, save the reticulum, showed any morbid lesion. In the midst of the curvature of the last viscus was a round yellowish patch, with an oblong orifice towards its centre of 1-5th of an inch in its longest diameter. This orifice was closed by a clot of blood. The yellow patch seemed to be from a softening and thickening of the mucous membrane. Around this patch the reticulum had become adherent to the diaphragm. The opening was found continuous with a canal, penetrating the diaphragm, pleura, mediastinum, and wall of the left auricle. The walls of this canal were composed of organised lymph, and the duct itself formed a direct communication between the cavity of the left auricle and that of the reticulum. The canal, which was somewhat flexuous, was capable of admitting a large-sized goose-quill, though at three separate points it was dilated to double that size. The pericardium was all more or less injected, but towards the perforation was much thickened and adherent to its inner layer, which was likewise thickened and firmly attached to the muscular tissue. The pericardium contained three ounces of a reddish serum. The heart was enlarged and more rounded than is natural; it had a deep reddish-brown colour, and its coronary vessels gorged with blood. The left cavities were filled with blood, the auriculo-ventricular opening more than normally open, and below this orifice was a little particle of wood arranged transversely and supported by its extremities on the tendinous cords of the mitral valve, which it pulled down so as almost to close the aorta. This piece of wood, which was a little over an inch long and as thick as a writing quill, was no other than a pomegranate prickle which the creature had picked up with her food. The internal aspect of the left auricle and ventricle was of a deep red colour, intermixed with black patches, which penetrated for some distance into the muscular tissue. Three cordæ tendinæ were torn, the aorta empty, the right side of the heart had its endocardium of a reddish hue, but with no other discolouration; the pulmonary artery was nearly half-filled with very black blood, and the lungs were congested. The whole venous system was engorged with black blood.

The most satisfactory account of accidents of the description of those under consideration is given us by M. Boizy, in the *Receuil de Médécine de Veterinaire* for 1858. He gives the details of six cases of this kind, all proceeding to a chronic form, and showing little difference in symptoms. The first, a six-year-old cow, continued ill for nineteen days, and was then destroyed. For fifteen days it had been attended by an empiric; on the eighth day she calved, but there was no secretion of milk. *Symptoms.*—Great emaciation and weakness; considerable effusion under the sternum and abdomen; eyes dull and sunk in their orbits;

conjunctiva pale and infiltrated; cold extremities, and dry muzzle. Respiration deep, laboured, and heavy, but very frequent; expiration most painful and interrupted, like in a horse with broken wind; no cough; pulse accelerated, small and feeble; jugulars full, with venous pulse; appetite lost, and frequent eructations of gas.

Percussion shows the superior parts of the chest to be resonant, the inferior dull. Auscultation indicates strong respiratory murmur in the superior half of the chest and almost none inferiorly; the noise of the heart being, however, very distinct. The first sound, as in the normal state, corresponds to the arterial pulse, but is more dead and precipitate than in health, the last sound is marked by a rushing noise, which also encroaches on the first sound, commencing previously to the end of the systole; this sound is compared to the plunging of butter in a churn.

Diagnosis.—A foreign body in the pericardium.

As the owner would not consent to destroy the animal, M. Boizy saw it again on the eighteenth day, when he found the substernal œdema greatly increased, but that in the intermaxillary space diminished. Breathing more laboured; sounds of the heart very faint, the rushing sound only showing itself at intervals three or four times during the day, at which times the beats of the heart could be heard at some distance from the animal. A rattling sound, however, was heard on a level with the base of the heart, and during inspiration, apparently from a considerable effusion into the pleural cavity.

Next day the animal was down, but rose easily; she was constantly changing her posture. Breathing was becoming more and more difficult, the head greatly extended to favour it; the œdema was much diminished, a great deal of serosity having flowed from scarifications made the day previous: the animal had coughed for the first time, eructations still continued.

Cadaveric lesions.—Considerable infiltration of the thorax, abdomen, and dewlap; blood very black, but did not stain the fingers much; the lungs were in parts congested; most of the interlobular cellular tissue infiltrated, in some parts marbled.

Superior part of the costal pleura sound; inferiorly on a level with the base of the heart, thickened by false membranes of slight consistence and yellow colour, the diaphragmatic pleura still more so; here they connected it closely with the pericardium, for about seven or eight centimetres. About eight or ten quarts of very thick, yellowish, fœtid fluid was effused into the pleural cavity.

The pericardium was more than tripled in size, and distended by at least three quarts of very thick purulent fluid of a grayish-yellow colour, insupportable gangrenous odour, and containing shreds of false membrane.

In the pericardium was a sewing-needle, blackened by rust; the sac had acquired walls of more than a centimetre in thickness; these were hard to cut, and showed three distinct layers; the median one, corresponding to the fibrous pericardium, was the thickest and most dense, of a yellowish-white colour; the other two corresponded to the two serous membranes which normally cover the above; they were three or four millimetres thick, having a rough irregular surface and a remarkable earthen-yellow colour; some shreds of false membrane were attached to them.

The heart was a little hypertrophied, and being completely covered by false membrane, was in physical aspect exactly like the pericardium; its section showed three layers, the outer, the thinnest, as of false membrane; the median, like the analogous one in the pericardium, bearing an aspect of rancid lard, and fading insensibly into the muscular tissue, which was pale and discoloured, and beginning to undergo a fibrous degeneration.

In the base of the right ventricle, at a level corresponding to the opening of the pulmonary artery, was a very irregular ulcer, penetrating the whole thickness of the ventricular wall, and large enough to admit the end of the little finger. Another existed on the surface of the median septum, penetrating as far as the endocardium of the left ventricle, but leaving it intact.

The bronchial lymphatic glands were hypertrophied, softened, and black. The adipose tissue at the base of the heart was considerably infiltrated, and contained a large number of little cysts of the form and size of an ordinary bean, and filled with coagulated blood; these had doubtless escaped from the right ventricle through the ulceration, and become inclosed in laminæ of areolar tissue. A fibrous cord, pierced by a canal, extended from the pericardium into the reticulum, the canal was filled with pus, and established a connection between the cavities of the pericardium and the reticulum. Abdominal dropsy had commenced.

The other five cases did not differ materially; the second was peculiar in having no eructations, the needle was bent almost at a right angle, and on separating the diaphragm from the reticulum, five canals were observed: their connection with the reticulum was obstructed, so that a probe could not be passed into it; three of them, each the length of the needle from its bend, led into a cul-de-sac, the size of a little bean, and filled with grayish thick pus. One led into the pericardium, the other led into a sac, the size of a pint measure, filled with grayish purulent blood of a fœtid odour, analogous to that in the pericardium. This case was at first taken for pneumonia, and treated as such, with the effect of relieving the pulmonary symptoms, but then the signs of heart disease became evident, and the patient gradually sank.

In the fourth case, there were also two canals, one in the muscular part of the diaphragm, and the other in its tendinous portion, the latter opening into the stomach and pericardium: the agent being a large copper pin, had given to both a green hue.

That such lesions have only been observed in ruminants, M. Boizy ascribes to the manner in which they first swallow their food in large pellets, and almost unmasticated, as well as to their being generally attended to by females from whose dresses such agents get mixed with their food. This is also partly dependent on their proper constitutions, the malady always assuming a chronic form, three or four months probably passing after the swallowing of the agent ere any symptoms are seen. No signs of its presence being exhibited so long as it remains in the digestive cavity, nor even in its course to the heart, until its presence materially interferes with the functions of that organ; whereas, were such an agent to penetrate the chest in the horse, an acute pleuropneumonia would in all probability result, which would in a few days destroy the animal.

In remarking on the peculiarity of the foreign agent always directing its course toward the central organ of circulation, as it did five times in the second, and twice in the fourth case, M. Boizy is inclined to attribute it to the action of the diaphragm and the motion of the heart, together with the relation between the reticulum and these organs.

Our author next endeavours to throw some light on the very important subject of the diagnostic symptoms which distinguish simple pericarditis from that caused by the presence of a foreign body. The small pulse, full jugulars, venous pulsation, and œdema of the dewlap, are symptoms common to both forms; the same may be said of the subsultus and palpitation. ·The only certain differential symptoms are the peculiar character of the sounds and the eructations. In simple pericarditis the gurgling sound is heard with extreme difficulty; in that caused by a strange body, on the other hand, it is easily heard, rather deserving the name of rushing than gurgling, the noise being likened to the plunging of butter in a churn. This is supposed to arise from the greater consistence of the liquid, and its admixture with gas. When the noise is feeble, causing the animal to walk a few steps will make it very distinct.

It is suggested that the eructations are from the free communication between the pericardium and the stomach, allowing the gas formed in the former to pass into the latter and thence into the mouth. This would seem to be supported by the circumstance, that in the second case mentioned there was no such communication, and eructations also were wanting. Also in simple pericarditis there are no marked eructations. This, with the comparative rarity of the last-named malady, makes error also much less common.

By attention to the above-mentioned diagnostic symptoms, M. Boizy states, that the presence of a foreign body may be diagnosed with great certainty.

DISEASES OF THE ARTERIES.—EMBOLISM.

One of the most remarkable diseases to which man and the lower animals are subject is 'Embolism,' or plugging of arteries. I have seen several cases of this description in the horse, and several observers, but especially Hertwig, Delafond, Bouley, and Barlow, have recorded instances. The disease, consisting in distention of arteries by solid coagulated lymph, first received the name of arteritis. It has been better studied, especially by human physicians, and termed

'Embolism.' In a number of the *Medical Times and Gazette* for January the 4th, of the current year, we find as follows:—

"The term 'Embolism' has till lately been taken to mean the impulsion of substances detached from the walls or valves of the heart into various parts of the arterial system, most of the cases noticed having to do with the cerebral arteries. But now a new class of observers, with Professor Virchow at their head, trace the offending body not only from the right or left side of the heart to its destination, but from its far-off nidus among diseased tissues whence it travels along the veins to the heart. And it is proposed thus to account as well for the deposition of morbid substances in distant and various parts of the body, as for a number of results now attributed to other causes, but which are really the effects of obstruction of the arteries. We have before us a work, extending to seven hundred octavo pages, in which the numerous bearings of the subject are discussed with German copiousness and precision. Its author, Dr B. Cohn, of the University of Breslau, signalises his admiration of the renowned Berlin Pathology Professor, by dividing time into the epoch before Virchow—that of Virchow himself, and that of the followers of Virchow; and gives the result of six years' careful and extensive observations on embolism, as his own contribution to the literature of the last-named epoch. Our space forbids us to give at present more than a slight sketch of the points put forward and supported by a formidable array of facts in this important work.

"The proof of the existence of the agency in question is grounded, first, on the presence of the conditions necessary for it in all parts of the circulation, such as the coagulability of the blood in all kinds of vessels. Next, on the facility with which solid products in the vessels, when once formed, can become detached. An endless variety of experiments on animals have confirmed its possibility; and the frequency with which identity of structure has been detected between the embolus and other substances yet undetached at distant parts of the stream, together with the fact that in some cases it has been possible to trace the intruder to the spot which it has just left, by comparison of surfaces,—as you detect a burglar by the nails in his boots,—has given additional weight to the evidence; while the absence of any appearance of pre-existing disease around the occluded vessel, and the suddenness with which the effect is produced, are circumstances which attend no other kind of arterial obstruction. But the solid substance in the blood may be of any size, from one sufficient to obstruct the pulmonary artery to that which would pass even a small capillary; therefore, among emboli we may reckon not only fibrinous clots from the heart,—polypi, as they were once called,—but fragments of decaying or suppurating tissue, and the elements of tubercle and cancer. Indeed, our author asserts embolism to be the one cause of secondary deposits in these diseases."

The late Mr Barlow addressed the following letter to Dr Gairdner, shortly before his death:—

"1, PILRIG STREET, Dec. 12, 1855.

"MY DEAR SIR,—I have recently met with a few instances in which arteries of considerable size have been almost entirely plugged up with fibrinous clots, firmly adherent to their walls. In these cases during life, there was sometimes visible but unexplained atrophy of certain muscles, in regions specially supplied by such vessels; and sometimes when a main trunk, such as the aorta posterior became thus plugged, there was palsy of the hind parts (of course I speak of the horse.) At first I fancied these things to possess no material interest, and did not preserve the vessels. However, this day week, a pony, greatly disabled behind, but not completely paralytic, was brought for dissection. I found a large plug of adherent fibrin in the aorta post., just where this vessel divides into two iliacs on each side. (In the horse, you will remember, there is no 'common iliac,' but the aorta post. divides into the internal and external iliacs.) This plug was firmly adherent to the roof of the artery; that is, to that part lying in contact with the vertebræ. It was not sufficiently large to obstruct the stream of blood completely, but it must have caused a material lessening of the stream. The internal iliacs, however, were *completely* plugged up, and the outside of the fibrinous clot was adherent to their walls—in many places all the way round. In one place, especially, a calcifying process is taking place in the coagulum. If such things are not already too familiar to you, I wish you would look in at Clyde Street any day before two P.M., for the condition is to me somewhat new.—Yours ever truly, JOHN BARLOW."

It is not easy to trace the origin of this disease in the horse. It is chiefly seen in young animals in good condition, and would appear to be characterised by periodic relapses. It is the arteries of hind limbs that are most constantly plugged, and as a typical case of this kind, I may relate the following:—

On the 26th of July, 1858, I was requested, to see a valuable coach horse, four years old, which a fortnight before had suddenly shown signs of severe lameness in the near hind leg, whilst being exercised on the sands at Portobello. The horse was rested after this, and the lameness, though not so severe as at first, did not subside, and I was accordingly consulted respecting its cause. I observed that the horse was affected with spavin, though the bony enlargement was slight. The horse was stiff, and I afterwards learned that awkward action of the near hind leg had been observed six months before by an experienced horseman. The horse had also been noticed to wear his shoes more like a stiff old horse than like a four-year-old. An operation was undertaken on the 27th, when the powerful young animal proved very refractory, and struggled with unusual violence whenever the issue needle was passed into the small cut made for its admission. Chloroform was therefore used, and the operation having been promptly performed, the horse was allowed to rise and to be conveyed to the stable. Next day he was removed to Portobello, and on the 29th I saw him, and found the issue in its proper place, and the horse doing well on the whole, though he had somewhat lost his appetite. On Saturday the 21st, Mr H—— and family left town for Selkirkshire, and I advised the young horse to be taken too. The coachman informed me that he was doing well, and going far better, and accordingly he was, with my consent, allowed to be put in harness for a distance of about four miles after being taken off the train. He did the journey well, but, on being placed in the stable, was noticed to tremble.

On Sunday, the 1st of August, Mr H—— came up to town, and informed me that his young horse had been suddenly taken seriously ill, that he seemed helpless on one side, the muscles of his neck were rigid, and though it was at first sight believed to be paralysis, a medical gentleman, with Mr H—— in the train, told him it was more probably tetanus. Next morning, the 2nd of August, I proceeded to Selkirkshire, where I found the horse in a natural state, without symptoms of paralysis or tetanus, though somewhat dull, and very slighly feverish. The issue had suppurated freely, and continued to discharge; the hock was quite cool, and the animal moved well, both about his loose box, and when taken out of the stable. I observed that there was some derangement of the secretion of urine, and I prescribed a few doses of nitre, and left in hopes that the horse would do well.

A few days afterwards I received a letter, stating that the horse had remained dull, that his throat was sore, and a swelling had formed between the jaws, and somewhat about the lips. I coupled these symptoms with what I supposed to have been the fever shiver of Sunday the 2nd of August, and concluded the young horse had an attack of strangles—a disease which was then prevailing. I recommended poultices to the swelling beneath the jaw, careful nursing, and that a veterinary surgeon should be called in, in order that he might watch the case, and open the abscess when it was ready. The poultices were not applied, but the neck was fomented with warm water. The abscess broke rather unexpectedly, so that a veterinary surgeon was not called in. The fomentations were continued, the abscess discharged abundantly, but the horse grew weaker and weaker. I advised gentle exercise and nutritive food, but the animal was too weak to be moved much about; and towards the 20th of August and following days, he was led out a little every morning, until Thursday the 24th, when he appeared rather better on first moving from the stable; whilst walking to and fro, however, he suddenly shook violently, gave evidence of great pain, was replaced into his loose box with difficulty, where he suddenly fell, paralysed on his hind extremities. He knocked himself about, and broke out into a sweat, which was limited to the head, neck, fore limbs, and trunk; the hind legs were deathly cold and rigid. This I learned on the evening of the same day, having been summoned to Selkirkshire by telegram. At nine P.M., I found him lying on the near side, with bloodshot eye and dilated nostril, pulse wiry and at 60, heart's action tumultuous, breathing accelerated, the surface of the body somewhat warm, but the extremities of a death-like coldness, especially the hind ones. Every now and then the horse would lift his head, and turn towards his flank, as if indicating that there was the seat of pain. I carefully examined the abdomen, and found that the horse flinched and struggled when I pressed on the parietes of the belly, just below the false ribs on the right side. This led me to believe that the pain was at all events in part seated in the liver, the margin of whose right lobe I could of course press upon directly. A warm water enema proved that there was no obstruction to the bowels, as the water was retained; but when attempts were made to evacuate the rectum, I observed that the straining was attended with intense agony. There was an opening in the submaxillary space—that of the abscess which had never been closed.

I took into consideration the occurrence of strangles attended with fever of inordinate severity; the low, weak state the horse had remained in; the chances that, with the absence of poultices and free incisions, the abscess in the submaxillary space had not been evacuated so thoroughly as it might have been, and I considered that all the symptoms were in favour of blood disease, from the introduction of pus in the vessels, and that probably abscesses would be found in the abdominal organs. I thought I might afterwards find inflammation of some of the veins of the body, but did not suspect arteritis. My opinion was decided as to the issue of the case, and recommended the animal to be destroyed; but as he could not be opened until next morning, and a change in the next few hours might be seen, though medical interference was abstained from, I suggested that the horse should be watched, and next morning I would consider how best to act.

Next morning the animal was found much in the same state, the pulse, however, having risen to 70. He was destroyed by division of the spinal cord between the occiput and the atlas. About two hours after pithing him, time having been allowed to procure assistance and convey the carcass to an adjacent field, where it was to be buried, I performed a post-mortem examination. The four limbs were first cut off, and they appeared healthy, dark blood flowing freely from them when they were removed; the muscles had a healthy appearance. I opened the chest, and the surface of the right lung indicated, from its ecchymosed appearance, that I had conjectured rightly as to the condition of the blood. The lungs and heart were removed from the chest, and no abnormal condition was found beyond ecchymoses on the pleura, on the pericardium, and on the endocardium in the left ventricle, especially over the papillary muscles. The abdomen was next opened, and the intestines removed. The anterior mesenteric artery was found thickened on dividing it, and on more careful examination, I found plastic exudation between its coats, and a blood clot within it and some of its branches. The stomach and intestines appeared healthy in every respect. The spleen, likewise, and the kidneys were well developed, but there were signs of congestion, and, on opening the pelves, ecchymoses were found within them.

The liver was considerably modified, being highly charged with blood, though the right lobe was discoloured and yellowish. It was exceedingly friable, and there was evidently a modification in its structure, which to the naked eye appeared to amount to nothing more than defective cohesion.

I observed, on opening the aorta, that a quantity of serum flowed out, the psoas muscles were somewhat discoloured, but believing the veins of the limbs must have borne indication of disease, I proceeded to examine, and found, in the first place, that the right external iliac artery was firmly plugged with a firm clot. This clot closed the posterior end of the aorta, and continued into the left iliac artery. We dissected further, and found the femoral, the anteria profunda, and other arteries of each thigh perfectly plugged and of a deep red colour, here and there assuming a purple hue. The plugging continued down as far as the popliteal arteries, which were pervious. The muscles of either thigh had not lost in bulk, but simply in colour; they were pale, though firm, and bore evidence that they had been well nourished up till recently, but had been very effectually deprived of blood a short time before the animal's death. The blood throughout the anterior part of the body, and in the cavities of the trunk, was of course found perfectly fluid, even in the heart.

We proceeded, in the next place, to examine the arteries of the pelvis, and found the internal iliacs and their branches distended with solid clots.

These arteries we preserved. Unfortunately, however, on reaching Edinburgh in the evening, we found that the mesenteric artery had been left behind. Thanks to Mr Clark Stanton, we preserve a beautiful water-colour drawing of the plugged vessels.

The post-mortem examination was concluded by the examination of the abscess in the submaxillary space, which we found to contain a little pus, which had not much chance of escaping through the small round orifice which remained. The cranium and spinal canal were opened, and their contents found healthy. The hocks were then examined; the right one being perfectly healthy, but the left one, from which the issue had been removed about ten days, had most thoroughly healed, found to be affected with spavin.

The severe pain attendant on the first symptoms of emboli in the arteries of the extremities, the disappearance of lameness soon after, the relapses at intervals which diminish as the disease advances, the certain fatal termination, render the subject of arterial obstruction one of great interest to veterinarians. We cannot say that such cases are very rare, and whenever they do occur, their diagnosis is most important. I should direct attention to the manifestation of pain in a limb, associated with the most marked general disturbance, the temporary paralysis of the limb affected, or of some of its muscles, the local tremors, the invasion of the opposite limb, as if by metastasis, with the subsidence of symptoms in the limb first attacked, the peculiar throbbing of the posterior aorta felt through the rectum, the absence of pulsation, a diminished pulse in the arteries of the limb implicated, and lastly, the incurable paralysis, partial or complete, of one or two limbs, soon followed by death. I have been struck by the anxious expression of the face, looking round to the flank, and profuse sweats due to the pain experienced. I am inclined to think that a partial attack of embolism may, in rare instances, be attended with recovery. The cure can only be spontaneous. No method of treatment, except careful nursing, can be suggested. When diagnosed with certainty, progression must always be avoided.

Errors of diagnosis will frequently occur. I have known such cases to be considered as affections of the hip joint, fractures of the innominate bone on one side, and spavin. It is evident that two conditions may be concomitant as indicated by the spavin and embolism witnessed in the case recorded in the foregoing pages. The absence of violence to account for sprains or fracture, the sudden manifestation of the acute general symptoms, offer a contrast to the development of most forms of disease attended with lameness.

Aneurism.

We mean by this a tumour formed by coagulated arterial blood within a dilated artery, or between the several coats of such a vessel, or externally to it. There are false and true aneurisms. In the latter the arterial coats are wholly or partially entire, and the former consist in accumulation of blood around the vessel. Aneurisms are also termed spontaneous or traumatic, according to their mode of origin; they may be external or internal.

Spontaneous aneurisms may consist in dilatations of a considerable extent, or they may be circumscribed; the coats may be intact and even thickened. In other instances the inner coats have become attenuated, the external coat is forced outwards. When the aneurism has commenced to form, it enlarges rapidly and becomes circumscribed. Layers of blood clot, undergoing progressive discolouration, accumulate, and a narrow aperture alone communicates in many cases with the current of blood. As the aneurism grows old, the coats of the artery become indurated, calcified, and liable to burst.

On the production of aneurism, Virchow says that "if the elasticity of the vessel be considerably diminished, without its becoming stiff and immoveable (from calcareous incrustations) in the same degree, the dilatation which it undergoes from the pressure of the blood, is not again compensated; the vessel remains in a dilated condition, and thus are gradually produced the well-known forms of *ectasis*, such as we are familiar with in the arteries under the name of aneurisms, and in the veins under that of varices. In these processes we have not so much, as has been represented of late, to deal with primary disease of the inner coat, as with changes which are situated in the elastic and muscular middle coat."

Spontaneous aneurism is chiefly seen in the horse and especially in deep-seated arteries. The posterior aorta, at the origin of the anterior mesenteric artery, is very subject to aneurism as animals grow old. Some remarkable cases are reported in journals. I may quote a few instances referred to by Mr Percivall in his *Hippo-Pathology*:—

"ANEURISM OF THE AORTA.

"Although aneurism is by no means an uncommon disease in our own bodies, in horses it is comparatively rare; so rare, that it scarcely has become an object of veterinary practice. Nevertheless, as extraordinary occurrences, accounts of cases must be at all times interesting to the veterinarian, and as such I give those that have come under my own observation, together with some others, of which there are several to be found scattered through the pages of *The Veterinarian*.

"The first I shall notice is a dried preparation belonging to my father's museum, at Woolwich, a very fine specimen of aneurism of the thoracic aorta. In shape, and indeed in magnitude, it may well be compared to a gourd of ordinary growth. Through the bottom of the aneurismal sac are two large circular apertures, where, evidently, it had burst into the cavity of the chest. In several places the sac is much attenuated, and appears—as far as one can judge in its dried state—to have been in an ulcerated condition at the time of death. Whether the sac is formed of the dilated or augumented coats of the vessel, or is composed of adventitious coatings, it seems impossible, correctly, to determine: its appearance most favours the latter supposition. No other history attaches to the preparation than that 'it was brought from the slaughter-house.'

"Mr Field has, in his museum in London, a preparation of the same kind as the one described above, and in most respects very similar to it.

"Mr Bowles, V.S., Blanavon, in 1841, sent Mr Morton, of the Royal Veterinary College, a specimen of ossified aneurism of the posterior aorta, a little anterior to the first lumbar vertebra, taken from a mare that died of ruptured spleen.

"Herr Böhling (or Röhling), from four cases he relates of aneurism, comes to the following conclusions:—Aneurism of the large arteries, in any of the cavities, particularly the aorta or mesenteric, may be ascertained by certain signs, through which a sure diagnosis may be established. The surest of these signs is the *pulsation of the parts*. Besides this pulsation, there is another symptom equally of importance, which is the *slow pulse;* or, as sometimes happens, an intermittent pulse. All we can add to this is, that, in our opinion, it little augments our knowledge of the mysterious existence of aneurism of the aorta or mesenteric arteries.

"The following cases occur in the foreign journals:—

"In the *Journal Pratique* for September, 1826, are two reports of aneurism by M. Chenard. A mare was led to him having fistula. She could hardly, he observed at the time, drag her hind legs after her. She had no sooner got into the stable than she fell on her haunches, and never rose again. She was bled and purged, but died on the sixth day. Internal tunic of the aorta highly inflamed; and immediately behind the emulgent artery was a true aneurism, as large as a hen's egg. Just below was an aperture in the vessel which protruded in the form of a pedicle, and communicated with another tumour, of the size of a child's head, full of fibrous matter, laminated. A similar clot filled the artery posterior to dilatation. The membranes occupying the spinal marrow in the lumbar region were also highly injected, and the marrow itself was softened and surrounded by a serous fluid.

"Another mare, usually full of animation and energy, suddenly, and without assignable cause, became spiritless and incapable of work. This continued for some months, when attention was directed to her loins. She turned with difficulty; shrank from pressure on the loins; was costive; and voided her dung and urine with straining and pain. She was treated for nephritis, and got better; but after a very little work every symptom relapsed. Two months afterwards her hind legs commenced swelling, and this went on to produce ulcerations, all which subsided again. One day she was seized with cramp in the near hind leg for a quarter of an hour. In two months again she got so well as to be considered fit for work. She performed one journey; but had hardly commenced a second, when she on a sudden lost the use of her limbs, then fell upon her off side, uttering dreadful cries. She continued for two days paralytic in her hind parts, then died. The posterior aorta, at the root of the emulgent artery, was dilated to double its ordinary caliber, and a tumour, osseous above and cartilaginous below, communicated with the aorta by an aperture the size of a nut, having attenuated edges. The aneurism ended abruptly near the origin of the crural artery. The internal coat was ulcerated where the ossific process had taken place, and a clot completely blocked the dilatation, and the posterior divisions of the aorta as well, and extended even to the origin of the renal arteries. The membranes of the spinal marrow were also highly inflamed above the lumbar region; and the marrow itself was softer than natural, and covered with bloody spots.

"The subjoined case occurred in 1826 at the college at Alfort:—

"A mare was brought in very lame from a sinus in the foot, perforating the long flexor tendon, which was treated for three weeks; when one day, while the foot was being dressed, the mare suddenly reeled about, threw up her head, and fell down. No sooner was she down than her nostrils and chest, and belly and flanks, were all in convulsive action for breath; her limbs became stretched, and her eyes rolled in their orbits. The jugular was opened instanter; but drops of blood only issued. In this very act, death closed the scene. The pericardium was found prodigiously distended with coagulated blood, looking at first like hypertrophy of the heart. This coagulum weighed five pounds. The trunk of the aorta was extensively ruptured at its base, and the lesion was evidently the result of attenuation of its coats.

"ANEURISM OF THE ILIAC ARTERY.

"The late Mr King, V.S., Stanmore, showed me a dried preparation —a specimen of an aneurismal tumour, communicating, as it seemed to him (for there was much confusion of parts), with the external iliac artery; if not with that, with the gluteal. The aneurismal sac was composed principally of the parts immediately adjacent. In several places it had become ossific: indeed, so large and evidently spreading were some of the patches of osseous matter, that, had the animal survived any great while longer, there is little doubt, ultimately, the whole sac would have become converted into bone. The history of the case was—A horse, not worth much, was casually brought into Mr King's yard, with a tumour equal in volume to a large pumpkin, and of an irregularly ovoid shape, upon the postero-superior part of the quarter. Finding it fluctuated, Mr King, by way of experiment, punctured the swelling with a lancet. A gush of blood followed the puncture. Compresses of tow, cloths, bandages, &c., were immediately applied. In the end, however, the animal became reduced, and died.

"ANEURISM OF THE RENAL ARTERY.

"Aneurism of the left renal artery, as large as the aorta, was found by M. Chouard in a horse, who was destroyed on account of a carcinomatous affection of the left kidney. For an account of the case see 'Nephritis,' Hurtrel d'Arboval's *Dictionary*."

A remarkable instance is to be found in the *Veterinary Record* for 1849. Mr Parker, of Montgomery, in describing a case of aneurism of the posterior aorta of a horse, says:—

"The patient from which the morbid specimen was taken was a well-bred bay mare, twelve years old, the property of a Mr Evans, farmer, near this place.

"I first saw her on the 26th of last August, the owner informing me at the time that she had aborted in March, 1847, and had never appeared well since; but in July of the same year he thought her better, and rode her to Ruabon and back the same day, distance 72 miles. Since then she has been gradually losing flesh.

"On examination, she appeared to be in foal, was very poor, coat unhealthy, staring, and hidebound; the visible mucous membranes were pale, except that a few of the largest vessels were injected, and of a bright scarlet hue; extremities cold, appetite good, mouth moist, hair in mane and tail easily withdrawn; no pain evinced, but countenance dull and dejected; respiration rather accelerated, and a slight cough present: the respired air was cold, and on placing my ear to the chest there was an absence of the respiratory murmur: the beats of the heart were loud and strong, but intermittent; and there was a peculiar noise following each beat, similar to the sound of the expired air passing off in hurried respiration. The pulse was 70, full and jerking, and the systole so very marked, as seemingly to double the beats of the heart, while the undulations in the jugulars extended nearly to the head: the alvine evacuations and urine were healthy.

"My prognosis was unfavourable, as I conceived it to be inflammation of the serous membrane lining the cavities of the heart, with tuberculization of the lungs. I consequently gave the owner no hope whatever of recovery; but, as she was a favourite animal, he did not like to have her destroyed, and wished me to place her under treatment. I administered sedative agents, occasionally interposing an alterative, and saw her about four times afterwards. On September 12th she aborted again.

"The only alteration perceived from the first was increased debility, amounting almost to marasmus, the animal being little more than a walking skeleton. Towards the last the urine became discoloured, and she manifested a frequent inclination to lie down, and on rising, which was accomplished with difficulty, she always gave a deep hollow groan.

"I requested, when she died, they would send me word, which they did on Tuesday last; and on Wednesday morning I made a post-mortem examination.

"*Autopsy.*—Lungs: left lobe of a light pink colour, studded with tubercles, and towards its anterior lobuli were large vesicles of air; the right lobe contained a few tubercles, and was bordering on congestion; the pericardium was thinner than usual, more capacious, and contained about two pints of serum tinged red; the outer portion of the parietes of the heart was much inflamed, especially towards the superior part of the right ventricle, which in places contained portions of pus; and there was a great quantity of lymph effused into the cellular substance around the base of the heart. On cutting into the left auricle, the cavity was found dilated, and its lining membrane much inflamed; there was hypertrophy of the walls of the left ventricle, with contraction of the cavity, but no traces of inflammation of the lining membrane. The serous membrane lining the right auricle and ventricle was highly inflamed, and the parietes of the right ventricle were unusually thin, as were also its valves: both the kidneys and the uterus were diseased. The intestines, especially the colon, exhibited patches of a similar bright scarlet colour assumed by the visible mucous membranes prior to death. The liver was tuberculous; and, in fact, all the viscera appeared affected."

There are records of scattered cases of aneurism in large numbers, but the most interesting memoir bearing on this subject appeared in the *Vienna Quarterly of Veterinary Science* for 1852, by Dr Bruckmüller, one of the Demonstrators in the College. It refers to aneurism of the anterior mesenteric artery. Hering was the first to indicate the frequency of this lesion, and Gurlt doubted Hering's observations. Bruckmüller examined carefully, from the 22nd May to the 30th September, 1851, 65 horses, with a view to determine the frequency of this aneurism, and found only 6 animals perfectly free from it; 59, or 91 per cent., had dilatation of the mesenteric artery to a greater or less extent. In 19 cases there was simple thickening of the arterial coats, without or with very slight dilatation, 8 small aneurisms from the size of a pea to a hazel nut, 29 larger, varying from the size of a walnut to a hen's egg, and 3 with hardening of the coats. The ages of the animals varied from 6 to 20, chiefly from 6 to 11. Aneurism is, therefore, not a rare, but a very common disease in the horse, and in a number of cases of mesenteric aneurism parasites are found occupying recesses in the thickened coats. The parasite is a variety of strongylus—*Strongylus armatus varietatis minoris*—which is often found in the textures of solipedes. It is met with in the submucous tissue of the cœcum, in the tunica vaginalis, peritoneum, &c. We know nothing of the causes of this singular lesion, and are never called to treat animals suffering from such a cause.

ATHEROMA.

Not unfrequently the arteries of the lower animals are atheromatous. This condition is only interesting to us in a pathological point of view, and Virchow very plainly states in what the lesion consists. He says:—

"I have, in order to clear up to some extent difficulties, as they are presented by an important, frequent, and at the same time much misunderstood process, prepared a series of specimens exhibiting *really atheromatous conditions of the arteries*. For it is particularly in the case of these conditions that the confusion, which has prevailed with regard to the interpretation of the change, has perhaps been the greatest.

"At no period in the course of this century has a complete understanding ever been come to as to what was to be understood by the expression atheromatous change in a vessel. Some have taken the term in a wider, others in a narrower sense, but still it has perhaps been taken in too wide a sense by all. When, namely, the anatomists of the last century applied the name of atheroma to a definite change in the coats of the arteries, they of course had in their minds a condition similar to that of the skin, to which, ever since the days of ancient Greece, the name of atheroma, grit-follicle, (Grützbalg) [sebaceous or epidermic cyst], had been assigned. It is self-evident, therefore, that the idea of atheroma presupposes a closed sack. Nobody ever called anything in the skin an atheroma that lay open and uncovered. It was therefore a curious misapprehension when people recently began to call changes in the vessels atheromata, which were not seated below the surface and shut off from the surrounding parts, but belonged to the surface. Thus it has come to pass that, instead of an enclosed deposit being, in accordance with the original meaning of the term, called atheromatous, a change has frequently been so termed which commences quite at the surface of the internal arterial coat. When the matter began to be examined more minutely, and fatty particles were found at very different points in the walls of the vessel, both when atheroma was, and was not, present—when at last the conviction was obtained, that the process of fatty degeneration was always the same and was identical with the atheromatous change, it became the custom to unite all the forms of the fatty degeneration of arteries under the designation atheroma. Gradually, people even came to speak of an atheromatous change in vessels, that only possessed a single coat, for in them too we meet with fatty processes.

"At all times there have, moreover, been observers who regarded the ossification of vessels as a change belonging to the same category as atheroma. Haller and Crell believed that the ossification proceeded from the atheromatous matter, and that this was a juice which, like that exuding under the periosteum of bone, was capable of generating plates of bone out of itself. Afterwards it was recognised that atheromasia and ossification were two parallel processes, which, however, might be referred to a common origin. Now it would, I think, have been logical, if in the next place an understanding had been come to as to what this origin was, from which the atheromatous change and the ossification proceeded. But, instead of this, the track of fatty degeneration was pursued, and thus the atheromatous process was extended to a number of vessels, in which, on account of the thinness and the simple structure of their walls, the formation of any dépôt, which could really be compared to an atheromatous cyst of the skin, was altogether impossible.

"The state of the matter here also is more or less very simply this, that two processes must be distinguished in the vessels, which are very analogous in their ultimate results; first, the *simple fatty metamorphosis*, which sets in without any discoverable preliminary stage, and in which the existing histological elements pass directly into a state of fatty degeneration and are destroyed, so that a larger or smaller proportion of the constituents of the walls of the vessel perishes; and, in the next place, a second series of changes, in which we can distinguish *a stage of irritation* preceding the fatty metamorphosis, comparable to the stage of swelling, cloudiness, and enlargement which we see in other inflamed parts. I have therefore felt no hesitation in siding with the old view in this matter, and in admitting an inflammation of the inner arterial coat to be the starting point of the so-called atheromatous degeneration; and I have, moreover, endeavoured to show that this kind of inflammatory affection of the arterial coat is, in point of fact, exactly the same as what is universally termed endocarditis, when it occurs in the parietes of the heart. There is no other difference between the two processes than that the one more frequently runs an acute, the other a chronic course."

Injuries to the Arteries.

In the lower animals accidents implicating arteries so as to endanger life, are comparatively rare. It is nevertheless important that the history of such injuries should be given, as they occur under circumstances when least expected, and call for judgment in their management. From the account I have already given of the structure of the arteries, it is evident that they are elastic vessels with coats sufficiently firm to prevent collapse, and protected by an external sheath. Professor Syme has shown that the inner arterial coat lacerates more readily than the outer ones, and when a ligature is properly applied, its efficacy in arresting hæmorrhage depends not a little on the rupture of the inner coat, whereby the caliber of the vessel is diminished, and the formation of a plug favoured. The forcible tearing of arteries is attended with an unequal laceration of the different coats, the curling inwards of the elastic lining, and, consequently, very slight, if any, hæmorrhage. When, in castrating small animals, the testicles are withdrawn so as to lacerate the spermatic artery, no blood is lost. Incised and punctured wounds are, however, not so safe as lacerated and contused arterial wounds. If an artery is pricked or cut, especially in an oblique or transverse direction, its elasticity tends to maintain the orifice wide, and fatal hæmorrhage ensues. Cutting an artery across is attended with its retraction within the sheath, and a stoppage of the bleeding if the vessel is not too large, and a longitudinal incision may close from the lips of the wound not being withdrawn from each other.

Bleeding from an artery is diagnosed by the peculiar jerk of a full and regular stream of bright arterial blood, which is pushed from the wound with considerable force. As the animal grows feeble and faints, the flow diminishes, and the jerks are more perceptible.

The spontaneous arrest of arterial hæmorrhage when an artery is cut across occurs as follows:—Blood enters the sheath around the arterial wound so as to press on the latter; the artery has a tendency to retract, and its orifice closes, and the blood clots as far up as the first collateral branch. This is the temporary plug which undergoes changes whilst lymph is thrown out at the mouth of the wound to close it by the ordinary process of cicatrisation. The clot itself becomes discoloured, and the constituents that remain adhere firmly to the arterial tunics. Very soon the portion of the artery obliterated shrinks, unites, and is to be traced afterwards as a fibrous remnant. The blood's flow is equalised by the adaptation of collateral vessels.

The arteries that have been most frequently injured in the lower animals, have been the palatine, temporal, carotid, metacarpal, branches of the femoral or gluteal, and metatarsal.

Treatment consists in ligature, pressure at a distance from or on the arterial wound. Ligature consists in securing the vessel at the wound, both above and below it, and having fixed it in a pair of artery forceps without including other tissues, especially nerves, a ligature of silk or thread is applied. The artery must be tied firmly, and the strength to employ, is ascertained by the force required to cut through the inner coat without severing the intestine.

Pressure at a distance from the seat of hæmorrhage is rarely employed in veterinary practice, and not of great service. I have heard of the posterior aorta having been pressed upon through the rectum, to favour stagnation in a case of bleeding from some gluteal branches, but I doubt the effectual application of such pressure, and would prefer the more safe surgical method of tying the vessels at the seat of injury. It is a rule, that unless circumstances are opposed to the adoption of the plan, a surgeon must cut down on the bleeding artery and tie it. With small vessels such as the metacarpal, pressure suffices. This must be applied so as to bear firmly on the arterial wound. A small solid compress being applied over the bleeding vessel, a wider one is placed on that, and others progressively wider are applied in succession, and fixed by a bandage.

When an artery has been tied, attention must be paid to the separation of the ligature, which may be attended with such an amount of ulceration as to open the blood-vessel, and cause it to bleed freely. This is called secondary hæmorrhage, which is very rare in the lower animals, and must be treated by ligature again.

VEINS—VENOUS HÆMORRHAGE.

Animals are liable to punctures of the veins, and may lose a sufficient amount of blood to die when the large vessels are freely opened; but unless the cutaneous orifice is too large, there is invariably a tendency to closure of the venous orifice by a clot forming around it, and then the wound in the coats heals. Pinning the cutaneous wound is alone to be had recourse to. The practice of tying even a large vein, except in the greatest emergency, is to be condemned. It is always dangerous.

Air in the Veins.

In the act of bleeding, if a bold opening has been practised low down on the jugular vein near the opening into the chest, the aspiratory force in the act of breathing is apt to draw air into the orifice made with the fleam. A gurgling sound is heard, the animal immediately staggers, roars, falls, and soon dies in considerable agony, as if suffocated and in violent convulsions. The symptoms are more severe than if air is blown into the veins, whereby a large quantity passes in at once, and kills almost instantaneously. I have seen a horse bled in a dissecting-room by a student, struggle between life and death for half-an-hour with violent symptoms of dyspnœa. In any such case the practitioner noticing that the moment he removes the finger from pressing on the vein which he has pierced, no blood flows, but that there is a suction sound, the finger must be instantly applied on the orifice, or, perhaps, best beneath it on the vein, so as to let a little blood flow, and then the aperture is closed. If the practitioner is not very prompt, the animal soon dies.

Thrombus.

When, in bleeding a horse, either from the imperfect adaptation of the venous and cutaneous orifices as the animal moves its neck, or from the smallness of the opening in the skin, blood is apt to become effused in the areolar tissue around the vein, the part swells, the blood ceases to flow externally, and a very considerable tumour may thus form. This is a thrombus. Having carefully pinned the outer opening, the animal's head must be held up to favour the regular flow of blood through the jugular, and cold water may be freely poured over the part at intervals, without pressure, and without disturbing the pin. Thrombus is most apt to occur in bleeding horses from the brachial vein. Fortunately, now-a-days, we do not have recourse to bleeding to the extent it was formerly practised, and we see fewer cases of thrombus than in days gone by. The result of thrombus is often inflammation of the vein.

PHLEBITIS.

The result of wounds in veins, especially by rusty instruments, is not unfrequently inflammation. Phlebitis may, however, occur independently of injury, as an idiopathic affection, but this is extremely rare in the lower animals, and I shall consider it when I refer to pyœmia, or purulent fever, in a future chapter. Traumatic phlebitis—for such is the name to apply to inflammation of a vein due to injury of the latter—occasionally occurs without a very readily discovered cause, and though sometimes a dirty instrument may have been used, practitioners have met with it when they have been extremely careful in the operation. A not unfrequent cause is the animal rubbing its neck after bleeding, and for this reason the head should be tied up for a number of hours as a rule. The production of a thrombus as the result of bleeding is to favour the development of phlebitis.

Symptoms of Phlebitis.—The wound which has been inflicted in blood-letting becomes surrounded by a swelling of a hot and painful character; an ichorous discharge oozes from beneath the tow or hair used to twist round the pin, and not unfrequently there is considerable constitutional irritation.

If the pin is removed at once, the wound is found open, red, moist with purulent matter, and very irritable. There is a tendency to hæmorrhage, and at other times to coagulation of the blood in the jugular upwards towards the head, for the blood becomes stagnant up to the first large collateral branch. Though losing a vein is a serious result, it is, so far as the life of the animal is concerned, not so dangerous as ulceration into the vein, and introduction of pus into the blood. Death, as the result of phlebitis, usually depends on the formation of abscesses internally, from the penetration of pus into the open vein.

Treatment.—Care must be exercised in tampering with the pin. We know that metallic substances do not irritate, and it is best to begin with not disturbing the part much, but to foment freely, keep the animal quiet, and give an active dose of cathartic medicine. If suppuration comes on, the pin must be removed, to permit of the escape of the pus, and having protected the wound by a layer of lard around it a blister of cantharides ointment must be applied over a surface as large as the palm of the hand. This may be repeated, and is usually sufficient to treat the case. Low diet and salines must be persevered with until the phlebitis is fairly overcome.

Occasionally both veins are attacked, from a horse having been bled on both sides almost simultaneously. Death very frequently results; and if both veins are obstructed, though life is saved, the animal is well nigh worthless.

VENOUS OBSTRUCTIONS—MEGRIMS.

There are many cases which may lead to impediments to the flow of blood in the veins—the most common results from an adhesive phlebitis affecting one or more veins. It is in the jugular vein of the horse that such obstructions are witnessed, and occasionally there is a tendency, from the shape of the animal's neck, to temporarily check the flow of blood from the head by the collar. A tight-fitting collar may produce this in any animal, but there are horses not easily fitted with an ordinary collar, so as to avoid pressure on the veins of the neck, and in pulling hard these are obstructed and induce symptoms of vertigo.

Both jugular veins are pressed upon by the collar, and when a horse is driven under such circumstances, it is soon found, especially on a hot day and on hilly ground, that the animal is uneasy. The head is shaken, the ears move convulsively, the eyes soon appear bloodshot, and the animal suddenly rushes forward blindly, and throws itself violently forwards, often falling on its head, its muscles twitching as if death was imminent. It is not easy to hold a horse in the stage of great excitement, but if the collar is drawn forwards, the flow of blood is restored, and all symptoms disappear with the exception of a feverish excitement for a short time. The pressure by the collar does not absolutely close the veins, so that the heat of the sun has usually to operate in favouring cerebral congestion before megrims is produced.

I have seen one case in which both jugular veins were closed as the result of phlebitis. The animal, a bay carriage colt, three years old, had only been mouthed, and during a severe illness was bled from both jugulars. He recovered apparently, and so long as he was kept in the stable, and was fed from the rack, no symptoms appeared; but if turned out to grass, his head began to swell, and if he held his head down long, he rolled over in a fit. I was asked to see this horse, as he was losing flesh in the field, and presenting these strange symptoms, I had no difficulty in finding that both jugular veins were impervious. With obstruction of one jugular vein, there is only a greater tendency to megrims from pressure by the collar.

VARIX.

Usually at the seat of repeated blood-lettings, but sometimes in other parts of veins, the coats, the latter become attenuated and pressed out by the blood. It is usually in the hind extremity that these venous dilatations or varices are noticed, and they may affect one vein or many. A cab horse appeared daily for several years on a stand in Princes Street, Edinburgh, in which the superficial veins of the off hind-leg and flank were enormously varicose. A rich network of varicosities was seen, especially when the animal had been driven briskly. I could learn nothing of the history of the case, and the varices would probably be due to some internal cause of interference with the blood's flow. The most interesting case of varix as occurring in the lower animals yet published, appeared in the second volume of the *Edinburgh Veterinary Review*. Mr Hunt of Birmingham says:—

"In 1856, my attention was drawn to a six-year-old black cart gelding, the property of Mr Thomas Oakley. On the internal and anterior part of the near hock, nearly in the position of so-called 'bog-spavin,' I found a fluctuating tumour, not larger than a hen's egg. Inclining to the opinion that it was of bursal nature, I recommended, after cursory examination, that it be left alone. In tendering this advice, I was acting on the conviction that, at least for a long time, the animal's usefulness would not be interfered with by the tumour referred to. As the sequel will prove, this conviction was well-founded, notwithstanding that, upon more careful examination, I was led to form a diagnosis at variance with my first impression. The animal did not come under my observation again for some time, probably two years. I then found that the tumour had nearly trebled its size, was broad at the base, and somewhat pointed at the surface, in size and shape comparable to a large pear, with its base in apposition to the inner surface of the hock. I now entertained a suspicion that the tumour was a varix, due to distension of the saphena-vein, and I felt desirous of obtaining another opinion. Accidental circumstances prevented the fulfilment of this wish until the summer, 1859, when I availed myself of the opportunity of consulting with a member of our profession, Mr J. S. Gamgee, who is surgeon to the Queen's Hospital, and Professor of Clinical Surgery in the Queen's College, Birmingham. At this time, about three years after my first observation, the tumour measured no less than eighteen inches in circumference at its base, eight inches across, and eleven in length,—quite flaccid to the touch, shaking loosely as the horse walked, and the lower portion slightly pendulous. We found that the sac could be evacuated by pressure from below upwards. The saphena-vein could be distinctly seen passing upwards from the tumour, which became more full and tense on compressing that vessel. At the same time, a vein, appearing to enter the tumour from below, filled.

"The diagnosis of the tumour at this period was:—An enormous varix in the course of the saphena-vein. The reasons for the diagnosis were,—1stly, The situation of the tumour; 2ndly, Its physical characters; 3rdly, Its various alterations in shape by pressure upon it, and upon the vein above it.

"It was evident at this period that, unless something were done, the horse, otherwise a useful one, would speedily become valueless. Extirpation of so large a tumour in such a situation—over one of the principal joints—was out of the question. Neither did it appear advisable to evacuate the liquid contents, so long as the interior continued in communication with the parent vein, through which a fresh supply might be continuously derived. The only course open appeared to be to evacuate the tumour by pressure, and to cut off its communication with the circulatory system, by passing a couple of steel pins under the vein, above and below, and inducing pressure, with a view to exciting local inflammation in the vessel, and producing adhesion of its inner coat.

"The advisability of operating was intimated to the owner, but, as he wanted the horse at the time, interference was further delayed until the 25th May, 1860. At this date great change was manifest in the size and character of the tumour. It measured no less than 34 inches in circumference, 17 inches in length, and 17½ inches in breadth. No vein could now be detected ascending to the lower part of the tumour, —its size was not influenced to any appreciable extent by manipulating it, or by compressing the vein above. The enormous mass no longer was soft and fluctuating, but tense and solid, though on deep pressure slightly elastic. Confident of the accuracy of the former diagnosis, taking into account the fact that the animal had now become useless, he was cast, and two strong steel pins, at an interval of three inches, were passed under the saphena-vein,—the lowest pin about a hand's breadth above the tumour. Over and across each pin a piece of elastic bougie, the size of an ordinary lead pencil, was firmly secured by a few figure-of-8 turns of twine. An exploratory trocar puncture into the lower part of the tumour merely gave exit to a few drops of bloody serosity. On making an incision with a scalpel to the extent of three or four inches in the long axis of enlargement, its thickened and almost cartilaginous walls proved to be the boundaries of a series of pouches full of clotted blood. Nearly two pints were evacuated, but the remainder was so solid as to defy removal except by an extensive dissection not deemed warrantable. No escape of arterial or fresh venous blood. The edges of the integumental wound, in its upper two-thirds, were approximated with the aid of a couple of pins and figure-of-8 ligature, leaving a good aperture below, and the horse was allowed to rise.

"The following notes record the progress of the case:—

"May 26th. Apparently very little general disturbance. Eats and lies down. Pulse 44. The sac distended to its fullest extent in consequence of tumefaction. Very little sero-sanguineous fluid has drained away during the night. No swelling from the needles under the vein above the hock. Cold water dressing and an aperient.

"27th. Symptoms the same as yesterday. Flexes the hock as well as he did before the operation. No change in treatment.

"28th. As yesterday.

"29th. 8 A.M. Going on well. Still flexes the hock. Pulse 60.

"7 P.M. Tumefaction of the leg and thigh has commenced. Pulse 80 and full; dyspnœa. Fomentations to be applied without intermission.

"10 P.M. Symptoms aggravated. Vesicles forming over the swollen part in several places, and discharging serum.

"30th. 5 A.M. Symptoms of general disturbance increased in intensity. Pulse imperceptible. Dyspnœa more decided. Leg and thigh much swelled; the vesicles have broken, and many small wounds over the seat of disease, both within and outside the hock, yield copious sero-purulent discharge.

"7 P.M. Death.

"*Post-mortem examination.*—May 31st, 9 A.M.—The whole of the affected limb greatly swollen. On making an incision through the integument and subcutaneous tissue on the inner side, from the sheath down to the hoof, and reflecting the skin, exit given to a quantity of sero-purulent liquid—in fact the areolar tissue of the entire extremity was infiltrated with the products of a diffuse inflammation of low type. Notwithstanding the greatest care in dissection, it was found impossible to trace a vein ascending to the lower part of the tumour; not so above. The saphena-vein in the thigh was exposed with facility, and traced down to the tumour. The outer coat of the crural portion of the vein was preternaturally red and thick, but on opening the vessel it was found pervious as far down as the tumour, and its lining membrane throughout the same extent was flaccid and glistening. Neither of the pins had perforated the venous coats, nor was the vessel in any way different at the points where they were passed under it. As the external dissection left no doubt that the outer coats of the tumour were inseparably connected with, seemingly a direct extension and expansion of, the venous walls themselves, a careful endeavour was made to pass an elastic tube down the vessel into the cavity of the enormous growth. This was found impracticable, owing, as further dissection proved, to closure of the venous canal by adhesive inflammation at the point of junction with what had been diagnosed, and with what proved anatomically to be, a varix. That the vein was patent, and functionally quite healthy above this point, was evident from a soft non-adherent filiform clot within it, extending into numerous collateral branches.

"At this stage of the examination the tumour was divided longitudinally through its middle from the point of departure from the vein. The section showed several membranous septa dividing the entire cavity into various chambers, each filled with fibrin, the product of coagulation of blood at different epochs, as proved by the different colour and consistence of the material filling the various cavities."

PHLEBOLITES.

Béclard, Jules Cloquet, Dr John Reid, and many other observers, have indicated the occurrence of concretions in the veins of the human subject, and usually in hæmorrhoidal, ovarian, and spermatic veins, and the inferior vena cava. We have not many cases on record in veterinary science, and the most interesting is one reproduced below, from Professor Morton's work on *Calculous Concretions*, from which we copy also the illustrations. Referring to the origin of phlebolites, Dr John Reid says:—"Though the different changes through which these bodies pass in their formation have now been pretty accurately ascertained, yet the nature of the causes which produce these changes is exceedingly obscure. Tiedemann, Otto,* Lobstein,† Cloquet, and Dr Carsewell,‡ all agree that they are formed in the interior of the veins; that they at first consist of a coagulum of blood; in the interior of this clot the fibrin becomes pale and concrete, then assumes an osseous appearance, and this goes on little by little, and layer after layer, towards the circumference. We could easily class their formation with the occasional deposition of calcareous matter among the other tissues, if Hodgson's opinion was correct, that they were first formed external to the veins, and afterwards made their way by absorption into the interior; or if, according to Andral,§ they were in general first developed in the middle coat of the veins, and then passed into their anterior in the same manner as the false cartilages are formed, and pass into the cavity of the joints. Hodgson stands alone in his opinion; and we even find Mr Langstaff,|| upon whose authority he describes these bodies, inclined to believe that they are formed in the interior of the veins. The adhesions of these bodies to the inner coat of the veins by a fine membrane, as observed by Tiedemann and

* Otto's *Pathological Anatomy*, translated by South.

† Lobstein's *Anatomie Pathologique*.

‡ *Cyclopædia of Practical Medicine*, article "Veins."

§ Andral's *Anatomie Pathologique*, tome ii. p. 412.

|| *London Medico-Chirurgical Transactions*, vol. viii.

Cruveilhier,* would afford some countenance to Andral's opinion, were it not at variance with accurate observation; and we may suppose that this appearance was produced by the presence of the foreign body causing irritation and effusion of coagulable lymph.

"Tiedemann,† and, following him, Lobstein, suppose them to be formed by a mechanical deposition of the calcareous matter contained in the blood, intermixing itself with the albumen of the blood. It appears to me that this opinion is unable to explain the manner of their formation in many cases, and consequently, can scarcely be regarded as the probable cause of their formation in these cases which seem to agree with this supposition. Mechanical deposition of the matters contained in the blood cannot, I think, explain their formation in those‡ cases, where we find an osseous-looking deposit taking place in the centre of a coagulum, around which the fibrin arranges itself in concentric laminæ, increasing in density as we proceed to the centre, and where apparently those nearest the centre gradually assume this osseous appearance, which extends itself towards the circumference.

"If these bodies resulted from mechanical deposition, could the earthy salts pass through the several dense laminæ of fibrin, and deposit themselves, apparently in certain proportions, in the innermost laminæ? If the presence of the earthy salts was the result of a deposition, would they not rather be found upon the outer surface of the most external lamina, instead of penetrating through it to reach the innermost? We cannot, at least in the present state of our knowledge on

* Cruveilhier's *Anatomie Pathologique*, tome ii. p. 71.

† *Journal Complementaire du Diction. des Sciences Medic.*, tome iii.

‡ Cloquet's *Pathologie Chirurgicale*, and Observations of Dr Carsewell in article "Veins," *Cyclopædia of Practical Medicine*.

the subject, refer their formation to any chemical agency. Their formation is probably akin to the occasional hardening of tubercles into bony concretions, which is a process independent of any vascular organisation of the tubercles themselves. It is also illustrated by the formation of the vegetations on the valves of the heart, as observed by Læennec and Dr Alison,—also by the tubercular, purulent, or encephaloid deposits, sometimes found in the fibrinous clots within the heart and great vessels.

"I can scarcely venture to hazard an opinion on this subject, but I must confess that I feel inclined to believe (however fanciful the opinion may appear to some physiologists) that the great resemblance of those bodies in their chemical analysis to the osseous texture, the manner of their formation, and their possessing in some cases physical properties similar to cartilage, can only be explained by supposing that they are the result of a process resembling the formation of the osseous tissue in the other parts of the body."

I shall conclude my remarks on this subject by introducing Mr Simonds' case, as it appeared in the above-mentioned work:—

"PHLEBOLITES IN THE JUGULAR VEIN OF A HORSE. By Mr J. B. SIMONDS.—The patient was a dark bay horse, fifteen hands three inches high, and about twelve years old. Mr Simonds was requested to see him on the 3rd of November, 1842. (The remainder of the case will be given in his own words).

"'Mr Thacker, who was with me at that time assisting me in conducting my business, first visited him; but, considering it to be a case of a very unusual kind, he returned home, and requested that I would see him prior to any remedial measures being adopted. On my arrival, I found that the animal had been used by a gentleman for two or three weeks as a job horse, and, until within a day or two of the attack, no illness had been observed, but, on the contrary, the horse had gained flesh, and gone on well. At that time the coachman observed lameness in the near fore-leg, and found that the horse did not go to the collar so readily as he had been accustomed to do. When Mr Thacker first saw him, the symptoms were—total loss of appetite; the pulse at the jaw accelerated, but faltering; a kind of pulsation in which the practitioner rarely feels himself warranted in abstracting blood; at the heart the pulsation was fuller, in number 65; the respiration was languid and heavy; the extremities were not particularly cold, and the visible mucous membranes were slightly injected. There was a peculiar spasmodic contraction just anterior to the left spinous process of the ilium—a jerking action, as if connected with the internal abdominal muscles. There was also a degree of tenderness on the right side, over the region of the liver; an obstinate constipation of the bowels, but no turning of the head to the side, nor any desire to lie down, although he was evidently suffering from abdominal pain. No lameness of the leg was at this time observable, but it was rested. From the general symptoms, I was inclined to think that the illness arose from some derangement of the digestive organs, more particularly of the liver, not, however, amounting to hepatitis; and notwithstanding the peculiarity of the pulse, to which I have referred, the symptoms otherwise warranted me in attempting to withdraw blood. I, therefore, directed Mr Thacker to open the left jugular vein, in order to ascertain what would be the result. Keeping my hand at the side, I watched the pulsation at the heart. The vein was readily opened, and the blood for an instant flowed out of the vessel freely, but as quickly ceased. By keeping up the pressure, similar effects were produced. Finding that the animal did not bleed readily, I left his side, in order to examine the vein, and immediately detected the presence of an enlargement a little above the entrance of the jugular into the thorax. At first I was inclined to think that there had been inflammation of the vein, and that other conduits were taking the blood from the head to the heart; in fact, that there was an obstruction to the flow of blood through the vein. But, on examining more minutely, I discovered this tumefaction to be caused by tumours, which at first sight bore a strong resemblance to enlarged absorbents. This horse had been a short time previously in a stud where there were several cases of farcy and glanders, and hence I was naturally led to infer enlarged absorbents; but, on a still more careful examination, they proved to be tumours within the jugular vein. You may now see their situation: they are very evident, and placed about half-way down the neck. When I first detected them, they were somewhat lower down than they are now. But you will observe that, by applying pressure beneath them, they can be passed up the vessel. There is one which I now pass into the superior branch of the jugular vein, but, on removing the hand, it falls back again into its original situation. The other two tumours are evidently not connected with it. It appears to me that these tumours are somewhat of the nature of polypi, and are attached to the inner tunic of the vessel by peduncles. If my supposition be correct, it proves that there are no valves in this vein between the situation now occupied by these tumours and the point to which they can be raised; for, although valves would allow the blood to pass down, they would as certainly prevent these tumours being passed in a contrary direction. If the peduncle be two inches long, of course it will allow the tumours to pass over a space of four inches. Elevating the whole of the tumours evidently gives the animal pain. Thinking that the case might not be uninteresting to the members of the Association, I ventured to send the horse to the College, and, on the road, he unfortunately became lame again in the near fore-leg.

"'It is interesting to inquire whether the lameness is referable to any accident he has met with, for there now seems to be some slight inflammation in the fetlock joint; or whether it is connected with these singular productions. But, taking the fact of its being an ambiguous case in the first instance, and of its being recognised by a loss of power, or a degree of lameness in this extremity; also of this horse not having done any work from that period, and then having become lame again when he had walked about four miles on the road hither, it does appear as if we might be almost warranted in concluding that some obstruction exists to the natural flow of blood in this limb, and which may account for the lameness. I have been inclined to think that the whole of the animal's illness has been referable to the existence of these tumours; for, if they exist in the jugular vein, they may be present in other vessels, and I think it is more than probable that they are. Mr Spooner, your President, has informed me that in his dissections he has detected similar productions in the abdominal veins. Here they occur in the jugular vein of a living animal, and are, as you see, about the size of a large nut. On grasping them firmly, they are found to be very hard and unyielding. Although pressing them gives the animal pain, yet it does not produce so much as we might have expected. The proof that they are attached by peduncles is satisfactorily demonstrated by the fact of their not falling down the vessel—not going on with the

Fig. 120.

Fig. 122.

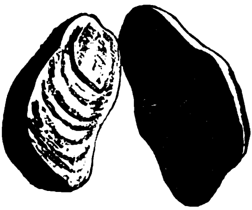
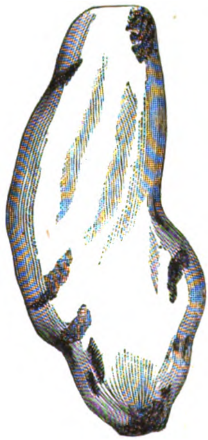


Fig. 121.

Fig. 123.



current of blood. As the caliber of the vessel readily admits of their passing upwards, so it would of their passing downwards, were they not attached by a footstalk. It is this which prevents them falling down into the heart, and thus at once putting an end to life by their presence in that organ.'

["This horse was subsequently purchased by Mr Simonds, and destroyed, on account of there being "but little probability of his ever becoming useful again." The diseased parts having been removed, the following description of them was given by Mr Simonds:—]

"'You will observe the jugular vein (Fig. 120), in which the tumours were situated, and which you will remember were about half-way up the neck, and that they admitted of being passed up the vessel as high as its bifurcation. On the pressure employed to elevate them, however, being removed, they immediately fell down to their original situation; but all our efforts to push them further down were ineffectual. The post-mortem examination at once proves why this should have been the case, for the vessel is impervious below the part they occupied, from lymph having become thrown out, so that no blood could pass down it. The obliteration extends from that part where the tumours were situated down to that portion where the axillary vein unites with the jugular, so as to enter the anterior vena cava.

"'The tumours themselves I have before me (Figs. 121, 122, 123). They are three in number, and varying in size as well as in shape. They are very dense, and on making a section of one of them, which has been effected with some little trouble, it appears to be composed of bony matter, or some of the earthy phosphates; but Mr Morton has undertaken to analyze one of them, and he will make known to you its composition.

"'The origin of these tumours must ever remain somewhat shrouded in mystery, and different views will be taken by different persons of their formation.

"'At the time I introduced the case, I thought they were pedunculated, but in this it appears I was mistaken. Whether they originally possessed a peduncle, which, becoming ruptured, allowed them to fall down the vessel to a certain extent, and nature, to prevent them from descending further, threw out lymph; or whether they might not have been produced from the vessel becoming impervious below, from some injury or pressure caused by the collar—are questions for your consideration. This animal had been accustomed to the common duties of a coach horse, and had been working for some time in one of the Brighton stages.

"'The weight of the tumours, taken altogether, is not quite fourteen drachms. The large one weighs just six drachms and a-half, and the small one but one drachm and a-half.

"'Being desirous of examining the heart, in order to see whether it, or the vessels immediately proceeding from it, had undergone any change, your President has made a section of it, and, I believe, there is nothing abnormal to be observed; but the jugular vein being impervious, and these tumours occupying it, I should not have been surprised if we had found the valves of the heart affected. I believe, however, that the semi-lunar valves opening into the aorta and the pulmonary artery are perfectly healthy, as well as all the others.

"'It is questionable whether these tumours possess a distinct organization. One would be almost inclined to conceive that they did, for, otherwise, they would have acted as foreign agents, and inflammatory action would have taken place, and a sloughing of the coats of the vein in order to allow of their escape. This not being the case, and their existing for the long time they must have done in order to attain their present size, are, I think, clear proofs that they possess a distinct organization. If I am right in this deduction, then I consider this to be one of the best proofs that can be adduced of the life of the blood. The fibrous part of the blood, in the first instance, was thrown out from the inner part of the vessel, and this became organized; so that thus they possessed organization within themselves. Their general appearance, with their not having any thing like a peduncle, is, I think, almost a positive proof that such was the case. It is, however, a matter of speculation whether they thus had their origin or not; but the promised analysis will tend much to set the question at rest.

"'The disease to which our attention was first directed arose from derangement of the digestive organs. I told you the liver was the principal seat of this affection, and the post-mortem examination also bears that out. This organ is very considerably altered in its shape, and parts of it appear to be in different stages of disease. When the horse was in the College, both Mr Spooner and myself were of opinion that there was a softening of the liver, and that hæmorrhage had taken place beneath the peritoneal covering, and, by forming a coagulum, had prevented its escape into the abdominal cavity. Many parts of the viscus now establish the correctness of this prognosis. The peritoneal tunic is thickened, from the chronic inflammatory action which has been going on in it. It shows that the symptoms, ambiguous as they were, were, nevertheless, sufficient to point out this organ as the principal seat of the affection.

"'The greatest change, however, in the organ, except its shape, is the formation of an encysted tumour, which, by taking an external view of it, appears to contain pus. My impression is, that had the animal lived much longer, an abscess would have been formed in this situation, this being the beginning of the process. On making a section of the encysted tumour, however, I find that instead of its containing pus, which one would naturally have expected, it is coagulated blood. This is an interesting circumstance, and proves more clearly the correctness of our opinion. There was hæmorrhage from the liver, and blood has been thrown into this cyst. The underneath part of this immense coagulum of blood is likewise surrounded by a dense membrane, thus forming a sacculated receptacle, into which blood was thrown. It is, perhaps, interesting to inquire whether this peculiar state of the liver was not referable to a morbid change going on in the blood-vessels, and more particularly in the jugular vein.

"'You will remember, that, at the time the animal was exhibited to you, lameness in the near fore-leg was present, and that very severe. That was supposed to be attributable either to the condition of the blood-vessels, or to some injury the animal had received. The examination of the leg shows that there was inflammation of the synovial membrane of the fetlock joint, as well as inflammation of the lining membrane of the mucous capsules, as they are called, but no local injury.'

"Mr Morton stated that he had, as requested, analyzed a portion of one of the phlebolites.

"Its investing tunic, he found, was made up almost wholly of albumino-fibrin. A portion of its interior being boiled for some time in distilled water, did not undergo any perceptible change whatever, nor did it impart any sensible properties to the water. In a solution of caustic potassa it became dark-coloured, but emitted no ammonia. Another portion, about five grains, being placed on a piece of platinum foil and subjected to the influence of heat by the aid of a blow-pipe, blackened, and threw off copious exhalations having the odour of burning animal matter. It then became white, and on being weighed was found to have lost nearly one-half its weight. The residuum quickly dissolved in dilute hydrochloric and with effervescence, and the gas eliminated rendered lime-water turbid. The solution being filtered and rendered nearly neutral, the oxalate of ammonia threw down from it an abundant precipitate, and on adding an excess of water of ammonia to it, gelatinization took place.

"The microcosmic salt threw down no precipitate; and the hydrosulphate of ammonia caused no discolouration, proving the absence of the metallic oxides.

"The inference deducible from the above analysis is, that the concretion consists of animal matter nearly one-half, the remainder being the phosphate and the carbonate of lime.

"Gmelin subjected some phlebolites taken from the human subject to analysis, and found them to consist of,

Animal matter	27.5
Phosphate of lime	53.5
Carbonate of lime	15.5
Magnesia and loss	3.5
	100

"He could not refrain from expressing his concurrence with the view Dr Carswell had taken of the formation of these bodies, which is, that they have their origin in the coats of the vein; and he thought the concretions adverted to by the President at the last meeting were very likely to be phlebolites in the early stage.

"It was the structure of these vein-stones that more particularly induced him to come to this conclusion. The one laid open by Mr Simonds shews a series of layers, but not around a common centre, which he thought would be the case if they were formed directly from the blood; but these layers of animal matter are superposited one upon another, and the outer one, that which is in contact with the membrane enclosing the mass, has much the greatest quantity of earthy matter in it. He also considered them to possess organization, although in a very low degree, and once to have had peduncles by which they were attached to the vein, although certainly not a vestige of any is now to be seen. Their shape also favoured this view, as well as the position of the lamellæ."

CAPILLARIES—CAPILLARY HÆMORRHAGE.

Just as the arteries and veins are occasionally injured, and blood flows from them, so wounds of the capillaries lead to hæmorrhage, which soon ceases spontaneously, or is stopped by pressure. Capillary hæmorrhage may, however, be active or passive, according to its origin. If the blood, modified in quality, exudes or transudes through the coats of the vessels, which have only very partially given way, the hæmorrhage is said to be passive. This occurs in many disorders in which a blood poison is in operation. Active capillary hæmorrhage is always the result of injury. In passive hæmorrhage you must treat the blood disease, or apply cold water to the part where the oozing occurs. In active hæmorrhage, stiptics, such as sulphate of iron, tincture of matico, alum lotion, tincture of the sesqui-chloride of iron, &c., may be applied, favoured by rest and pressure.

CHAPTER VIII.

ORGANS OF RESPIRATION.

Respiration in different animals.—Respiratory apparatus.—Nasal chambers: position, openings, and septum.—Sinuses.—Pharynx.—Larynx: its cartilages and muscles.—The glottis.—Windpipe or trachea.—Bronchial tubes.—Ultimate pulmonary lobules.—Air-cells.—Pleura.—Blood-vessels.—Nerves and lymphatics of lungs.—Mechanism of respiration.—Inspiration.—Expiration.—Number of respirations per minute.—Respiration in birds.—The Blood: its physical properties and microscopical characters.—Blood corpuscles.—Liquor sanguinis.—Coagulation of blood.—Gelatinization.—Separation of serum.—Circumstances which favour or oppose the clotting process.—Exposure to air—Heat—Cold.—Fainting.—Action of alkalies.—Contact with living tissues.—Dr Richardson's and Professor Lister's researches.—Buffy coat.—Causes of coagulation.—Chemical characters of the blood.—Chemical changes in respiration.—Physical signs of respiration.—Auscultation.—Percussion.—Palpation.—Succussion.—Mensuration.—Auscultation in the horse—Ox—Sheep—Pig—Dog—Cat—Birds.—Auscultation of nasal chambers—Larynx—Windpipe—Chest.

IT is an essential condition of existence in all animals, that the blood should at some part of its course be subjected to an interchange of materials with the external air. The bright red arterial blood, in passing through the capillaries of the system, has a quantity of oxygen replaced by carbonic acid, assuming at the same time a dark hue, and acquiring poisonous, in place of its previous healthy, stimulating properties. By free exposure to the air, a substitution of an opposite character is induced, and the process is designated respiration. This function is variously effected in the different grades of the zoological scale. In the lowest orders of animals, as in zoophytes and infusoria, the blood is sufficiently exposed to the air through the thin and impermeable skin. In fishes and most aquatic animals, aëration of the blood is effected by means of gills; these are thin, feathery-like tufts, of a highly vascular structure, attached to the mucous membrane of the pharynx, and either projecting externally to be waved in the surrounding liquid, or remaining within the pharynx, and subjected to a constant stream of water, which is taken into the mouth, and expelled through two lateral pharyngeal orifices, in an act, somewhat analogous to deglutition. In terrestrial and air-breathing animals, the apparatus of respiration is generally situated internally, and is more or less complex, according to the rapidity of the respiratory process. It may be composed of two simple, undivided cavities or lungs, as in the salamander; each cavity may be incompletely divided into separate cells as in frogs and the majority of reptiles; or the single air-tube proceeding to each lung may repeatedly subdivide into numerous smaller tubuli, each of which ultimately terminate in a variable number of cells (pulmonary cells or vesicles). This last arrangement we find in warm-blooded animals, the high temperature of which calls for great activity in the respiratory process.

In our domestic quadrupeds, the respiratory apparatus is formed, 1st, of the air passages with the lungs and pleura; and, 2nd, of the thorax, including the respiratory muscles. The air passages comprise the nasal chambers, pharynx, larynx, trachea, bronchia, air sacs, and pulmonary cells.

The nostrils are two cavities placed above the mouth, and extending the whole length of the face. The anterior extremities open externally; the posterior conduct into the pharynx. The former are constantly open, in which state they are retained by two curved cartilages, placed back to

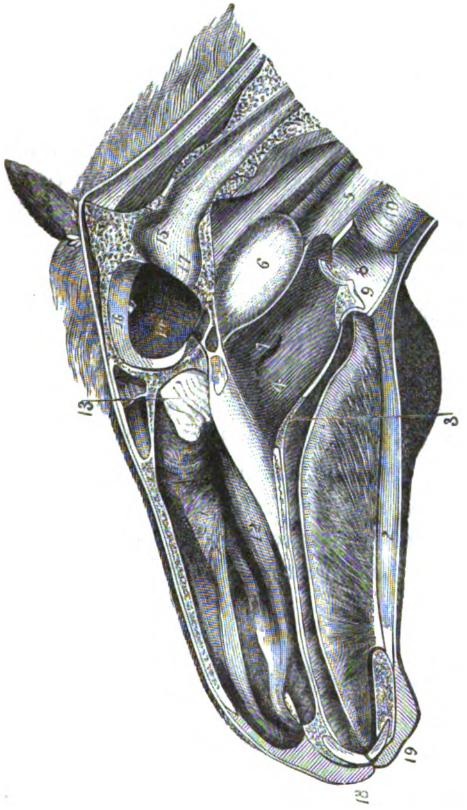


Fig. 124.—Antero-posterior section of the head, showing the entire mouth, pharynx, and nasal cavities. 1. Genio-hyoglossus; 2. Genio-hyodeus; 3. Section of the soft palate; 4. Pharynx; 5. Œsophagus; 6. Guttural pouch; 7. Pharyngeal opening of the Eustachian tube; 8. Cavity of the larynx; 9. Ventricle of the larynx; 10. Trachea; 11. Superior turbinated bone; 12. Inferior turbinated bone; 13. Ethmoid cells; 14. Portion of the cranial cavity which lodges the brain proper; 15. Portion of the same, which lodges the cerebellum; 16. Falx cerebri; 17. Tentorium; 18. Upper lip; 19. Lower lip.

back in the median line, and supporting the muscles, glands, adipose tissue, and skin of the nose. These cartilages form the basis of the external wall of the orifice, technically called the alæ nasi. The false nostril, a peculiarity of solipedes, is a cavity within and on the supero-external aspect of each orifice; it is almost completely separated from the corresponding nasal chamber, and lined throughout by fine skin, similar to that surrounding the opening. The posterior orifices of the nostrils are generally open, though when a pellet of food is passing they are closed by the soft palate, a musculo-membranous fold, projecting downwards and backwards from the posterior border of the floor of the nasal chambers. This structure attains its greatest length in solipedes, in which it entirely prevents the process of breathing through the mouth; in these, as in other animals, however, it allows the ready passage of agents from the mouth into the pharynx, and in this case is pushed upwards against the posterior nares, effectually preventing the introduction of foreign bodies into the nostrils. The nasal chambers themselves are two considerable cavities, separated from each other by a median osseo-cartilaginous plate, composed of an elongated and slightly flattened bone (the vomer) inferiorly, and of a cartilaginous

Fig. 125.—Vomer.

septum, continuous with the superior border of the latter. The roof, floor, and external wall of each chamber are composed of various facial bones, the frontal, superior, and anterior maxillary, nasal, and palatine. Each nostril is imperfectly separated into three subdivisions or meati, a superior, median, and inferior, by the two turbinated bones. These are each formed of an extremely thin and fragile perforated lamina, rolled, as it were, upon itself, and attached by its external or free border to the outer wall of the cavity. Each turbinated bone contains two cavities internally, an anterior and posterior, separated from each other by a median plate, and communicating respectively with the middle meatus, and the maxillary or frontal sinuses. Projecting into the posterior part of each chamber are the *ethmoid cells*—a collection of small horn-like structures, formed of thin laminæ, rolled upon themselves, and resembling turbinated bones in miniature. Still another set of cavities communicate with the nostril—the sinuses. These are irregular interspaces between the superficial and deep plates of the facial bones, opening into one another, and into the nasal chamber. They are three in number on each side, the frontal, the sphenoidal, and the maxillary. The frontal is situated between the eyes, and extends as far forwards as the nasal bones; the sphenoid is deeply situated in front of the cranium and beneath the frontal, with which it communicates; the maxillary is placed immediately above the molar teeth of the upper jaw, and extends from the level of the eye to the third molar tooth. These spaces are small in very young animals, and gradually increase with advancing age. In oxen they are very capacious, covering the whole front of the cranium, and extending into the horns. In carnivora, on the other hand, they are very restricted. The osseous and cartilaginous walls of the nostrils, and the various contiguous cavities—the false nostril of the horse excepted—are covered by mucous membrane, formed of a somewhat lax layer of connective tissue, covered by a basement membrane and epithelial cells. In each chamber and communicating cavities, with the exception of the posterior part of the former, these cells are columnar, and the superficial layer is provided with vibratile ciliæ, the constant movements of which serve to clear the passages of mucus and other matters. On the ethmoid cells, and the posterior part of each nasal chamber, where the nerve of smell ramifies, the epithelium is reduced to a single layer, and is unprovided with ciliæ. In the interior of the turbinated bones and sinuses, the mucous membrane, and especially the epithelial layer, is thinner than in the nasal chambers. This membrane contains numerous racemose glands for the secretion of mucus, and at various points, especially over the posterior portions of the turbinated bones, presents a dense venous network or erectile tissue. The chief object of the sinuses seems to be to assist in preserving the proper contour of the face, without adding to its density.

The pharynx is that space through which food and air both pass, as already noticed in the article on the digestive organs. In solipedes it communicates on each side, through a narrow opening, with a large cavity (Eustachian pouch), lined, like itself, with ciliated epithelium, and communicating through the Eustachian tube with the middle ear.

The larynx is a cartilaginous box, compressed laterally, placed at the upper extremity of the windpipe, and conducting the air into that passage. Its framework is composed of five cartilages, the cricoid, thyroid, two arytenoid, and the epiglottis; these are bound together by more or less elastic ligaments, and moved upon one another by special muscles. The cricoid cartilage is a complete ring, placed at the lower part of the larynx, and connecting it with the windpipe. The thyroid is composed of an anterior and two lateral portions, which embrace the cricoid on all sides save the posterior. The arytenoid are two quadri-lateral cartilages, placed above and behind the cricoid, and bounding laterally the superior opening of the larynx. The epiglottis is an irregularly triangular fibro-cartilage, attached by its base to the front of the thyroid by yellow and white fibrous tissue, and to the semicircular portion of the hyoid bone by muscle.

From these connections, its apex projects upwards and forwards in its ordinary condition, but on the passage of a bolus of food is passed backwards and downwards to close the opening of the glottis. On looking into the larynx from above, we see that, for some distance below the orifice, it is tolerably capacious, though slightly flattened from side to side; below this is a constricted triangular portion, the base of which is turned posteriorly; and, still lower, a widened and circular part, leading into the trachea. The median constricted part, or glottis, is bounded laterally on each side by two folds of mucous membrane, the superior and inferior vocal cords, separated from each other by a cavity called the ventricle of the larynx. The superior or false vocal cords are simply folds of mucous membrane, with a few elastic fibres as a basis, while the lower or true vocal cords contain each a considerable elastic bundle. The latter extend from the inner aspect of the arytenoid cartilages, forwards to the thyroid. They are chiefly put upon the stretch by two pairs of muscles, the crico-arytenoideus posticus, and the thyro-arytenoideus transversus, whose function is to pull the arytenoid cartilages backwards and outwards. Two other muscles assist in the dilatation of the glottis, while five pairs and a single muscle serve to relax the vocal cords, and constrict the glottal orifice. Any alteration in the size of this orifice modifies the pitch of the voice. In ruminants the vocal cords are much less prominent than in the horse. The whole internal surface of the larynx is covered by mucous membrane, provided with ciliated epithelium, and attached to the subjacent parts by a considerable amount of connective tissue. It contains numerous racemose mucous glands, especially towards the base of the epiglottis, and near the entrance of the larynx. This membrane, which is supplied by the superior laryngeal nerve, is extremely sensitive, a provision which leads to the ready

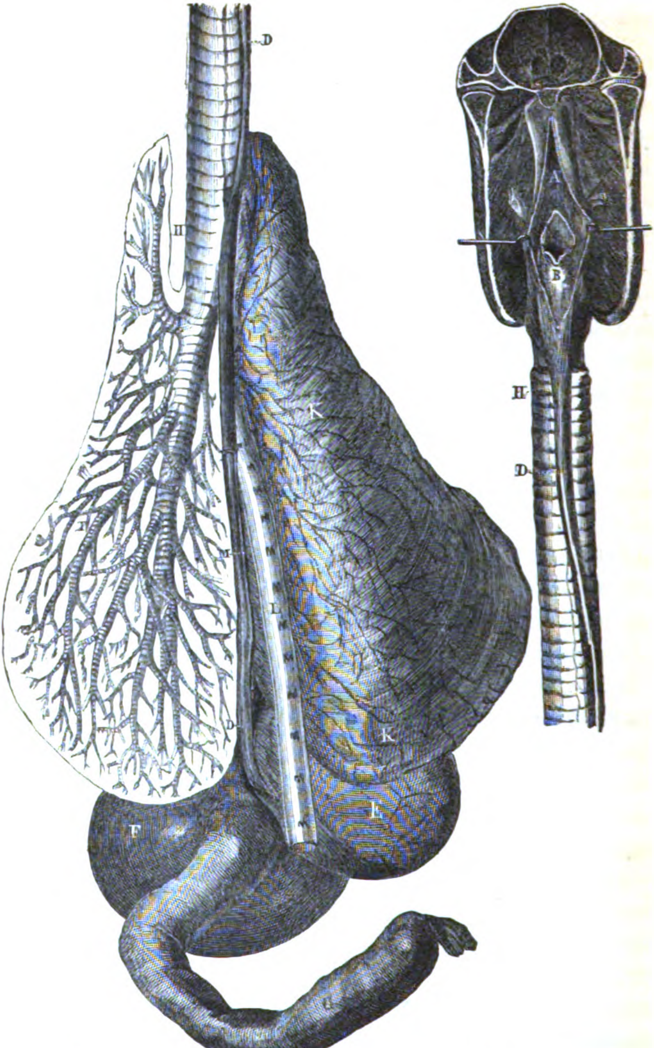


Fig. 126.—Trachea, bronchia, and lungs (superior aspect).—A, Cavity of the pharynx, open; B, Œsophagean infundibulum; C, Entrance of the larynx; D D, Œsophagus; E, Left cul-de-sac of the stomach; F, Right cul-de-sac of same; G, Duodenum; H, Trachea; I. Right bronchial ramifications; K, Left lung; L, Posterior aorta; M, Common origin of the bronchial and œsophagean, with some intercostal arteries.
This drawing has been turned in the engraving.

expulsion by coughing of any noxious agent, and the protection of the lungs from injury. The muscles of the larynx are supplied by the inferior laryngeal or recurrent nerve, a branch given off inside the thorax by the pneumogastric. This nerve is frequently affected in *roaring*.

The windpipe or trachea is a flexible tube, slightly compressed from above downwards, extending from the larynx along the lower border of the neck, and within the thorax as far as the right side of the posterior aorta, where it divides into two bronchi. It is formed of a congeries of cartilaginous rings, imperfect posteriorly, where the one end overlaps the other, and showing their greatest breadth towards the middle of the neck. About fifty of these rings are found in the horse, and as many as seventy in ruminants. They are subject to singularities of form, sometimes becoming bifurcated or joining each other at their extremities. Their adjacent margins are bound together by yellow elastic tissue, which extends over both their anterior and posterior aspects, though in the thickest layer on the former. Their extremities, moreover, are bound together by this elastic layer, so that the latter forms, with the cartilage, a complete external coat to the tube. The extremities of the cartilages are further joined by involuntary muscular fibres (trachealis muscle), which are extended transversely on the inner aspect of the elastic layer. Spread over the inner aspect of the elastic and muscular fibres, is a layer of connective tissue one-eighth of a line in thickness, and joining the former to the mucous membrane. The mucous membrane is composed of a connective and elastic layer, covered by ciliated epithelium. This membrane, which is supplied by the recurrent nerve, is possessed of very little sensibility.

On arriving above, and to the right side of the heart, the trachea divides into two larger bronchi, and in most of the large domestic quadrupeds, into a third, much smaller than either of the other two. Each of these tubes or bronchi, again, divides into secondary bronchial tubes, these again into tertiary, and so on until they are reduced to about $\frac{1}{25}$th of an inch in diameter, when they individually terminate in

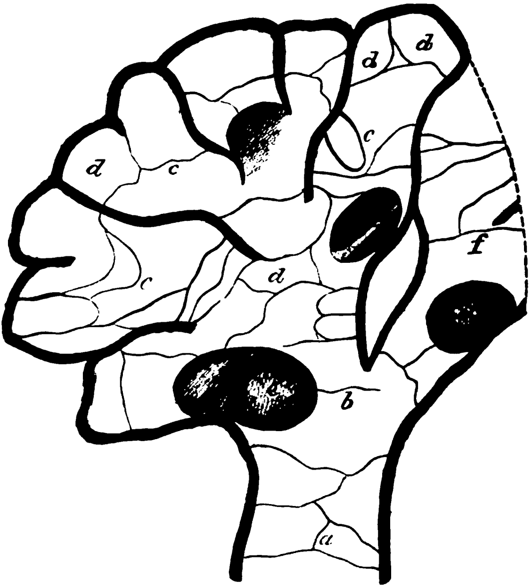


Fig. 127.—(WATERS.)—Ultimate bronchial tubes, with air sacs connected with it (of a cat). *a*, Ultimate bronchial tube, forming the *point de réunion* of all the air sacs; *c c c*, the air sacs; *d d*, the alveoli; *e e*, opening leading to other sacs. At *f*, a part of the wall separating two other air sacs is seen, the whole of which sacs could not be included in the sketch. The drawing was made from the image reflected by the camera lucida.

a dilatation which opens into the ultimate air sacs and cells. The bronchial tubes differ from the trachea in being nearly circular, and having their cartilages disposed in plates in place of rings. Three or four of these plates generally unite to encircle one segment of the tubes, and their extremity, especially in the larger tubes, overlap each other to a considerable extent. On the small tubes they are found scattered irregularly over the walls, leaving considerable intervals. The cartilaginous plates on the primary bronchi are nearly as thick as the rings of the trachea, but on the smaller tubes become gradually attenuated, and cannot be demonstrated on tubes less than half a line in diameter. The cartilages are enveloped in a layer of white and elastic fibres which completely encircles the tube, and, with the cartilages, forms its external coat. Within this is a coat of circular involuntary muscular fibres, which become gradually thinner on the smaller tubes, but can be demonstrated on those of $\frac{1}{10}$th to $\frac{1}{12}$th of a line in diameter. The internal or mucous coat has an outer layer of elastic longitudinal fibres on which lies a thin homogenous layer (basement membrane) supporting the ciliated epithelium. Like the coats already mentioned, this becomes much attenuated on the smaller tubes. Racemose mucous glands are numerous in the larger bronchia, but disappear on those of one or one-and-a-half lines in diameter. The mucous membrane of the bronchia is much more irritable than that of the trachea.

The terminal bronchia, each enter a pear-shaped mass of parenchymatous tissue, constituting a lobulette or ultimate pulmonary lobule. The bronchus here ends in a dilatation communicating with several elongated cavities (terminal cavities, Mandl; air sacs, Waters), separated from one another by thin and delicate walls, and having each upon its walls from ten to twenty minute depressions, likewise separated from each other by thin membranous parietes. The latter are the *alveoli* or *air cells.* Some air cells may likewise be noticed on the commencement of the bronchial tube to which they give a moniliform appearance. Two or more

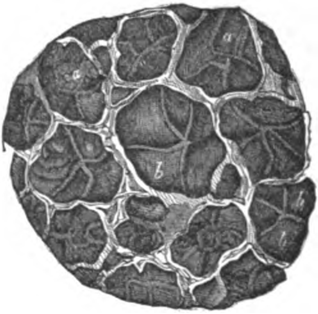


Fig. 128—(WATERS)—Represents a very thin slice of a cat's lung (injected, inflated, and dried), from the surface of the lung. The eye is looking upon the cut surface. The depressions, *a a*, are the bottoms of the air sacs, resting on the pleura. The light coloured lines that surround them are their walls, and the small depressions seen within the walls, *b b*, marked off by less distinct lines, are the alveoli. The specimen from which this drawing was made was a very good one, and the drawing may be considered as fairly representing the appearance presented.

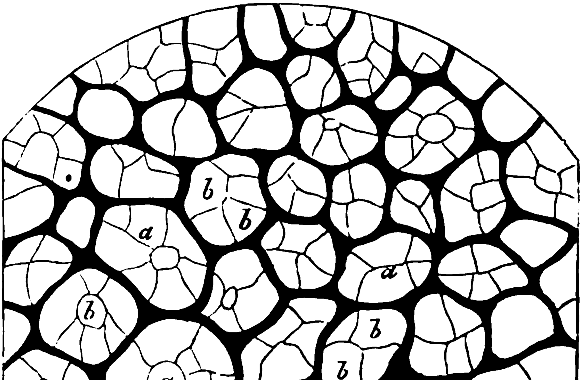


Fig. 129—(WATERS)—Represents a thin slice of a cat's lung, viewed in the same way as in the last two drawings. *a a*, are the air sacs, and *b b*, the alveoli, situated at their fundus. The dark lines are the walls of the air sacs and alveoli. This drawing was made from a reflection of the object by means of a camera lucida fixed to a microscope: the outline of the walls of the air sacs and of the alveoli was traced as it was thrown on paper.

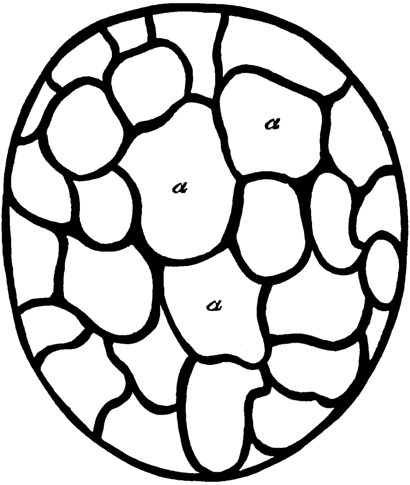


Fig. 130.—(WATERS)—Is a drawing of a thin slice, cut transversely, of the lung of a cat. It shows the shape of the air sacs. This drawing was taken by means of the camera, in the same way as the last three. *a a*, are the cut air sacs, the dark parts their walls.

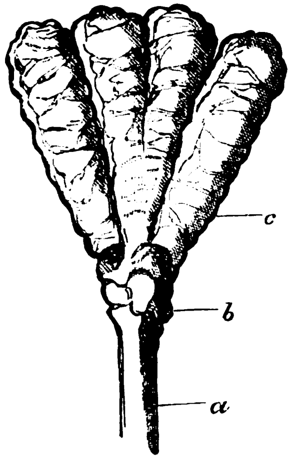


Fig. 131.—Theoretical view of the pulmonary tissue, viz., terminal bronchial tube, its dilated extremity, and its group of air sacs or lobulettes, divided transversely. *a*, Terminal bronchial tube; *b*, Cavity in which the air sacs end; *c c*, The air sacs (the central one is seen to divide). The markings denote the alveoli of the air sacs, and of the dilated extremity of the bronchial tube.

air sacs are occasionally found to coalesce and open by a single common orifice into the dilated extremity of the bronchial tube. Each pulmonary lobulette receives only one bronchial tube, and its air sacs and cells have no means of communicating with those of other lobulettes, except through this channel. Each air cell has a diameter of from $\frac{1}{80}$th to $\frac{1}{180}$th of an inch in man (Kölliker), $\frac{1}{280}$th in the dog, $\frac{1}{210}$th in the goat, $\frac{1}{190}$th in the horse, and $\frac{1}{100}$th in the cow, (Rossignol.) Mandl states that in castrated animals they are much smaller than in perfect males and females. The walls of the air cells and sacs are similarly constructed. They are composed of a single coat formed of a fibrous and an epithelial layer. The former is chiefly composed of elastic fibres which interlace in encircling the walls of the cavities, and support the plexus of pulmonary capillaries. The epithelium presents a single layer of cells devoid of cilia. Connecting these, a very delicate basement membrane has been demonstrated.

The lobulettes vary from a quarter to a line in size, and are pyriform when on the surface of the lung, but are modified in shape when deeper situated. They are bound together by a thin layer of elastic tissue, so as to form lobules varying from a quarter to an inch in size. These lobules are in turn similarly, though more loosely, connected into groups, and by a still more lax union of such groups, the pulmonary lobes are formed. The lobes result from the breaking up of the lung by intervals, more or less deep, into separate masses, each communicating with a single large bronchus. The horse's lungs have no lobes, unless a slight depression existing on the posterior part of the right lung, and transmitting the vena cava, is to be looked upon as indicating such a division. In the cow, sheep, and pig, the left lung is divided into two lobes, and the right into four, the anterior of which extends across in front of the heart. In the dog, the left has three lobes and the right four, the divisions extending, in this case, nearly to the roots of the lungs. It is noticeable that each lobe receives a single large bronchial tube, each group of lobules a special bronchial tube of smaller caliber, each lobule a still more diminutive special branch, while each ultimate lobulette has its own terminal bronchus.

The interlobular connective tissue predominates most in young animals; its amount varies likewise in the different species, being especially abundant in the lungs of ruminants.

The lungs, as a whole, have a somewhat conical form, the rounded apex being presented toward the neck, while the irregularly concave base is turned backward, and applied against the diaphragm. The right lung is generally larger than the left, on account of the position of the heart being slightly to the left side of the median line.

Each lung is covered by a special serous membrane (pleura), which envelopes the lung, and is reflected on the walls of the thorax. Each pleura is divided into four portions—the pulmonic or visceral, the mediastinal, the diaphragmatic, and the parietal. The pulmonic pleura covers the whole external aspect of the lungs, to the parenchymatous structure of which it is intimately attached by a layer of elastic tissue. This connecting layer dips into the pulmonary tissue, becoming continuous with the interlobular layer. Each pleura passes off the lungs at the bronchial tubes, and becomes continuous with the mediastinal pleura. The latter is an extensive membrane attached to the sides of the vertebræ above, the sternum below, and the middle of the diaphragm behind. The mediastinal pleuræ on both sides thus concur in forming a complete median partition for the thorax, but in the horse their structure is so lax, postero-inferiorly, that liquid readily passes from the pleura on one side to that on the opposite. An interval (mediastinum) of varying dimensions is left between the mediastinal pleura on the one side, and that on the opposite. This space has been divided into the anterior, median, and posterior mediastina. The anterior contains superiorly the trachea, œsophagus, anterior aorta with its branches, the anterior vena cava, the thoracic duct, the cardiac plexus, and the pneumogastric recurrent and phrenic nerves: in the very young subject it includes the thymous gland. The middle mediastinum contains the heart and the roots of the large vessels, the œsophagus, the first divisions of the bronchia, and the nerves above noticed. The posterior mediastinum, much narrower than either of the others, is traversed above by the posterior aorta, the asygos vein, and the thoracic duct; a little lower by the œsophagus, with the pneumogastric and left phrenic nerves. The mediastinal pleuræ are attached to one another or to the structures in the mediastinum by a more or less lax areolar tissue. The diaphragmatic pleura is that part applied on the anterior aspect of the diaphragm, and the parietal that covering the ribs and intercostal muscles. Both are attached to the subjacent structures by areolar tissue.

The lungs have two separate sets of blood-vessels, the bronchial and pulmonary. The former are engaged chiefly in the nutrition of the organ—the latter in the function of respiration. The bronchial arteries arise from the posterior aorta, and, proceeding to the roots of the lungs, divide with the bronchia, and distribute their blood to the walls of these tubes, to the pleura, to the interlobular connective tissue, to the large vessels of the pulmonary system, and to the lymphatics. The capillary plexuses of the bronchial tubes are two in number, a deep and a superficial. The former is composed of minute vessels, running circularly round the muscular coat, and the latter of still smaller vessels, running longitudinally in the elastic layer of the mucous coat. Numerous anastomosing vessels proceed from the deep to the superficial plexus—(WATERS). These capillaries, especially in the smaller bronchia, have their blood aërated in traversing the mucous membrane, and terminate in the pulmonary veins. The bronchial veins seem chiefly to originate from the walls

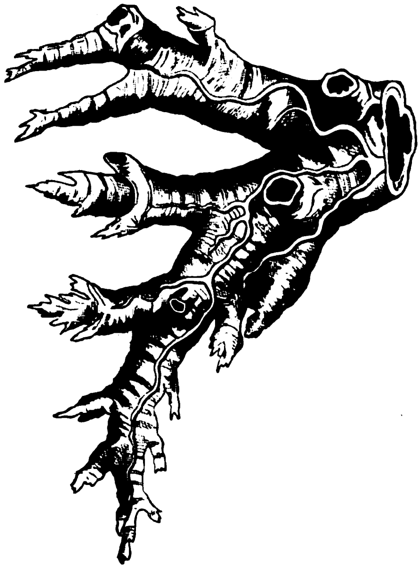


Fig. 132—(HEALE)—Shows the ramifications of the trunks of the sustinent arteries on the external surface of the bronchial tubes—natural size.

of the larger bronchi, the bronchial glands, and other structures about the roots of the lungs, and follow an irregular course to the asygos vein, into which they pour their blood. Heale describes other small venous trunks, proceeding from the coats of the smaller bronchial tubes, the interlobular connective tissue, and the pleura, to terminate in the æsophageal and asygos veins.

The pulmonary artery, which conveys venous blood to be aërated in the lungs, originates from the base of the right ventricle, and curving upwards and backwards, bifurcates over the left auricle of the heart, sending a branch to each lung. It subsequently divides in the same manner as the bronchial tubes, and sends an ultimate twig to each lobulette, to be distributed on the walls of the air sacs and pulmonary cells. The resulting capillary plexus is consequently exposed on both sides to the action of the air, except in those parts where the walls of one lobulette are applied against those of another; in such a case they are necessarily related on one side to the interlobular connecting tissue. The capillaries of the network vary in size from $\frac{1}{3000}$th to $\frac{1}{2500}$th of an inch.—WATERS.

The pulmonary veins are those vessels which convey the arterialized blood from the lungs to the left side of the heart. They originate by numerous small radicles, passing from the periphery of the lobulettes, and joining to form veins in the interlobular spaces. These veins continue to traverse the interlobular spaces, and generally follow the most direct course towards the root of the lung. Other veins are found running along the bronchial tubes, and returning the blood from their mucous membrane. On reaching the root of the lung, they unite into several large trunks (4 to 8 in number), by which the blood is discharged into the left auricle.

The whole of the blood from the pulmonary lobulettes, and the mucous membrane of the bronchial tubes, seems to be returned by the pulmonary veins, while that from the outer coats of the larger pulmonary vessels and bronchial tubes, the bronchial glands, and, according to Heale, the pleura and interlobular tissue, is taken up by the bronchial veins.

The lymphatics of the lung are arranged in a superficial and a deep set. The former ramify beneath the pleura, and in the walls of the lobulettes; the latter accompany the bronchial tubes and pulmonary vessels, to which they are distributed. The two sets anastomose with each other, and at the root of the lung unite, previous to their entering the bronchial glands. These glands are situated in the angle of bifurcation of the bronchi, as well as above and around the primary bronchial tubes. In these glands the lymphatic vessels terminate, and they in turn give rise to different vessels, which, after passing through a number of glands in the mediastinum, discharge their contents into the thoracic duct.

The nerves of the lung are derived from the sympathetic and pneumogastric. The latter nerves, on reaching the root of the lung, divide into numerous branches, which join with branches from the sympathetic to form two plexuses at the root of each lung, one being above and one below the bronchi. From these plexuses branches may be traced to the bronchial glands, to the bronchial tubes nearly as far as their extremities, to the larger blood-vessels, and, according to Waters, to the pleuræ and surface of the lungs.

MECHANISM OF RESPIRATION.—The movements of the thorax by the respiratory muscles are the chief means by which the actions of inspiration and expiration are effected. The thorax is a conical cavity, with its apex turned anteriorly, and its base posteriorly. The former is closed by the trachea, œsophagus, several muscles, blood-vessels, and nerves; the latter is entirely closed by an extensive muscular structure, the diaphragm. The sides of the cone are formed above by the dorsal vertebræ, below by the sternum or breast-bone, and laterally by the ribs and intercostal muscles. The thorax is compressed from side to side at its anterior part, but approaches the circular form posteriorly. This depends on the variation in the form of the ribs, the first pair being strong, nearly straight, and firmly fixed at their extremities, and the second pair slightly curved in an outward and backward direction, which curvature goes on increasing to the last. A number of the anterior ribs—called also the true ribs—are attached directly on the sternum by cartilaginous prolongations, while the remainder, or false ribs, have their cartilaginous prolongations simply attached to those of the ribs next in front. The true ribs are eight in number in the horse and ox, seven in the pig, and nine in the dog. The false ribs number ten in the horse, five in the ox, seven in the pig, and four in the dog. The false ribs have necessarily a freer action than the others, a circumstance accounting for the freedom of respiration in the horse; nevertheless, in certain animals, as in the dog, this is made up by the supply of additional and powerful inspiratory muscles.

Inspiration is that process by which the cavity of the thorax is enlarged, and the lungs inflated. The dilatation of the thorax takes place in a lateral and an antero-posterior diameter.

Lateral dilatation is effected by a slight rotatory movement of the ends of the ribs, the median part being at the same time turned outwards and forwards. The above movement is chiefly dependent on the action of the scaleni, external intercostal and levatores costarum muscles. The scalenus extends from the four last cervical vertebræ to the first ribs, which it fixes, or even pulls slightly forwards. In the ox it extends to the fourth, and in the dog as far as the sixth rib, so that its direct action on these is much extended. The external intercostal muscles proceed from the posterior border of one rib, downwards and backwards to the anterior border of that immediately behind. When, accordingly, the first rib is fixed by the scalenus, these act powerfully in dilating the whole cavity of the thorax. The levatores costarum are a series of small muscles running from each dorsal vertebra downwards and backwards to the anterior border of the succeeding rib. Like those already noticed, they actively rotate the ribs, turning their median part outwards and forwards. Other accessory inspiratory muscles may be mentioned, especially the anterior serratus of the back, and in the dog the latissimus dorsi. The former, in the horse, extends from the dorsal spines downwards and backwards, to be inserted on the sixth and following ribs, as far as the thirteenth inclusive. The latissimus dorsi, which is attached anteriorly on the inner aspect of the arm bone, is fixed to the two last ribs in the ox, and to all the ribs which it covers in the dog and pig, so that it greatly assists in the lateral dilatation of the thorax. The abdominal muscles and diaphragm fix, to some extent, the last rib, so that, in place of the latter being much advanced, the intercostal spaces are widened, and any great diminution of the antero-posterior diameter of the thorax prevented. This enlargement of the intercostal spaces increases from the first to the eleventh, twelfth, thirteenth, or fourteenth, from which backwards a marked diminution may be noticed. In ordinary calm respiration, the forward motion of the last rib is scarcely if at all detectable.

The dilatation of the thorax, in an antero-posterior direction, is due to the contraction of the diaphragm, a large musculo-tendinous partition separating the thoracic from the abdominal cavity. The diaphragm is muscular round its circumference and tendinous in the centre, towards which the muscular fibres converge. It is attached to the ensiform cartilage, to the lower ends of the two last true, and of all the false ribs, to the inner aspect of the last rib, and through two strong muscular prolongations (pillars) to the bodies of the lumbar vertebræ. It is not a straight partition, but bulges forwards into the thorax, its anterior aspect being markedly convex, while the posterior is correspondingly concave. The contraction of the muscle necessarily approaches it to the flattened form, increasing the antero-posterior dimensions of the thorax, and diminishing those of the abdomen. The viscera of the abdomen are accordingly pushed backwards, and cause a bulging of the abdominal walls, from which this process has received the name of abdominal respiration, in contradistinction to the lateral dilatation of the thorax, or thoracic respiration. In the ox, the diaphragm is attached upon the inner aspects of the two last ribs, so that the last intercostal space is not related to lung or pleura in those animals. The diaphragm, too, in their case, projects far into the chest, since the hand introduced into the rumen can readily feel the sixth rib.

When, by these means, the thorax is dilated, the lung which occupies the whole of its interior, with the exception of the mediastinum, and the surface of which is constantly in contact with its parietes, must necessarily increase in size. Air accordingly rushes in to fill up the cavities of the air cells, and prevent the occurrence of a vacuum. Coincident with the dilatation of the thorax, the glottis, and the anterior opening of the nostrils, have their capacity increased, so that we have a simultaneous and regular or rythmic action of all those parts, to insure a constant and free supply of air in the pulmonary cells. The dilatation of the anterior nares is well marked in solipedes, since the false nostrils of these animals give this part great mobility, and these are fully distended during laboured breathing. The opening of the glottis is effected by the rotation of the arytenoid cartilages outward, and the rendering tense the vocal cords. The dilatation of the lungs takes place simply to obviate the formation of a vacuum, which would otherwise result from the increased capacity of the thorax. In becoming distended, the lungs must necessarily alter their position relatively to the walls of the mediastinum and thorax. Their gliding over these parts is, however, greatly facilitated by the smoothness of the layer of epithelium covering the adjacent surfaces of the pluræ, and by the moisture with which these are bedewed.

The lateral dilatation of the thorax, which is greatest towards the lower extremity of the false ribs, has been found, by measurement, to be about two inches and seven lines during quiet ordinary respiration in the horse. The ordinary increase on the antero-posterior diameter of the thorax, as ascertained by opening the abdominal cavity, and employing a graduated measure, is about four and a-half inches in the horse. The dilatation, in either case, is necessarily much increased when the respiration is excited. The quantity of air taken into the lungs of the horse, during quiet respiration, is found to vary from a quart to a quart and a half. (COLIN.) This does not indicate, however, the amount of air present in the lungs after an inspiration; the trachea, bronchial tubes, and even the air cells, always retain a considerable quantity of air which, by mixing with the cold air inhaled, raises its temperature and moistens it, so as to render it less liable to irritate the delicate walls of the pulmonary cells.

Expiration is effected by a series of actions exactly the converse of those just described.

The lateral diameter of the thorax is diminished by a rotation of the ribs backwards and inwards. When the various agencies leading to inspiration are thrown out of use, this movement is induced by the arrangement and elasticity of the thoracic walls. The elasticity of the ribs and their cartilages, together with the mode of articulation between the latter and the vertebræ, all tend to bring about such a result. The action is, however, generally completed by muscles, especially in deep expiration. The posterior serrated muscle of the back, extending from the back and loins downwards and forwards to the last six ribs, assists greatly in the depression of these. The transversalis costarum, extending from the first rib downwards and backwards to the lateral parts of the sternum, compresses the first four ribs. The triangularis sterni, attached to the upper surface of the sternum, and the inner aspect of the cartilages of all the true ribs, except the first, contracts the anterior part of the thorax. This muscle is very active in carnivora, from the great length of their costal cartilages. The external oblique, which is attached to the fourteen last ribs, and the internal oblique, which is fixed on the border of the last rib, actively depress the posterior part of the thorax. The transversalis abdominis, from its attachment to the cartilages of the false ribs, acts along with the oblique. Lastly, the internal intercostals, which extend from the anterior border of one rib downwards and forwards to the rib in front, are active expiratory muscles, provided the last rib is a fixed point. The thorax is diminished in an antero-posterior direction, by the projection of the diaphragm into the chest during the relaxation of that structure, and this is still further increased by the contraction of the abdominal muscles.

The great amount of elastic tissue in the bronchial tubes and pulmonary tissue gives to the lungs an inherent contractile power of great energy, which comes into play in effecting expiration. The muscular coats of the bronchia would seem to act little, if any, in the regular rythmic breathing, since, by watching their movements on the trachea, they are seen to contract, but not coincidently with the expiratory process. This muscle is spasmodically contracted in asthma.

Respiration takes place in a regular manner, or with a rythm. Inspiration occupies a much shorter time than expiration, by which it is immediately succeeded. Between each expiratory and inspiratory act is a short interval, quite perceptible, when the respiration is undisturbed, though obviated by exciting the animal so as to accelerate breathing.

When respiration is undisturbed, it commonly maintains a constant standard in each species of animals. Most frequently it holds to the pulse a relation of about one to four, but it is relatively faster in some animals. In the horse, it varies from 9 to 12 in the minute, in the ox from 15 to 20, in the sheep from 13 to 17, and in the dog from 15 to 20. It is always most rapid in young animals, for which the higher figures may accordingly be taken. Breathing is accelerated by anything that impedes the dilatation of the lung, or excites the animal. The former cause is well exemplified in an overloaded stomach, especially in the cow, while the latter is readily shown by subjecting to exercise. Colin found that a horse respiring at the rate of 10 per minute had the respirations increased to 28 when walked for several hundred yards. In a few minutes' it had returned to the ordinary standard. After five minutes trot, they had increased to 52 per minute, but became perfectly quiet again three minutes later. He was then galloped for five minutes, after which the respirations numbered 65 for the first minute, and 60 the second.

In birds the lungs are confined to the posterior part of the chest, to which they are bound down by areolar tissue. They are much less complex in form than in mammalia, but aëration of the blood is also conducted in a number of air receptacles in the thoracic and abdominal cavities, which, in addition to this use, prove highly favourable to flight and swimming. The chief receptacles are one inter-clavicular placed in front of the lungs and between the furculum, one median and two lateral thoracic occupying the anterior and lateral aspects of the chest; two hepatic, extending from the thorax into the pelvis; two abdominal, placed beneath the latter. These communicate through small orifices with air cavities inside the bones, and especially the dorsal vertebræ, the vertebral ribs, the sternum, the scapula, coracoid and furculum, the humerus, the pelvic bones, and the femur. So freely does the interior of the bones communicate with the bronchia, that in some birds, if the femur or humerus is fractured, it is impossible for the bird to rise in flight. In such a case, too, breathing can be imperfectly carried on through the cavity in the bone. Some birds of prey can, by expelling the air suddenly from these internal cavities, increase their specific gravity, and dart with great velocity on their prey.

CHEMICAL CHANGES IN RESPIRATION.

The Blood.

The food which an animal assimilates is transformed into blood, and from this material is derived for the nourishment of the tissues. In the process of nutrition, blood, however, becomes charged with the products of decomposition, which have to be excreted by various organs, and in part by the lungs. The exchange of impurities for the vivifying elements of pure air constitutes in essence the function of respiration. Such a function cannot, therefore, be understood if we do not describe the blood. This liquid, as we have already seen, flows through the body in arteries, capillaries, and veins, through which it is propelled by an active heart. If derived from the arterial system, it is found of a bright scarlet hue, and if from the veins, it is of a dark Modena red colour. Bernard has shown that the venous blood flowing from some glands is bright red, owing probably to its purification by the excreting process within the gland. Blood has a saltish taste, a smell characteristic of the animal from which it is derived, and by which Barruell thought he could detect at any time from what animal blood might have been obtained. Blood has a specific gravity, varying from 1.052 to 1.057, and it is found composed of various materials, which are obtained separate under different circumstances. Within the body, blood is seen to be composed of blood-particles flowing in a blood liquid, or *liquor sanguinis;* outside the body, it clots and separates into clot and serum. The following table shows the change occurring from fluid to coagulated blood:—

Circulating blood.

Blood particles. Liquor sanguinis.

Fibrin. Serum.

Clot.

Coagulated blood.

Blood is warm; its temperature amounts to about 100° Fahr., it varies from 98° to 100° in health, ascending in fever as high as 107°, and occasionally being as low as 96° as in cyanosis.

If a drop of blood is placed under the microscope, with a little pure serum or water, blood particles are found dispersed in the field in large numbers. A multitude of red flattened discs, with a depression on either side, are seen free or running together in rolls. These particles are red in colour, and vary much in size. Their magnitude bears no proportion to the size of the animal from which they are derived. Thus they average about $\frac{1}{4000}$th of an inch in diameter in the horse or ox, but they are of a smaller size in the bat and mouse. In the goat they are exceedingly small, measuring only $\frac{1}{6400}$th of an inch. In the dog, as in man, they vary from $\frac{1}{3600}$th to $\frac{1}{3200}$th. They are about one-third or one-fourth as thick as they are wide. All these blood-discs are round in mammalia, with the exception of the camel, dromedary, and llama, in which they are ovoid. They are oval and nucleated in reptiles.

But floating in the liquid, in the field of the microscope, may be seen, amongst the red particles just described, some larger pale cells adhering to the glass in far less numbers than the smaller red ones. They are in the proportion of about one to thirty.

The blood-particles are usually described as vesicular, the red not having any nucleus, but the white possessing a single or double nucleus, which is surrounded by granular matter. Water is absorbed by, and alters the shape of, both white and red particles. Acetic acid renders their envelope transparent, and in excess destroys them. Both water and acetic acid tend to show the nucleus of the pale corpuscles better than without such an addition. The cellular nature of the blood-particles has been doubted by Robin, Dr Dalton of New York, and Dr Lionel Beale. They think that the blood corpuscle may be regarded as consisting of matter of different density in different parts, being firm externally, but gradually becoming softer, so as to approach to the consistence of fluid towards the centre.

The red blood-discs, if exposed to the air, shrink, become angular, and acquire a variety of very singular shapes. These appearances have sometimes been wrongly described as due to disease.

The liquid in which the blood-particles are seen to flow in the living body is not easily obtained for microscopic examination at rest, from its tendency to clot. In the horse it may rather readily be procured, from the blood-discs gravitating to the bottom of the jar in which blood is contained, so as to leave a tolerably free layer of pure liquor sanguinis. It is of a yellowish colour, mucilaginous consistence, and, on clotting, separates into fibrin and serum. The constitution of these elements of blood we shall refer to, after having alluded to the process of coagulation.

COAGULATION OF BLOOD.—Moving within the living body, blood has no tendency to clot, but when at rest in a jar, it is found first to give off a vapour with a characteristic odour. In two or three minutes, and much sooner in the dog, a pellicle forms on the surface, extending from any solid object, such as the sides of the vessel or a rod placed in blood. The pellicle descends on the surface of the mass of blood where it is in contact with the jar, and the process of consolidation then advances towards the centre. When the whole blood is in a trembling mass, it is said to be gelatinized, and this occurs in from one to three minutes in the dog, from a half to one and a half minutes in the sheep, from five to ten minutes in the horse, and from two to ten minutes in the ox. When gelatinization is complete the clot begins to shrink, and serum exudes all over its surface, so that in three or four hours a contracted red coagulum is found floating in an abundant yellow fluid. This separation of serum goes on to a certain extent for a day or two, but it is most complete when the coagulation is slow, and *vice versa*. Thus, blood coagulates more rapidly in an open basin than in a vessel with a narrow neck, and the serum is most abundant, hence the clot is smallest under the latter circumstance; and Dr Babington found that the proportion of clot to serum was as follows:—

	Serum.	Clot.
Blood in flask, ...	10	9
„ basin, ...	10	17

Exposure to air favours coagulation, and for this reason whipping or stirring blood leads to rapid clotting. Contact with living tissues prevents coagulation, as well shown by Professor Lister, so that movement within the blood-vessels is adverse to the clotting process. Blood at rest in the body does not consolidate readily unless the tissues are bruised or injured. Tissues seem to retain their vitality for some time after death of an animal, and the blood within them remains fluid. This explains how blood keeps fluid for long in the blood-vessels of dead animals. To show the cause of the blood's fluidity in the body, the late Mr James Turner dissected round the jugular vein of a living horse, placed a ligature around it on the side near the heart, and then one above, so as to include a certain quantity of blood in the tube. On removing this piece of vein from the body, it was found that the blood remained fluid within it for hours, until, by puncturing it, volatilization occurred and coagulation. In proof of the contact with living tissue having an effect in this process, if the vein is tied and left connected with the tissues in the neck, it becomes congested, inflamed, devitalized in fact, and the blood clots speedily within it.

From the circumstance that blood clots on being exposed to the air, it was supposed that cold favoured coagulation, but the reverse holds true. Moderate heat favours this process, and cold retards it. Blood may be frozen, and thus transformed into a solid mass, which, on thawing, coagulates

Frozen blood may be preserved for an indefinite period, and the property of the fibrine to clot is retained.

The process of coagulation is favoured by fainting. When blood is flowing freely from an animal, its coagulability increases as its quantity in the body diminishes. This is a remarkable provision of nature for the spontaneous arrest of hæmorrhage. It has been said that death by lightning tends to destroy the coagulability of blood. This has been disproved, especially by an observation of Mr Henry Thomson, which I have heard mentioned by Dr Sharpey. Mr Thomson examined several sheep killed in a thunder-storm, and found that their blood coagulated. Dr Sharpey has also shown that animals that have died of suffocation, contain coagulable blood, contrary to an opinion once generally held.

Coagulation is impeded by a variety of substances. The generality of materials mixed with blood favour the clotting process, but alkalies check it. Nitrate of potash, sulphate of soda, &c., keep the blood in a fluid state, but if water is added, so as to dilute the salt, the fibrine is observed to solidify. Water added to blood in small quantity accelerates coagulation, but in large amount, stops it. Serum favours the process, and a solution of opium is said to check it.

Horses' blood presents a singular exception to the normal blood of man and animals in general in the process of coagulation. It was observed long since, that the blood of man in inflammatory diseases was attended with the production of a clot, yellow on the surface, and red below. The yellow layer has received the name of 'buffy coat.' Such blood presents also a singular appearance of the surface of the clot, which is concave, and hence termed 'cupped.' The 'buffy coat' consists of clotted fibrine, with pale corpuscles and a portion of serum; the red particles in such blood subside. This inflammatory blood has also been termed 'sizy.' If some is poured fresh into a dish, it acquires a party-coloured appearance, from particles of decolorized clot being interspersed amongst red coagula. The appearance of inflammatory blood in some animals is the appearance of normal blood in the horse, and especially of blood drawn from a horse in a weak or anæmic condition. If, for some time previous to death, horses have been starved, their blood presents a clot which, to a great extent, is yellow, and only a small portion is of a red colour. The cause of the production of a 'buffy coat' is evidently a tardy coagulation, which admits of the precipitation of the blood particles. Hewson thought the blood was thinner, and that it coagulated quickly when the buffy appearance resulted, but such appears not to be the case. Nasse believed that the blood-corpuscles in the horse or in inflammatory blood, ran together so as to form masses which readily gravitate to the bottom of the jar, and leave the surface of a yellow colour. Dr Jones said that the running together of the corpuscles tended to form a network from which the liquor sanguinis was expressed This does not appear, however, to have a great influence in the production of the buffy coat. The rolling together of the particles may, however, explain the mottled appearance of horse's blood, and of inflammatory blood when exposed in a thin layer in a dish.

The cause of the blood's coagulation has been investigated by many intelligent observers. The most recent and certainly the most satisfactory experiments have been conducted by Dr Benjamin Richardson, who obtained the Astley Cooper prize for 1856, for his Essay on this subject. A large volume contains the results of Dr Richardson's observations. He says:—

"The total of this essay is summed in two major and a few minor propositions.

"I. *First Major Proposition.* The primary and essential part of the process of coagulation consists in the evolution of a volatile principle from blood.

"[This is proved by the experiments which have gone before. These have shown that coagulation is *prevented* by exclusion from air or other gas, by cold, and by cold and pressure; and that it is *retarded* by motion in a closed circuit, and by addition of dense fluids. Conversely, other experiments have indicated that exposure to the vacuum, to the air, or other gases, motion during such exposure, and increase of temperature during such exposure, are each and all physical conditions which *quicken* coagulation.

"With the escape of a volatile agent these conditions are all in perfect accord and harmony; in the presence of any other view, they become mere disjointed and even contradictory phenomena.

"The proof is carried further still in the experiment of passing the vapour of blood through blood, and in the suspension of coagulation which succeeds.]

"II. *Second Major Proposition.* The volatile principle thus eliminated from blood is *ammonia*, differing perhaps in formula in different classes of animals, but serving essentially the same purpose in all.

"[This proposition is proved by two series of experiments; first, by those which have shown that ammonia may be obtained from blood-vapour; and secondly, by the results which follow the addition of ammonia to newly drawn blood. Still further, but in the same direction, it is proved in the experiments of re-dissolving the blood-clot or the fibrin-clot in ammonia solutions, and reproducing coagulation by eliminating the ammonia.

"Lastly, the proposition is exemplified by the experiments which show that, in blood held temporarily fluid by access of ammonia, coagulation is favoured or retarded by the same physical agents as those which favour the normal coagulation of blood.]

"The minor propositions which spring naturally from the foregoing, are the following:

"(*a*) As a result of the evolution of the volatile solvent from newly drawn and liberated blood, the fibrin, which has previously been held in solution in the serum by virtue of the alkalinity imparted by the ammonia, is transformed from the fluid to the solid condition; its particles, coming together, constitute with the blood-corpuscles and serum, in ordinary coagulation, the red clot; and the after separation of the serum is due to the contraction of the fibrin, by a continuance of the same process.

"(*b*) In cases where blood coagulates with its fibrin partly or wholly in an isolated form, the effect arises either from an excess of fibrin, or from slow coagulation (the result of slow elimination of the solvent), or from rapid subsidence of the red corpuscles, or from a combination of these causes; the particles of fibrin are thus brought together in mass, and rise to the surface.

"(*c*) The imperfect coagulability of blood, under the abnormal conditions specified in preceding pages, is due, according to the case, either to an absolute deficiency of fibrin, or to slow evolution or excess of its volatile solvent."

Mr Lister, now Regius Professor of Surgery in Glasgow, has, I think, justly insisted on the process of coagulation as being influenced materially by the contact of blood with living tissues. It is not merely a physical change, as we find that blood does not coagulate when exposed for a considerable time to the air in contact with tissue recently obtained from an animal, and, therefore, retaining certain propèrties which may be justly called vital. Indeed, Mr Lister has even demonstrated, that in blood removed from the body, blood does not coagulate in obedience to the laws established by the 'ammonia' theory. Though occupying much space, still I think the quotation of Mr Lister's last paper on the subject of considerable moment.

In this paper, read at a meeting of the Medico-Chirurgical Society of Edinburgh, on the 16th of November, 1860, Mr Lister said:—

"I take this opportunity of demonstrating what appears to be a point of considerable importance with reference to the coagulation of the blood,—a subject to which my attention has been again directed by the recurrence of that period of the Session in which the fundamental principles of pathology are discussed in a course of surgical lectures.

"I may remind the Fellows of this Society, that in a paper which I had the honour to read before them the Session before last,* I brought forward facts which seemed to prove that the ammonia theory does not apply to blood within the vessels of a living animal. That theory, as my hearers are doubtless aware, asserts that the fluidity of the blood depends upon the presence of a certain amount of free ammonia holding the fibrine in solution, and that coagulation is the necessary result of the escape of the volatile alkali. But it was shown in the paper referred to, that the blood, in man and other mammalia, though coagulating soon after death in the heart and great venous trunks, remains fluid for days in vessels of smaller size, and this under circumstances affording free opportunity for the escape of ammonia; and, on the other hand, that when a portion of a vessel either in an amputated limb or in a living animal is treated in a manner calculated to destroy its vital properties, the blood coagulates in the injured part, but retains its fluidity elsewhere, although there is no greater opportunity for the escape of ammonia in the one case than in the other. A striking instance of the difference between the natural receptacles of the blood and ordinary matter in their relations to the vital fluid happened to come under my notice this morning, in an arm which I amputated last evening at the shoulder-joint, on account of injury inflicted by machinery. On examining the limb, which had lain undisturbed since the operation, I saw that the axillary vein, which was patulous at the part where it had been divided by the knife, contained some blood at a distance of about half-an-inch from the open orifice; and having squeezed out a few drops, found that it was perfectly fluid, but yielded threads of fibrine when the point of a needle was drawn through it some minutes after emission. The blood had been for upwards of twelve hours freely exposed to the air, but being situated in an uninjured part of a blood-vessel, had remained free from coagulation.

"Further, in the opening meeting of last Session I demonstrated another important principle, viz.—That ordinary solid matter, unlike atmospheric air, induces coagulation of blood in its vicinity when introduced within the living vessels. Having inserted a piece of clean silver wire for a considerable distance into one of the veins of an amputated sheep's foot, I slit up the vessel after a short time had elapsed when I exhibited a coagulum extending along the whole length of the foreign body, whereas a mere wound of the vein failed to induce a clot

* Vide *Edinburgh Medical Journal*, April 1858.

except immediately at the spot where the injury had been inflicted. It was obvious that the introduction of the wire could not affect the amount of ammonia in the blood; and from this and many other facts to which I need not here allude,* I was led to the opinion, that as regards what takes place within the living vessels, the ammonia theory might practically be left entirely out of consideration.

"What I have to show this evening will, I think, prove that even for blood outside the body, the ammonia theory, whatever degree of truth it may contain, is very far indeed from representing the whole truth.

"One of the most remarkable circumstances connected with blood that has been shed from the vessels is, that it refuses to coagulate below a temperature of 40° Fahr. or thereabouts. This is explained by Dr Richardson on the hypothesis, that the low temperature prevents the evolution of ammonia,† while the rapidity with which coagulation takes place at high temperature seems to him satisfactorily accounted for by the increased volatility exhibited by the ammonia under such circumstances. I was myself at first disposed to accept this interpretation; but subsequent reflection led me to think that, to say the least, it required confirmation. It occurred to me, that if it were true that the fluidity of blood below 40° was due to free ammonia retained in it, coagulation would take place immediately, in spite of the cold, if the alkali were neutralized by the addition of acid, provided the fibrine were not impaired in its coagulating property by the reagent employed. In order to ascertain whether this result would really follow, I poured blood freshly shed from a sheep into vessels surrounded by ice-cold water, and by this means succeeded in keeping some portions of it fluid for a considerable time, and found that it continued liquid notwithstanding the additon of dilute acetic acid in what I supposed must be sufficient quantity to overcome the feeble alkalinity of the blood, while the acidulated specimen retained the property of coagulating very rapidly when raised in temperature. But on attempting to discover whether this blood was really acid in reaction, I found that its red

* For some of these facts see *Philosophical Transactions* for 1859, pp. 673, *et seq.*

† See *Dr Richardson's Astley Cooper Prize Essay*, p. 303, where a fact is mentioned, indicating that no ammonia was given off at 34° Fahr. from a specimen of blood which had been artificially ammoniated, and which at 96° afforded distinct evidence of evolution of the alkali.

colour entirely vitiated the indications of both litmus and turmeric; and even the serum obtained after contraction of the clot was too much tinged to admit of the satisfactory application of the test paper.

"Being thus baffled in my experiments with the sheep, I had recourse to the horse, in which the red corpuscles subside with peculiar rapidity in the plasma, giving rise to the buffy coat well known to occur in the blood of that animal in the state of health, so that the opportunity would be presented of obtaining liquor sanguinis free from red corpuscles, to which the tests could be applied without risk of fallacy. Accordingly, yesterday afternoon, a horse having been placed at my disposal by my friend Mr Gamgee of the New Veterinary College, I tied into the right jugular vein one end of a piece of vulcanized India rubber tube, four yards in length, the greater part of which was coiled up in a freezing mixture, and some of the blood, having been allowed to remain for a while in the tube, was shed into vessels standing in ice-cold water. Its temperature on first escaping into the air was 39½° Fahr., and having been since kept in the cold it is still only partially coagulated at the present time (twenty-nine hours after it was shed). At first, however, it appeared as if we were likely to fail, the blood of this horse being a rare exception to the general rule, in exhibiting for a long time no appearance of the 'sizy' layer. But after it had stood for about two hours, I succeeded in removing from the surface, by means of a glass tube, a sufficient amount of liquor sanguinis for the performance of an experiment, taking care that the glass into which it was shed, and the tube, were both near the freezing point. To half a drachm of this plasma I now added one minim and a half of moderately dilute acetic acid, which had the effect of rendering it distinctly acid, as indicated by its communicating a red tint to litmus and restoring the colour of turmeric paper which had been reddened by dipping it in the portion of the liquor sanguinis which had not been acidulated. I kept the specimen in ice-cold water till this evening. For a long time it remained perfectly fluid, except the formation of little soft coagulum at the surface, just as in the unacidulated blood; but a few drops placed in a watch-glass and brought into a warmer atmosphere, coagulated in about the same time as the blood that first flowed from the tube, a soft clot forming in about a quarter of an hour. Even at the expiration of twenty-four hours a portion of what remained in the cold was still fluid, though faintly acid, but set into a pretty firm clot on being removed into a warmer situation.

"From these facts it is obvious that the ammonia theory utterly failed to explain the influence of temperature on coagulation. The circumstance that the liquor sanguinis was acid in this experiment is clear proof that it contained no free ammonia whatever; yet the acidulated plasma was affected by cold and heat, just like ordinary blood. It remained fluid near the freezing point, although the ammonia it originally contained must have entered into combination and lost its reputed power of dissolving the fibrine, and it coagulated when warmed, though the ammonia, fixed by the acid, must have been incapable of evolution. If the author of the ammonia theory were asked to explain why this horse's blood took a quarter of an hour to coagulate, he would no doubt reply that it must have contained a large amount of ammonia, requiring all this time to escape. But we have seen that the acid liquor sanguinis, though possessing no free ammonia at all, took as long to clot. There can therefore, I think, be little question but that the slowness of coagulation in the horse, compared with the rapidity of the process in the sheep, and the variations met with in the human species, depend not on the amount of ammonia present in the blood, but on differences in its other constituents, and, speaking generally, that the theory which attributes the coagulation of the blood to the escape of ammonia is fallacious."*

* "Since the above communication was made, I have seen for the first time the able essay of Dr E. Brücke, which competed for the Astley Cooper Prize (see *Med.-Chir. Review*, vol. xix.); and I find that the principle which he advocates—viz., that the fluidity of the blood within the living body depends upon an action of the walls of the vessels upon it—is supported by many facts which he has observed in the chelonian reptile, very similar to what I have made out in mammalia. Thus, he found that the blood remained fluid in the heart of the turtle for days after death, and for several hours after he had blown air through the veins of the neck, so as to make a foamy mixture in the cavities of the organ. He also found, as had been previously ascertained by Virchow and others, that after the introduction of mercury into the heart the blood coagulated about the globules of the metal, but not elsewhere, and this he regarded as an example of the influence of ordinary matter in inducing coagulation in its vicinity. He also succeeded with the following very striking experiment, which would not answer with mammalia: He drew blood into a cup from the veins of a living turtle, and injected it into the empty heart of another turtle just killed, and found that the blood remained fluid for several hours in its new situation, instead of coagulating in a few minutes as when retained in a cup.—J. L."

CHEMICAL CONSTITUTION OF BLOOD.

	Man.	Dog.	Cat.	Horse.	Ox.	Calf.	Goat.	Sheep.	Rabbit.	Pig.	Goose.	Hen.
Water	798,402	790,50	810,02	804,75	799,590	826,44	839,44	827,765	817,30	768,945	814,884	793,42
Corpuscles	116,529	123,85	113,392	117,13	121,865	102,803	85,998	92,425	170,72	145,532	121,450	144,57
Albumen	74,194	65,19	64,46	67,58	66,901	56,414	62,705	62,705		72,875	50,976	48,52
Fibrin	2,233	1,93	2,418	2,41	3,620	5,757	3,920	2,970	3,80	3,950	3,360	4,67
Fat	1,970	2,25	2,7	1,31	2,045	1,610	0,91	1,161	1,90	1,950	2,560	2,63
Alkaline phosphate	0,823	0,730	0,607	0,844	0,468	0,957	0,402	0,395	0,637	1,362	1,135	0,945
Sulphate of soda	0,202	0,137	0,201	0,213	0,181	0,269	0,265	0,348	0,202	0,089	0,090	0,100
Alkaline carbonate	0,956	0,789	0,919	1,104	1,071	1,263	1,202	1,498	0,970	1,198	0,824	0,350
Chloride of sodium	4,690	4,490	5,274	4,659	4,321	4,864	5,186	4,895	4,092	4,287	4,246	5,392
Oxide of iron	0,834	0,714	0,516	0,786	0,731	0,631	0,641	0,589	—	0,782	0,812	0,743
Carbonate of lime	0,183	0,07	0,136	0,107	0,098	0,130	0,110	0,107	—	0,085	0,120	0,174
Phosphoric acid	0,201	0,208	0,263	0,123	0,123	0,109	0,129	0,113	—	0,206	0,119	6,935
Sulphuric acid	0,952	0,013	0,022	0,026	0,018	0,018	0,023	0,044	—	0,041	0,039	0,010
Magnesia	0,015	—	—	—	—	—	—	—	—	—	0,018	—
Silica	0,043	—	—	—	—	—	—	—	—	—	0,056	

The amount of water in blood varies from 730 to 815 parts in 1000; it is in excess in ill-fed animals, and its quantity varies in disease.

The albumen of the blood, similar in nature to the white of eggs, is met with in the blood in the proportion of six to nine per cent. Schmidt found in a horse that had been starved long before death, that the amount was 6·68 per cent., but in a horse well fed up to the time of death, the proportion was 9·08 per cent. According to Lehmann, venous blood contains more albumen than arterial. Simon found the albumen increased in quantity in the blood of glandered horses.

Fibrin appears very bulky in clotted blood, but if dried and weighed it is found only to the extent of from 3 to 4 parts in 1000. Young animals have more fibrin in their blood than old, and there is more in arterial than venous blood. It increases in febrile and inflammatory diseases, but is rarely below the normal quantity. According to Delafond it may amount to twice and thrice the proportion in health, in inflammation of important organs in the horse, and in glanders.

The fats are dissolved in the serum, and also enter into the composition of the corpuscles. Simon found 5·59 in 1000 parts of blood in the ox, 4·191 in the calf, and 1·73 in the horse. They vary according to the manner in which the animal is fed. Blood always contains a small quantity of sugar, especially in the hepatic veins.

The blood corpuscles are composed of cruor, or blood red, with probably coagulated albumen. Cruor consists of globulin and hæmatin. The latter is the red colouring principle of blood, soluble in water. It contains about 10·151 per cent. of oxide of iron, on which, at one time, the colour of blood was thought to depend; but Dr Graham and others demonstrated this to be an error.

Various organic principles are found in blood, which I need not enter upon at length here, such as kreatin, kreatinine, hippuric acid, &c. The table will indicate the salts of blood.

QUANTITY OF BLOOD IN ANIMALS.—It is extremely difficult to estimate this, as the body cannot be deprived of all its blood. According to Colin, blood to the amount of the 18th part of the weight of a horse can be obtained; in the ox and sheep the 23rd part, and in the dog the 12th part may be abstracted, but the total amount of blood in the body is very much greater.

It is important to know, that if blood is drawn from the body in considerable quantities, it reproduces itself rapidly, and the facilities for its reproduction seem to increase by such periodical abstractions as are not too large to endanger the animal's life at the time. It is in this way that periodic bleeding tends rather to induce than to prevent plethora.

CHEMICAL CHANGES IN RESPIRATION.

The respiratory act, as we have already said, consists in a change induced in blood by contact with atmospheric air. The air loses in one way, and gains in another, and the same may be said regarding the blood. Atmospheric air consists of

Oxygen, ...	21 parts
Nitrogen, ...	79 „

It always contains a certain quantity of water, varying from a minimum of 4 to a maximum of 16 grains in 1000, and respiration goes on more equally and thoroughly when the air is moist, than if very dry. There are many impurities always floating in the air; but thanks to constant currents, and purifying changes, the atmosphere is preserved in a condition in which it is respirable. Thus it usually contains 4.5 per ten thousand parts of carbonic acid, which is derived from the processes constantly going on in nature, of combustion, putrefaction, and animal respiration. Ammonia is a very constant compound floating in the atmosphere, but like the carbonic acid, actively absorbed by plants. It is the oxygen which maintains life, and is diluted for the purposes of respiration by the large proportion of nitrogen entering into the composition of air. A part of the oxygen is in the form of ozone.

Air that issues from the lungs of an animal is found to have lost from 4 to 5 parts of oxygen, and to have acquired a corresponding quantity of carbonic acid and water. In man not less than seventeen and a-half cubic feet of oxygen disappear out of 350 cubic feet of air, consumed in 24 hours. This amounts to more than one pound avoirdupois, or 7.134 grains by weight. Herbivora consume about 10 per cent. of the oxygen they inhale, and carnivora from 20 to 25.

Carbonic acid is formed rapidly, and in man it is calculated that 13 cubic inches of this gas are produced in an ordinary respiration.

Air that has acquired 10 per cent. of carbonic acid is irrespirable, and it is estimated that a man contaminates in breathing, 130 cubic inches of air per minute. Four cubic feet, however, should be allowed to each man by ventilation, viz., 50 times the actual amount consumed.

According to Lassaigne's calculation, the following are the quantities of carbonic acid produced by the different animals:—

	Volume of Carbonic Acid produced in one hour.	By Weight.
Horse . . .	219·72 litres	13·90 oz.
Ox . . .	271·10 „	16·58 „
Sheep at 8 months	55·23 „	3·41 „
Goat at 8 years .	21·48 „	$1\frac{1}{3}$ „
Kid at 5 months .	11·60 „	$\frac{2}{3}$ „
Pointer dog .	18·31 „	$1\frac{1}{8}$ „

Dumas finds that a horse consumes $78\frac{1}{8}$th ounces of carbon per day, a dog a little over one ounce, and a cat a little over half that quantity. The production of carbonic acid is greater in early life than in adult animals. It is increased by exercise, cold weather, during the act of digestion, and during pregnancy. More carbonic acid is produced during the day than at night, and though activity tends to this result, if an animal is exhausted, the amount of carbonic acid developed diminishes.

Reynault has found that the smaller the animal the more active the respiration, and in a great measure this is due to the necessities of the small animal for the production of animal heat. The whole of the oxygen which disappears from the air during respiration does not form carbonic acid. One part combines with hydrogen, sulphur, phosphorus, and other substances.

The blood absorbs oxygen, and discharges carbonic acid and water. It thus undergoes the change from arterial to venous blood. The oxygen penetrates through the respiratory mucous membrane and the coats of blood-vessels, to become incorporated with the blood, which greedily absorbs it. It was at one time supposed that the saline constituents of blood became oxidized in the lungs, and were the special carriers of oxygen, but the nitrogenous elements readily appropriate it. The changes occurring in the blood from the constant admixture of air with it, are going on in all parts of the system, and not simply in the lungs. Many comparative analyses between arterial and venous blood have been made. Béclard has found—

IN THE HORSE.

	Blood of the Carotid.	Blood of the Jugular Vein.
Water . .	772·87	783·84
Albumen and salts	90·62	88·72
Globules . .	132·31	122·94
Fibrin . . .	4·2	4·5

Hering, in analyzing the blood of the ox, ascertained as follows:—

	Arterial Blood.	Venous Blood.
Water . . .	798·9	794·9
Fibrin . .	7·6	6·6
Albumen . .	26·1	25·8
Globules . .	164·7	170·4
Extractive matter and salts . .	2·7	2·3

In the dog, Denis found little difference between the blood in the veins and that in the arteries:—

	Arterial Blood.	Venous Blood.
Water . . .	830·0	830·0
Fibrin . .	2·5	2·4
Albumen . .	57·0	58·6
Globules . .	99·0	97·0
Extractive matter and salts . .	11·0	12·0

In testing the proportion of carbon, nitrogen, hydrogen, and oxygen contained in the albumen, cruor, and fibrin of blood, Michaelis arrived at the following conclusions:—

		Carbon.	Nitrogen.	Hydrogen.	Oxygen.
Albumen	Venous	52·650	15·505	7·359	24·484
	Arterial	53·009	15·562	6·993	24·436
Cruor	Venous	53·231	17·392	7·711	21·666
	Arterial	51·382	17·253	8·354	23·011
Fibrin	Venous	50·440	17·207	8·228	24·065
	Arterial	51·374	17·587	7·254	23·785

The specific gravity of venous blood is a little lower than arterial, and it contains about 5 parts in 1000 more water. Venous blood is of a dark Modena red colour, whereas arterial is of a brighter scarlet hue.

Animal Heat.—The chemical changes resulting from the admixture of air and blood in addition to other physical and chemical processes, constantly going on in the living body, lead to the development of animal heat. The mean temperature of animals of different classes and species is shown in the following table from Dr Dalton's *Physiology:*—

	Animal.	Mean Temperature.
Birds	Swallow	111°·25
	Heron	111°·2
	Raven	108°·5
	Pigeon	107°·6
	Fowl	106°·7
	Gull	100°·0
Mammalia	Squirrel	105°
	Goat	102°·5
	Cat	101°·3
	Hare	100°·4
	Ox	99°·5
	Dog	99°·4
	Man	98 ·6
	Ape	95 ·9
Reptile	Toad	51 ·6
Fish	Carp	51 ·25
	Tench	52 ·10

The temperature of animals is very equal throughout the body, the surface being cooler than the interior, and the internal heat being little influenced by the temperature of the external air. Dr Davy found the heat of the human body a little increased in the torrid zone. Sir George Back ascertained the temperature of foxes in the arctic regions to be the same as that of our British ones. Disease affects the heat of the body; we find it raised to 107° in fever, and as low as 80° in cyanosis.

The great source of animal heat is the oxidation of materials in the body. Mayo first held this opinion, and Black and Lavoisier afterwards indicated that the development of animal heat was connected with the respiratory process. These authors believed the heat to be generated in the lungs, but a difficulty arose as to how it could be explained that the lungs were not hotter than other parts of the body. Crawford attempted an explanation, on the ground that different substances have a different capacity for heat, and that arterial blood had a larger capacity for heat than venous. The rapidity of the blood's flow would have accounted for the diffusion of heat, but La Grange and Hassenfratz superseded the views entertained by Black and Lavoisier, and suggested that heat was produced throughout the whole body. There is no doubt a singular relation between the activity of the respiratory act and the temperature of the body. This is especially noticed in comparing the activity of respiration and the temperature between birds and mammals. In puppies, the ductus arteriosus keeps open until the eyes open, and during this period respiration and the production of animal heat are below par. In hybernating animals, it is observed that respiration is active in summer and the temperature of the body high; in winter, breathing is almost entirely suspended, and the body cools almost to zero. This, however, only shows that the more active the change between the blood—hence the body—and air, the larger the quantity of heat developed.

The production of animal heat is affected by the nervous system. Sir Benjamin Brodie noticed in the human subject, and other observers in the lower animals, that the higher the spine is affected by injury or disease, the greater the extent to which the body cools. It has been remarked that, immediately after the division of a nerve, the temperature of the part to which that nerve is distributed is increased, but this is due to a morbid change such as congestion or inflammation. Thus, on division of the fifth pair of nerves, the eye is apt to inflame, and symptoms of catarrh also manifest themselves. Sir Everard Home and Elliotson showed that ultimately there was a loss of temperature in all parts deprived of nervous influence by section of the nerves. Division of the median nerve has been observed to lead to a reduction in the temperature of the hand, and these cases demonstrate how heat is generated in all parts of the system.

"Animal heat," says Dr Dalton, "is a phenomenon which results from the simultaneous activity of many different processes, taking place in many different organs, and dependent, undoubtedly, on different chemical changes in each one. The introduction of oxygen and the exhalation of carbonic acid have no direct connection with each other, but are only the beginning and the end of a long series of continuous changes, in which all the tissues of the body successively take a part. Their relation is precisely that which exists between the food introduced through the stomach, and the urinary ingredients eliminated by the kidneys. The tissues require for their nutrition a constant supply of solid and liquid food which is introduced through the stomach, and of oxygen which is introduced through the lungs. The disintegration and decomposition of the tissues give rise, on the one hand, to urea, uric acid, &c., which are discharged with the urine, and on the other hand to carbonic acid, which is exhaled from the lungs. But the oxygen is not directly converted into carbonic acid, any more than the food is directly converted into urea and the urates.

"Animal heat is not to be regarded, therefore, as the result of a combustive process. There is no reason for believing that the greater part of the food is 'burned' in the circulation. It is, on the contrary, assimilated by the substance of the tissues; and these, in their subsequent disintegration, give rise to several excretory products, one of which is carbonic acid.

"The numerous combinations and decompositions which follow each other incessantly during the nutritive process, result in the production of an internal or vital heat, which is present in both animals and vegetables, and which varies in amount in different species, in the same individual at different times, and even in different parts and organs of the same body."

Diseases of the Respiratory Organs.

In estimating the healthy or diseased condition of the organs of respiration, various physical modes of examination are often had resort to. These are *auscultation*, *percussion*, *palpation*, *succussion*, and *mensuration*. Although not equally applicable to every case of disease of the air-passages, these measures are so generally necessary to a correct diagnosis of this class of maladies, that they will be most conveniently described before noticing any of the latter individually. In what follows, the general methods of applying the various modes indicated will first be considered, and afterward their individual application to the different parts of the respiratory tract, with the normal and abnormal indications which can thereby be elicited.

Auscultation.—This term, in medical language, indicates the method of ascertaining the condition of any organ of the body by means of sounds conveyed to the ear, when applied over the region in which such organ is situated. This method of diagnosis was discovered by the immortal Laennec, who by this means conferred a lasting benefit on medical science, which it is perhaps impossible to exaggerate. By this means morbid conditions, hitherto only guessed at, can now be ascertained with almost mathematical accuracy, and rational therapeutic measures applied, where our ancestors would have groped along in helpless darkness.

Auscultation is either *immediate* or *mediate*. *Immediate auscultation* is that in which the ear is applied directly upon the surface of the body, or with the intervention of a handkerchief, or other thin cloth. *Mediate auscultation* is that in which the sound is conveyed from the body to the ear by means of an instrument called a stethoscope. The stethoscope in common use is a hollow cylinder of soft wood—cedar or ebony—or of gutta percha, varying in length from five to seven inches, and having a bore of about a quarter of an inch. At the end applied upon the skin, it is widened out so as to form a funnel with a hollow diameter of an inch. The opposite end has a flattened or slightly rounded form, with an orifice in the centre for the conduction of sound. Dr Pennock has introduced a flexible stethoscope, made like the flexible ear-trumpet, and provided at its extremities with two pieces of ivory similar in form to the ends of the more common instrument. This apparatus is more difficult of application, but in certain cases, as in cardiac disease, it possesses this advantage over it, that it conveys the sound, without the impulse, of the organ examined.

In immediate auscultation, the ear should be closely applied over the surface of the skin, to prevent the entrance of any extraneous sound. The right or left ear should be employed, according as one or other can be most accurately applied to the part, a preference being, at the same time, given to that in which the sense of hearing is most acute. If a cloth is placed over the skin, it should only be in a single fold, since the rubbing of two folds on each other may give rise to the production of adventitious sounds. In mediate auscultation, not only must the funnel-shaped end of the instrument be accurately applied to the chest, but the opposite end ought to be likewise retained in perfect apposition to the ear. The instrument should accordingly be applied perpendicularly to the surface examined; it should be moderately pressed, to diminish the bulk of the soft parts, and fix it more firmly upon the solid structures beneath. Care should be taken that no long hairs pass into the stethoscope, and thereby modify the sound.

In either case, the following precautions should be attended to: 1st. A quiet place and time should be selected. Thus, at an early morning or late night visit, there will be fewer sounds to distract the attention, and such accordingly are to be preferred. 2nd. In the summer season we should endeavour to prevent irritation from insects, which would excite movements entirely subversive of our efforts. 3rd. Auscultation ought not to be practised over any muscle in a state of contraction, as the sound of the contracting fibres is a frequent source of fallacy. In certain cases, where the respiratory sounds are feeble or indistinct, they may be rendered more prominent by exercise, which may be walking, trotting, or galloping, according to the necessities of the case.

Each of the two methods of auscultation possesses merits of its own, which render it applicable on particular occasions. As a general rule, direct application of the ear is to be preferred, and for several reasons. It can at all times be readily resorted to; the ear is applied closer to the organ examined, and will hear the sounds more distinctly; and the chest of the patient affords a support for the head of the operator, who thereby avoids the necessity of holding it in a constrained position, which would distract his attention. The stethoscope is useful when we are anxious to localize the sound, or when the surface is depressed, and prevents the accurate adaptation of the ear, as close behind or in front of the shoulder.

Percussion.—This consists in striking upon the surface, with the view of eliciting sounds, whereby we may form an opinion as to whether the subjacent organs are in a healthy or morbid condition. Not only do we learn from the sounds in such cases, but when liquid is contained in the part, a vibratory movement is imparted by the stroke, and in certain instances, such an examination may draw forth indications of pain, which could not be produced by pressure or otherwise. The sounds correspond with the condition of the subjacent parts. Thus, when a large hollow cavity, as the distended first stomach of cattle, is percussed, it is very resonant or *tympanitic.* In the abdomen of the horse, in ordinary cases, the resonance is much less. Again, in the case of the lungs, with their myriads of minute air-cavities, it is even less noticeable, though still well marked, while, when a thick and solid part is struck, the sound is *dull* or *flat.* Even with solid organs, degrees of resonance may be observed; thus a firm, unyielding body, like bone or cartilage, resounds more than soft structures, as fat or muscle. When percussing a fat animal, accordingly, allowance must be made for this non-conducting character of adipose tissue, and the impulse must be considerably increased. In the same way, when examining a deep-seated organ, or the interior of a bulky one, a greater impulse should be given than when a superficial part has to be tested.

Percussion may thus enable us to ascertain the presence of air in parts in which it does not normally exist, and likewise the occurrence of solids or liquids where air should normally be, while, by this means, the presence of fluid may be recognised in parts which ought to be solid. It may sometimes be advantageously employed along with auscultation, the surface being struck close beside the part where the ear or the stethoscope is applied.

Percussion, like auscultation, is either *immediate* or *mediate*. The former is effected by simply striking the surface without any intervening body; in the latter an elastic solid is placed upon the surface, and on which the impulse is sustained. The intervening body is known as a pleximeter.

There are still some varieties in the method of applying immediate percussion. When our larger domestic quadrupeds are the subjects of the operations, and when the deeper parts are to be examined, the closed hand may be employed, and the surface may be struck with the knuckles. When the smaller animals are concerned, or in testing the more superficial parts of the larger, the four fingers, with the nails previously pared, may be brought together at the same level, and supported by the thumb, that the requisite impulse may be given with their tips. In some of the smallest of our patients, and when we want delicately to test a superficial part, the middle finger only may be used. In either case the movement should only be from the wrist, since not only is the movement of the forearm or whole member clumsy, but the stroke is liable to be too strong or irregular, Where a choice can be made, as in the case of the thorax, the hardest part of the surface (ribs) should be struck, and the blow must be perpendicularly to the surface, otherwise the character of the sound will be misleading.

The pleximeter employed in mediate percussion, is generally a flattened and oblong, oval, or circular piece of ivory, silver, or caouchouc, the latter being the most suitable, from its making little or no sound of its own when struck. A still more convenient pleximeter is the median finger of the left hand, firmly applied over the surface to be examined. In using these agents the following precautions are to be adopted:—(*a*) The instrument must be applied closely to the surface to prevent any sound from air contained beneath it; (*b*) It must be pressed somewhat firmly, where much superficial fat or muscular tissues exist, in order to compress the latter and render them more conducting, and bring it closer to the organ to be examined; (*c*) in the case of an ivory or other unyielding pleximeter, the nails must be cut close, and the blow made with the palmar aspect of the finger ends, to prevent any clicking sound from the contact of the two hard bodies.

Palpation is the examination of a part by touch; *succussion*, by shaking; and *mensuration*, by measuring. The modes of applying these will be best considered when speaking of their individual applications.

In applying these various means of diagnosis in the lower animals, we find that, notwithstanding all their advantages, they are less useful than in the hands of the human physician. This is more especially the case in the maladies we are about to consider, namely, those of the organs of respiration. The chest of the human subject is almost entirely exposed to examination, the mammæ of the adult female proving the chief obstacle to a thorough exploration. Thoracic maladies can accordingly be traced through all their stages, and with the most surprising accuracy, by the physician. With us it is far otherwise. The great and muscular shoulder placed on each side of the chest anteriorly, virtually prevents examination of the front portions of the lungs, especially in the horse. The great muscular masses lodged on each side of the vertebral column, interfere in a similar way with the examination of the superior portions of these organs. The false ribs are in their turn covered by a considerable thickness of muscle, which hinders the exploration of this region, and the whole is covered by a thick cutaneous muscle, which not only tends to deaden sound, but the movements of which, especially in summer, corrugate the skin, and sometimes greatly interfere with our investigation. Add to these the horizontal position of the body, the oblique arrangement of the diaphragm, and the consequent pressure of the digestive organs far into the thoracic cavity, and it will readily be understood why we gain less favourable results from these physical methods of examination than does the medical man.

The nasal chambers, the larynx and trachea, are superficially seated and readily accessible to physical methods of diagnosis in all our domestic animals. The extent of the thoracic walls, however, which yield instructive indications on the application of these tests, varies with the species,* and in order to their correct application, a knowledge of such differences is essential.

Horse.—The heavy muscular shoulder of the horse covers the anterior part of the thorax as far back as the sixth rib in ordinary circumstances. By raising and advancing the limb, however, the cavity may be explored to the fifth, and in some cases, as far as the fourth rib. The diaphragm, it must be borne in mind, is attached on the ends of the false ribs, and in the case of the posterior ribs, at a gradually increasing distance above these ends, so that these costal cartilages and the lower ends of the last ribs cover the abdominal organs only. The large muscular masses situated on each side of the back-bone prevent any correct exploration of the upper part of the lung, while the extensive pectoral muscle lying on each side of the breast-bone interferes with the examination of the extreme lower portion. On the whole, it may be accepted, that no more than about two-thirds of the chest in solipedes afford physical indications with any amount of precision.

Ox.—In the bovine race, as a rule, a greater extent of the thoracic walls is exposed. The shoulder is very mobile, and may be carried forwards considerably by raising and advancing the limb. By flexing the member, and pushing the shoulder backwards, the two first ribs may be felt in very lean animals or calves, and the anterior part of the thorax subjected to examination. In such a case, nearly the whole thorax may be satisfactorily explored. This is at best an extreme case, and in well-conditioned, and especially fat animals, this part is little, if at all, more accessible to examination than in the horse. In the ox the breast-bone is flat, causing a greater width of the chest, and the presence of a greater amount of lung tissue inferiorly than is possessed in the horse; this, with the relatively greater thinness of the pectoral muscle, renders the examination of the lower part of the chest more satisfactory than in that animal. The flattened condition of the sternum, moreover, enables us to examine through this bone the thoracic organs situated immediately above. The posterior limits of exploration likewise differ from those in the horse. The diaphragm in this race is not attached on the last rib, it is only fixed to the upper third of the next or twelfth rib, and from this forwards its insertions are taken gradually lower until the ninth, the lower fifth of which alone responds to the abdominal cavity. It follows that the last intercostal space, the lower two-thirds of the twelfth rib, and all that part behind a line drawn from this point to the posterior bone of the sternum, responds to the abdominal cavity and not to the thorax.

Sheep.—In this species the thorax may be examined in the same way as in the ox, this difference only being borne in mind, that the diaphragm, like that of the horse, is inserted on the false ribs close to their cartilages, so that the latter, and the extreme ends of some of the posterior ribs alone, belong to the abdominal cavity.

Pig.—In this subject, the thorax can only be explored behind the shoulders, which are thick and possessed of little mobility. The diaphragm is attached to the upper two-thirds of the last rib, and to the three ribs next in front, immediately above their lower third, so that all above and in front of this responds to the thoracic viscera.

Dog and Cat.—The thorax of these animals is nearly all open for examination. The shoulders are thin and extremely mobile, and the rest of the chest is covered only by a thin layer of muscle. The diaphragm is attached to the lower end of all the false ribs except the two last, the lower third of which may be said to be extra-thoracic.

Birds.—The anterior aspect of the bird's thorax is covered by enormous pectoral muscles which prevent all exploration of this part. This is less necessary, however, from the lungs of these animals being lodged in the posterior part of this cavity, which is very open to observation from the thinness, or almost complete absence of muscles on the back and under the wings.

The larger quadrupeds may be examined standing in their ordinary position; but such a practice is attended with considerable disadvantage in the case of the smaller subjects.

In these it is necessary to kneel and keep the body in a constrained pôsture, which distracts the attention and prevents the proper appreciation of the various healthy or morbid symptoms elicited. The most convenient position for the smaller animals is standing on a table, by the side of which the investigator may stand or kneel as convenience dictates. By placing them upon their sides or back, the sternal and contiguous regions may be most conveniently examined.

For the better description of healthy and morbid symptoms, and to afford some guidance in exploring this part, the thorax is mapped out into separate regions. Two ideal lines are drawn from the posterior border of the shoulder, in the direction of the central axis of the body as far as the last rib, or, in the case of the ox, the second last. These lines are placed at equal distances from each other, and form the extremities of the ribs, so as to divide the lateral aspect of the thorax into three equal regions. The lower line may be said to extend along the superior border of the large pectoral muscle and the external oblique of the abdomen, while the upper is midway between this and the lower margin of the longissimus dorsi. The other regions are designated the superior, median, and inferior.

It remains to consider the indications of health and disease obtained from these various regions when subjected to physical examination. In the following pages will be considered, *seriatim*, the various methods of diagnosis, and at the same time will be discussed the advantages of their individual application to all parts of the respiratory tract.

Here let the reader be warned against the too common error of supposing that he may learn to elicit the symptoms and to give to each its proper importance, by giving close attention to any written description. Without assiduous practical application of the various indicated methods, and the closest attention to the different indications, no excellence in these modes of diagnosis can be attained. Healthy chests should be first examined, and when these have become familiar, the various diseased conditions may be introduced to study. In either case, and especially in the latter, the assistance of one already well-versed in the science may be said to be indispensable to satisfactory progress. The attention ought not to be directed exclusively to any one method of inquiry, nor should a conclusion be rashly arrived at before having resort to all the different measures applicable to the particular case. Thus the fallacious tendency of certain symptoms will be corrected by others, and it is only when all that can be elicited point in the same direction, that any satisfactory opinion as to the condition of the parts can be arrived at.

For the application of auscultation to the lower animals, we are indebted to Delafond and Leblanc, who were not slow to introduce Laennec's discovery into veterinary science, and who, by industriously availing themselves of their extensive means of observation, advanced this means of diagnosis to considerable perfection.

Nasal chambers.—In the healthy condition of these parts a soft blowing noise may be heard by approaching the ear to the nostrils. The sounds of the two nostrils should be of equal intensity. After exercise it is considerably exaggerated, and bears some resemblance to the sound emitted by the orifice of a large bellows. Neither the parietes of the nose, nor the sinuses of the head, show any sound when the animal is standing quiet, while, after exercise, a slight snoring may be observed in the former, and a soft murmur in the latter.

If the pituitary mucous membrane is engorged, or if the passage is otherwise diminished, as by a polypus or foreign object, a loud blowing sound is induced, which may exist in one or in both nostrils. If the passage is still farther diminished, the sound acquires a *whistling* character. These noises generated in the nose may be distinguished from those originating in the larynx or elsewhere, by their gradually decreasing in pitch, as examined first on the nasal bones, next over the larynx, and latterly over the trachea and thorax. Sounds generated elsewhere often appear very loud when heard at the nostrils, but may be readily referred to their proper place, by auscultating successively the walls of the different portions of the respiratory tract.

Larynx.—When the ear is applied over the larynx, or upper end of the trachea, in a healthy animal, a soft and very slight murmur is observed.

In a diseased condition, when there is a diminished orifice for the transmission of air, a dry whistling sound is produced. This symptom is a result either of distortion, of mechanical compression, or of atrophy of the laryngeal muscles, with imperfect separation of the vocal cords, as a result of lesion of the recurrent nerve. If the subject is put to severe exercise, the sound becomes louder and assumes a sonorous character, to which the name of *roaring* has been given. When the orifice is smaller the tone is shriller, and the condition is known as *whistling*. The above refers to dry sounds produced in the larynx, but a *soft whistling* may likewise exist, as in the case of acute laryngitis, when a considerable secretion of mucus has taken place. This may intermit on the occasion of the larynx being cleared by coughing. By auscultating the larynx and trachea, the sound can easily be localised.

Windpipe.—The trunk of the trachea generally yields no sound. At its superior extremity may be heard a modified laryngeal murmur, while close to its entrance into the thorax there is a blowing sound, resulting from the rushing of air into and out of the bronchial tubes. This sound, which is most prolonged in expiration, is called *tracheo-bronchial respiration.* Should liquids be effused into the bronchia, this changes to a *mucous rale,* which may be accompanied by a *hissing* or *gurgling rale.* When the bronchia contains blood, the rale is *spumous* or frothy.

Chest.—In the healthy chest two distinct sounds may be perceived in ordinary respiration. These are the *vesicular* and *bronchial* or *tubal.*

The *vesicular sound,* or *respiratory murmur,* as it is sometimes called, seems to result from the passage of air through the narrow ultimate bronchia in their entrance into and exit from the somewhat larger air sacs, and also from the dilatation of the latter. It is a soft diffused murmur, compared to the rustling of a gentle breeze among green leaves, but must be heard to be fully appreciated. It is found in greatest purity at a distance from the position of the large bronchial tubes, when in short it is not interfered with by the tubal sound. The sound is loudest during inspiration, the vesicular sound of expiration being invariably feeble and sometimes quite imperceptible. Its intensity is increased by exercise, or any other cause which activates the process of respiration. It varies, likewise, with the form of chest; thus, in a deep and wide thorax, the respiratory murmur is much stronger than in a flat chest of little depth. In individuals of excitable temperament, and without any superabundance of flesh, the sound is louder than in dull lymphatic animals, or in a state of obesity. With an empty stomach it is relatively stronger than when that organ is in a state of repletion. This no doubt depends on the diaphragm being pushed forwards by the ample gut, and thereby preventing the dilatation of the thorax. The species of animal influences. Thus the horse, goat, dog, pig, and birds present an intense respiratory murmur; in sheep it is perceptibly diminished, while in the ox, *cœteris paribus*, the sound is very distinctly less. Lastly, in young animals this murmur is decidedly stronger than in adults, and is known as *puerile*, or in the case of the lower animals, *juvenile respiration*—(LEBLANC). This peculiarity in young animals would seem to depend on the smaller size of the air sacs, and the greater elasticity of the lung substance. In very old subjects it becomes very weak, and is known as *senile*. Independently of these sources of difference, considerable modification may be met without any apparent cause. In such cases, the two sides of the chest in the same region ought to be compared, or two parts on the same side, which normally present the same indications, and if these do not correspond, an abnormal condition is to be inferred.

The term *bronchial* or *tubal sound* were perhaps more properly applied to that heard on laying the ear over the lower end of the trachea, in front of the thorax. This sound has been already referred to as the *trachea-bronchial*. The term *bronchial* is applied to the healthy sound perceived immediately behind the shoulder in the superior region of the chest. It is a somewhat harsh blowing sound, dependent on the column of air striking against the walls of the bronchial tubes in its course to and from the air cells, with some superadded respiratory murmur from a small intervening portion of lung tissue. The bronchial sound, so far at least as its blowing noise is concerned, differs from the vesicular in being almost as intense and prolonged in expiration as in inspiration. It likewise differs in having a distinct interval between the inspiratory and expiratory sounds, dependent, no doubt, on the time

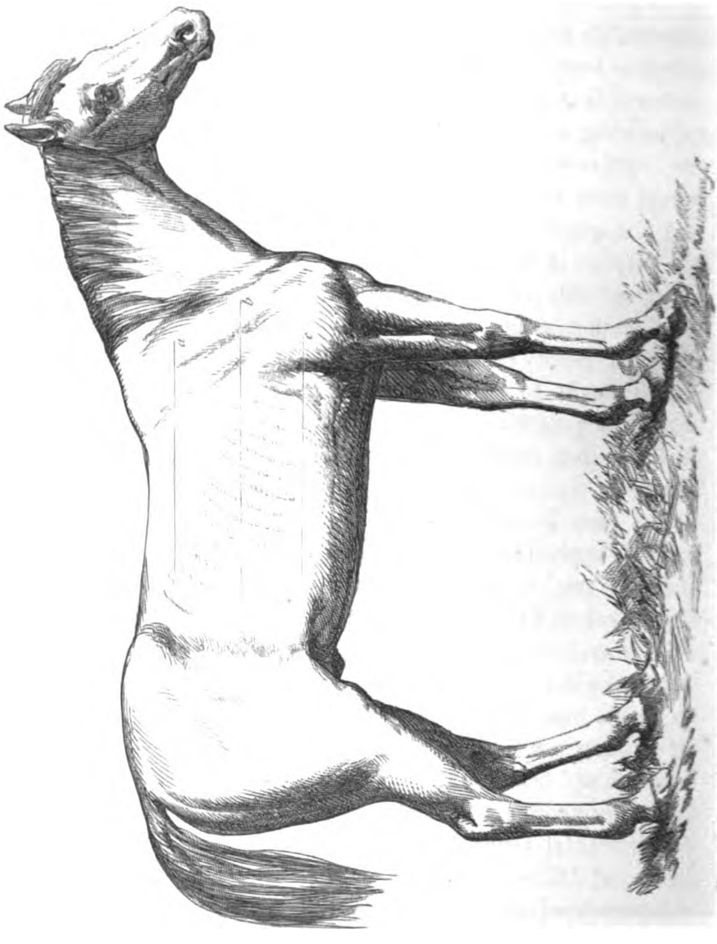


Fig. 133.—View of the horse's chest, indicating the positions of the ribs and extent of the thorax over which

requisite to convey an impulse from the ultimate cells to the larger bronchi.

Some consideration of the existence and pitch of these sounds in the various regions of the chest, and in the different animals, is essential.

1. *Horse.*—In this animal it will be remembered that we can only auscultate with profit behind the shoulder. This is scarcely true as regards young foals, and very thin animals,

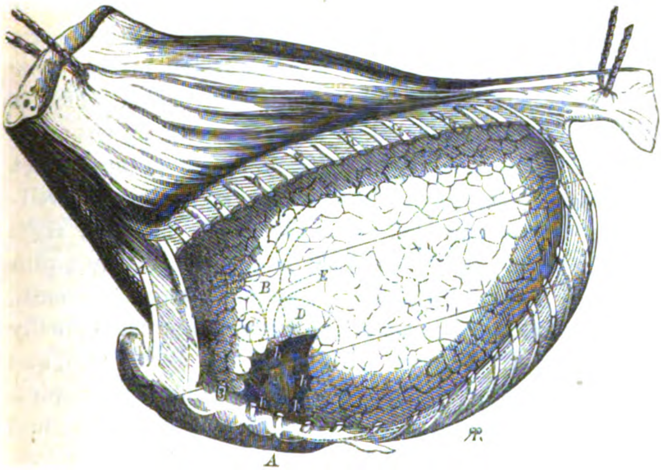


Fig. 134.—DELAFOND.—Horse's chest opened from the right side, and indicating the positions of the heart and lungs.

in which the shoulder is moveable, or so destitute of muscle that it can be auscultated on the antea and postea spinati fossæ. Even in these, however, and especially in the latter case, the sounds of respiration are so mixed up with those of the heart or large blood-vessels that they afford no very satisfactory data.

(*a*) *Right side.* In the superior region a bronchial sound is heard immediately behind the shoulder, on a level with the tenth rib. It diminishes in intensity to the twelfth, where it gives place to the vesicular. Behind this the vesicular sound becomes gradually feebler to the seventeenth rib, where it is entirely lost. In the median region, and where the limb is carried forward, a distinct vesicular sound may be heard over the fifth and four following ribs; from the ninth backwards it diminishes in force, and is altogether lost over the sixteenth. In the inferior region, where the limb is carried forwards, and the ear or stethoscope applied close above the elbow, the vesicular murmur is well marked over the fourth, fifth, sixth, and seventh ribs, behind which it decreases in pitch to the tenth, where it is entirely lost.

(*b*) *Left side.* The superior region differs in no respect from that of the right. The median region gives a well-marked vesicular murmur over the fourth, fifth, and sixth ribs, where the base of the heart is covered only by a thin portion of lung; the sound is more intense over the seventh, eighth, and ninth ribs, from which to the sixteenth it gradually diminishes. In the lower region over the fourth, fifth, and sixth ribs, the sounds of the heart only are heard; a respiratory murmur is heard over the seventh and eighth ribs, and diminishes gradually from the latter to the tenth.

Superadded natural sounds may be occasionally heard in the middle and lower regions, and especially towards their posterior parts. These are of a rumbling or gurgling nature, and depend on the movement of matters contained within those abdominal viscera, which lie close behind the diaphragm. They may be distinguished from abnormal thoracic sounds by their extreme irregularity, and by their bearing no relation to the rythm of the respiration.

CHAPTER IX.

ORGANS OF RESPIRATION.

Auscultation continued.—Ox; right side; left side.—Sheep—Goat—Pig—Dog—Bird.—Abnormal sounds.—Vesicular sound increased or diminished.—Supplementary respiration.—Variations of bronchial sounds.—Râles.—Sonorous—Sibilant—Mucous râle.—Metallic tinkling.—Friction sound.—Gurgling or splashing sound.—Cough.—Bronchial, cavernous, and amphoric sounds.—Percussion—Horse—Ox, and other animals.—Palpation. — Mensuration. — Succussion. — Diseases of the respiratory organs.—Epistaxis.—Nasal catarrh.—Coryza, simple and malignant.—Chronic nasal discharge.—Nasal gleet.—Ozœna.—Injection of the nose.—Rey's tube.—Accumulations of pus in the sinuses.—Trephining the sinuses.—Impaction of the guttural pouches.—A grass cold.—Hyovertebrotomy.—Abscess of the turbinated bones.—Disease of the facial bones.—Malignant sore throat of horse and ox.—Tracheotomy.—Sore throat or Laryngitis.—Œdema glottidis.—Angina.—Cynanche.—Quinsy of pig.—Tracheitis.—Croup.—Fracture of the trachea.—Congestion of lungs.—Pulmonary apoplexy.—How to apply mustard to the chest.—Bronchitis.—Collapse of the lung.

2. *Ox.*—(*a*) *Right side.*—In the superior region the vesicular sound is well marked from behind the shoulder to the level of the tenth rib, from which it gradually decreases in intensity, to be lost opposite the eleventh. In the median region a loud and sometimes rather rude respiratory murmur is heard over the fourth and three following ribs, which, however, gradually decreases from the seventh, and is lost over the tenth or eleventh. In the lower region the sound

Fig. 135.—Cow, showing the extent of surface for auscultation on the right side.

may be said to be bronchial over the fourth and fifth ribs, evidently on account of the considerable tube passing to the anterior lobe of the right lung. From the sixth to the ninth rib it is vesicular, and its force decreases from before backwards.

(*b*) *Left side.* The superior region simply repeats that of the right side. In the median region, the only difference is, that the sound is more feeble over the fourth, fifth, and sixth

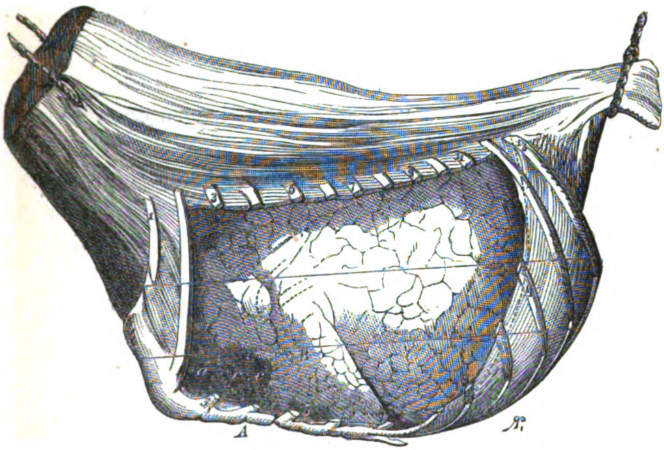


Fig. 186.—View of left lung of ox *in situ*.

ribs. In the inferior region, a feeble respiratory murmur is heard over the fourth rib; this increases over the fifth and sixth, and then decreases as far as the eighth or ninth.

In cattle, as in horses, a rumbling intestinal sound will frequently be noticed. It is usually confined to the posterior part of the right side, and to the superior and median regions. It seems to originate in the convolutions of intestine which lie above the right cul-de-sac of the rumen. A crepitating sound may be heard on the right and especially on the left side, in the two lower regions, and posteriorly to the eighth rib. This is best marked shortly after the animal has fed, more so if on green fodder, and seems to depend on the evolution of gas among the contents of the rumen. Another source of crepitation not unfrequently existing, is the extravasation of air into the subcutaneous areolar tissue; this sound may be readily distinguished from all others, by its being increased by manipulation. On both sides, and in the same regions as the first crepitating sound is met with, may be often heard a strong friction sound, evidently resulting from the active contractions of the rumen upon its contents, and most common during rumination. Lastly, a gurgling sound may be heard in the posterior part of the inferior region on the left side; this seems to depend on the passage of liquid from the first into the second stomach, and *vice versa.* These all differ from the true thoracic sounds, in occurring at irregular intervals, and bearing no relation to the rhythm of respiration.

Sheep.—In the sheep, as in the horse, the true *respiratory murmur* may be heard as far as the second last rib. The moveable shoulder of this animal allows a tolerable examination of the anterior part of the chest. From the heart being entirely surrounded by pulmonary tissue, and from the size of the anterior lobe of the right lung, the vesicular murmur is stronger and less confounded with cardiac sounds, than in the same part in the animals previously noticed. It is remarkable, too, that the sound behind the shoulder is not more powerful on the right than on the left side.

The superadded sounds are similar to those met with in the ox, but subcutaneous crepitation is less frequent.

Goat.—The normal sounds resemble those of the sheep, with this difference, that they are much more intense. In the latter respect they exceed even those of the horse's chest.

Pig.—Seldom can this animal be coaxed into sufficient quietness to allow of auscultation. When he does submit to such an examination, the respiratory murmur may be heard with tolerable distinctness over all that space between the shoulder and the last rib. In the front of the superior region it is complicated with a tubal sound. The only superadded sounds are slight borborygmi in the middle and lower regions posteriorly. In fat pigs auscultation is impossible.

Dog.—The race of dogs in general, and greyhounds in particular, present a very strong vesicular murmur, audible over the whole chest. Though feebler, and somewhat confounded with the sounds of the heart on the level of the fourth, fifth, and sixth ribs, it is still distinctly marked on both sides at this point. In the anterior portion of the upper region, it is complicated with a tubal sound. The superadded natural sounds are similar to those noticed as occurring in the pig.

Birds.—The stethoscope applied to the thorax, and especially below the wing, detects a strong vesicular sound which often becomes harsh or rude. It is calmer as heard over the back; and over the sternum, especially in palmipedes, it is often imperceptible.

Abnormal Sounds.—These are extremely numerous and complicated, frequently running into each other, and producing sounds of every grade, which prove very perplexing to all but the most practised ear. In reading the subsequent remarks, it must be understood that the typical sounds only are given, and in practice the auscultator is left to refer each of the many modifications to that to which it seems most closely to approximate.

Abnormal sounds consist either in modifications of the normal respiratory sounds, or in superadded sounds entirely distinct in their nature.

The *vesicular sound* may be increased in pitch, it may be diminished, or it may be entirely wanting.

When the respiratory murmur is more intense than natural, this intensity is said to be general when heard over the entire surface of the thoracic walls, and partial when heard only over a portion of that surface. The intensity may be such as to simulate juvenile respiration, or it may have some rudeness, like the respiratory sound heard normally behind the superior part of the shoulder extended to other parts of the chest. A general increase in the respiratory murmur results from any cause which accelerates respiration. Thus it results from active exercise, or from the high fever which accompanies the majority of acute maladies. The increase of the respiratory murmur in one lung alone, or in different parts of one or both lungs, invariably depends on some obstruction to the entrance of air into some other portion of the respiratory apparatus. Such obstruction may, however, be very varied, so that this symptom may be looked upon as of very secondary importance in diagnosis. Among the obstacles to the entrance of air may be noticed bronchitis, with thickened walls and diminished calibre of the tubes, the blocking up of one or more tubes by mucus, hepatisation of a portion of lung, pulmonary œdema, phthisis pulmonalis, hydrothorax, and pneumothorax. Coincident symptoms may decide whether any, or which, of these causes exist in a particular case. In these cases of partial increase in the respiratory murmur, the origin of the condition has suggested the very appropriate name of *supplementary* respiration. The occurrence of the rude vesicular sound in other parts of the chest than is natural, commonly depends on some condensation of pulmonary tissue, which thereby becomes a better conductor of sound, and enables us to hear the sound of bronchi over a greater extent of surface.

Diminution, like augmentation, of the sound may be partial or general. Partial diminution commonly results from pulmonary congestion, is accompanied by a supplementary murmur in other parts of the lung, and is succeeded by the humid crepitant râle, which announces the onset of inflammation. It is likewise an accompaniment of emphysema in which air readily enters the dilated air sacs, or adventitious vesicles, but cannot be expelled in consequence of the lung tissue having lost its elasticity.

General diminution of the murmur may depend on numerous causes, and frequently such as do not directly impair the thoracic viscera. Thus it may depend on certain diseases of the brain causing sluggish respiration. Anæmia or low fevers may, by their prostrating influence, lead to a similar result. The same remark applies to enteritis, peritonitis, or any violent abdominal pain which renders the breathing slow and careful. Obstructions in the glottis or trachea may act in a similar way. Percussion will enable the practitioner to ascertain the healthy condition of the lung in these various cases. The cause may, however, reside within the thorax, as tuberculosis with calcareous deposition, catarrhal bronchitis with an abundant secretion which blocks up the greater part of the small bronchial tubes, or general emphysema, in which the lung has lost its elasticity. In the case of the last lesion there is generally consistent bronchitis, and percussion detects an abnormal resonance.

Various other modifications of the respiratory murmur are occasionally met with. Thus the sound may be absent at the commencement of respiration, but appears towards its conclusion; this seems to result from some obstruction, as mucous or pleuritic effusion, which can only be overcome by the whole force of inspired air. In some such cases the obstruction may be removed by coughing the animal. On other occasions, as in spasmodic asthma, the murmur, though evident at the commencement, is lost towards the end of the act. Still another modification is that in which the respiratory act is interrupted, and seems to proceed by a number of successive jerks. This is common in pleurisy, when the lancinating pain prevents the subject taking a full continuous inspiration.

Complete absence of the vesicular sound may claim different sources. It may result from hepatisation, in which case it has been preceded, and in case of recovery will be followed, by a crepitant râle. If dependent on that variety called splenisation, no crepitant râle will have preceded its onset; it is generally accompanied by a tubal sound. Effusion into the cavity of the pleura is not an infrequent cause, one or both lungs, according to circumstances, being compressed by the fluid. Such cases are generally ushered in by friction sounds, and always exhibit the dulness on the lower part of the thorax. By turning the smaller patients upon their backs, such cases can thus afford the most satisfactory evidence of their character. These two are the most common sources of this symptom. Others, however, exist as tumours pressing on one or more large bronchial tubes, considerable tuberculous deposition, or the occlusion of bronchial tubes by blood, pus, mucus, or fibrinous exudation.

The *bronchial sound* is likewise liable to great variations. Its most common modification, perhaps, is its presence at parts of the chest in which it is not normally heard, and in this case unaccompanied by the vesicular murmur. This is called bronchial respiration, and is nearly constantly present in cases in which the pulmonary tissue has become hepatised to some extent. In such instances, the sound generated in the larger bronchial tubes is conducted along the unyielding walls of the smaller tubes, and through the hepatised tissue, which, from its increased density, has become a better conductor of sound, so that it ultimately falls upon the ear with nearly all its original intensity. If such a case has been previously watched, a crepitant râle will be found to have preceded the bronchial respiration. Extensive deposition of tubercle, from its causing more or less pulmonary condensation, will give rise to symptoms of a similar kind. Bronchial breathing may result from dilatation of the bronchial tubes without any pulmonary condensation; when conjoined to the latter condition, this gives the loudest variety of tubal respiration. Pulmonary emphysema may likewise induce this condition; but in this case, the absence of condensation may be ascertained by percussion, while, from the frequent co-existence of bronchitis, crepitant and dry sibilant râles are common accompaniments, and the cough is small, short, and feeble. In dyspnœa from section of the recurrent nerves, or in paralysis of the muscles of the glottis from other causes, bronchial respiration may be heard over the greater part of the chest independently of pulmonary condensation; this is well observed in cases of roaring. Notwithstanding the frequency of this symptom with condensation of the lung, it is not invariably met with in such a case. Thus, when an entire lung is hepatised, the air in the corresponding organ is placed in a condition of stasis, and the solid mass meanwhile transmits the vesicular murmur of the opposite lung, so that the healthy normal sound is retained. In other cases, though the bronchial sound is audible, yet, from its having traversed a solidified lung of little density, the sound has become modified, and strikes upon the ear with more of the softness of the vesicular than the usual characters of the bronchial sound. In such instances, the obvious source of fallacy will be at once corrected by having resort to percussion.

Bronchial respiration varies in intensity in different cases. When extended over a considerable part of the thorax, it is usually less powerful, and seems to come in greater part from the smaller tubes. Occasionally it is more circumscribed and powerful, seeming to originate in the larger bronchial trunks; in this case it is sometimes called tubal respiration. It may be further modified by the existence of a cavity which opens by a large orifice into a bronchial tube. The sound, in this case, has a peculiar hollow character, resembling that produced by blowing into a wide-mouthed glass or porcelain vessel, and is known as *cavernous respiration*. When preceded or accompanied by an acute, circumscribed pulmonary inflammation, and a cough with a discharge having the smell of decomposing animal matters, the cavity has probably resulted from gangrene of the lung; when the discharge is white or purulent, a large abscess of the lung may be diagnosed, while, in some few cases, it may be the result of softened tuberculous matter. When a large cavity communicates with a bronchial tube through a small opening, the resulting respiratory sound is called *amphoric*. It may be very fairly imitated by blowing into a narrow-necked jug. The usual cause of this sound is the existence of pneumothorax, and a narrow communication between the cavity of the pleura and a bronchial tube. It is very rare in the lower animals, but two cases are noted by Delafond.

The cavernous sound is in most cases to be distinguished with difficulty from the bronchial or tubal breathing, while the amphoric sound, when it does exist, is not to be mistaken.

Râles.—Besides the above, which are truly modifications of natural sounds, another series have to be mentioned, which are essentially distinct from the sounds of health; these are called *râles* or rattles. They are called *dry* or *humid*, according as they convey the idea of air passing through a dry tube or one containing liquid. The dry râles depend on a narrowing of the bronchial tubes. trachea, or larynx, from the deposition of a viscid mucus in layers over the mucous membrane. The shrillness of the sound depends on the narrowing of the tube, and the dry râles have accordingly been referred to two principal standards, the *sonorous* and the *sibilant*. The sounds of the subcrepitant râles convey the idea of bubbles of air bursting in passing through a liquid. They vary necessarily with the size of the bubbles from which they are produced. The chief varieties are the *mucous*, the *crepitant*, and the *subcrepitant*.

The *sonorous râle* has been likened to the humming of a gnat, the cooing of a wood-pigeon, or the bass notes of a violin. From these supposed resemblances it will be inferred that it is liable to considerable modification of tone. The deepest or gravest tones are necessarily formed in the largest tubes. It frequently results in the early stages of bronchitis from swelling of the mucous membrane. It is usually very transient, from the mucus which causes it being removed by coughing; but even when permanent, does not last over two or three days, when it is replaced by the mucous râle. In the majority of cases, too, it is very irregular, and can seldom be heard with every successive respiratory movement. It is sometimes accompanied by the sibilant or mucous râles, the former dependent on the smaller tubes being in a similar condition, and the latter on some portion of the tubes having commenced to secrete actively. The sonorous is sometimes modified so as to form what is known as the *dry mucous râle*. In this case a piece of tenacious mucus is attached to the walls of a tube, obstructing it and producing at intervals a clicking or crackling noise, which, during excited breathing, is obviated, and merges into the sonorous râle. The sonorous râle is best heard over the trachea at its entrance into the chest.

The *sibilant* is dependent on the same cause as the sonorous râle, but is generated in the smaller tubes, or the larger, when their capacity is very much diminished. It is a low, whistling sound, heard during inspiration or expiration, or both, and subject to the same conditions, as regards interruption and duration, as the deeper sound. Like the latter, too, it commonly owes its origin to the onset of bronchitis, though it is likewise said to accompany some cases of pulmonary emphysema.

In certain cases, these sounds are modified, and resolve themselves into a *hissing* noise, but this simply depends on some alteration in the calibre of the tubes. When loud enough to be heard without applying the ear to the chest, these sounds constitute *wheezing.*

The term *mucous râle* has been applied to a sound produced in the bronchial tubes from the passage of air through mucus, pus, or blood. It may be temporary or permanent; in the former case it may be removed by coughing or even excited breathing, either of which may temporarily clear the tubes in which it is generated. This râle may be much modified according to the size of the air-bubbles in any individual case. The size of these may be affected by the kind of liquid present, by its amount, by its viscidity, and by the strength of the current of air by which the tubes are traversed.

In bronchitis, with profuse secretion of viscid mucus, especially when the breathing is slow, the resulting bubbles are large, and the râle may be imperfectly simulated by blowing a large number of soap-bubbles in a viscid lather. This noise, which may be accompanied by a slight gurgling, is best heard behind the shoulder in the median region; it may also be heard over the lower end of the trachea. With more rapid breathing, in bronchitis, when the secretion has been well established—in chronic bronchitis, or when pus from a pulmonary abscess has been discharged into the tubes—the bubbles are of median size, and the sound correspondingly modified. It may be imitated by blowing a number of large and small soap-bubbles, so that they burst simultaneously. The bubbles may burst separately, or a number at once, so that the sound may be continuous. This, which is sometimes called the *sub-mucous râle*, is heard both in inspiration and expiration. When air passes through fluid, in an enlarged bronchus or a pulmonary cavity, the sound is modified accordingly, and takes the name of cavernous.

The *crepitant râle* is a very fine crackling sound, variously likened to the crackling of common salt when subjected to heat, to that caused by a sponge expanding in water after having been compressed in the hand, or to the sound developed by rubbing a lock of hair between the finger and thumb close to the ear. It is developed exclusively in the ultimate bronchial tubes or the air-cells, and is ascribed either to the passage of air through a viscous mucus in the former, or to the separation of the walls of the latter, which have been agglutinated together by the same material. It is only heard in inspiration, which would support the latter opinion, and may be taken as a tolerably certain diagnostic sign of pneumonia. By carefully auscultating, we find it to precede the march of hepatisation in an inflamed lung, and in a similar way the removal of the consolidation is followed by a recurrence of the crepitant râle. In the latter case it soon gives place to the ordinary respiratory murmur. In some cases, with a coarser variety of the crepitant râle, the sound is heard to some extent in expiration, probably from its being developed in the small bronchial tubes as well as in the air-cells. All pneumonias are not accompanied by a crepitant râle; in weak animals with an adynamic type of inflammation, tending to gangrene, and in cases of croupous pneumonia in cattle, in which fibrinous exudations exist in the ultimate bronchia and air-cells, this sound may be either absent, or so weak as to be all but inaudible, even to a well-practised ear. Even when it is heard it may owe its existence to other causes, such as pulmonary œdema, capillary hæmorrhage, or any other means whereby liquid becomes effused into the ultimate bronchial tubes or air-sacs.

The *subcrepitant* is an exaggeration of the crepitant râle. It holds an intermediate place between the latter and the mucous râle, and is comparable to a moderate effervescence in beer or other liquid. It has a bubbling character like the mucous, but the bubbles seem to be much smaller, and the sound is much finer. This râle may be taken to indicate existing broncho-pneumonia, with some exhalation of blood into the tubes. It is the spumous râle of Leblanc.

Metallic tinkling is another peculiar superadded sound. It may be imitated by striking a pin gently against a glass vessel, or by applying the palm of the hand closely over the ear, and giving it a smart tap on the back with the median finger of the right. As a rule this sound is only produced when air and fluid co-exist in a closed cavity, as in that of the pleura, or in an excavation in the lungs. It may result from a drop falling from the roof of the cavity into the liquid beneath; it may likewise depend on the ascent of a bubble of air through the liquid, and its bursting on the surface, or on the sudden reflection of the air in the cavity from one side of its walls to that opposite, as a result of sounds transmitted from the deeper-seated parts. The first-mentioned cause is undoubtedly the most common, and is commonly best heard after the animal's position has been changed. Thus, when the patient is lying, the collapsed lung, or it may be shreds of false membrane, become bathed in the liquid, which is not plentiful enough to reach these parts when standing. On changing the former for the latter position, accordingly, a number of drops fall from above into the liquid below, and they will be found to succeed each other with a gradually decreasing rapidity until they finally cease altogether.

A *friction sound* is developed by the pleuræ as a result of the deposition of lymph on those first attacked by inflammation. It consists in superficial, quick, jerking sounds, comparable to that heard on applying the palm of the left hand over the right ear, and rubbing its back softly with a finger of the right. Few jerks are heard at each respiratory act, and chiefly or exclusively at the lower part of the thorax, where the contained organs enjoy the greatest freedom. The sounds are most marked during inspiration, though they may likewise be produced during the respiratory act, or during the beats of the heart from the movement caused by the contraction of that organ. They are especially distinct in the cow and dog, from the thinness of the muscles on each side of the sternum. After the lapse of twelve, twenty-four, or thirty-six hours, the sounds usually disappear, on account of pleural effusion; during recovery, when the effused liquid has been taken up, friction is again heard until the exuded lymph has been absorbed. It is accompanied by vibrations of the thoracic walls, perceptible to the touch.

Closely allied to the friction sound is a *creaking noise*, developed by movement in a layer of coagulated lymph, by which the costal is bound to the pulmonic pleuræ.

A *gurgling* or *splashing sound* is sometimes heard, and, like the above, is referable to the pleura. The sound can only be produced when both gas and liquid are present in the pleural sac. Even with these conditions, the sound is rarely heard, and too often have gurgling sounds in the intestines been mistaken for this. When hydro-pneumothorax exists in the smaller animals, a gurgling sound may be developed by succussion—that is, quick shaking—and in the larger, movements of the body may give rise to it.

The cough cannot be auscultated with the same advantage in the lower animals as in man. We can readily cough the former by compressing the first tracheal ring between the finger and thumb, but we cannot, as the physician can, get our patients to take a full inspiration, and succeed this by a short, quick cough, the sound of which is conveyed through the air compressed in the bronchial tubes to near the surface of the lungs. Again, in the coughing of our larger patients, the sudden movement of the chest renders it difficult to keep the ear in close apposition to the thoracic walls. When this can be effected, some useful indications may be obtained from the cough. As heard over the healthy lung, it gives a short, dull, indistinct sound. In consolidation of the lungs from compression, hepatisation, or pleural effusions, it becomes loud, and is heard over a greater or less extent of chest according to circumstances; the same sign may arise from dilated bronchia. When a considerable cavity communicates with a bronchial tube, and extends to near the surface of the lung, the sound is even louder and more distinct as heard by the ear applied directly over the part. Should such a cavity communicate with the bronchia by a narrow orifice, the sound becomes clear and metallic, like that produced by coughing into a narrow-necked vessel. These are respectively designated *bronchial*, *cavernous*, and *amphoric* sounds.

Other valuable indications may be obtained by coughing the animal. The deep inspirations which precede and follow a cough will often bring out indistinct sounds into greater prominence, and enable us to decide as to their character. The clearing of the air-passages which results from coughing will likewise temporarily remove certain sounds, such as the mucous râle, by obviating their cause.

In auscultation, be it remembered, that though sounds are generally heard in greatest intensity closest to their seat of origin, yet, by travelling through condensed pulmonary tissue, they may reach the ear at a considerable distance with nearly their primitive force. Such a source of fallacy will often be corrected by the indications yielded on percussion.

Percussion.

The methods of performing this operation have already been indicated (see page 499.) It remains to mention the sounds elicited in healthy and diseased conditions of the chest.

In all parts of the healthy chest, when the proper substance of the lung comes into contact with the thoracic walls, a clear sound is elicited on percussion. This varies with the force of percussion. Thus, when the surface is lightly struck, the sound though low is clear, proceeding only from the more superficial air-sacs. When a stronger impulse is made over a part containing a considerable thickness of lung tissue, the sound is louder and even somewhat sonorous. If the patient be lying, the sound may be modified by the character of the bed; thus it will be more resonant in an animal reclining on a hard surface than on a soft yielding material. To a certain extent the sounds on the one side may be taken as a criterion by which to judge the condition of the opposite; but this is to be received with considerable reservation. Allowance must be made for the position of the heart and some of the abdominal viscera in relation to the two sides of the chest, in various domestic animals, before any satisfactory conclusions can be arrived at from their variations in resonance. This will be better illustrated by considering shortly the degrees of resonance elicited by percussion from the various parts of the thorax in our domestic animals. The sounds, however, vary greatly on the same parts of animals even of the same species. Thus, in the case of a flat or ill-developed chest, the sound is much less marked than in one active and well-developed; this results from the latter containing a larger quantity of air, and having the individual air-sacs better filled. Resonance is always much reduced by a full stomach, or any cause, in short, which prevents the perfect inflation of the lungs. In order to obtain a satisfactory result, the different parts of the lung, and especially the corresponding portions on the two sides, should be examined at the same stage of the respiratory act.

Horse.—Left side.—In the superior region the sound is very clear immediately behind the shoulder, especially so over the 12th and 13th ribs, and diminishes gradually from the latter backwards. Behind the 14th rib the abdominal resonance is easily produced by forcible striking. In the median region, considerable resonance exists behind the shoulder on the level of the 5th and 6th ribs, it is especially marked from the 7th as far the 11th, but behind this gradually diminishes to the last. In the inferior region the resonance is present, though weak, over the 4th rib; the sound is nearly dull over the 5th, 6th, and 7th, when the heart occupies a notch in the lung; it acquires intensity again over the 8th, behind which it becomes less marked, and is replaced by dulness over the 13th rib.

Right side.—The superior region, as compared with that of the left side, differs only in this, that in applying percussion behind the 13th rib, very little force must be employed, as otherwise the arch of the colon will give a sound simulating that of an emphysematous lung. The median region may be said to correspond exactly to that of the left side. The lower region is clear and resonant from the 5th to the 7th rib, but from the 8th to the 11th it is nearly entirely dull, from this part responding to the liver.

Ox.—*Left side.*—The superior region is very resonant over the 8th, 9th, and 10th ribs. If it be struck very gently between the latter and the 12th rib, the diminished resonance of the posterior border of the lung may be still brought out, though, if struck at all forcibly in this region, a tympanic sound is produced, due to gas in the rumen. The median region is very resonant over the 5th, 6th, and 7th ribs, much less so over the 8th and 9th, and quite dull over the lower third of the 10th, and half the 11th; this dulness proceeds from the abdominal organs. The lower region, unlike in the horse, shows considerable resonance over the 4th, 5th, and 6th ribs, from this part lying over the anterior lobes of the right and left lungs, which almost completely envelope the heart. From the 7th to the 9th ribs, the resonance diminishes, and is entirely lost in the lower fourth of the latter, as well as over all the ribs behind it. In young and emaciated subjects, by drawing the limb forcibly backwards, and applying the pleximeter as firmly as possible over the first two ribs, a clear sound may be obtained.

Right side.—The resonance of the right side differs little from that of the left; the resonance is sometimes perceptibly less posteriorly on account of the presence of the liver.

In very thin animals a clear sound is produced by percussion in the fossæ of the scapula.

Sheep.—In employing percussion over the chest of the sheep, the following differences may be noticed:—1st, The resonance is clearer over the 5th and 6th ribs in the lower region of the left side, as a result of the heart being completely covered by the anterior lobe of the left lung. 2nd, The pulmonary resonance maintains its clearness and depth more posteriorly than in the cow, in consequence of the anatomical arrangement of the diaphragm already referred to. Thus, in the superior region, the pulmonary sound becomes less clear over the 11th, though it may be detected as far as the 12th or 13th; in the median region it diminishes from the 8th to the 11th, where it is lost, while in the lower region it is gradually feebler behind the 7th as far as the 10th, where it is replaced by dulness. On the right side posteriorly, the resonance of the abdominal viscera is not so likely to interfere with the proper appreciation of that of the lung.

Pig.—When this animal is emaciated, it may afford satisfactory indications on percussion. The resonance is deepest on either side, close behind the shoulder in the median region. From this it gradually diminishes to the level of the attachment of their diaphragm. In very young or lean subjects the first and second ribs may be examined in front of the shoulder, and will afford a clear resonance.

Dog.—In ordinary cases the resonance elicited on percussion of the chest in the dog is especially clear. In the superior region it is well marked behind the shoulder, increases as far as the 7th rib, and from this diminishes to the 12th; between the two last-named ribs the strokes should be very light, made with the median finger only, to avoid the production of abdominal sound. In the median regions the sound elicited is very clear from the 3rd to the 7th rib, from which it again diminishes to the last. In the lower regions a distinct, though moderate resonance may be observed from the 1st to the 8th rib; there is no modification on the left more than on the right side, over the region of the heart. In all dogs in moderate condition only, percussion may be effected over the two first ribs, which yield a moderately clear sound, and over the anterior and posterior fossæ of the shoulder-blade, which in their turn give a slight resonance, though of a much less distinct character.

Birds.—In birds, over that interval between the thick pectoral muscle and the wing on each side, a clear resonance is yielded on percussion. A less marked though still distinct resonance may be elicited by employing percussion along the back in the interval between the two wings. In examining these animals, it is well that the pleximeter be small and thin, and that the strokes of the finger be slight.

In states of disease the percussion sound may be augmented, diminished, or abolished.

Augmentation of sound may be partial or general. *Partial augmentation* arises from an obstruction to the respiratory process in the remainder of the lung tissue; thus when one lung is hepatised, its fellow, which is called upon to perform its functions, must take in an increased quantity of air, and hence becomes abnormally resonant. A similar result will follow effusion into one or both pleural sacs; in the horse, when in this condition, the resonance will be exaggerated superiorly, while dulness exists lower down. *General increase* of resonance is especially noticed in cases of extensive emphysema. In this case the character of the sound is much more clear than when there is simple exaggerated respiration in a single lung. It resembles somewhat that produced by percussion over the left flank in cases of hoven, and has from this been designated *tympanic.*

Diminution of sound may be general or partial. General diminution of resonance may result in the ox, from the presence beneath the costal pleura of an extensive tuberculous deposit, or from an extended formation of false membrane over the same. The former may often be distinguished from the latter, by its being accompanied or preceded by a distinct friction sound, audible on auscultation. A third cause of general diminished resonance, is a uniform deposit throughout the lungs of cancerous, or other abnormal material. The causes of partially diminished resonance are:—a circumscribed false membrane on the pleuræ, or the infiltration of the pulmonary tissue by some liquid, which only partially prevents the entrance of air into the air sacs. There may likewise be hepatisation of a small portion of lung tissue, but this is readily distinguished from the causes previously mentioned, by the presence of a crepitant râle round the hepatised portion.

Absence of resonance is never observed over all parts of the chest at the same time. It is necessarily circumscribed, and is usually due either to hepatisation of lung tissue, or the effusion of liquid into the pleural cavities. If from hepatisation, it will not probably occur in the lower region of the chest, or over the whole of that region, the progress of the dulness will be preceded by a crepitant râle, audible on auscultation, and the resonance and respiratory murmur will be slightly increased on the same part of the opposite lung. If dulness results from effusion, the history of the case will indicate that pleurisy has existed, and has become suddenly relieved, friction sounds will have preceded the dulness, pain is felt on pressing the intercostal spaces, and, in the case of the horse, the dulness will exist equally upon both sides. In the ox, fluid may exist in one side only of the pleuræ, and the last statement accordingly does not hold good in this animal. The same remark applies to the smaller classes of animals, but in these we can easily change the position of the body, and the existence of liquid may be diagnosed from the dulness being always found at the lower part of the thorax. Any circumscribed induration or large cyst in the lung, may give rise to dulness over a limited extent of surface.

A peculiar sound, called the crack-pot sound, may be elicited by percussion over the chest in certain conditions of the lung. To represent this sound, clasp the one hand in the other so that they may be in contact all round the palm, while between the palms a space is left containing air, then strike the back of one hand against the knee, when the noise of the air escaping closely resembles the crack-pot sound. It occurs when a large cavity containing air opens into a bronchial tube, through a small orifice, and will probably be accompanied by amphoric breathing and cough.

Palpation.

By this term we understand the application of the hand in order to ascertain the condition of a part. It is chiefly important from its assisting in the diagnosis of pleurisy. If an animal is affected by this malady, whether in an acute or chronic form, firm pressure in the intercostal spaces, at the diseased part, will lead to wincing, and in some cases to moaning, especially in cattle.

Mensuration.

Mensuration, as applied to the chest, consists in the application of a cord or tape to the similar parts of the two sides of the chest, in order to ascertain whether any difference exists in their relative prominence. For the larger animals, a tape of three or four feet, and for the smaller, of one-and-a-half to two feet, may be employed. One end is placed immediately behind the withers, and the line carried downward to the middle of the sternum, which part is marked by a knot; a second measurement is made from the withers to the lower end of the 8th rib, or the commencement of the cartilages of the false ribs, and similarly marked; a third measurement is made from the lower end of the 3rd rib to the commencement of the cartilages of the false ribs; lastly, the tape may be carried from the posterior border of the shoulder along the middle region of the chest, as far as the last rib. The same measurements may then be made on the opposite side of the thorax, care being taken that they be always made at the same stage of the respiratory act, as otherwise false results will be obtained. It is well, indeed, to measure the different parts after both inspiration and expiration, that any difference in the expansion of the two sides of the thorax may be ascertained. In some of the smaller animals, as the dog and sheep, the variations in the expansion of the two sides of the thorax may be noticed by inspection only; in this case, the practitioner stands at a short distance behind the animals, and examines the relative movements of the two sides during the respiratory process.

The greater dilatation of one side is noticed in cases of hydrothorax in the dog and cow, especially when confined to one side, and of some standing. In such a case, the intercostal spaces may be observed to be larger than usual. Delafond notices a similar increased dilatation as a result of a nearly complete hepatisation of one lung.

A decrease of the volume of the thoracic parietes is commonly an accompaniment of chronic disease of the lung, with atrophy of pulmonary substance.

SUCCUSSION.

Succussion consists in grasping the thorax between both hands, and shaking it quickly, so as to elicit sound. It is only useful when gaseous and liquid matters co-exist in the pleura; in such cases, however, a splashing or churning sound may be heard. It will strike every one that this measure is only applicable to the smallest class of animals.

DISEASES OF THE RESPIRATORY ORGANS.

The diseases of the respiratory organs prevail to a large extent in this country, and may be classified under two heads, —the local and non-contagious, the general and contagious. I mean by *local,* more particularly, the affections of some part of the respiratory apparatus due to a cause operating on it locally; any systemic disturbance being a secondary result. The general and contagious class includes malignant forms of angina and pleuro-pneumonia—in which the local manifestations are but secondary, and dependent on causes which operate on the system generally.

The local and non-contagious disorders above mentioned may be divided into acute and chronic, but more commonly they are considered in the order of succession suggested by the relation to each other of the part affected, beginning with the nose, and passing on to the larynx, trachea, bronchial tubes, lungs, and pleura. I shall reserve as a distinct section of this subject, to be considered after the local disorders, the various affections which are due to organic changes, the results of injury or otherwise, and which are characterised by difficult breathing or dyspnœa. Under this head I shall include roaring, asthma, and broken wind.

DISEASES OF THE NOSE.

Epistaxis, or Hæmorrhage from the Nose.

The discharge of blood from the membrane lining the nose is usually a symptom rather than a special disease. It is more common in the ox than horse. It may be seen in cases of chronic nasal catarrh, in glanders, and blood disorders. It is also the result of local injury, or exudation from a soft polypus, and may supervene on active exertion, coughing, sneezing, &c., especially in a plethoric animal. It is favoured by pressure on the jugular veins by a collar.

The flow of blood occurs from one or both nostrils of a bright scarlet or dark venous hue. In malignant diseases it is of the latter colour, and dark blood clots are seen dispersed over the lining membrane of the nose. A very considerable quantity of blood may thus escape, and the owners of animals become alarmed as to the result. The pulse is found to be frequent and often full, the breathing laboured, and the animal bespattering the blood in various directions in the act of sneezing.

Schwarz* has seen epistaxis in the ox so severe as to induce him to resort to bleeding, cold applications to the head, and the injection of vinegar and astringents into the nose. We are not often called upon to adopt such active measures.

INFLAMMATION OF THE NOSTRILS—NASAL CATARRH—CORYZA.

Two forms of this disease have been described—the simple and malignant. The inflammation is not usually confined to the nasal chamber, as it extends to the maxillary and frontal sinuses. The simple coryza either terminates in resolution in six or eight days, or it ends in chronic catarrh. Gangrenous coryza is more frequently observed in cattle than in horses.

* *Edinburgh Veterinary Review*, vol. i. p. 387.

Simple Coryza.

Causes.—Exposure to wet and cold, or to alternations of temperature, bad ventilation, and damp stabling. Coryza is frequently noticed in animals placed in new buildings before the plastered walls have had time to dry thoroughly, and in temporary sheds on damp ground, where no attention is paid to running off the urine, &c. Weak, ill-conditioned animals are more subject to the disease. The complaint is common in the eastward of Scotland, and almost unknown to the south-west.

Symptoms.—Simple coryza is indicated by sneezing, redness and dryness of the pituitary membrane, soon followed by a discharge of a thin colourless and irritating secretion. Breathing is rendered more or less difficult according to the state of engorgement of the membrane lining the nose, and the determination of blood to the head is indicated by redness of the eyes, tumefied eyelids, and heat over the frontal region. Febrile symptoms vary in intensity, being almost absent in some cases, and severe in others. In two or three days the discharge becomes thick, opaque, and purulent. The more free the production of pus, the more rapidly does the disease disappear, and resolution occurs by the rapid diminution in the quantity of the discharge and the restoration of a normal condition of the nasal membrane. There is always a tendency to the extension of congestion and inflammation towards the throat, and then cough and difficult swallowing constitute diagnostic signs.

Simple catarrh may result in chronic discharge from the nose, either due to a persistent suppuration from the nasal membrane itself, or from the sinuses connected with the nose. If the flow continues beyond a fortnight or three weeks, it constitutes a chronic catarrh or nasal gleet.

Treatment.—Whatever animal may be affected with coryza, it will be benefited by warm clothing and the administration of a dose of physic. Should there be any objections to the purgative, doses of nitre or other neutral salt may be administered daily. The diet must be restricted, and the nose steamed. To steam the nose, large hot mashes are given to horses, but I prefer a sack or nose-bag in which hay-seeds or bran are placed, and over which boiling water is poured. Half a pint of vinegar thrown on the steaming material renders the application more active. A very good plan to perform this operation consists in having a kettle to which a flexible tube is attached. By boiling water in the kettle a jet of steam is obtained, which can be directed into the nose, and according to the distance that the tube is held from the nose, is the temperature of the vapour applied to the schneiderian membrane. Care must be exercised not to scald the latter.

MALIGNANT CORYZA—CORYZA GANGRENOSA.

This has been called the glanders of the ox species. Considerable confusion exists in the writings on malignant catarrh of the horse and ox. Hering describes a malignant catarrh of cattle—catarrhus sinuum frontalium—and a gangrenous form of strangles, or coryza gangrenosa, affecting both horse and cattle. The latter malady, it is evident, consists in the worst form of the disease, known in Britain as purpura hæmorrhagica, though cases of œdema of the glottis in the horse appear to me to be included under the head of gangrenous coryza. I shall consider the specific and malignant catarrh of cattle here, and speak of the other disease in treating of the general disorders of animals.

The malignant catarrh of the ox species occurs in the spring and autumn, especially when there is much wet

Oxen and young cows are chiefly subject to the disease, old cows rarely.

Symptoms.—The premonitory signs consist chiefly in diarrhœa, the eyes are red, dull, dry, and the head hot. Dulness, sunken head, a shivering fit, followed by heat, dry muzzle, hot mouth, salivation, discharge of tears and swollen eyes, with intolerance of light, and even turbidity of the aqueous humour, are all symptoms of the early stage. The mucous membranes are of a blueish-red colour, pulse frequent and full, heart's action feeble, breathing accelerated, and painful cough. There is much thirst, urine high coloured, and fæces black and hard.

In the second stage, which appears about twenty-four hours after the first indication of illness, the catarrhal symptoms are fully developed, the discharge is ichorous and mixed with blood, and accumulations of pus occur in the nasal sinuses, over which there is much heat. There is dulness on percussion over the frontal sinuses; red patches develope in the mouth, and the cuticle over them falls off. The appetite is totally lost; the discharge of fæces and urine is attended with pain, and there are pains in the extremities, indicated by lameness, &c. Pregnant cows have a great tendency to abort.

In the third, or nervous, stage there is an increase in the nasal discharge, sloughing of the schneiderian membrane, and of the secreting structures of the horns, and also sometimes of the hoofs. The horns and even the hoofs drop off. Convulsions and symptoms of apnœa immediately precede death. Near Berlin, in 1854, false membranes were found to form on the mucous membrane of the mouth and respiratory passages, with ulcerations of the conjunctiva.

After death the signs of lesions mentioned under the head

'Symptoms' are observed, besides ecchymoses, and it is said, also, inflammatory changes of the brain and spinal cord. The brain-substance is softened, and its cavities contain fluid. The blood-vessels are all full of dark-coloured blood, and there are ecchymoses on the serous and mucous membranes generally.

The disease lasts from six to nine or eleven days, and usually results in death. The animals that survive are blind, and suffer from paraplegia.

Treatment.—Bleeding is recommended. Washing the head with vinegar and water, or applying ice to the head, giving a laxative and clysters; seton in the dewlap. Gellé and Ercolani are advocates for the most copious bleeding. Nitre and acetate of ammonia may be given freely in water. Mineral acids.

℞ Hydrochloric acid, } of each one drachm,
Nitric acid, . . }
Water, ... 10 oz.

Mix. To be given three or four times a-day in beer.

Setons may be passed through the sinuses, and the latter washed out with chlorine water, or an astringent lotion. Support by stimulants is essential.

Chronic Nasal Catarrh.

A discharge from the nose, persisting beyond the few days which simple catarrh takes to run its course, must depend on some constitutional or local cause. Cases in which chronic nasal discharges are observed, may be classified under two heads: those with organic lesion of the nasal chambers, and those without. The first may be included under the usual term, 'nasal gleet.'

NASAL GLEET—OZŒNA.

This consists in a chronic discharge from one or both nostrils derived from the nasal chambers, the nasal sinuses, or the guttural pouches. I include the cases of suppuration in the guttural pouches under this head, because, in practice, such a condition is usually brought under our notice as an ordinary nasal gleet.

I have carefully studied the different forms of nasal catarrh, which are apt to persist for months unless properly treated, and there is no doubt that a large number of horses have been injudiciously destroyed for glanders, when suffering from benignant discharges.

I. *Simple Nasal Gleet, or Ozœna, properly so called.*—A simple catarrh may leave an animal in an unthrifty state, with staring coat, disturbed appetite, dulness at work, cough, and discharge from one or both nostrils. The discharge is muco-purulent, varying in quantity, but flowing without intermission. The submaxillary glands are very slightly, if at all, enlarged, loose, and have no tendency to adhere to the jaw. If the animal's constitutional state is bad, there may be slight ulcers on the nose, close to the exterior nares, but such a symptom is usually indicative of a transition from the chronic nasal gleet to true glanders.

A diagnosis is much facilitated by treating the case. I have never known a case of simple ozœna, however chronic, resist the internal administration of arsenic and injections with Rey's tube.

INJECTION OF FLUIDS INTO THE NOSE.

Fluids are sometimes poured into the nose that they may be swallowed; but, usually, the internal exhibition of remedies by the nose is effected by means of a stomach-pump with a long flexible tube, as represented in fig. 137. The practice

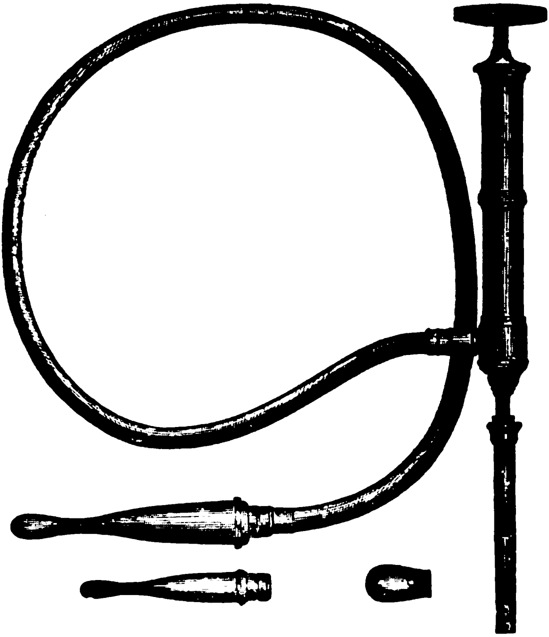


Fig. 137.

is an objectionable one, but may under certain circumstances be absolutely indispensable.

The introduction of liquids into the nasal chambers to exert a curative influence on the schneiderian membrane, is a more common practice, and attended with much good. The old method of performing this operation is simply to use a syringe, or to elevate the head and pour lotions, &c., into the

the nose. Professor Rey has adopted a very simple and satisfactory procedure. It consists in causing the fluid to rise in each nasal chamber by atmospheric pressure, and when the one division of the nose is thus filled, the liquid passes over the septum, and is seen to flow out at the opposite nostril. In this way the liquid most effectually touches every part of the schneiderian membrane, and a mild solution of sulphate of zinc or copper, and other sedative, astringent, or antiseptic lotion, may be brought in contact with the suppurating or ulcerated surface. The instrument which Professor Rey employs for this purpose, and the advantages of which I have fully experienced in practice, is drawn at Fig. 138. The long tube is fifteen inches in length, and one and a-half inches in diameter, expanding and funnel-shaped above, where the broadest part is two inches wide. The short arm is five inches in length, and the aperture two thirds of an inch in diameter. Over the short arm is passed a closely-fitting leather ring, $4\frac{1}{2}$ inches in diameter. This serves as the surface over which, and round the short arm, wet tow may be adapted, so that, on introducing the small tube in the nostril, the latter is compressed carefully on the tow; at the same time fluid is poured into the funnel, and rises in the nasal chamber. If the horse's head be bent in, and held as much as possible in a perpendicular position, the lotion will pass out at the opposite nostril. We sometimes have a little difficulty in performing this operation with awkward horses, but by quiet means I have always seen them accustomed to the operation. Some

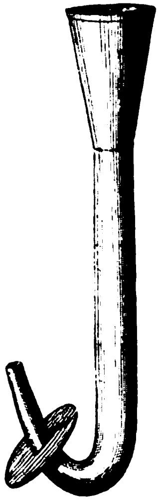


Fig. 138.

persons advocate twitching; occasionally the ear may be twitched; the animals sometimes require to be blindfolded, but at others it is best to let them see what is being done; and most frequently not the slightest trouble attends the injection. It is an invaluable method of using remedies in the treatment of diseases of the nose.

There are many remedies very active in checking nasal discharge, and the best appears to be the arsenite of strchynia. It should be given in three or four grain doses daily, made up in a ball with common mass. The effects of the remedy must be narrowly watched by a veterinarian. I have used the liquor potassæ arsenitis in ounce doses daily, given in food, or the following powder:—

℞ Acid. arsen.	. . . . . .	ʒj.
Sodæ carb.	. . . . . .	℥ij.
Pulv. sem. coriand.	. . . . .	℥iv.

Mix. Divide into twelve powders. One to be given daily in food.

The administration of arsenic in chronic nasal catarrh calls for attention, and should be stopped when irritation of the visible mucous membranes is noticed, and the alimentary canal is disturbed. An occasional dose of aloes may be very useful, and if any other tonic is preferred to arsenic, it should be selected from amongst the salts of iron, especially the sulphate, sesquioxide, and iodide; salts of copper have been largely used, but I do not advocate them.

II. *Nasal Discharge dependent on Accumulations of Pus in the Nasal and Frontal Sinuses.*—In severe catarrh a dense pus fills the cavities communicating with the nasal chamber, and usually escapes through an opening shown in the annexed cut. (See Fig. 139.)

Symptoms.—When a discharge from the nose proves decidedly chronic, and on percussion of the sinuses a dull sound is emitted, the source of the flow may be readily determined as being the sinuses. The submaxillary glands are swollen and free. The accumulation may be on one side of the

Fig. 139.—Section of horse's head, showing the cranial cavity separated from the nasal chambers by the ethmoid bone with its cells. Nasal chambers, with the turbinated bones. The inferior turbinated bone is broken at the posterior part, to show the opening of the antrum maxillare

head only, and then the contrast offered by percussing the two sides of the head, as well as the appearance of the face from the swelling which occurs in very chronic cases, leaves no doubt as to the nature of the disease.

Treatment consists in using Rey's nasal tube daily, but if the sinuses cannot be cleared that way, trephining must be resorted to.

The instruments necessary for this operation consist in a pair of scissors, knife, and forceps, trephine, whalebone probe, about six inches in length, or a seton needle, and tape.

The horse being cast, is turned, so that the side of the head to be trephined is uppermost. An imaginary line is then drawn from one orbital arch to the other, and below this line, midway between the margin of the orbit and the mesian line of the head, the hair is clipped, and a crucial incision is made. The skin is reflected back after separating it thoroughly from the bone with the periosteum. The point of the trephine is then implanted in the centre of the exposed portion of the bone, and with a few sharp turns a circular piece of bone is removed. Another opening must be made in the same way into the upper jaw above the zygoma. The cavities are then washed out with tepid water, and a seton is drawn through from the upper to the lower orifice; the ends of the seton are tied together. The cavities must be washed out daily, and an astringent lotion occasionally used. The seton must be frequently changed, and this simple operation is performed by cutting the old tape across and fixing to one end a fresh piece. The old is then pulled through, and it carries with it the new seton, which is tied in its place.

The constitutional treatment required is usually very simple, but there are cases which need the same tonic course as that adopted in simple nasal gleet.

III. *Accumulation of Pus in the Guttural Pouches.*—This is the result of strangles or severe catarrh, and frequently the discharge occurs into the pharynx, or through the skin at the angle of the jaw. Suffocation has frequently occurred from the bursting of an abscess of the guttural pouch, as a horse has lifted its head to the rack when suffering from chronic strangles, and having shown considerable swelling of the parotidean region on one or both sides. Sometimes, but rarely, an opening occurs at the angle of the jaw as well as into the pharynx. This double aperture is due to the enormous size of the distended pouch, and is the direct result of ulceration. Liquids which the animal drinks may thus drop out at the throat. But where no pointing occurs, the pus which accumulates finds its way occasionally through the Eustachian opening, or its solid constituents become firmly packed and rolled into bean-shaped bodies, of which large quantities are found. I first saw an accumulation of this consolidated pus in a donkey, and have since met with it frequently. I have had the purulent concretions for twelve years in spirit, and they are as solid now as they were when first immersed in the fluid.

Symptoms.—Chronic nasal discharge, due to pus in the guttural pouches, is usually unilateral, and the submaxillary glands are enlarged on the side from which the pus flows. I know, from experience, that although the discharge may occur only from one nostril, there may be disease in both pouches, but, on the one side, the Eustachian orifice is plugged, and nothing can escape. I once performed hyovertebrotomy on a cart-horse on one side of the head, and cured him of a chronic nasal discharge, but some months after the animal died from ruptured diaphragm, and on examining the head. I found the consolidated pus in the opposite pouch, from which, during life, there had not been any escape of pus.

The nasal discharge in this disease is always intermittent. The animal has usually a dry nose in the stable, especially if fed entirely from the rack and manger. A profuse flow occurs at work, and may be brought on at any time by causing a horse to eat oats, hay, or, better still, a turnip on the ground. The shaking of the head as the turnip is being nibbled, leads to a free escape of fetid pus. I have found that the attendants on a horse thus affected have usually spoken to me of pus dropping into the pail as the animal drank. When horses are at grass the discharge is regular, but at no time so abundant as when the horse is kept in the stable and occasionally worked. This depends on the regular escape of the pus when a horse is constantly feeding off the ground, and in mild cases I have found this sufficient to effect a cure. I attribute to this that the disease has been termed "a grass cold," and the advice often given by some veterinary surgeons in Scotland, when failing to cure a chronic nasal discharge, that it will pass off at spring time, when the animal is turned out for a month or two. If the relation of the Eustachian opening to the guttural pouch, pharynx, and nasal chamber is noticed in Fig. 124, page 451 of this work, it will be readily understood how the pus only escapes when the animal's head is depressed.

A horse with much accumulation of pus in the guttural pouch, sometimes roars, and has a thick gummy neck. He does not thrive well, and is often looked upon suspiciously, as probably affected with glanders.

Treatment.—If feeding a horse from the ground for some time, or a run at grass does not cure the discharge, the guttural pouch must be opened. Günther has devised an instrument to wash out the guttural pouch (Fig. 141), but I have not found it of much service in practice, and prefer performing hyovertebrotomy at once.

The instruments needed for this operation consist in scissors, scalpel, forceps, iron staff (see Fig. 140), and tape. A syringe may be used to wash the pouch as thoroughly as possible whilst performing the operation.

Having cast the horse so as to have the affected side uppermost, the head is extended, and the anterior margin of the wing of the atlas is felt for. Over this the tendon of the splenius is readily felt, and an incision about an inch and a-half in length, obliquely from above downwards and backwards, is made. The fascia covering this region is then cut through, and the index of the left hand pushed downwards and forwards on to the stylo-hyoideus muscle. The margin of the superior cornu of the os hyoides is felt, and, with a sharp-pointed scalpel held in the right hand, the stylo-hyoideus muscle is divided. It is most important to attend to the position and direction of the knife, to avoid wounding the internal carotid artery. For this purpose the sharp edge is turned forwards, and the point is directed in a line with the horse's nose—the head, as stated above, being extended. The stylo-hyoideus is thus punctured about its middle, and obliquely from behind forwards. An iron staff is then pushed through the opening, and turned downwards and forwards to the antero-inferior angle of the parotid gland. The staff is readily felt behind the angle

Fig. 140

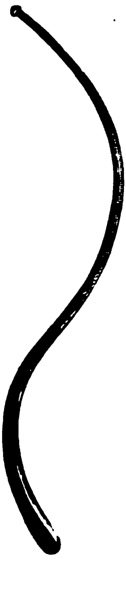


Fig. 141.

of the jaw, the skin is then divided with a scalpel, and an opening is obtained into the pouch. A tape tied to the staff is passed through the two openings made, and left in the pouch as a seton. Through the lower orifice the pouch must be washed daily, and astringent lotions may be injected, and the horse constantly fed from the ground. In about three weeks the seton is removed, and if the case has been properly managed, the animal may be discharged cured.

I have now to speak of chronic nasal discharge connected with organic lesion of the facial bone.

I. *Abscess of the Turbinated Bone.*—This occurs chiefly in colts, and only on one side of the head. It supervenes on a severe coryza, attended with difficult breathing and swelling of the schneiderian membrane. For some time the dyspnœa is so considerable as to lead to the belief that a polypus is forming. This opinion may be apparently confirmed by deformity of the nasal bones, such as is seen in the annexed engraving. (See Fig. 142.)

The nasal discharge, in such a case, varies in quantity, and may be termed intermittent. Instead of the flow occurring when the head is depressed, as in cases of impaction of the guttural pouches, it is noticed, when the animal elevates its nose, and immediately after coughs and drops its head, that an abundant expulsion occurs. This diagnostic character of the disease is readily explained. It is at the upper part of the turbinated bone that the opening for the escape of pus occurs. It is only when the cavity is full to overflowing, or when the pus can be thrown out by an uptilting of the head, that it can possibly find its way into the nasal chamber, and as in flowing back into the pharynx it approaches the sensitive larynx, a fit of coughing leads to its forcible expulsion.

Fig. 142.—Portrait of a cart-horse with abscess of the superior turbinated bone.

Treatment.—The nasal bone which is deformed must be trephined, and the abscess washed out daily. I have found it necessary, in cases of great deformity, to remove a considerable portion of the bone, and by this means have restored an animal's good looks.

II. *Nasal Discharge due to Organic Disease of the Facial Bones.*—The bones most frequently affected with caries are the superior maxillary, the turbinated, and nasal. The cause of this obstruction is the presence of foreign bodies either in the shape of a projecting tooth or materials accidentally lodged in the nasal chambers.

Symptoms.—Discharge always on one side, very fetid, sometimes tinged with blood, and containing particles of dead bone. Enlargement of lymphatic glands on one side, but free. No ulceration of the Schneiderian membrane. Partial occlusion of the affected nasal chamber, evidence of a diseased tooth, or the absence of a molar, and projection of the one opposite the vacant alveolus.

There is a head in the London Veterinary College, obtained from a horse destroyed as glandered, and, after death, the presence of a physic ball lodged in the posterior part of the arc of the nasal chamber, demonstrated the real origin of the disease.

I have noticed the discharges due to carious teeth at page 95 of the first volume of this work, and here reproduce the engraving of disease of the nose due to a projecting molar tooth. (See Fig. 143.)

Treatment.—This consists in removal of the cause, whether it be a diseased tooth, diseased bone, or a foreign body. In the latter cases the constant use of Rey's tube may have a beneficial effect. Whenever necessary, the diseased bones should be freely removed by an operation.

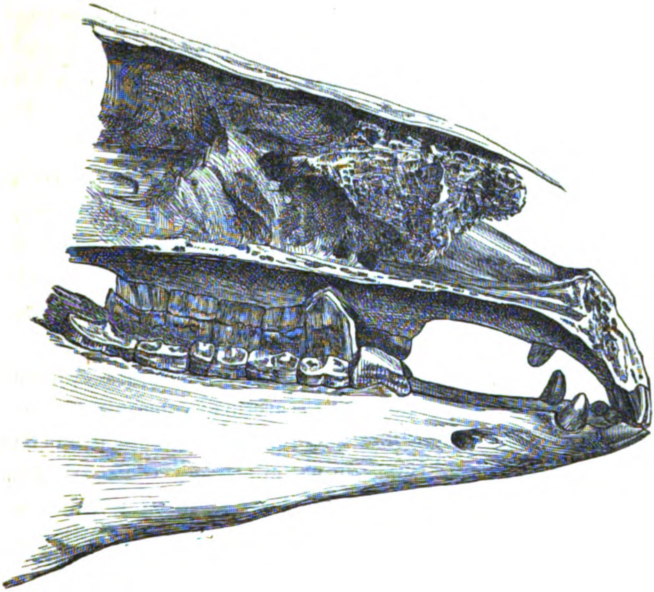


Fig. 143.

SORE THROAT—ANGINA—LARYNGITIS—LARYNGO-PHARYNGITIS.

Inflammation of the larynx is a very common disorder in all animals, and either exists as a symptom or complication of other disorders, or is observed independently of any other morbid state.

Similar causes, symptoms, and methods of treatment are applicable to all animals. I may be permitted, however, to speak more particularly of the horse.

Causes.—Young animals first put to work, and out of condition, are more subject to sore throats. The hotter the stables they are kept in, and the higher they are fed, the more are they susceptible to the disease. Coughs and sore throats are very rarely, if ever, seen in animals exposed to all weathers in the fields. Horses are specially prone to attacks of laryngitis when first placed in stables, and especially when transferred from a country house to the dealer's hot establishment.

Symptoms.—Hard dry cough, loss of appetite, thirst, but difficulty in swallowing liquids or solids, and especially the latter. Tenderness and swelling of the throat, redness of the visible mucous membranes, frequent pulse, and quick breathing. Sometimes there is much constitutional irritation. As the disease advances the cough becomes less hard and less frequent. A discharge not unfrequently flows from the nose, and there is an abundant secretion in the posterior part of the mouth. Laryngitis may result in inflammation of the bronchial tubes and lungs, in chronic cough and roaring.

Treatment.—The animal must be kept on low diet, and have some nitre thrown in the water allowed it to drink. I disapprove of tormenting horses with balls in this disease, and if a purgative can be dispensed with, injections may be used with great benefit. I recommend the administration of electuaries, which, in the first stage of the disease, should contain salines and sedatives, and afterwards astringents. The astringent electuaries are in many cases useful throughout the attack. I commonly prescribe the following electuary:—

℞ Ammoniæ hydrochlor. . . ℥ij.
Camphoræ . . . . . ℥j.
Theriacæ . . . . . ℥xx.

Mix. A table-spoonful occasionally to horses with cough.

As an astringent, either of the following:—

℞ Acid. tannic. . . . . ʒj.
Sp. vini gallica . . . . ℥ij.
Mellis . . . . . . ℥iv.

Mix. A dessert-spoonful twice daily.

℞ Camphoræ	ʒj.
Pulv. aluminis . . .	℥ij.
Theriacæ	℥xx.

Mix. A table-spoonful every three or four hours to horse or ox.

In the dog, laryngitis is best treated by the internal administration of potassio-tartrate of antimony, in very small doses, frequently repeated. I often prescribe as follows:—

℞ Antim. pot. tart. . . .	1 gr.
Pot. nitr. . . .	ʒj.
Sacchari albi pulv. . .	ʒj.

Mix. Divide into twelve powders. One to be given thrice daily.

An ample mustard poultice, applied to the throat in any animal, is of great use. Stimulating liniments or blisters are frequently used.

MALIGNANT SORE THROAT—ŒDEMA GLOTTIDIS.

This disease affects horses and cattle. It is characterised by rapid exudation around the laryngeal opening, attended by great difficulty of breathing, and death, unless early relief is afforded by tracheotomy. Mr Percivall says:—

"My attention was first drawn to this sad and fatal disease, through the *Veterinarian*, by Mr Thomas Proctor, V.S., Solihul, who kindly, in October 1850, sent me an extremely interesting account of it, from which I am about to take the remarks here offered to the notice of my reader:—

"Cattle as well as horses are subject to it, and in Mr Proctor's practice, although 'scores of cases' have presented themselves, they have all of them proved fatal.

"The symptoms differ from those of ordinary or catarrhal sore throat, in the disease being sudden in its attack, and rapidly running its course, the patient rarely surviving the third day, the entire system from the first sympathising, as is shown by the rapidity (100 per minute) of the pulse, and the general strength of the body failing. At first the salivary glands take to swell, and are extremely painful to the touch. Then the throat generally commences swelling, and becomes sore, so much so, as the tumefaction increases, as to make it so painful to swallow that food and liquids too are refused by the animal. At length the throat becomes prodigiously swollen, and difficulty of respiration, with sonorous and distressing breathing, ensues, accompanied with fetor, which, as the complaint advances, turns in some cases so obnoxious, that before death it is stinking in the extreme. The membrane of the nose is of a dark crimson colour. The countenance turns doleful and sharp, and even haggard, and, with increase of all his anxiety and distress, the poor animal dies a victim to a disease which we appear to have no power even to arrest, much less to cure.

"The appearances after death are—larynx and pharynx in a state of inflammation, ulcerated perhaps as well, and covered with putrid discharges, root of the tongue ulcerated, considerable enlargement of the salivary glands, and of the surrounding tissues also. Sometimes inflammation and effusion are likewise discoverable at the base of the brain.

"The disease is contagious: at least the following facts which Mr Proctor received from 'good authority,' would lead us to believe so:—Two sturks were found dead in a field, or nearly so, with affections of their throats. The butcher was sent for to dress their carcases. His own horse partook of some grains mixed with some of the blood taken from the beasts, and in less than twenty-four hours afterwards he died from swelling of the throat, producing suffocation. A sow and nine pigs ate of the blood and grains, and were soon afterwards seized with throat affection, with sonorous breathing, of which some of them died. The others, after much trouble, eventually recovered.'"

My own experience of this disease is limited to three cases, one of which I saw in London, and the other two in Scotland. The symptoms were the same as those mentioned by Mr Proctor, but the apnœa was so urgent as to demand the immediate performance of tracheotomy.

Tracheotomy is an operation which may be required in all obstructions of the air-passages above the trachea, and it is important, therefore, to describe it.

The instruments needed are scissors, scalpel, and forceps, needle and thread, and a tracheotomy tube.

The selection of the tracheotomy tube is of great importance. Those hitherto used in Scotland have had the great defect of being very clumsy, difficult to hold in position, unless by tying on the neck, small in bore, and long. The length of these tin tubes has led, to my knowledge, to serious injury to the mucous membrane of the trachea, so that, after having removed the tube several times in order to clean it, it was found almost impossible to return it again.

In operating, the horse or ox is kept standing, and the hair clipped over the seat of the operation; an incision is made in the middle line of the neck about two inches in length, fairly exposing two rings of the trachea. The needle is then forced through the ligament connecting the two rings, and with the scalpel a semicircular piece is excised from each of these. A self-fixing tracheotomy tube is introduced, and the lip screwed in so as to prevent displacement. Two or three spare lips are adapted to one instrument, inasmuch as the tissues are swollen immediately after the operation, and afterwards regain their normal size. The tracheotomy tube requires to be removed as often as necessary to clean the parts. It is found that, in some cases, the laryngeal disease is so extensive as to prevent the permanent removal of the tube, but an animal can live in perfect comfort with the tube permanently in, and prove useful for various kinds of work.

Whenever suffocation is threatened, the practitioner must not hesitate in performing tracheotomy.

MALIGNANT SORE THROAT OF PIG—QUINSY OF PIG—CYNANCHE MALIGNA S. CARBUNCULARIS.

Two diseases may be included under the head of malignant angina of the pig. The one is a local affection, and the other is rather a local manifestation of anthrax, and has received the name of *soie* or *pique* in France. Both these diseases have been described very carefully by many authors, and I have witnessed the first myself. For convenience they may be distinguished as quinsy of the pig and malignant sore throat.

I. *Malignant Sore Throat.*—This disease of the pig is characterised by feverish symptoms, dulness, stiff gait, and loss of appetite, followed by difficult breathing, gasping for breath, cough, heat of expired air, great heat of back, bluish colour of the buccal membrane, swelling of the tongue, difficult deglutition, and symptoms of suffocation. Externally and along the course of the trachea a hard inflammatory swelling extends, which may pass down to the fore extremities. Desquamation of the epithelium occurs from within the mouth, and there is a great tendency to gangrene. The disease may terminate fatally in from one to three days.

After death the local lesions of inflammation, with extensive exudation of blood and lymph, are noticed. In addition to this, the organs of the body generally are dark-coloured from the accumulation of dark blood in the blood-vessels.

Treatment.—An active emetic such as the following:—

℞	Potassio-tartrate of antimony .	4 grains.
	Ipecacuanha	6 ,,
	White hellebore	6 ,,

Mix. To be given in food, or thrown into the mouth.

If the animal will drink anything, or eat a little, a purgative powder, consisting of two or three drachms of castor oil seeds, should be given. When the difficulty of breathing is great, tracheotomy must be performed, an active blister applied over the throat, and injections given frequently. If the animal can swallow, and will drink water, some hydrochlorate of ammonia and nitre should be dissolved in it. It has been recommended to apply the actual cautery on either side of the neck, or, perhaps better, rugs wrung out of boiling water.

CARBUNCULAR QUINSY—CYNANCHE TONSILLARIS.

This is the *soie, pique, piquet, maladie piquante,* or *soies-piquées* of the French, and the *kropfbrandbeule* of the Germans. It is a disease chiefly manifesting itself on one side of the neck, and implicating the tonsil on that side.

Symptoms.—The bristles on the affected side are erected. There are twelve or fifteen of them sticking out and firm. If they are pulled or even touched, the animal screams with pain, and the surface over which they are implanted is depressed or cup-shaped, of a dark bluish colour. The animal becomes exceedingly dull, listless, deaf, and is always lying. There is no desire to take anything, and if made to rise and move, it is evident that the body cannot be supported on the extremities. The breathing becomes laboured, the expired air hot and fetid, the mouth hot and foaming, and the lower jaw is constantly moved from right to left, or left to right. The eyes are bloodshot; there is either constipation or diarrhœa, and the evacuation of fæces seems to afford some momentary relief. The animal becomes comatose, and dies asphyxiated in from 24 to 48 hours, or lingers on and dies in convulsive fits, on the seventh, eighth, or ninth day.

Post-mortem appearances.—Evidence of acute inflammation of the larynx and pharynx, and especially of the tonsil on one side. The other lesions are similar to those occurring in any animal that dies of anthrax, or from an acute inflammatory affection.

The quinsy of the pig is often enzootic or epizootic, and Chabert says that it is always contagious. The disorder is much favoured by foul sties, bad food, &c.

Treatment.—The affected animals must be instantly separated from healthy ones, and in the first, the affected tissues must be either extirpated freely with the knife, or very deeply cauterized. Cold water may be allowed to the animals, with vinegar and nitre in it. Washing the throat frequently with chlorine water, administering an emetic or purgative as in malignant sore throat, persisting in the use of injections, and giving stimulants to support the animal through the attack, constitute the chief means that can be employed by us. A drachm of aloes has been prescribed by Leroy, besides the use of potassio-tartrate of antimony frequently, in moderate doses.

Tracheitis.

Inflammation of the trachea is rarely seen unless as an extension of laryngitis and bronchitis. Under this head the affection that needs most attention is

Croup.

The name *croup* is essentially Scotch, being familiarly used in the Lowlands of Scotland to signify—*to croak*. Scotchmen may be further interested in the fact that the term has been generally adopted over the continent of Europe, and in America as well. The disease consists essentially in acute inflammation of the larynx, associated with more or less severe spasms of its muscles, and very frequently, though not invariably, with a fibrinous exudation on the mucous membrane.

Symptoms.—Croup is characterised by a sudden manifestation, intense fever, full hard pulse, up to 80, 100, or more per minute, with crowing noise in breathing, louder in inspiration than expiration; violent coughing, easily excited by pressure on the throat, and paroxysms are observed at irregular intervals; in the second stages, the expectoration of false membranes may be looked for. The disease may, however, be complicated with pleuro-pneumonia or other chest affections, and on such occasions the attending dyspnœa will be more urgent. The symptoms may differ according to the type of the attending fever. This may be sthenic; and in such cases, if promptly and energetically treated, a favourable termination may be looked for. The fever has, however, a marked tendency to assume a typhous form, the violent dyspnœa prevents a sufficient aëration of the blood. And it will be found that, when an active attack of the malady has continued for several days, the fever acquires a low form, though, at the outset, it bore a sthenic character. When this is the case, the chances of a favourable termination are much reduced. If the disease occurs, as it sometimes does, in an epizootic form, all cases show a remarkable tendency to assume the typhous type at the very outset of the disease, and on such occasions the mortality is very largely increased.

Mr James Law wrote an interesting paper on this subject, in the *Edinburgh Veterinary Review*, vol. iii. p. 216, and from his article I extract the following:—

"The prognosis will always depend on the stage of the disease, on the strength of the patient, on the type of the fever, and on the existence or non-existence of complications. At all times many cases will terminate fatally, and for this it is well to be prepared.

"The *causes* of the malady are not well understood. Low, damp situations would seem most liable, more especially if the animals are much exposed. The general causes, indeed, correspond in great measure to those of laryngitis occurring in its ordinary form. Sudden excitement and violent emotion are recorded as among the immediately exciting causes. Age seems to have a great influence in determining the disorder, since the great majority of cases occur in animals varying from six months to a year old. Why the laryngeal inflammation should in this case take on the process of throwing out fibrinous exudations has never been demonstrated, nor can its greater liability to attack young animals be accounted for. The exudation is in this case associated with a very elevated type of inflammation, but this cannot be accepted as a satisfactory explanation of its productions. We meet with inflammations in older animals of so severe a nature that all secretion is for a time suspended, and we meet with all intermediate degrees, from the mildest hyperæmia up to the most intense vascular irritation; why then do we not more frequently meet with fibrinous exudation? Moreover, the affection is almost confined to young animals: how can this be accounted for on the supposition, that it is only an elevated type of inflammation? Some specific cause must be acknowledged; but as regards the origin and nature of this cause, it is imperative that we acknowledge the most profound ignorance. The hypothesis may be hazarded, that the morbific agent or agency, whatever that may be, is capable of inducing such a change in the impressible cells of young animals, as leads to a perverted secretion, and the consequent formation of false membrane.

"The *cadaveric lesions* will vary according to the mode of death; when the animal dies asphyxiated during a paroxysm, there will be the congested lungs and the general appearance characteristic of death beginning at the lungs; when the patient, on the other hand, dies, in a comatose condition, from the venous character of the blood, the engorged venous system and other accompanying effects will be manifest. To pass over all these, it may be said that the truly characteristic lesions are those of the mucous membrane of the respiratory passages. This expression in reference to the respiratory passages is employed advisedly, inasmuch as genuine croup is understood to be confined to these passages; it may extend to the fauces, but never, like thrush and diphtheritis, spreads to the mouth, the pharynx, or the œsophagus. These morbid conditions consist in the presence of false membranes of a greyish white colour, though sometimes yellowish or brownish, from a certain amount of colouring matter of the blood. These productions are most frequent in the larynx, though they are by no means confined to that structure; they extend, in many cases, into the trachea, less frequently they are found on the fauces, while, in a certain number of cases, the bronchial mucous membrane itself is affected. They bear some analogy to the false membranes found in inflammation of the pleuræ and of other serous membranes, but are nevertheless essentially different. Pleuritic exudations have a plastic or formative power, by virtue of which they become organized, and may remain as fibrous bands or layers permanently attaching the costal to the pulmonic pleuræ. The false membrane in croup, on the other hand, has never been known to become organized; though it adheres firmly to the mucous membrane, the entrance of blood-vessels into its substance has never been demonstrated. The false membrane in pleuritic cases is essentially coagulated lymph, having the tough quality, the fibrous structure, and, when treated with acids, the characteristic reactions of fibrine. The croupous exudation, on the contrary, seems more allied to albumen; it is very brittle, is destitute of the fibrous network, and shrivels up when treated with dilute sulphuric acid. If complicated with pneumonia or bronchitis, the lesions resulting from these maladies will be superadded to those proper to the croupous affection.

"The *treatment* of croup must be energetic, and should be adopted without loss of time. The great tendency to low fever entirely precludes bleeding, except in the very early stages. The animal should be kept in as equable a temperature as possible, somewhat elevated, and with a somewhat moist atmosphere, but without any impurity. Such a measure is much more beneficial than heavy clothing, which interferes with the motion of the chest, and aggravates the embarrassed respiration. Light clothing should, however, be adopted, and especially should the limbs be kept warm. The action of the bowels may be solicited; in the case of the carnivora, however, this may be advantageously preceded by emesis. This latter measure has been found highly beneficial in loosening and favouring the expectoration of false membranes. A warm bath often proves eminently serviceable in relaxing spasm, and in alleviating the general morbid condition. These measures may be followed up by febrifuge medicines, as potassio-tartrate of antimony, with the nitrate or acetate of potass, or the liquor of the acetate of ammonia, given in water, or, better, in linseed decoction. When the fever is of a typhous character, and the powers of the system reduced, stimulants are urgently called for. Wine whey, sulphuric ether, or carbonate of ammonia, may be employed, along with mild aromatics and tonics, such as ginger or gentian.

"Blisters may be applied early in the disease; they should be confined to the throat, unless there is attendant pneumonia. It is advisable to avoid the application of such agents to the trachea, as it may be requisite at a later stage to have recourse to tracheotomy, and the vascularity of the dermis which a blister induces, is calculated to interfere with this operation.

"The employment of tracheotomy in this disease has been condemned as being liable to hasten a fatal result; there can be no doubt, however, that much of the prejudice against it has been owing to the cases in which it has hitherto been resorted to. It has been chiefly performed in extreme and advanced cases, to obviate, *pro tempore*, a fatal result, when that seemed imminent. Can we wonder, then, at the greater relative number of fatal cases after tracheotomy?

"Local applications to the mucous membrane have likewise been employed. Delafond blew calomel through an artificial opening into the trachea. The same agent might be introduced by insufflation, and a traumatic lesion avoided in cases in which it is unnecessary to resort to tracheotomy. Powder of burnt alum may be employed in a similar manner. Perhaps the best application, however, is the nitrate of silver, employed in the form of solution, and introduced into the larynx by means of a sponge attached to a whalebone probang, which may be actually introduced into the glottis. The solution in common use consists of 30 grains of the crystallized salt dissolved in an ounce of distilled water. These local applications at first produce a great amount of irritation, and paroxysms of spasmodic coughing of extreme violence; they nevertheless prove highly useful in many cases, by altering the condition of the mucous membrane, and bringing about a condition incapable of sustaining the peculiar exudation."

Fracture of the Windpipe.

Accidents to the trachea are rare, considering its exposed position. This is accounted for by its elasticity and the readiness with which the windpipe moves from one side of the neck to the other. Nevertheless, blows and wounds are occasionally causes of injury to the cartilaginous rings of the trachea, and the principal inconvenience resulting consists in a very general emphysema of the neck and body. Air passes into the surrounding areolar tissue, and gives the animal a very peculiar and alarming appearance.

Little more can be done in such cases than keeping the animal quiet. Should any symptoms of suffocation appear, tracheotomy must be performed. A dose of purgative medicine may be administered.

DISEASES OF THE LUNGS.

Congestion—Pulmonary Apoplexy.

The lungs are extremely vascular, and are not unfrequently subject to irregularities in the flow of blood through them. In horses which are often exhausted by reckless and prolonged driving or riding, nothing is more common than a sudden and fatal engorgement of the lungs. This may in some cases be the precursor of a well-developed bronchitis or pneumonia, but not unfrequently terminates fatally before the development of a true inflammatory disease. I cannot refer to this subject without noticing the practical observations made by Dr Watson, in his "Lectures on the Principles and Practice of Physic." These observations are strictly applicable to what we observe in the lower animals, and especially in the horse and dog. Referring to *engorgement*, he says,—"All modern observers agree, I believe, both as to the nature and the name of this condition. The substance of the lung is gorged with blood, or bloody serum. It is of a dark red colour externally, and crepitates less under pressure than sound lung does. We feel that there is more liquid than air in its cells. It is heavier, also, than natural, inelastic, and retains, in some degree, the impression of the finger. When the engorged portion is cut, we find it red, and we see a great quantity of a reddish and frothy serum flow from it. Its cohesion is at the same time diminished; it is more easily torn; more, in that respect, like the spleen; and, accordingly, the term splenization of the lung has been given to this stage of its inflammation, as hepatization has to that which succeeds it. In this stage of engorgement the mucous membrane of the smaller bronchial ramifications is of a deep red colour. The portions most engorged, although their specific gravity is increased, will nevertheless almost always float in water."

Congestion of the lungs has, perhaps, been more frequently seen as the result of a hard run in the hunting-field, than from any other cause. A case is recorded by Mr John Field, which appears to have been due to violent coughing and bleeding.

Symptoms.—The animal is in a state of great disturbance, standing with outstretched legs, the head is sunken, nostrils expanded, eyes prominent and bloodshot, the animal pants, and its flanks are heaving at the rate of from 80 to 100 per minute. The pulse is indistinct at the jaw, but felt at the brachial artery, to be at from 80 to 100 per minute, small, thready, and compressible; heart's action tumultuous. There is sometimes a slight discharge of blood from the nose, restlessness, grunting, partial sweats, cold limbs and ears, mouth hot and dry. If bleeding is attempted, the blood often trickles like tar, and will not flow freely.

Auscultation.—I have on several occasions noticed the minute crackling or crepitating noise described by human physicians. It is heard over the whole chest in severe attacks of congestion. Dr Watson says,—"You hear a peculiar crackling sound; the smallest and finest possible kind of crepitation; which has been happily illustrated by saying that it resembles the multitudinous little crackling explosions made by salt when it is scattered on red-hot coals. Andral has another resemblance for it, and not a bad one; he says, the noise is often like that which is produced by rumpling a very fine piece of parchment. Dr Williams observes, that a pretty correct idea of this sound may be obtained in a ready way, by rubbing between the finger and thumb a lock of one's own hair close to the ear. Læennec calls this *crepitant rhonchus;* I would speak of it as *minute crepitation.*"

When a horse, after a severe gallop and exposure, manifests much oppression, with an active congestion, resulting in hæmoptysis and sudden death, the case is properly termed *pulmonary apoplexy.*

Treatment.—In the earliest stage a stimulant may greatly relieve the animal. A full dose of chloroform, sulphuric or nitric ether, from one to two ounces of either, in cold water, will be attended with the best results. Hot whisky or brandy and water may activate and regularise the flow of blood, so as to cut short a very dangerous attack. Some strongly recommend a free abstraction of blood.

If the first symptom has passed, or if the stimulant has been given, warm cloths must be placed on the animal's body, the legs hand-rubbed and bandaged, warm water clysters given, and a large mustard poultice applied to the chest. The application of mustard should not be made according to the frequent practice of tormenting the animal, with a little rubbing on the sides of the chest. The plan to follow is, to take a pound, or even two, of good mustard and place it on a sheet. The latter should be folded so as not to be broader than the chest, but to wrap round the body once or twice. Having placed the mustard so as to form a good thick poultice with boiling water, it is applied against the lower part of the chest, being spread out a little on either side. The sheet is then fixed by ropes, rollers, or sewing, as most convenient, and care is taken that the mustard is fairly applied to the skin. This is left on for three or four hours at least, until a considerable œdema has occurred beneath the skin. The animal is greatly relieved, and never blemished by this method of treatment.

Doses of nitre, liquor ammoniæ acctatis, and, if necessary, a purgative, may be needed to follow up the treatment; but unless death occurs at an early stage, I find the simple remedies above described amply sufficient.

BRONCHITIS.

Inflammation of the bronchial tubes is a frequent disorder of our domestic animals. I have especially studied it in the horse, ox, and dog, and though sheep, pigs, and other animals suffer severely from this disease, individual cases have been less watched in them.

Causes.—An attack of bronchitis may supervene on a severe sore throat, or the pulmonary congestion just described often results in a severe inflammation of the air-passages. I have seen far more bronchitis in the three animals above mentioned, since I have been practising in Edinburgh, than

I did in Yorkshire, the south of England, or the continent of Europe. The prevalence of east wind and a dry state of the atmosphere along the east coast of Scotland, no doubt accounts for this circumstance. The disease prevails more in winter and spring than at any other time. I have seen it very severe in bullocks on exposed pastures, and so general has the disease been in a herd, as to lead to its being mistaken for contagious pleuro-pneumonia. Animals are not seized with this affection that are permanently housed, like the cows on many farms. Alternations of temperature, and a drenching rain after the system has been subjected to the enervating influence of heat and foul air, must be included amongst the most frequent causes. Dogs suffer very severely from bronchitis, and especially if left in damp stables, and without due attention being paid to their cleanliness and exercise.

Symptoms.—Bronchitis has been usually confounded by British veterinarians and authors with pneumonia, and although the symptoms are most unmistakeable, we do not find them well described. Feverish symptoms and a short, frequent, painful cough, direct our attention to the state of the respiratory organs. The breathing is found accelerated, and the pulse frequent and full. The animal is dull, listless, thirsty, but refuses food. A certain amount of laryngitis may lead to difficulty of swallowing; the visible mucous membranes are red, the ears and limbs usually cold, and the back rigid.

When the state of the respiratory organs is carefully examined, we find that the breathing is accelerated to 25, 30, or even 50 per minute. It is the inspiratory act that is accomplished with greatest difficulty, and the expulsion of air is comparatively easy. The respiration is audible, and this is not so much due to the want of secretion within the tubes, which is limited to the first stage of the disorder, but depends on the rigidity of the tubes from congestion of their walls, and especially of their mucous lining. A veterinarian recognises the same noise on applying his ear to the trachea that he detects on galloping a roarer. In the roarer the 'whistle' or roar is produced by a diminution in the calibre or rigidity of the larynx or trachea, and in bronchitis there is a harsh sound called '*rhonchus*.' This *roar* (in veterinary language) is chiefly confined to the larger bronchi, and is best heard on applying the ear at the root of the neck, just where the trachea passes into the chest. The difficulty with which air is drawn into the lungs, coupled with the roar, would indicate an obstruction in the passage of air through the tubes, which Dr Watson has said is mostly occasioned by portions of viscid, half-solid mucus, which adhere to the membrane, cause a virtual constriction of the air-tubes, and act as vibrating tongues while the air passes by them. "It seldom happens," says Dr Watson, "that the rhonchus cannot be temporarily got rid of by a vigorous cough."

As bronchitis fairly sets in, a secretion, at first watery and frothy, is expelled in coughing. The mucus becomes thicker and more purulent, containing solid masses which may obstruct some bronchial tubes. This leads to symptoms of dyspnœa, which I have seen very severe in the horse and dog. The muco-purulent discharge is sometimes very abundant, and relieves the animal much, being expelled readily by a vigorous cough, which is less frequent and much less troublesome than the cough of the first stage of bronchitis.

I have observed total loss of respiratory murmur over certain portions of lung from obstructions within the bronchi, and I have also seen abscesses form as the result of severe acute bronchitis.

Dr Gairdner has shown, in the human subject, that from obstruction of the bronchi by mucus of a certain degree of tenacity, the air-cells of portions of lung collapse so as to cause them to sink in water and assume the appearance of fœtal lung. Dr Gairdner* says:—

"Bronchitic collapse of the lung occurs under two distinct aspects—the diffused form, and the limited or lobular form. Of these, the latter variety is the more striking and characteristic, and has been, especially in the lungs of children, the subject of more discussion than the former; but the diffused form is by far the more common, and is in fact of very frequent occurrence, at least in its slighter degrees. Both forms present the same fundamental changes of the pulmonary tissue, which is usually of a dark violet colour externally, as seen beneath the pleura, and internally of a more or less deep brownish-red, or mahogany tint. The colour, however, is by no means an invariable criterion, depending almost entirely on the amount of blood in the collapsed tissue. The affected parts are always more or less condensed; this condensation may amount to a mere diminution of the crepitation, or to a total absence of it, in which case portions are usually found to sink readily in water. These latter portions are both more flaccid and much less friable than the pulmonary tissue when in a state of red hepatization, and they differ greatly from this lesion in the aspect of their section and the nature of the fluid it yields to the knife. In every variety of true pneumonic consolidation in which the lung is completely void of air, the air-cells are occupied by a deposit, presenting to the naked eye (and still more distinctly to a power of 20 or 30 diameters) the well-known granular aspect of the hepatized lung. If the deposit is fluid, or semi-fluid, it is capable of being pressed out, or scraped off, in the form of a thick opaque emulsion-like matter, of yellowish, orange, or grey colour, and in all cases it shows under the microscope abundant granular elements and cell-structures of the kinds usually found in inflammatory exudations in parenchymatous organs. In the collapsed lung, on the contrary, the section is comparatively smooth, having the appearance, as described by Lænnec, of muscular flesh; it presents no trace of granulations, and yields, on pressure, or to the knife, only a semi-transparent bloody serosity, which, under the microscope, is seen

* *On the Pathological Anatomy of Bronchitis, &c.* 1850.

to contain little or nothing besides blood corpuscles, epithelium, and other portions of normal tissue, and possibly a small amount of pus from the interior of the bronchi."

I have not had an opportunity of studying this subject in the lower animals, but it merits the attention of every intelligent practitioner. I have not the slightest hesitation in saying, that though the collapse may be more rare than in man, still auscultation in cases of bronchitis in animals demonstrates its not unfrequent occurrence. That this collapse is due to obstruction in bronchi, is proved by the experiments of Mendelsohn and Traube. The former inserted a leaden shot into the trachea of a dog, pushing it down as far as possible into the bronchus with a probe. In another instance he inserted a ball of paper. In both cases, the parts to which the obstructed bronchi led were red and void of air. In the former there were emphysematous portions in the other parts, and in the opposite lung. Traube's experiments were similar, but more numerous. The general result was, that the artificial obstruction of a bronchus always produced expulsion of the air from the corresponding part of the lung, which had a dark-red colour, and presented the characters of collapse. Mendelsohn also threw a solution of gum into the air-passages of an animal, with the result of a collapse of some portions of the lung. In one instance Dr Gairdner tried the experiment upon a rabbit with a similar result; but the difficulty of limiting the fluid to particular parts of the lung makes these experiments less valuable.*

The pulmonary collapse is curable, though amongst the immediate causes of death from bronchitis. It may persist on portions of lung, and be associated with extensive pulmonary emphysema. Horsemen will easily understand from

* Dr Gairdner, *loc. cit.*

this, how an animal that has suffered from a severe bronchitis may remain 'thick-winded.'

The duration of acute bronchitis varies from three or four days to as many weeks. Chronic cases are very rare. The usual result, under proper management, is recovery.

Treatment.—In a well-marked case of bronchitis, and in the early stage, venesection is to be advised. I do not recommend this in the dog, but certainly in the horse and ox. A mustard poultice must be applied, and salines administered at regular intervals. Liquor ammoniæ acetatis, nitrate of soda and potash, are amongst the best remedies. If the cough is very troublesome, a stimulant expectorant may be given. Antimony is most useful, in the dog, with syrup of squills. In the horse, half-ounce doses of ether or chloroform, occasionally, in cold water. Opium is invaluable in the dog if the cough is troublesome. I frequently prescribe as follows:—

℞ Antim. pot. tart.	gr. ij.
Pulv. opii	gr. ij.
Pot. nitr.	ʒj.
Sacchari albi pulv.	ʒj.

Mix. Divide into twelve powders. One to be thrown on the tongue thrice daily.

Steaming the nose, as recommended in laryngitis, is very useful. Clysters are valuable, and purgatives must not be neglected. Should the case prove obstinate, an active blister to the neck and sides often affords great relief.

CHAPTER X.

DISEASES OF THE RESPIRATORY ORGANS.

Pneumonia, or inflammation of the substance of the lungs.—Abscess of the lungs.—Pleurisy.—Mr John Field on advanced pleurisy—Post-mortem appearances—Quantity of fluid effused.—Saint-Cyr on pleuritic lesions.—Treatment.—Hydrothorax, or water in the chest.—Tapping.—Mr Percival on treatment of hydrothorax.—Sporadic pleuro-pneumonia: in the horse, ox, and sheep.—Contagious pleuro-pneumonia of cattle.—Causes.—The history of the steppe disease and pleuro-pneumonia interwoven.—The epizootic pleuro-pneumonia of cattle enzootic in Central Europe.—Spreads elsewhere exclusively by contagion.—Experiments of the French Commission.—Conditions which increase or mitigate the severity of the disease.—Symptoms.—Post-mortem appearances.—Treatment.—Prevention amongst feeding stock—Amongst dairy stock.—The absurdities of inoculation.—Curative treatment of the disease.—Possibility of banishing the disease from British soil.—Chronic diseases of the respiratory organs.—A chronic cough.—Roaring—Broken wind.—Thick wind.—Parasitic diseases.—The nose bot.—Œstrus ovis.—Attacks of strongyli in calves, sheep, and pigs.

PNEUMONIA—INFLAMMATION OF THE SUBSTANCE OF THE LUNGS.

THIS disease is frequent in certain climates in all our domestic animals. Its causes are similar to those already referred to under the heads 'Laryngitis,' 'Pulmonary Congestion,' and 'Bronchitis.' Contrasted with the latter disease, it will probably be found that pneumonia occurs more frequently in young and vigorous animals, than bronchitis, especially of a relapsing form.

Symptoms.—The leading premonitory sign of pneumonia is a shivering fit, more or less violent according to the intensity of the attack. The symptoms mentioned under the head 'Congestion of the Lungs,' apply very much to the early stage of pneumonia. The cold stage of a symptomatic fever passes on to heat, which pervades the body more or less generally. The mouth is hot, the mucous membranes red and dry, and there is an anxious expression of countenance. In the horse, we find a characteristic position. The animal stands obstinately, with its limbs outstretched, and its head protruded. This is to bring into play the auxiliary muscles of respiration. The breathing is short, frequent, and abdominal; it is often as much as 30 or 40 per minute. There is cough. The pulse rises to 60 or 70, is full and oppressed. The back is rigid, bowels costive, urine high coloured, and skin dry and tight.

Auscultation enables us to make an exact diagnosis. One or both lungs may be affected. If both are seized, the inflammation is chiefly towards the posterior part; but if one lung alone is affected, it may be inflamed throughout its whole substance. There is usually some degree of bronchitis, and over all the free portion of lung the murmur is more audible than usual. The affected part is consolidated; over it the ribs are fixed, and no respiratory murmur can be heard. I have seen cases of pneumonia in which a lung was inflamed in its centre, and free both at its anterior and posterior part. In such cases several large and rigid bronchial tubes permit the passage of air through the partially consolidated lung, and the loudest rhonchus is then detected. It is this that human physicians have called bronchial respiration.

The expired air in pneumonia is hotter than usual, and breathing becomes more and more laboured as the disease advances. There is a great tendency to coldness of the extremities, and the body may be bedewed in patches with perspiration. The animal occasionally attempts to cough, and may discharge a little reddish-coloured mucus.

The consolidation of lung may extend, and this is determined by auscultation and percussion. There are also the visible signs of dyspnœa, which may be very severe, and lead to the horse standing, as before stated, with outstretched limbs, dilated nostrils, and protruding head.

Pneumonia terminates in resolution, abscess, gangrene, and death. When it terminates in resolution, the animal is usually convalescent during the second week. Death occurs in unfavourable cases about the twelfth or fourteenth day.

Post-mortem appearances.—In animals that have died of pneumonia, the affected lung is consolidated. It is the seat of an extensive interstitial exudation of lymph, which solidifies, and, from its dark red or brown colour, gives to the lung a solid appearance of liver; hence the lung, in pneumonia, is termed hepatized. This hepatization is usually circumscribed, and there is a transition from the harder portions to the unaltered tissue. In the ox species, from the abundance of interlobular tissue, the hepatized lung has yellow streaks, which cross each other, and produce a singular mosaic-like appearance. This is sometimes regarded, but wrongly, as a characteristic of the contagious pleuro-pneumonia. Pneumonia sometimes depends, and especially in cattle, on irritant matters passing down the windpipe. If medicine administered contains solid and insoluble matters, these are found adherent to the lining of the bronchial tubes, and there are the lesions of bronchitis, consolidation and abscess in the most dependent parts of the lung. Very active absorption occurs from the respiratory mucous membrane, and when saline solutions are passed accidentally into the windpipe, they may be taken up into the system unless very concentrated.

Treatment.—Venesection; a mild dose of aloes to the horse, a saline purge to the ox, and a dose of castor oil to the dog. Injections of warm water should be used every two or three hours. The limbs must be hand-rubbed and bandaged. At one time, animals with inflammation of the lungs were shut up in very warm stables. Some practitioners follow Mr Coleman's plan of exposure in the open air, and allowing pure air to breathe is certainly a great desideratum; there is no advantage, however, in exposing an animal to an intense cold. Counter-irritants, and especially the mustard-poultice applied early, are very useful. A very prompt blister, which is used much by Danish veterinarians for these diseases, consists of

Croton oil	1 part.
Sulphuric ether	10 parts.
Spirit of wine	10 parts.

This forms a uniform liquid, which is rubbed actively over the chest, and washed off after an effect is produced. I disapprove of setons and rowels. Neutral salts must be given frequently, and the animal allowed water with nitre in it. If the pulse is very active and fever high, ten drops of tincture of aconite may be given, with six ounces of liquor ammoniæ acetatis, and a quart of water. Two or three such doses, at intervals of six hours, may be very useful. As the inflammation subsides, stimulants may be of service, and an occasional dose of spirit of nitric ether has a beneficial effect as a diuretic. In the convalescent stage, judicious diet and vegetable tonics are to be recommended.

Abscess of the Lung.

Both as the result of bronchitis and pneumonia, I have seen abscesses in the lungs of horses and cattle. The lung around the seat of the suppuration usually becomes clear and healthy. A bronchial tube may communicate with the cavity of an abscess that has burst, and the fetid contents of which are thrown up in coughing. There is a very characteristic cavernous râle over the seat of the abscess. The animal thus affected does not thrive, lingers on with a small, frequent pulse, capricious appetite, fetid breath, and may die from hectic.

Treatment.—Fresh air, moderate exercise, mineral and vegetable tonics, stimulants, linseed cake, whether to horse or ox, cod-liver oil to smaller animals, and, in severe cases, the application of one or two active blisters to the sides.

Pleurisy—Inflammation of the Pleura.

This very common disease is, in the horse, often mistaken for influenza. It is very prevalent in exposed countries, and wherever rheumatic disorders are frequently observed. Its causes are very similar to those mentioned for other acute affections of the respiratory organs, but it is especially noticed, at different periods, to prevail in an enzootic or epizootic form, attacking animals of all ages and under all circumstances. Pleurisy is noticed when injuries are inflicted on the chest. Mr John Field says he has seen it, after clipping, as the result of exposure to cold. Duvieusart saw 300 cases of pleurisy in a flock of sheep, shorn in February, 30 of which died. It occurs chiefly in horses of spare but vigorous habit, and may affect one or both sides of the chest. It is most frequently seen implicating both pleural sacs in the horse.

Symptoms.—Feverish symptoms usher in the disorder, but they are at first slight. There is a firm, wiry pulse, from 45 to 60 per minute. Respiration abdominal; inspiration short and interrupted; expiration prolonged. The animal stands with sunken and outstretched head. Waldinger has noticed that, if the pleurisy is on one side, the animal extends the fore-limb on that side. On pressing over the intercostal muscles, the animal evinces pain, and grunts; there is a twitching of the muscles, cough, sneezing, and peculiar tucked-up appearance of the flanks. On percussion, the chest sounds clear and resonant, but on applying the ear to the side, a distinct friction sound is heard. When any serum is effused, the friction sound may diminish, and on percussion, dulness is observed at the dependent parts of the chest. The expired air is not so hot as in pneumonia, the visible mucous membranes are not so red, there is less discharge from the nose, and often none at all; there is more pain, and often complications in the form of rheumatic fever. The hacking cough contrasts, also, with the rare cough of pneumonia. Pleurisy usually terminates either in effusion or resolution. Suppuration is rarely witnessed in the domestic animals.

Mr John Field, as long back as 1828, very faithfully pourtrayed the symptoms of pleurisy in the second stage, both when effusion and resolution results. He says:—

"The rigid contractions of the abdominal muscles diminish, the pleuritic grunt is less frequent, the belly drops, a fuller inspiration produces less pain, the convulsive twitchings occasionally recur, the horse assumes a livelier appearance, there is an inclination to take food, the pulse becomes distinct and soft, but remains very frequent, sometimes reducing considerably in frequency, and increasing again; and now the respiration is rendered more laborious, percussion gives no sound in the inferior costal regions, the dorsal and upper costal regions having alone the resonance and respiratory murmur: generally at this time, but not invariably, anasarcous swellings affect the legs, and there is œdema beneath the integument of the chest and abdomen; the inspiration is sudden or prolonged, the expriation difficult, or performed with double effort; the legs are extended and separated, the auxiliary respiratory muscles are called into action; the dilated nostrils, staring eyes, anxious countenance, and laborious heaving, strikingly indicate the threatened suffocation. A mucous rattle is heard in the windpipe, the extremities become cold, the pulse fluttering, or scarcely to be felt, the horse stands tottering, and, life just extinct, falls dead.

"Should the result prove more fortunate, a marked but gradual abatement of the symptoms in the most severe cases is perceived after the fourth day. The abdominal spasm ceases, there is more freedom in respiration, the pleuritic twitchings do not recur, the grunt is no more heard, the pulse becomes distinct, soft, and less frequent, the body regains its flexibility, the horse moves with more liberty, the appetite returns, he lies down, and, gradually recovering, is generally within three weeks to be considered well, though unfit for work."

Post-mortem appearances.—When an animal dies of pleurisy, fluid is usually found in considerable quantities in the chest. A large quantity of serum may be effused in a day or two. Dupuy found as much as 40 lbs. in a case of 50 hours' standing. Usually the pericardium is involved in the inflammation, and the lungs may be the seat of congestion and even consolidation. M. St. Cyr is the most recent observer on the subject of pleuritic lesions, and he furnishes us with much information on the subject:—

"*Pathological Anatomy.*—The rapidity with which the early changes of inflammation occur in the pleura, is, according to our author, truly surprising; in the course of a few hours a very marked enlargement of the vascular network is observed. With reference to the inflammatory exudation and false membranes formed, Saint-Cyr alludes to the different degree of development of the latter. Whatever may be the form of the false membranes, they are soft, pulpy, easily crushed and torn, completely amorphous, finely granular, or more or less impregnated with different elements, such as cells, nuclei, &c., which can only be discovered by the microscope. They adhere feebly to the pleura, and may accumulate with prodigious rapidity, so as to cover in three or four days almost the whole pleural surface on one or both sides.

They are friable, puffy, extremely irregular, soaked in serum, which is more or less turbid or lactescent. On removing the false membrane, the pleura beneath has a rough appearance, and is studded with small red conical prolongations, which are very small and very fragile. They are highly vascular, and attain considerable development within three days from the commencement of the disease. Sometimes the subserous cellular tissue is the seat of exudation.

"Sometimes about the sixth, and generally later, about the eighth or ninth day, the false membrane begins to be vascular, and the formation of blood-vessels goes on rapidly. At this time the adherence between the membranes and the pleura becomes very firm; the false membranes are more firm, resistant, and less easy to tear. From the blood-vessels of the latter there is a further exudation, and the result is their development into stratified layers. Such are the changes which may be followed closely in the course of ten or twelve days from the commencement of a pleuritic attack. Ulterior changes are not observed so closely with relation to the time required for their occurrence.

"From the tenth to the fourteenth day, another stage in the metamorphoses of the false membranes commences. The organization becomes completed, and the pleuritic patient may for some days remain without much change in its condition. An inflammatory relapse may lead to further effusions, fibrous deposits, and even to the formation of abscesses within the false membranes. This second period may extend over the thirtieth day, and even beyond the sixtieth; but Saint-Cyr cannot speak with precision in this respect.

"Gradually the irritation subsides, exudation is checked, absorption occurs, and there is an active effort of repair. This is more or less completely effected; but with the complete disappearance of functional disturbance, there is not always as complete a disappearance of signs of the organic lesions, and remnants of fibrous tissue are developed; the false membranes persist for ever. This tissue may afterwards influence the character and severity of another inflammation of the pleura, being vascular, and susceptible of being inflamed, and offering a great extent of surface for the inflammatory process. These pathological products may become the seat of transformations or deposits, whether cartilaginous, tubercular, cancerous, or melanotic.

"*Pleuritic Effusion.*—The pleuritic effusion is a direct consequence of the inflammation, and is as constant an anatomical character of pleuritis as are the false membranes. As such, it deserves the utmost consideration from the practitioner, and must be studied in its *chemical* and *physical* composition as well as in the quantities in which it occurs.

"1. *Chemical Composition.*—As a direct product of the pleuritic exudation, it consists of the same elements as the blood—viz., fibrin, albumen, salts, extractive matter, and blood; but these principles are not always to be found in the same proportions, and some of them appear with peculiar characters, and under various forms, interesting in a pathological point of view. The extractive matter and salts are of less interest; water is in a proportion varying from 911 to 924 in 1000.

"*Albumen* is constantly present; it is detected by treating the fluid by ether, alcohol, or an acid, and more especially by nitric acid. In four analyses, M. St Cyr and M. Boiteux found it from 73·54—82·50—63·33—81 parts in 1000.

"The liquid at this period, left at rest in a glass at a low temperature, separates into clot and serum, in the same manner as the blood.

"The quantity of fibrin thus obtained has been found in four analyses to vary from 2·16—12·50—6·00—7.34 in 1000 parts.

"The fibrin, however, in this state, is not chemically pure, but shows, notwithstanding, the considerable oscillations which may occur in various samples.

"*Fibrin*, which constitutes the basis of the pseudo-membranous productions, is found in variable proportions, and in two different forms:—

"1st, As long as the febrile state is persisting to a great extent, the fibrin coagulates, and is found as molecular granulations, amorphous particles, parts of false membranes, either resting against the pleural surface or in suspension in the liquid—in one word, in a state, more or less advanced, of disaggregation, but not forming a distinct clot.

"2nd, As soon as the inflammation subsides, and passes to a subacute or chronic state, the fibrin coagulates more slowly, and is even for a long time in a state of solution, and in considerable proportion in the liquid contained in the serous cavity.

"2. *Physical Aspect.*—At the beginning of the inflammatory state, a plastic lymph, containing a large proportion of coagulable fibrin, escapes from the modified capillaries. Part of it adheres to the pleura, another part gravitates at the bottom of the thoracic cavity. The rupture of some capillaries allows the blood to escape, and the globules impart to the fluid a port-wine colour, sometimes almost black. Sometimes the exudation consists of almost pure blood, which separates into clots and serum. This form constitutes the *Hæmorrhagic pleurisy.* The fluid thus exuded loses its colour, the heavier parts fall at the most declining part of the pleuritic sac; the exudation, which continues, coagulates more slowly, and forms *free* and floating false membranes. The exudation assumes a greyish dirty appearance, sometimes resembling pus. This form constitutes what the author calls *pleurisy* with *empyema.* This state lasts for some time; generally between the 7th and 15th day exudation becomes more slow; it is more serous and less fibrinous. Then the exudation increases, but tends to clear up by precipitation and absorption of the constituent particles, and the liquid is then clear, serous, limpid, yellowish, slightly greenish. This constitutes the pleurisy with hydrothorax, and lasts for a more or less time, until death ensues, or the animal recovers.

"Such is the typical course of the *acute pleurisy*, but it may vary according to circumstances, so that the exudation from reddish may clear up at once without passing through the intermediate or greyish state. In some other cases the liquid will ever persist, more or less, thick and muddy.

"From the preceding observations the author concludes that, in the regular course of pleurisy, the exudation passes through at least three different forms corresponding to three distinct periods; but these periods vary in length, they may be more or less long, according to circumstances. The 43 cases observed are classified in the following table:—

Duration of the Disease.	Effusions.				Total.
	Port Wine.	Sero-Sanguineous.	Muddy or Greyish.	Limpid.	
From 1st to 7th day	9	6	3	...	18
„ 8th to 15th „	2	3	4	6	15
„ 16th to 30th „	...	1	1	5	7
After the 30th „	...	...	...	3	3
	11	10	8	14	43

"M. Saint-Cyr draws these conclusions:—

1st. There is not a distinct limit between the first two periods.

2nd. These two periods have together a duration averaging from 8 to 15 days.

3rd. Towards the end of the second week the expanded liquid begins to clear up. This is the indication of the beginning of the third period.

4th. The liquid is almost always clear after the 25th or 30th day, and this is the epoch of transition in the horse from the acute to the chronic state of pleurisy.

"The change which the pulmonary tissue undergoes as a result of pleurisy is specially considered by M. Saint-Cyr. In a case of confirmed pleurisy, the lung is of dull colour, diminished in size, collapsed, and flabby, scarcely crepitant under pressure, specifically heavier than water. Under pressure, it is tough, not friable like lung *hepatized* as the result of inflammation. The cut surface of such pleuritic lung is dry, smooth, and presents the interlobular septa unusually well marked. Nevertheless the lung tissue is free from adventitious deposit, and the air-cells, though flattened, are not destroyed; they admit of being expanded, as in the healthy condition, by artificial respiration. Only in one case, a dog affected with pleurisy for more than two months, has the author been unable to re-expand the collapsed lung. The causation of this collapsed state is complex: pressure of the effused liquid, insufficient expansion of the chest, deposition of false membranes, and our author even supposes sympathetic contraction of the visceral muscular fibres."

Treatment.—I have no great faith in blood-letting in cases of pleurisy, and rely more on purgatives, injections, and mustard poultices, or more active blisters. This is to be followed up by the administration of diuretics, such as the draught here prescribed:—

℞ Pot. nitr.	℥ss.
Camphoræ	ʒij.
Sp. eth. nitr.	℥ij.
Aquæ	℥xx.

Mix. Draught to be repeated every six hours.

I have used digitalis in considerable doses when the first symptoms of hydrothorax have appeared, giving a half-drachm with half an ounce of nitre, and made into a ball with soft soap. One of these balls to be given every four hours until four had been given; and as the result of this, there has been a copious discharge of urine, and marked relief. A mild dose of aloes then proves of great service. The animal must be kept warm, and its limbs hand-rubbed. Since the New Veterinary College has been established, though I have had eight and ten cases of severe pleurisy under treatment at a time, I have never lost one. I attribute this to the active evacuant treatment, and avoiding the use of the fleam.

HYDROTHORAX—DROPSY OF THE CHEST.

In describing the disease *pleurisy*, I have mentioned that effusion occurs in the chest. This complication is so important that it merits separate consideration.

Dropsy of the chest occasionally occurs from debility, when there is a tendency to effusion in the serous sacs generally, and also beneath the skin. It is then only a sign of a general weakness, which is usually overcome by astringents and tonics. The exudation of pleurisy may, however, vary in character from the grumous and highly albuminous to a diluted serum; and in the one case the pleura is so covered with false membranes and modified by disease, as to interfere with that active absorption which may be induced in any purely dropsical state.

Whenever or wherever attacks of pleurisy are frequent, cases of hydrothorax are to be expected. The effusion is very rapid in animals that have been much depressed by blood-letting, or when other injudicious treatment has been adopted. The last two fatal cases of hydrothorax I have witnessed followed after treatment by blood-letting, in one case, and in the other from the disease assuming a very severe form in consequence of the foul and close place in which the animal was condemned to stand.

Symptoms.—The acute symptoms of pleurisy subside; the friction sounds are to a great extent lost; the animal appears lively, and may manifest appetite; and thus, on auscultation, there is a clear respiratory murmur above a certain line, and below this perfect dulness. As fluid accumulates, the line limiting the dulness ascends, and the animal becomes extremely depressed, weak, with rigid back, tucked-up flanks, anxious expression of countenance, and the hair is readily pulled out of mane and tail. The pulse is rapid and small, and, as the disease advances, is imperceptible at the jaw. The breathing is short and laboured, and nostrils dilated. Œdematous swellings occur in the limbs, sheath, and over the chest and belly.

Treatment.—In the majority of cases the active employment of purgatives and diuretics—the latter being preferable—suffices for the treatment of hydrothorax.

I believe that a large majority of cases treated judiciously, without the evacuation of the effused fluid, will recover, whereas veterinary surgeons have been, on the whole, unsuccessful when they have resorted to tapping. Digitalis, cantharides, spirits of nitric ether, and nitre, administered in active doses, and repeated several times during 18 or 24 hours, will excite the renal secretion, and change the aspect of a case. Having thus produced a free evacuant effect, sulphate of iron and alum may be administered daily in conjunction with vegetable bitters or aromatics.

Mr Percivall has said that the treatment of hydrothorax is an affair of desperation. He adds, however:—"Hydrothorax is not necessarily incurable. The cases I have related prove this. Under what circumstances have we much chance of curing? Let us consult our cases again. We find that in all of them the water was confined to one, and that the *right* side; the quantity in the left was too inconsiderable to notice. This, then—as appears in theory so imperative—constitutes a favourable indication. We find again—with the exception of Mayot's case, in which the quantity of water was inconsiderable, and which, after all, looks like a relapse—that two of them were tapped in the second, the other in the fourth week after the attack; none, therefore, could be called old or chronic cases. The secreting membrane could in neither case be said to have acquired any habit of secretion or any materially altered organism. *Age* may have some influence. Mr Sewell's patient was five years old, Mr Trapp's eight. Stamina, healthiness of constitution, and in other respects, must have great influence. All these circumstances, and there are others, ought, I repeat, to be taken into consideration in dealing with a case of hydrothorax."

Tapping the chest—*paracentesis thoracis*—is a simple operation. It is performed at a dependent point in the 8th or 9th intercostal space. The anterior margin of a rib is felt, and a slight incision into the skin and subcutaneous tissues made with a lancet or bistouri. A small trochar is then pressed inwards with great ease, pushing the canula over the stilet the instant it has penetrated. On removing the stilet, the fluid escapes freely. A probe must be at hand to remove any object which may plug the canula, and ensure the free flow.

After being tapped, animals must be supported by stimulants, tonics, and judicious diet.

Sporadic Pleuro-Pneumonia.

The serous covering of the lung, and the substance of this organ, may be simultaneously inflamed, and the combined symptoms of pleurisy and pneumonia are observed, as the name of the disease indicates. In a number of the best veterinary works no special allusion is made to pleuro-pneumonia in the horse and other animals, with the exception of the epizootic lung disease of cattle. A very imperfect sketch of the malady is given by Mr John Field, and Mr Percivall only says that pneumonia admits of division into *simple* and *complicated*. The complicated pneumonia is either associated with bronchitis, broncho-pneumonia, or pleurisy, pleuro-pneumonia.

Symptoms in the Horse.—The early symptoms of an attack of pneumonia or pleurisy are followed by active fever, rhonchus, pain on pressing in the intercostal spaces, with quick, painful, subdued cough, tendency to œdema beneath the chest, in the sheath and limbs, with effusion also in the pleural cavities. The consolidation of a considerable portion of one or both lungs is ascertained both by auscultation and percussion. As the disease advances the respiratory murmur is absent at the most dependent part of the chest, and with the accumulation of fluid there is more and more dulness from below upwards.

Symptoms in Cattle and Sheep.—Sporadic pleuro-pneumonia observed on a few members of a herd of cattle or flock of sheep, is not an unfrequent disease. So far as cattle are concerned, I rely more on the history to prove that I have not to deal with the contagious lung disease than on the symptoms, though the latter are far from unsatisfactory. When chest affections occur in home-bred cattle on farms, and in counties and districts where animals are never imported, and no chance of contamination with diseased stock having occurred, I find that they are easily cured, and soon stop without a fatal issue. I had some cases last winter, and one, particularly, was seen by some practical men, who believed, on opening the chest, they had to deal with a case of the contagious pleuro-pneumonia, though, during the animal's lifetime, they had declared that it had not the symptoms of the disease. I must refer the reader to what I say concerning the symptoms of the epizootic pleuro-pneumonia, and need only add here, that in any sporadic inflammation of the pleura and lungs there is not the same spasmodic action of the nose or severe tracheitis. The animal is seized more promptly, and not so insidiously as in the epizootic affection. A shivering fit, loss of appetite, suppression of milk, are followed by acute symptoms, which usually terminate favourably in a week or ten days. The sporadic pleuro-pneumonia is not so fatal a disease as the contagious form.

In sheep there has been much pleuro-pneumonia on hilly lands and in damp districts during the last few years. This disease has nothing in common with the epizootic lung disorder of cattle, and is characterized by the general symptoms of pleurisy and pneumonia.

The treatment of sporadic pleuro-pneumonia is the same as for any other inflammatory affection of the lungs, though sometimes requiring to be more energetic, in consequence of its great severity.

Contagious Pleuro-Pneumonia of Cattle.

This disease is popularly known now in this country as the lung disease of cattle. It is the *lungenseuche* of the Germans, and technically termed by them *peri-pneumonia exudativa contagiosa*, &c., &c. The first reports in Britain, about twenty years ago, were written under the name, "the new disease of cattle," though a century since it had visited our island.

When Youatt wrote his treatise on cattle, nothing was known of pleuro-pneumonia in Britain. What has induced it since?

Causes.—The history of a plague, as it spreads from a centre of origin, affords us the most certain data whereby to judge of the influences capable of inducing the disease. Such a history must include the special facts brought out by the careful study of the malady in special localities; but a truthful picture of the source and extent of ravages due to a decimating epizootic, may, for the purpose of affording a ready and satisfactory glance, bring out in relief the greater incidents faithfully recorded, without burdening the narrative with irksome details.

A malignant form of inflammation of the lungs, of an eminently contagious character, and peculiar to the ox species, has been recognised as having existed within the memory of man in the mountainous regions of the centre of Europe. There is every reason to believe that the malady described by Valentin in 1693,* Jacob Scheuchzer in 1732, Bucard Mauchard in 1745, and Kauch in 1778 and 1784, was the same pleuro-pneumonia which has caused such terrible ravages over Europe during the present century. The cattle of the Swiss Alps, of Hesse, Swabia, and Upper Silesia, were especially affected by the pestilence. The epizootics reported by the ancients cannot be readily recognised at the present day, from the meagre descriptions handed down to us. Many are evidently outbreaks of malignant anthrax, affecting man and beast. There is no such doubt, however, hanging over the histories of the murrain under consideration, as it was studied in Central Europe during the early part of the eighteenth century. Wirth, one of the best authorities on cattle plagues, says,† "Certain it is that it (pleuro-pneumonia) manifested itself in the years 1713 and

* *Ephem. Natur. Cur. et Sydenham.* Op. et Gen. 1, p. 276.

† *Lehrbuch der Seuchen und Ansteckenden Krankheiten der Hausthiere.* Von J. C. Wirth. 2nd edition. Zürich, 1846.

1714 in Swabia, and also in several cantons of Switzerland." The same author alludes to its attacks in the same countries in 1726, 1727, 1736, and 1739. Even less doubt, if any there might exist, hangs over the outbreak in 1743, and, indeed, we find that from this period onwards, the lung disease never ceased to commit extensive ravages. The immortal Haller writes very positively as to the nature of the disorder.* He says: "It is a lung disease, beginning in an inflammation, which passes into gangrene, or at other times in abscess, and ends in a true marasmus." "It is very wonderful," he adds, "that amongst the many modern physicians who have written on this plague, which has been observed so generally and for so long, that they have not noticed the seat of the disease to be in the lungs." Such an observer as Haller could not help writing a faithful description of the malady, and he affords us incontestible proof that the epizootic which spread during his lifetime over Europe, as generally, perhaps, as it has extended in modern days, was the contagious pleuro-pneumonia.

The history of the contagious typhus, or steppe disease, is interwoven, to a great extent, with the history of pleuro-pneumonia, during the middle of last century. The ravages of the two, spreading each from the countries in which they are capable of spontaneous development, are readily accounted for, by the commotion due to wars and rebellion, and by the necessary transport of cattle in the rear of armies. The cattle trade was always active from east to west, and, after a most anxious study, with a view to trace separately and distinctly the course of the contagious typhus and pleuro-pneumonia. I can only arrive at the conclusion which Dr Headlam Green-

* *Abhandlung von der Viehseuche.* Von HERRN ALB. HALLER. Bern. 1773. This is the ablest memoir I have read concerning pleuro-pneumonia during the eighteenth century.

how felt himself driven to, as stated in his official report on murrain in horned cattle,* that steppe murrain and pulmonary murrain existed, side by side, during last century. Dr Greenhow referred particularly to Britain—I refer to Europe. There are certainly some points of contrast between the two diseases. In tracing the history of the destruction amongst cattle by plagues from 1710 to 1800, we can distinctly indicate outbreaks extending from Russia westward. There have always been specific invasions of the steppe disease, and it is easy to demonstrate that this malady penetrated to the south of Italy, into France as far as Franche Comté, Dauphiné, and to Paris, and across Prussia, Holland, and into England. But the same causes which led to an active transport of cattle from east to west, led to outbreaks of the pleuro-pneumonia, which, in times of peace, might be regarded as enzootic in the Alps of Central Europe. Herds infested with contagious typhus, were doubtless mingled with cattle that were affected with pleuro-pneumonia: the combination of the two diseases may account for the terrible devastation amongst cattle which turned the attention of many illustrious physicians to the study of epizootics, and which soon led to the institution of veterinary colleges. Is it not remarkable that the prevalence especially of one malady, the lung disease, which gave a great impetus to the study of veterinary science, has since been, in the eyes of the world, the cause of much dissatisfaction as to the limited powers of the veterinary profession in dealing with epizootic diseases—a veritable *opprobrium scientiæ?*

The outbreak of pleuro-pneumonia in different countries beyond the centres of spontaneous origin above mentioned, is wholly due to contagion, and the contagious nature of this virulent malady is incontestibly proved by an overwhelming

* *Report on Murrain in Horned Cattle*, &c. 1857.

amount of evidence, which I cannot adduce at full length here, but which may be classified under the following heads:

Firstly, The constant spread of the disease from countries in which it rages to others which, previously to the importation of diseased animals, have been perfectly free. This may be proved with regard to England, where it was carried in 1842 by affected animals from Holland. Twelve months after, it spread from England to Scotland by some cattle sold at All-Hallow Fair, and it was only twelve months after, that cattle imported as far north as Inverness took the disease there. Lately, a cow taken to Australia from England was observed to be diseased on landing, and the evil results were limited to her owner's stock, who gave the alarm, and ensured the effectual check to further spread. Lastly, the recent importation of pleuro-pneumonia into the United States from Holland seems to have awakened members of the agricultural press here, and convinced them of the stubborn fact that our cattle have been decimated by a fearfully contagious and probably preventible plague. In a letter from America we find on this subject:—"Its contagious character seems to be confirmed beyond a doubt, though some of the V. S. practitioners deny it, which is almost as reasonable as it would be to deny any other well-authenticated historic fact. Every case of the disease is traceable to one of two sources—either to Mr Chenery's stock in Belmont, into which the disease was introduced by his importation of four Dutch cows from Holland, which arrived here the 23d of last May, or else to one of the three calves which he sold to a farmer in North Brookfield last June."

Secondly, Apart from the importation into countries, we have the certain proof, to which I drew special attention several years back, that cattle-dealers' farms, and public markets, constitute the busy centres of infection. Most anxious and careful inquiries have proved to me that in breeding districts where the proprietors of extensive dairies, as in some parts of Dumfries, &c., abstain from buying, except from their neighbours who have never had the lung disease amongst their stock, pleuro-pneumonia has not been seen. There is a wide district in the vicinity of Abington, and in the parish of Crawford, and I could mention many others, which has not been visited by this plague, with the exception of two farms in which market cattle have been imported and carried the disease.

Thirdly, In 1854 appeared a Report of the researches on Pleuro-pneumonia, by a scientific commission, instituted by the Minister of Agriculture in France. This very able pamphlet was edited by our esteemed friend Professor Bouley of Alfort. The members of the commission belong to the most eminent veterinarians and agriculturists in France. Magendie was president; Reynal, secretary; besides Rayer, the renowned comparative pathologist; Yvart, the Inspector-General of the Imperial Veterinary Schools; Renault, Inspector of the Imperial Veterinary Schools; Delafond, Director of Alfort College; Bouley, Lassaigne, Baudemont, Doyére, Mauny de Morny, and a few more representing the public. If such commissions were occasionally appointed in this country for similar purposes, how much light would they not throw on subjects of paramount importance to the agricultural community.

The conclusions arrived at by this Commission are too important to be overlooked here. I must refer the reader to the Report itself, if he needs to satisfy himself as to the care taken in conducting the investigations; but the foregoing names sufficiently attest the indisputable nature of the facts alluded to.

In instituting its experiments, the Commission had in view to solve the following questions:—

1*stly*, Is the epizootic pleuro-pneumonia of cattle susceptible of being transmitted from diseased to healthy animals by cohabitation.

2*dly*, In the event of such contagion existing, would all the animals become affected, or what proportion would resist disease?

3*dly*, Amongst the animals attacked by the disease, how many recover, and under what circumstances? How many succumb?

4*thly*, Are there animals of the ox species decidedly free from any susceptibility to be affected from the contagion of pleuro-pneumonia?

5*thly*, Do the animals which have been once affected by a mild form of the disease enjoy immunity from subsequent attacks?

6*thly*, Do the animals which have been once affected by the disease in its active form enjoy such immunity?

To determine these questions, the Commission submitted at different times to the influence of cohabitation with diseased animals forty-six perfectly healthy ones, chosen from districts where they had never been exposed to a similar influence.

Of these 46 animals, 20 were experimented on at Pomeraye, 2 at Charentonneau, 13 at Alfort, and 11 in the fourth experiment at Charentonneau.

Of this number, 21 animals resisted the disease when first submitted to the influence of cohabitation, 10 suffered slightly, and 15 took the disease. Of the 15 affected, four died and 11 recovered. Consequently the animals which apparently escaped the disease at the first trial, amounted to 45·65 per cent., and those affected to 21·73 per cent. Of these 23·91 per cent. recovered, and 8·69 per cent. died. But the external appearances in some instances proved deceptive and 6 of the 11 animals of the last experiment which were regarded as having escaped free, were found, on being destroyed, to bear distinct evidence of having been affected. This, therefore, modifies the foregoing calculations, and the numbers should stand thus:—

15	enjoy immunity,	or 32·61	per cent.	
10	indisposed,	„ 21·72	„	„
17	animals cured,	„ 36·83	„	„
4	dead,	„ 8·84	„	„
46		100·00		

Of the 42 animals which were exposed in the first experiments at Pomeraye and Charentonneau, and which escaped either without becoming affected or recovering, 18 were submitted to a second trial, and of these 18, 4 were subjected to a third.

Of the 18 animals, 5 had in the first experiment suffered from the disease and had recovered, 5 had never become affected, and 4 had been indisposed. The 4 animals submitted to the influence of contagion a third time had been affected on the occasion of the first trial. None of the 18 animals contracted the disease during these renewed exposures to the influence of contagion.

From the results of these experiments the Commission has drawn the following conclusions:—

Firstly, The epizootic pleuro-pneumonia is susceptible of being transmitted from diseased to healthy animals by cohabitation.

Secondly, All the animals exposed do not take the disease —some suffer slightly, and others not at all.

Thirdly, Of the affected animals some recover and others die.

Fourthly, The animals, whether slightly or severely affected, possess an immunity from subsequent attacks.

These are the general conclusions which the Commission has deemed itself authorised to draw from their experiments. The absolute proportion of animals which become affected or escape the disease, or of those which die and recover as a general rule, cannot be deduced from the foregoing experiments, which, for such a purpose, are too limited. The Commission simply states the numbers resulting from their experiments. From these it transpires that 45 of the animals became severely affected with pleuro-pneumonia, and 21 per cent. took the disease slightly, making in the whole 66 per cent. which were more or less severely attacked. 34 per cent. remained free from any malady. The proportion of animals which re-acquired their wonted appearance of health amounted to 83 per cent., whereas 17 per cent. died.

If, therefore, we are asked, What is the cause of this disease? we can reply in one word, *Contagion;* and the many accessory causes tend simply to increase or to mitigate the severity of the plague, not to induce it. Thus—

Firstly, We can shew the most sceptical on this point filthy town dairies which have been perfectly free from the disease when it has been most severe in the large towns, and the health of these dairies could only be accounted for by the judgment exercised in making the purchases.

Secondly, The disease, like all other plagues and malignant fevers, attacks more readily and more severely animals at the period of parturition, or during lactation. This is one reason which accounts for the greater prevalence of the disease amongst dairy stock.

Thirdly, The animal introduced into a healthy stock, and which carries the disease, may be in perfect health apparently, and in good condition. It usually has a cough; but a professional man can usually detect that the animal is recovering, or is passing through a mild attack of the disease.

Fourthly, In proportion as the animals are closely packed in a confined apartment will the stock most readily take the disease. In a lofty, airy byre, the cases do not occur so rapidly, and at the onset are milder than in inferior places. We find that the animals most recently introduced into a byre, and whose systems are prejudicially affected by the overcrowding, &c., are the first to be seized. It is usually easy to distinguish which animal has introduced the disorder, inasmuch as this one will show symptoms very soon after entering its new abode; and it is not unfrequent that within one month, and often much earlier, from the date of purchase, a diseased animal has either been carted off dead or is convalescent; whereas healthy stock, placed amongst diseased animals, only manifests signs of the disorder between a month and six weeks from the date of its first impure contact.

Fifthly, Stock in high condition suffers as severely as stock in very low condition. A healthy, moderately-fed ox is more likely to be attacked mildly than a full-fed bullock, or a very lean rich-milking cow.

Attention has been recently turned to the state of our live-stock markets. It is well known that since the publication of facts demonstrating that cows as frequently take the disease standing in the live market as in a polluted byre, dairymen have adopted various means to keep clear of the public market in Edinburgh, and have preferred paying a better price for a cow at the station, just as she entered the town, than allowing her to approach the stock which visits our market the second time in being transferred diseased from the cowkeeper's shed to the butcher's hand. It is disgraceful to witness the number of diseased cows which are walked through our streets, fall from sheer exhaustion, and wait for hours by the roadside till they are carted away. If we suffer from pleuro-pneumonia in cattle, we cannot say that we attempt to avert any means by which it may spread.

Symptoms.—From the time that an animal is exposed to the contagion to the first manifestation of symptoms, a certain period elapses; this is the period of incubation. It varies from a fortnight to forty days, or even two months. Some credit may be given to reports of even longer periods of incubation. During this period cows are found to thrive fast, and often to yield much milk. The first signs, proving that the animal has been seized, can scarcely be detected by any but a professional man; though, if a proprietor of cattle were extremely careful, and had painstaking individuals about his stock, he would invariably notice a slight shiver usher in the disorder, which for several days, even after the shivering fit, would limit itself to slight interference with breathing, detected readily on auscultation. Perhaps a cough might be noticed, and the appetite and milk secretion also diminish. Though the amount of milk may not be much diminished at first, I have heard milk-maids say that a clever milker can tell in drawing that the cow is taken ill. The animal becomes costive, and the shivering fits recur. The cough becomes more constant and oppressive, the pulse full and frequent, usually numbering about 80 per minute at first, and rising to upwards of 100. The temperature of the body rises, and all the symptoms of acute fever set in. A moan or grunt, in the early part of the disease, indicates a dangerous attack, and the alae nasi, or nasal cartilages, rise spasmodically at each inspiration; the air rushes through the inflamed windpipe and bronchial tubes, so as to produce a loud coarse respiratory murmur; and the spasmodic action of the abdominal muscles indicates the difficulty the animal experiences also in the act of expiration. Pressure over the intercostal spaces, and pressing on the spine, induce the pain so characteristic of pleurisy, and a deep moan not unfrequently follows such an experiment. The eyes are bloodshot, mouth clammy, skin dry and tightly bound to the subcutaneous textures, and the urine is scanty and high-coloured.

On auscultation, the characteristic dry, sonorous râle of ordinary bronchitis may be detected along the windpipe and in the bronchial tubes. A loud sound of this description is not unfrequently detected at the anterior part of either side of the chest, whilst the respiratory murmur is entirely lost posteriorly, from consolidation of the lung. A decided leathery friction sound is detected over a considerable portion of the thoracic surface. As the disease advances, and gangrene, with the production of cavities in the lungs, ensues, loud cavernous râles are heard, which are more or less circumscribed, occasionally attended by a decided metallic noise. When one lung alone is affected, the morbid sounds are confined to one side, and on the healthy side the respiratory murmur is uniformly louder all over.

By carefully auscultating diseased cows from day to day, interesting changes can be discovered during the animal's lifetime. Frequently the abnormal sounds indicate progressive destruction; but at other times portions of lung that have been totally impervious to air, become the seat of sibilant râles, and gradually a healthy respiratory murmur proves that, by absorption of the materials that have been plugging the lung-tissue, resolution is fast advancing. I have seen some very remarkable cases of this description.

Unfortunately, we often find a rapid destruction of lung-tissue, and speedy dissolution. In other cases, the general symptoms of hectic or consumption attend lingering cases, in which the temperature of the body becomes low; the animal has a dainty appetite, or refuses all nourishment. It has a discharge from the eyes, and a fœtid sanious discharge from the nose. Not unfrequently it coughs up disorganized lung-tissue and putrid pus. Great prostration, and indeed typhous symptoms set in. There is a fœtid diarrhœa, and the animal sinks in the most emaciated state, often dying from suffocation, in consequence of the complete destruction of the respiratory structures.

Post-mortem appearances.—In acute cases the cadaveric lesions chiefly consist in abundant false membranes in the trachea, and closure of the bronchial tubes by plastic lymph. The air-vesicles are completely plugged by this material, and very interesting specimens may be obtained by careful dissection, in the shape of casts of the bronchial tubes and air-vesicles, clustered together like bunches of grapes. On slicing the lungs in these cases, hepatization is observed, presenting a very peculiar appearance, which is in a great measure due to the arrangement of the lung-tissue in cattle. The pulmonary lobules are a deep red or brown colour, perfectly consolidated, and intersected or separated one from the other by lighter streaks of reddish-yellow lymph, occupying the interlobular areolar tissue. In the more chronic cases the diseased lobes and lobules are found partly separated from the more healthy structures. This occurs from gangrene and putrefactive changes, or in some instances from the ulcerative process so constantly observed in the segregation of dead from living tissues. Abscesses are not unfrequently found in different parts of the lungs, sometimes circumscribed, at others connected with bronchial tubes, and not unfrequently communicating with the pleural cavity. True empyema is not often seen, but at all times the adhesions between the costal and visceral pleura are extensive, and there is much effusion in the chest. In dressed carcases of cows that have been slaughtered for pleuro-pneumonia, even though the disease has not been far advanced, it will be found that the butcher has carefully scraped the serous membrane off the inner surface of the ribs, as it would be impossible for him to give the pleura its healthy, smooth aspect, from the firm manner in which the abundant false membranes adhere to it. The diseased lungs sometimes attain inordinate weights. We have known them as high as 60 pounds.

Treatment.—The great essential in attempting to apply our knowledge of this disease to the mitigation of losses amongst stockowners is to study the means of prevention. On this point we have been very deficient in Great Britain, not only as regards the epizootic lung disease, but other forms of cattle murrain.

These imported plagues in poorer countries than ours, lead governments to establish *cordons militaires*, to slaughter and bury diseased animals, and to compensate individuals for their loss. The whole country is under careful inspection, and persons are bound to report the appearance of a contagious disease, or submit to the infliction of a severe penalty. Such measures would not find favour here; but are we to fly to the other extreme, to continue from one year's end to the other without perceptible abatement in the mortality amongst our cattle, and not only to manifest the greatest carelessness regarding the presence of contagious disorders, but to favour their spread by permitting frauds of the vilest description?

A farmer goes to the market and buys a lot of lean cattle; shortly after purchase pleuro-pneumonia breaks out, and as the condition of the animals prevents a good price being obtained from the butcher, he sends the whole to the market again, knowing them to be unsound, and either the lot is transferred to another farm, or sold to a number of purchasers.

I have been asked, when the disease has broken out amongst a lot of yearlings, whether they should be sold at once or chanced. The law takes no cognizance of such a case, the practice is advocated and carried out by those who, in ordinary transactions, are scrupulously honest, and yet if you probe the matter you cannot but admit that the person selling a lot of lean cattle affected with a spreading malady, though perhaps only in the stage of incubation, is defrauding the purchaser and the nation. Some may find relief under the absurd supposition that diseases are not catching; but if any such individual is cross-questioned it will be found that he would not have sold the cattle had he not believed that the whole were in imminent danger, and that the majority must die.

It is evident that such a practice is totally opposed to the nation's best interests; but in reality the public interest is made up by the sum of private interests involved; and although at first sight the individual threatened with loss thinks he had better clear out his bad stock, he may, at his next purchase, be not a whit better off, from the very practice he has encouraged and followed out. I have satisfactorily found, in numerous cases, that it is unadvisable to clear out a farm stock, and local means can be adopted to check mortality with the greatest success.

But there is another way in which the owner of diseased animals is permitted to spread contagion. He is allowed to send them by railway, to entrust them to a salesman, and to expose them amongst healthy cattle that are to be transferred to different parts of the country for grazing purposes. Fat or not fat, they are exposed without restriction, and any amount of good stock may be contaminated. A dairyman in town has a cow taken seriously ill. A number of hungry fleshers are ready for her at a good sum, but in order to cause keen competition, the poor animal is walked into the public market, and stands with a number like herself amongst store animals. Such a practice is as reckless and horrible, as if a patient with small-pox were placed amongst a lot of non-vaccinated people for hours together; and the healthy cows just fresh from the country are especially prone to imbibe a deadly virus.

I am conversant with another evil demanding instant suppression. A cow-dealer may buy a fine lot of healthy cows for the town. They are trucked, and somewhere near their destination a truck, containing diseased animals, is attached to the train. I knew an instance of a dealer, who, with three large trucks full of fine English cows, had, on reaching Carstairs, to submit to their being placed behind a lot of three suffering from the lung disease. Imagine how favourable the breeze and the proximity of those animals to spread contagion! It should be a standing rule that every cattle-truck should be washed thoroughly, and sprinkled with an antiseptic substance, before other cattle are exposed in it. There are animal poisons, such as that of epizootic aphtha, which may be found to adhere to places, and spread disease with the greatest certainty.

The home trade in diseased cattle is sufficient to keep up for an indefinite period of time pleuro-pneumonia in a country like our own, but I have specially alluded, in the *Edinburgh Veterinary Review*, to the necessity for legislation to prevent the constant importation of diseased cattle from foreign lands. In the June number for the current year, I state:—Free trade may have its disadvantages. The impetus it gave twenty-five years ago to the cattle trade led to the introduction of much disease on British soil, and unless some influential men will take an interest in this subject and exert themselves for the common good, we shall continue to import disease, and lose millions by such importations. In an article on pleuro-pneumonia in Holland, which appeared in our last number, and the facts of which were gleaned from a blue-book, it is shown how extensively that country is swept by cattle-plagues, whence we chiefly obtain foreign store cattle for our dairies or for feeding purposes. If our imports of live cattle vary from 30,000 to 60,000 per annum, it is evident that there is a wide field for the contamination of our home stock, and this is facilitated, 1stly, By the wants of the country throughout its whole length and breadth; 2ndly, By the totally unchecked trade in diseased animals; 3rdly, By the absence of all proper means to detect and counteract disease. If thousands of men were landed from countries infected by yellow fever or other pestilence, and systematically communicated these amongst us, vigorous efforts would soon be made, and even quarantine enforced for our own protection; but we observe precisely such an occurrence as affecting our cattle, and as the country is wealthy enough not to be destroyed by it, the loss is tolerated, and no attention paid to the consequences of a most pernicious traffic.

Free trade is surely not incompatible with an enlightened inquiry as to the countries which are clear of cattle-plagues, and those that are suffering from them. We need not court a trade with that part above all others in Europe, which is overrun with pleuro-pneumonia, and as fat cattle ready to slaughter are needed by us more than lean cattle and cows, which we can breed in such enormous numbers, and better than our neighbours, we do not see why some restrictions on the importation of cattle, to be exposed amongst healthy stock here, should not be enforced.

Can a Member not be found in Parliament to move in this matter? The subject is worthy the most anxious and careful study. It has been well proved that epizootics, like epidemics, disappear if permitted to do so, and if they are not encouraged by facilitating contagion, &c. It is also easily demonstrated that the United Kingdom is naturally the most healthy portion of Europe, and in which cattle plagues are only seen as the result of importation. The very diseases which prove so destructive now visited us last century, but trade was not so active, importations were few, and the disorders disappeared.

The veterinary profession in this country has not hitherto turned its attention to the great questions which affect our national prosperity, and which are purely veterinary in their nature. We must do more than learn how to physic, blister, and operate: we must study prevention. This is the great field for future workers and for men of science, trained to the investigation of laws governing health and disease. Let us not turn a deaf ear to the statements of the London dealers and cowfeeders, who say that all the disease is imported, that it all spreads through markets; let us not shut our eyes to the evident fact, that the great centres of disease in this country are those in direct communication with the centres of importation, and where diseased cattle are freely bought and sold. We are armed with knowledge, and we are armed with means to prevent even such a disease as pleuro-pneumonia. The requirement of the age is enlightened action, but the curse of the past has been an apathy and resignation to fate, only pardonable because the result of ignorance.

When a veterinary surgeon is called upon to prevent pleuro-pneumonia on an estate or farm, he finds that he has to deal with cows, bulls, oxen, and calves. These animals are more or less freely intermixed; but where cows are constantly tied up in a separate compartment, and a number of oxen are in stalls away from other stock, it is not unusual to observe one lot of animals escape the disease entirely. Calves most frequently escape from the fact that they are by themselves, and are often not brought in contact with the infected stock.

The practitioner's duty may be stated in the form of a series of rules, all of which must be carefully observed:—

Firstly, The whole stock must be inspected and auscultated carefully, and the source of the disease made out, when it will either be found, that bought-in animals have been first affected, or those that have been near diseased stock on a field or high road. I have frequently found difficulty in tracing the cases to contagion, but simply because people are forgetful or ignore important circumstances. Thus I have found farmers state that they could not have imported the disease, because they never bought, but their next-door neighbour had it, or diseased cattle were passing through their farms constantly.

Secondly, Stop all communication with the ascertained source of the disease. It is difficult to do this in town dairies, because cows die off and fresh ones must come in. If possible, no healthy stock, much less diseased, should be brought amongst the animals you are called upon to treat.

Thirdly, Having discovered the diseased animals amongst the herd, have them all removed where they can be at a distance from other cattle. The only treatment they want is to allow them water, very little if any food, and the smallest amount of medicine.

Fourthly, Keep the healthy stock as much as possible in separate lots. Do not disturb the cows from their byres, or the oxen from their stalls. I disapprove of removing animals from their old quarters; it tends to spread disease, and does no good to the cattle.

Fifthly, All the animals, with the exception of milk cows, should be fed judiciously, and receive in their food from two drachms to half an ounce of sulphate of iron daily. Suppose there are ten oxen feeding in stalls, a dozen calves in the strawyard, a dozen two-year-olds in a field, I should prescribe as follows. For the ten oxen,—

℞ Ferri sulph.	. . .	℥iv.
Pulv. sem. coriand.	. .	℥iv.

Mix. Make four dozen such powders. Mix a powder thoroughly with two pecks and a half of bran and bruised oats or other feeding material. This is sufficient for one day for the ten oxen, giving each animal the fourth of a peck of the mixture. The treatment must be continued till the forty-eight powders are used, that is to say, forty-eight days.

For the twelve two-year-olds, if not stall-fed, I would mix a similar powder daily in any food they would take, or if being fed on turnips, would cause the latter to be wetted daily, and sprinkled over with the powder. For the calves, I should halve the above powders.

Sixthly, The milk cows must be simply watched, and the attendants on the animals must be made to announce whenever the slightest symptoms of ill health appear in any case, and the affected one must be instantly removed.

Concerning dairy stock I have now to say, the iron treatment cannot be adopted, segregation is alone at our disposal. Farmers and dairymen should be most careful with their purchases, and it is usually found that the early removal of any animal showing signs of disease has a marked effect in diminishing the number of cases. Cows that are nearly off their milk should be dried and receive tonics like other cattle, and in some instances it is desirable to dry the whole, feed them up, and sell to the butcher. Clearing out a diseased stock is more to be recommended in dairy farms than elsewhere.

Every attack of this disease must be specially studied. I find that I have to vary my practice according to circumstances, but have no fear whatever as to stopping the disease speedily, and with the smallest loss which the farmer can sustain after having the disease in his stock. This I accomplish without recommending that our markets should be polluted by diseased animals.

About the beginning of the year I am usually consulted as to what shall be done with feeding stock on a farm where disease has appeared, in order to consume an abundance of food. I never recommend the diseased to be sold, and half-fed cattle to be bought in. Loss is apt to be incurred two ways in doing this, and I do not find above one, or at most two animals, seized with pleuro-pneumonia after the preventative treatment I have suggested.

The practice of inoculation is one which I have to condemn from experience. It does some good, but a great deal more harm. The good is only such as may follow the use of setons, and is obtained at the cost of a certain per-centage of deaths, and cases of gangrene of the tail. It is not an infallible preservative, but very far from this, and it simply tends to keep up disease in the country by turning the attention of people from the true means of prevention. A wealthy Glasgow cowkeeper buys in cows to which he communicates disease by placing a diseased cow amongst them. He has a large per-centage of recoveries, and all the animals that have thus had the disease, or resisted it, are kept on as regular stock. A capitalist may attempt such a procedure, but it is an expensive way of keeping clear of pleuro-pneumonia.

Dr Willems of Hasselt suggested and carried out in 1851.

the inoculation of the virus of pleuro-pneumonia, in order to induce a mild form of the disease on healthy animals, and prevent their decimation by severe attacks due to contagion. Dr Willems met with much encouragement, and perhaps more opposition. Didot, Corvini, Ercolani, and many more, accepted Dr Willems' facts as incontestable, and wrote advocating his method of checking the spread of so destructive a plague. The first able memoir which contested all that had been said in favour of inoculation appeared in Turin, and was written by Dr Reviglio, a Piedmontese veterinary surgeon. This was supported by the views of many more. Professor Simonds wrote against the plan; and in 1854 the French Commission, whose Report we have before mentioned, confirmed in part Reviglio's views, though from the incompleteness of the experiments further trials were recommended.

Inoculation is performed as follows:—A portion of diseased lung is chosen, and a histouri or needle made to pierce it so as to become charged with the material consolidating the lung, and this is afterwards plunged into any part, but more particularly towards the point of the tail. If operated severely and higher up, great exudation occurs, which spreads upwards, invades the areolar tissue round the rectum and other pelvic organs, and death soon puts an end to the animal's excruciating suffering. If the operation be properly performed with lymph that is not putrid, and the incisions are not made too deep, the results of the operation are limited to local exudation and swelling, general symptoms of fever, and gradual recovery. The most common occurrence is sloughing of the tail; and in London, at the present time, dairies are to be seen in which all the cows have short tail stumps.

Dr Willems and others have gone too far in attempting to describe a particular corpuscle as existing in the lymph of pleuro-pneumonia. All animal poisons can be alone discovered from their effects. In structure and chemical constitution there is no difference, and often the most potent poisons are simple fluids. The Belgian Commission appointed to investigate the nature and influence of inoculation for pleuro-pneumonia very justly expressed an opinion that Dr Willems had not proved that a specific product, distinguished by anatomical characters, and appreciable by the microscope, existed in this disease.

The all-important question—"Is inoculation of service?"—has, in my opinion, been solved. I cannot deal, in the pages of this little work, with the large amount of conflicting evidence on the subject. The Belgian and French commissions, Reviglio's, Simonds', Hering's, my own observations, and those of many more, prove that a certain degree of preservative influence is derived by the process of inoculation. It does not arrest the progress of the disease. It certainly diminishes to some extent, though often very slightly so, the number of cases, and particularly that of the severe ones. This effect has been ascribed to a derivative action, independently of any specific influence, and indeed similar to that of introducing setons in the dewlap. I cannot speak very favourably of the latter process, as indeed I cannot recommend the inoculation of cattle. In London some dairymen have considerable faith in this operation, though its effect is uncertain, and its *modus operandi* a mystery. I should counsel the keeper of dairy stock to select his own animals from healthy herds, and strictly avoid public markets. In many instances, to my knowledge, this has been sufficient to prevent the invasion of this terrible disease.

There is a vital question, the solution of which has rarely been attempted, and which I desire particularly to refer to. "Is it possible to rid her Most Gracious Majesty's dominions of pleuro-pneumonia?" During last century the disease disappeared shortly after we imported it. Meat was less consumed, the population was not so great, the cattle trade not so brisk, and importation from foreign countries very small. Observers last century noticed that "this disease, like most infectious diseases affecting mankind, and imported from distant countries, grows milder the longer it stays with us."* Why shall we not learn from what our forefathers recommended? Dr Layard said in 1757, "The means to prevent this dreadful calamity are twofold: first, to prevent the admission of this disease into these kingdoms; secondly, when unfortunately the contagious distemper is once received, to prevent the spreading and check the progress of it."

Government should adopt means whereby information may be had, at all times, of the extent and exact whereabouts of the disease. A full and satisfactory inquiry should be instituted into the trade in cattle with foreign countries, or within the United Kingdom. The foul trade in diseased meat should be suppressed, the sale of diseased live cattle in public markets prohibited, and sound knowledge diffused, wherever the disease exists, as to the best methods of checking it. All this implies no coercion. Pleuro-pneumonia and every other imported disease may be permanently banished from this country, and the day must come in which such a glorious result will be attained, but not so long as we submit to eating diseased meat, and to an unchecked traffic, home and foreign, in infected cattle.

When you have clearly established the nature of a cause of any disease, its influence can be counteracted by intelligently-directed measures. The period of incubation of

* *The Complete Cow Doctor.* By Joshua Rowlin. Third Edition. 1804.

pleuro-pneumonia is long. It is rare that during that period infected animals communicate the disease. It is most communicable when fully developed. The poison is weak, and often ineffectual until the advanced stages of the malady. Early separation of diseased stock ensures the check, or total arrest of the disease; and the great question is how to accomplish this.

A country invaded like ours, or like Australia, by pleuro-pneumonia, should enforce the infliction of severe penalties on those knowingly selling diseased animals from their own stock or that of others. The channels of importation should be under most rigid inspection, and probably in some cases, such as in our own country, quarantine would be indispensable. Stocks should be mixed as little as possible; all past purchases kept apart; and where large droves of cattle, as in Australia, have to be protected, a system of separating them in lots as small as possible should be adopted. The moment an animal might be observed unwell—and inspection should be very careful—that animal should be slaughtered; and any lot in which this may be noticed should be most rigidly examined, and separated into smaller lots, to be kept clear from each other for a space of at least two months. Placing land on which animals have been fed in quarantine for a twelvemonth, is a ridiculous and useless restriction; but this, we understand, has been largely practised in Victoria.

In this country, in many establishments we have consulted for some time past, the disease has been cleared out at once without selling out or killing an entire stock. If a farmer suffers from pleuro-pneumonia long, it is owing to negligence or ignorance of the fact that the disease is eminently contagious. He should breed his own stock entirely if possible; buy, if necessary, from indubitable sources, and watch against the pasturing of animals near infected ones, or near high roads through which diseased cattle are likely to be driven. If, unfortunately, the disease does appear, kill the first affected, separate the animals as effectually as possible, and support all those in health by liberal diet and ferruginous tonics. It depends entirely on the intelligence with which these injunctions are carried out whether they are successful or not.

CHRONIC DISEASES OF THE RESPIRATORY ORGANS.—CHRONIC COUGH.

What is a chronic cough? is a question of some importance to horsemen, and one which is not very easily answered. When a man coughs beyond the limited period usually assigned to a common cold, he is in fear that it has "settled on his chest," and, perhaps, that he may be consumptive, or attacked with the chronic bronchitis so common on our east coast, and so deadly amongst old people. But the horse is not subject to consumption, and the instances of *bonâ fide* chronic bronchitis are rare. There are several kinds of chronic coughs in horses. One is called a hollow cough, due to lung derangement, and another is characteristic of broken wind; a third is a short cough whilst feeding on dry oats or after drinking cold water. This is often the roarer's cough, due to derangement of the nerves of the throat. The chronic cough is not usually characterised by any special feature which will enable an experienced man to say that it is chronic. I do not, of course, allude to the cough of a broken-winded horse, but to a short sharp bark which may be heard occasionally in the stable, always when the horse is first brought out into the cold air, and usually when any dry and solid object is swallowed. The only sure test of the existence of such a cough is time, and it is of considerable moment that purchasers of horses should know this, as they are very frequently offered horses with colds, throats blistered "a little out of sorts from the sea passage across the Irish Channel," and with the assurance that the symptoms will all disappear in a day or two. I have known such horses bought, taken home, treated, and dead within a short time, proving the disease to be acute and severe enough, and quite sufficient to impress upon the mind of the purchaser a lesson of caution. In other instances, the cough does not disappear, and there is then an endless dispute, where all chances of difference of opinion should have been avoided long before.

Were I to attempt a definition of a chronic cough, I could not say more than that a cough is chronic when the period has elapsed during which a chance of its cure exists. This is vague enough; but there are cases of relapsing sore throat, of slight irritation of the larynx, which persist, and are, after a time, cured, or which disappear when the animal is got, by good management, into robust condition. The disappearance of the cough is an indication that it cannot constitute a permanent cause of unsoundness. On the other hand, if all means have been adopted to control the cough and to cure it, and a newly-bought horse continues to cough for two or three months, it is not expedient for a purchaser to risk the issue; and if the conditions of the purchase admit of it the animal should be returned.

The treatment of a newly-bought horse with such a derangement should be carefully conducted. In the first place, the animal cannot be worked. Gentle exercise is alone admissible, and this is not desirable should any degree of fever exist. An airy stable or spacious loose box is the most certain to benefit the animal, with moderate diet—a double handful of oats thrice daily, and 8 lb. or 10 lb. of hay. Keeping the animal warm by closing every inlet for air, and giving mashes frequently, if not daily, are means often adopted, but with injurious influence.

I wish to denounce the administration of "constitution balls" and "cough balls." An animal that has a cough should not be tormented with balls day after day, and we advise people to give nothing as to the nature of which they are not quite certain, or which is not prescribed by a competent person. A dose of physic has frequently a most desirable effect, and two or three days after its operation has ceased, if the animal is costive, a milder dose may be given, but that is all the animal needs. Again, it is not desirable to mix large quantities of nitre with every feed. Nitre has a very debilitating effect if given repeatedly. There are some astringent electuaries, &c., which a veterinary surgeon may prescribe, but our advice to the purchaser of a young horse with a cough, is to quack as little as possible, use the animal very gently, and attend carefully to diet, free ventilation, and moderate exercise. With horses coughing, it is a very wholesome rule not to do any mischief with drugs, as any ordinary cough has a tendency to cease, and will frequently be cured by nature's spontaneous efforts.

Blistering the throat is very constantly adopted by horse-dealers, and should they have an animal with a chronic cough, the raw blister is an admirable disguise, as it indicates the treatment the animal is undergoing for "a cold." A mustard poultice applied over the throat is of great service in acute cases, but active blistering, which may, perhaps, blemish a horse for life, should be carefully avoided.

I can say with regard to a chronic cough what holds good with many forms of unsoundness, that a well-made animal is not very subject to permanent disease. A horse with a neat head—well put on, a good neck, deep chest, well out behind the elbows, well ribbed home, and with a short back, is likely to be sound in wind, as in most instances he will be sound in limb, in accordance with the laws of symmetry.

Roaring—Dyspnœa.

A roarer, or whistler, is a horse affected with difficulty of breathing from contraction of the air-passages. There are several lesions, which are characterised by the symptoms of harsh, sonorous breathing, and which constitute permanent unsoundness. The deformity in the air-passages may exist in the nose, pharynx, larynx, and trachea.

Cases of Roaring due to Diseases of the Nose.—I. I was recently driven home from the railway station in a cab, and on alighting, remonstrated with the driver for using the worst roarer I think I ever heard. It turned out that the horse, only now six years old, fell on his head when a colt, and smashed his nasal bones, so as to constrict the nasal passages. I have witnessed other cases of depression of the nasal bones attended with a similar result.

II. Tumours frequently plug the one nostril, and as air can only pass through the opposite one, the noise in breathing is extremely loud. The tumours of the nose may be classed under two heads: 1st, The fibrous, or soft polypi; and, 2nd, The osseous.

With regard to the soft nasal polypi, they may be single or multiple, and either occupy the nasal chamber or the adjoining sinuses. They occur usually in adult or aged horses, and their presence is at first only indicated by the larger current of air through one nostril than through the other. Breathing may be totally stopped through one chamber, and by this time deformity of the facial bone is observed. On examining the nose carefully, the polypus may be seen or felt. On percussion, the part occupied by the solid mass is found dull, especially when contrasted with the healthy side; there is frequently some discharge, and occasionally some hæmorrhage from the chamber occupied by the polypus.

Roaring, due to such an obstruction, can be cured by removal of the polypus, which must be effected by cutting, ligature, or torsion.

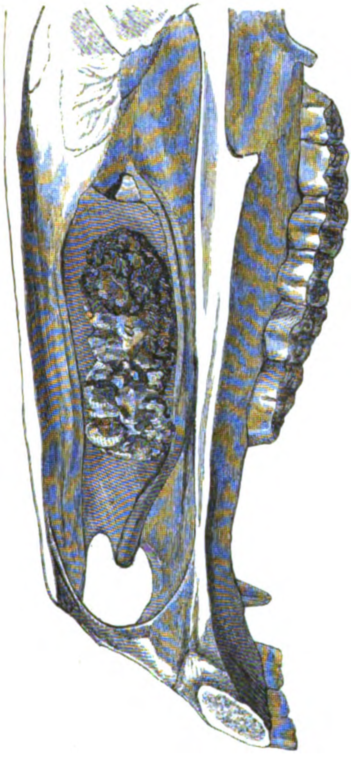


Fig. 144.—Nasal Polypus.

Of the three operations, torsion, or laceration of the polypus, is most practicable. It is attended with very considerable hæmorrhage and injury to the turbinated bones and schneiderian membrane, but it is safe and effectual.

The osseous tumours of the nose are not common, but disease such as that represented by Fig. 143 in this volume, may come under this head. I have, however, had a singular case since coming to Edinburgh.

Mr A. M. Edwards, the distinguished young surgeon of this city, was, whilst on a professional visit in Fifeshire, driven from Kilconquhar station in an omnibus drawn by two horses, of which one, to all appearance the best, appeared to suffer intolerably from difficult breathing. Mr Edwards found that the violent roaring was due to an osseous tumour in the near nostril; and as the animal was young—six years old—and well-bred, he suggested that my advice should be obtained. The horse was sent in to the New Veterinary College Infirmary, and I then learned that several veterinary surgeons declared that death must necessarily follow so formidable an operation.

I had the horse cast, the false nostril slit up, a narrow saw passed up, and the tumour cut through to its base; a second cut with the saw enabled me to remove a large slice, and with the aid of bone forceps, the mass, about the size of a man's fist, was effectually removed. I fixed the horse so as not to lacerate the wound, which I carefully stitched, and in a month the animal was discharged cured.

III. A singular case of roaring is recorded by Hering. In the month of September, 1842, a filly, 2½ years of age, was taken to Professor Hering, in consequence of severe roaring, which had been observed since the animal was a year and half old. The breathing was laboured and audible, though but slightly heard when the animal was quiet, and very manifest on exertion. There was a dense mucous discharge from both nostrils, but especially the left; and in every other respect the filly appeared healthy. There was no enlargement of glands, and percussion of the sinuses indicated that they were clear. On further examination, to ascertain if any morbid matter escaped from the guttural pouches, Hering noticed that there was no air passed through the right nasal chamber. A flexible tube passed freely into the pharynx through the left nostril, but not through the right; and an obstruction was diagnosed, but of what nature, there was not sufficient evidence to indicate. The animal was slaughtered, at the request of the owner; and the posterior opening of the right nasal chamber was found closed by a fold of mucous membrane. I have striven to shew this in the accompanying sketch, which I made in Stuttgart from the dried head, in 1854.

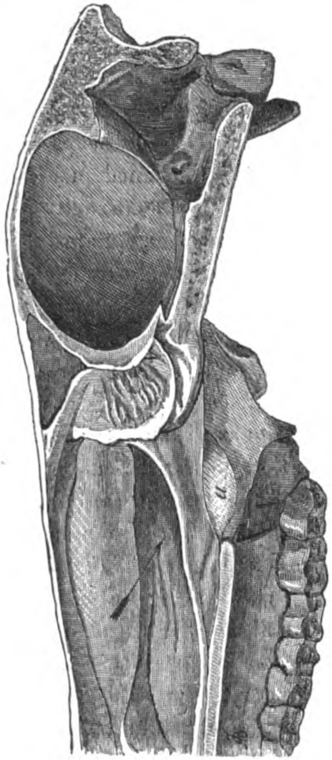


Fig. 145,

Hering says that, without doubt, the deformity was congenital, and the occurrence of such a case should put practitioners on their guard in future, so as to resort to the puncture of the occluding membrane, and cure the roaring.

IV. Tumours in connection with the pharynx are not unfrequently the causes of roaring. Simple pharyngeal polypi may partially obstruct the larynx, and sometimes may move in position, and choke the animal. Fibrous and fibro-cystic tumours, growing from the epiglottis, or from the arytenoid cartilages, have been met with on dissection in animals known during life to have been bad roarers.

I have seen bad cases of roaring from melanotic disease in the group of lymphatic glands situated behind the pharynx and below the atlas; also, from similar disease in the lymphatic glands on the inner side of the parotids. Distension of the guttural pouches by thickened pus will have the same effect.

V. When the larynx and pharynx are inflamed, roaring is a symptom. We cannot satisfactorily examine horses when affected with sore throat, and must wait for the acute disorder to have passed off. A permanent thickening of the mucous membrane may result, and in some rare cases false membranes are thrown out, become organised, and may form septa in the passage, so as to interfere permanently with the respiration. Cline, the celebrated London surgeon, who lived in the first quarter of the present century, said that the disorder in a horse which constituted a roarer, was caused by a membranous projection in a part of the windpipe, and was a consequence of that part having been inflamed from a cold, and injudiciously treated. Such cases are, however, quite exceptional.

VI. Youatt demonstrated in 1833 that roarers are usually affected with atrophy of the muscles of the larynx on the

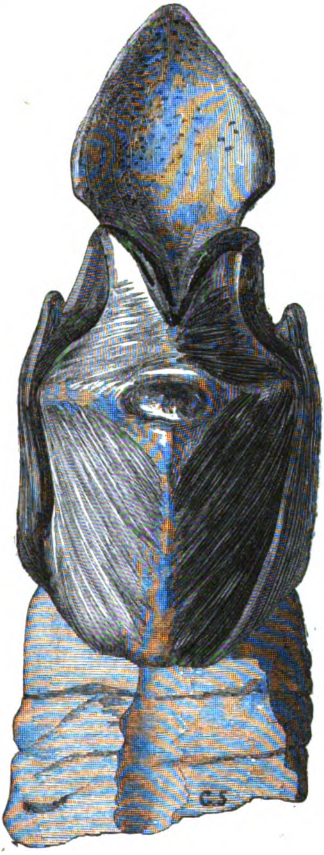


Fig. 146.

left side. Mandl has since described the process of fatty degeneration which occurs in these muscles as the result of paralysis. The origin of the paralysis is usually an inflammatory attack, and the circumstance that the muscles on the left side are usually affected has been explained by stating that as these muscles are supplied with the recurrent nerve, which, on the left side, passes off from the pneumogastric further back than on the right, any inflammatory disease of the chest is more likely to affect the left recurrent nerve, and indirectly induce disease of the muscles to which it is distributed.

Fig. 147.

VII. The deformities of the windpipe, attended with roaring, are numerous. The trachea may be distorted in horses that have been used with a tight-bearing rein, and an instance of this is here figured.

Constriction of the windpipe has frequently been witnessed, and amongst the most curious forms of this disease we have cases in which the ends of the cartilages curl in and divide the passage into two narrow tubes, through which an insufficient amount of air at last passes, and the animal dies of suffocation. Tumours from the vertebræ, and deposits such as those represented below, sometimes occasion roaring.

The diagnosis of roaring demands a careful examination of a horse through various paces, and chiefly in a gallop. An enclosed space such as a riding-school is favourable for the trial, and the precise seat of roaring may be made out by direct examination of the air passages, and especially by auscultation.

The treatment of roaring is either palliative or curative. A bad roarer may be rendered useful by being made to wear

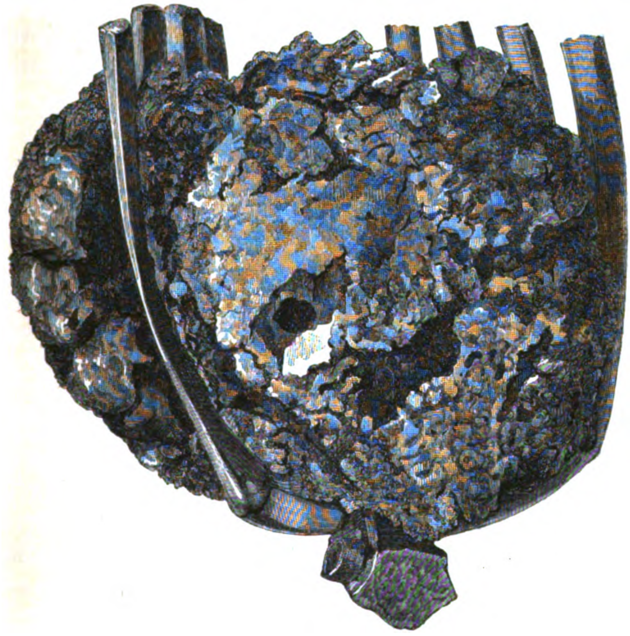


Fig. 148.

carefully adapted pads over the false nostrils, or by having a tube inserted in the trachea. The latter is an operation chiefly performed in acute cases when suffocation is threatened.

Various cures for roarers have been from time to time suggested. It is evident that nasal tumours, depressions of bone, exudations, &c., must be very differently treated. When ever paralysis of the laryngeal muscles occurs, the disease must be incurable, but Günther of Hanover has suggested, and I understand successfully carried out, for this form of disease, the excision of the lip of the arytenoid cartilage on the affected side.

The details concerning the causes which are attended with roaring, suggest to practitioners a variety of ways to overcome the troublesome symptoms in special cases.

Broken Wind.

This is a form of dyspnœa or difficult breathing in the horse, due to organic lesion of the thoracic organs. It is usually observed as a chronic and incurable disease, interfering with the animal's usefulness, and constituting one of the worst forms of unsoundness. Concerning it there has been much discussion, and many differences of opinion; and it would be well to have a large number of well-observed cases in different countries, grouped so as to deduce more accurate information than we possess at present.

Causes.—Broken wind is a disease of the low-bred horse, with a defective form and bad constitution. It is asserted that the Arabian, Persian, Barb, Spanish, and Portuguese horses are quite free from the malady. This has been ascribed to the good management, as well as to the constitutional vigour of these animals; and in Spain it is said that the cultivation of artificial pastures has led of late years to the development of broken wind. Rodriguez, a Spanish veterinarian, asserts that in the vicinity of Aranjuez many horses became broken-winded on being fed with the artificial grasses, and the disease ceased when the natural grasses were employed.

Demussy says that the long experience of the people of various countries would indicate that broken wind depends on the use of hay and dry forage, inasmuch as the malady never developes itself in horses chiefly fed on the straws of cereals and barley. Green food does not produce broken wind.

We are inclined to think that broken wind depends more on the feeding of horses than on any other cause. In some countries, the hay is bad, rushy, coarse, and often musty A large quantity of such food, with a very moderate supply of corn, tends to produce a pod-belly, and interferes with the organs of respiration. In this country, it is more the cart-horses and bad-bred coach-horses that suffer from the disease, and frequently from their injudicious management as regards feeding.

Professor Coleman attributes broken wind to the fact that horses are compelled to perform exertion on a full stomach, and that one of the most common causes is riding or driving a horse hard which has previously drunk a large quantity of water. The experience of coaching days is brought to bear by Professor Coleman, who mentions in his lectures that post or coach horses never become broken-winded when used on the road, and no animals with this disorder were seen in the coaches, except such as were bought affected with it. He attributed this to the manner in which they were fed, each horse having probably 20 lbs. of oats daily, but not more than 5 lb. of hay, and no water before work. They were driven fast and long, but were not subject to broken wind on such treatment. Coleman went on to say that farmers' and millers' horses are most disposed to this disease, because they feed them largely with hay and chaff and mealy food, which blows them out enormously, and then they are worked without discretion. 'Nimrod' confirms Coleman's statement. He says that, in the stables of the fast coaches, horses were only allowed half rations of hay (28 lbs.) each for seven days; but that they got a bushel and a half of corn (about 60 lbs.) each, besides; and that a broken-winded horse was scarcely heard of among them. "I have taken some pains," said 'Nimrod,' "to ascertain this fact by my own personal inquiries. One proprietor, who has nearly fifty horses at work—many of which are in as fast coaches as any that travel on the road—assured me lately that he had not a broken-winded horse in his yard; whereas, before he stinted them in their hay, he generally had one in five in that state." Percivall said, in 1853:—"I believe that broken wind is a much less frequently met with disease than formerly. I can avouch that it prevails little among military horses; its occurrence is not anything comparable to that of roaring, and it seems to be less prevalent among high than low bred horses. . . . For the most part, broken wind affects aged horses; rarely do we see it in young ones. D'Arborne says, he never met with a case prior to the sixth year of age, and believes that mares are more disposed to it than horses."

We have seen a case of broken wind at five years of age, and the subject of it was a bay gelding, about fifteen hands, narrow and leggy, in which the disorder appeared very suddenly and became very severe.

Symptoms.—In the earliest stage, a horse is observed not to thrive as well as he should; has a short, continuous cough. The broken-winded cough is spasmodic, occurring by paroxysms, and very troublesome on the first appearance of the disorder; it becomes feeble, short, and single as the malady developes itself. In examining horses for soundness, the cough produced by pressure on the larynx is often quite sufficient to indicate that the animal is broken-winded. The animal cannot relieve itself by an active action of the chest and lungs, and the suppressed cough induced is extremely characteristic.

On looking at the flanks of a broken-winded horse, it is found that at every expiration the solid walls of the chest drop, and then the abdominal muscles succeed in action, so that there is a double movement to effect the expulsion of air from the lungs. Mr Percivall proposes to call this *jerking respiration.* In bad cases of broken wind, if the anus is watched, a singular protrusion and recession may be noticed as the animal breathes, and synchronous with the respiration. The double action of the expiratory muscles is best seen in the broken-winded horse after exertion, but even when not exerted, the breathing is frequent and laboured.

Auscultation has been resorted to for the diagnosis of broken wind, and Mr Percivall quotes Delafond, who says:—"The pathognomonic signs of pulmonary emphysema"—a condition of lung often witnessed in broken wind—"are: 1st, The interrupted respiration; weak respiratory murmur; loud resonance of the thoracic parietes; rubbing sound; sibilous and crepitant râles. 2ndly, The simultaneous existence of all these symptoms in many parts of the lung indicates general vesicular dilatation and interlobular emphysema. 3rdly, Weak respiratory murmur during expiration, rubbing sound during inspiration, abnormal resonance of both sides of the chest, are more especially the signs of simple vesicular dilatation confined to the anterior lobes, or of dilatation throughout the pulmonary tissue. 4thly, The dry crepitous and dry sibilous râles, deeply interrupted respiration, very loud resonance, and extreme dyspnœa during exercise, are the special indications of interlobular emphysema. 5thly, and lastly, The presence of dry crepitous râle and loud resonance, located in one or more parts of the lungs, announce local vesicular dilatation in those places."

The digestive organs are functionally disturbed in broken wind, and the flatulence which so often constitutes a prominent symptom, doubtless suggested to the older farriers the name by which the malady is generally known in Britain. A barbarous operation used to be performed, and we have heard of its having been practised within the last ten or fifteen years, to relieve the flatulence, and cure the broken wind. It consisted in making an artificial anus, by passing a red-hot iron into the rectum below the anus.

Broken-winded horses become unfit for hard, quick, and constant work. They wear out rapidly, and sometimes die suddenly during exertion, from active congestion of the lungs and hæmoptysis.

Post-mortem appearances.—Delafond tells us that out of fifty-four broken-winded horses which he examined, he found forty-five with emphysema, including dilatation of the air-cells of the lungs. One-fourth of the total number of cases of broken wind are attended with other lesions. Bracy Clark observed emphysema in a broken-winded mare as far back as 1795. Coleman declared that broken wind was due to a rupture of the air-cells, and that "in examining broken-winded lungs we find the surface externally assuming all the appearances of health; though, if compared with lungs in a normal state, we shall find them specifically lighter, arising from their containing a quantity of air, which the last expiration of the animal was unable to get rid of." M. Percivall observed in two cases thickening of the mucous membrane in the trachea and bronchial tubes, coupled with emphysema, and in one case thickening of the mucous membrane of the larynx, especially over the arytenoid cartilages. Several observers have failed to discover any trace of emphysema in some well-marked cases of broken wind, and it is now undoubted that the symptoms of the disease may occasionally be due to the lesions of chronic bronchitis (Rodet, Percivall), atrophy of the heart (Bartlet, Gibson, and several others), hypertrophy of the heart and tumour pressing on the lungs (Ercolani), lesions of the diaphragm (Girard), and in some cases to some hidden lesions of the nerves, manifested only by the symptoms of broken wind.

In stating our opinion on the nature of broken wind, we unhesitatingly affirm that it is at first a purely nervous disorder, dependent on the condition of the digestive organs, and in which the pneumogastric nerve is especially involved. As the result of a cause which thus operates through the nervous system, dyspnœa ensues, and organic lesions soon follow, and most frequently in the shape of pulmonary emphysema. We do not attribute the early symptoms of broken wind to the latter lesion, and consider the structural changes as mere effects of the disease rather than the disease itself. If pulmonary emphysema constituted broken wind, how could we explain the remarkable influence exerted by arsenic in the treatment of this disease, of the sudden disappearance of all symptoms when shot or tallow has been introduced within a horse's stomach by a fraudulent coper, or the very remarkable improvement on a judicious system of diet. The latter might palliate in the case of emphysema, but the first has an effect which we consider to be induced chiefly through the nervous system.

The symptoms of broken wind may be very greatly relieved by feeding on the principle already noticed, and by administering daily arsenic in three-grain doses, with a drachm of carbonate of potash, and a quarter of an ounce of bruised coriander seeds. The latter is chiefly used as a palatable encipient. Powders thus made up may be given in food, and the operation of the medicine must be watched, so as to check its administration when the appetite is disturbed, or the eyes appear red and inflamed.

THICK WIND.

This is a horseman's expression for that short, quick breathing observed in animals that have once been subject to acute inflammation of the lungs, or that, from some other cause, have only a very limited portion of lung to breathe with.

Thick wind is a permanent unsoundness, and can only be partially relieved by attention to the animal's diet, &c.

PARASITIC AFFECTIONS OF THE NOSE—THE SHEEP BOT.

The most accurate information on the subject is furnished us by Bracy Clark, and I do not therefore hesitate to transcribe his remarks from his celebrated Memoir on the Bots:—

"The eggs of this species I have not yet seen, the sheep being very shy under their attacks, which renders it difficult to approach them near enough to see the actual operation; the obscure colour of the fly also adds to the difficulty. The sheep are exceedingly annoyed with them, and to defend themselves get into the roads in dry hot weather, and lie down along the dusty ruts, holding their heads close to the ground, which makes it difficult for the fly to get at them; at other times one finds them standing up, with their heads held low, almost to the earth, and the nose turned between the fore-legs, their nose being nearly in contact with the ground. This mode of defence must render the attack of the fly exceedingly difficult; at other times, when in the open field, they congregate together, forming a dense compacted mass or phalanx, which, except to the exterior ones, is scarcely accessible to the fly, the noses of the greater part of them pushed against each other, or held nearly close to the ground; in this way those placed in the centre must be very secure.

"The manner in which this species deposits its ova, has not, I believe, been described; nor is it easy to see, though close to the animal at the time, exactly in what way this is accomplished, owing to the rapid motion and obscure colour of the fly, and the extreme agitation of the sheep; but from the actions of the sheep afterwards, and the mode of defence it takes to avoid it, there is little doubt that the egg is deposited on the margin of the nostril. The moment the fly touches this part of the sheep, they shake their heads, and strike the ground violently with their fore-feet, at the same time running away, and holding their noses close to the ground, and looking about them on every side to see if the fly pursues, and as they go along they often smell also to the grass, and look anxiously into it, lest one should be lying in wait for them; if they observe one, they gallop back again, or take some other direction. As they cannot, like the horses, take refuge in the water, they have recourse to a rut, dry dusty road, or gravel-pit, as a defence, as we have before remarked.

"Observations on these flies are best made in dry weather, and during the heat of the day, when by driving the sheep from the retreats, the attack of the fly and the emotions of the sheep are easily observed.

"I imagine the nostril becomes highly inflamed and sore, from their repeated attacks, and the consequent rubbing of the nose against the ground, which, together with certain instinctive apprehensions of these flies, occasion their touch to be so much dreaded.

"From the difficult and precarious modes these Œstri pursue in depositing their eggs, they cannot succeed in depositing but a few in each sheep; whereas, if, on the contrary, they actually entered those cavities of the face to effect it, they must deposit them all, and in one subject, the improbability of which in respect to the other species is already stated.

"*Of the Larva.*—From one to seven or eight are generally found in the cavities of the face, what are called by anatomists of the human, the maxillary and frontal sinuses, but which in quadrupeds are cavities of considerable extent and magnitude, and the thin flexible bones which constitute them are covered with a dense white membrane, upon the secretions of which they feed, and these membranes are found more or less inflamed by their presence.

"Vallisneri has remarked, that Alexander Trallien, a famous Greek physician of the sixth century, relates the following anecdote, which has an undoubted reference to these larvæ, that 'Democrites, an Athenian, being subject to fits of epilepsy, determined to consult the oracle at Delphos for a remedy, and received for answer,

'Quos madidis cerebri latebris procreare capella
Dicitur humores, vermem de vertice longum.'

"An old man of eighty years explained to him the fact of the existence of such worms, and pointed out the means of obtaining them by a sack tied about the nose of the sheep, into which they were received on falling from the sinuses, and this way also was employed by Vallisneri and Reaumur.

"When young, these larvæ are perfectly white and transparent, except the two horny plates, which are black. As they increase in size, the upper side becomes marked with two transverse brown lines on each segment, the anterior one shorter and narrow than the posterior; and some spots are also seen on the sides. The body consists of eleven segments.

"I procured, about the middle of June, some full-grown larvæ of the Œ. Ovis from the inside of the cavities of the bone which supports the horns of the sheep. They are nearly as large as those of the Œ. Equi, of a delicate white colour, flat on the under side, and convex on the upper; having no spines at the divisions of the segments as the Gastricolæ, but are provided with tentacula at the small end. The other end is truncated, with a prominent ring or margin, which serves the same purpose, in an inferior degree, as the lips of the Œ. Equi and hæmorrhoidalis, by occasionally closing over, and cleaning the horny plate from the mucus and pus of the membranes, with which it is subject to be smeared and prevented from performing its office. When this margin opens after closing over the plate, it occasions frequently a slight snap from the sudden admission of the air.

"They move with considerable quickness, holding with the tentacula as a fixed point, and drawing up the body towards them. On the under side of the larva is placed a broad line of dots, which, on examination with glasses, appear to be rough points, serving, perhaps, the double purpose of assisting their passage over the smooth and lubricated surfaces of these membranes, and of exciting a degree of inflammation in them where they rest, so as to cause a secretion of lymph or pus for their food.

"I have mostly found these animals in the horns and frontal sinuses, though I have remarked that the membranes lining these cavities were hardly at all inflamed, while those of the maxillary sinuses were highly so. From this I am led to suspect they inhabit the maxillary sinuses, and crawl, on the death of the animal, into these situations in the horns and frontal sinuses.

"The breeds of these, like the Œ. Bovis, do not appear confined to any particular season, for quite young and full-grown larvæ may be found in the sinuses at the same time.

"When full-grown, they fall through the nostrils, and change to the pupa state, lying on the earth, or adhering by the side to a blade of grass.

"The fly bursts the shell of the pupa in about two months, and the veins of the wing."

Parasitic Disease of the Lungs in Calves and Sheep.

This malady is known by many names, such as bronchitis, hoose, &c. It is very prevalent in some counties of England, usually confined to low and damp lands, and affecting young animals immediately after they begin to eat grass. In Scotland we have generally seen the disorder in English calves. It prevails extensively over the continent of Europe. The Germans call it *lungenwurmseuche* and *lungenwurmhusten*, or in Latin, *Phthisis pulmonalis verminalis*.

Symptoms.—The early signs are fits of coughing, followed by very manifest dyspnœa, gaping and rubbing the nose and chin on the ground. The animals get weak, often retain their appetite, but are very anœmic, thin, and with peculiarly blanched mucous membranes. The disease is chronic in its nature, and death is due to exhaustion, and is sometimes preceded by a dropsical state of the body.

It is rare to see the disease in an old animal, and whenever such a case occurs, it is in an animal reduced much by previous illness. It has been seen in cows as old as six and ten years. In Jamaica cattle of all ages are affected, and in Switzerland the disease is common in pigs.

In fowls the malady is known by the name of gapes, and Dr Wiesenthal, Professor of Anatomy at Baltimore, U.S., writing in 1797, says:—"There is a disease prevalent among the gallinaceous poultry in this country called the *gapes*, which destroys eight-tenths of our fowls in many parts, and takes place in the greatest degree among young turkeys and chickens bred upon established farms. Chicks and poults, in a few days after they are hatched, are found frequently to open their mouths wide and gasp for breath, at the same time sneezing, and attempting to swallow. At first the affection is slight, but gradually becomes more and more oppressive, and ultimately destroys. Very few recover; they languish, grow dispirited, droop, and die. It is generally known that these symptoms are occasioned by worms in the trachea. I have seen the whole windpipe completely filled with these worms, and have been astonished at the fowls being capable of respiration under such circumstances."

What Dr Wiesenthal wrote last century applies well to gapes as prevailing in different parts of this country at the present time. Pheasants and partridges are also liable to the disease. Dr Spencer Cobbold says:—

"This parasite has been found and recorded as occurring in the trachea of the following birds, namely, the turkey, domestic cock, pheasant, partridge, common duck, lapwing, black stork, magpie, hooded crow, green woodpecker, starling, and swift. I do not doubt that this list might be very much extended if our British ornithologists would favour us with their experience in the matter. Hitherto I have been surprised to find how few of those to whom I have mentioned the subject appear to be acquainted either with the nature of the parasite, or with the various methods to be adopted in curing the disease to which its presence in the windpipe gives rise."

In the calf, the parasites are found in large numbers in the trachea, or partially developed in the substance of the lungs. It is the *strongylus micrurus* which is found in the calf, and occasionally in the horse and ass. In lambs and kids, the parasite is termed *strongylus filaria;* and in the pig it is *strongylus contortus.* In *gapes,* the parasite is *sclerostoma syngamus.*

We find, on examining the lungs of sheep at the slaughter-house, that almost all in the first year of their lives have indications of deposit in the lungs—at one time supposed to be tubercular, but which we now know is due to parasitic productions.

Strongyli are not easily killed. Ercolani has found them living thirty days after exposure to air. They were dried up, but on being moistened with water, moved and gave other signs of life.

Treatment.—The same principles must guide us in treating this disease in animals, and Dr Spencer Cobbold has stated the methods to be adopted in the gapes of birds as follows:—

"First, When the worm has taken up its abode in the trachea of fowls and other domesticated birds, the simplest plan consists, as Dr Wiesenthal long ago pointed out, in stripping a feather from the tube to near the narrow end of the shaft, leaving only a few uninjured webs at the tip. The bird being secured, the webbed extremity of the feather is introduced into the windpipe. It is then twisted round a few times and withdrawn, when it will usually happen that several of the worms are found attached. In some instances this plan entirely succeeds. But it is not altogether satisfactory, as it occasionally fails to dislodge all the occupants.

"Secondly, The above method is rendered more effectual when the feather is previously steeped in some medicated solution which will destroy the worms. Mr Bartlett, superintendent of the Zoological Society's Gardens, employs for this purpose salt, or a weak infusion of tobacco; and he informs me that the simple application of turpentine to the throat externally is sufficient to kill the worms. To this plan, however, there is the objection that, unless much care be taken, the bird itself may be injuriously affected by the drugs employed.

"Thirdly, The mode of treatment recommended by Mr Montagu appears worthy of mention, as it proved successful in his hands, although the infested birds were old partridges.' One of his birds had died from suffocation; but he tells us that 'change of food and change of place, together with the infusion of rue and garlic instead of plain water to drink, and chiefly hempseed, independent of the green vegetables which the grass-plot of the menagerie afforded, recovered the others in a very short time.

"Fourthly, The plan I have here adopted, by way of experiment, of opening the trachea and removing the worms at once. This method is evidently only necessary when the disease has advanced so far that immediate suffocation becomes inevitable; or it may be resorted to when other methods have failed. In the most far-gone cases, instant relief will follow this operation, since the trachea may with certainty be cleared of all obstructions.

"Lastly, The most essential thing to be observed, in view of putting a check upon the future prevalence of the disease, is *the total destruction of the parasites after their removal*—a precaution, however, which cannot be adopted if Mr Montagu's mode of treatment is followed. If the worms be merely killed and thrown away (say, upon the ground), it is scarcely likely that the mature eggs will have sustained any injury. Decomposition having set in, the young embryos will sooner or later escape from their shells, migrate in the soil or elsewhere, and ultimately find their way into the air-passages of certain birds in the same manner as their parents did before them."

So far as calves and sheep are concerned, we find that they should be supported with tonics, and be made to inhale the fumes of iodine, chlorine, or tobacco. Mr Stephen, of Cartruther, mentioned, at a meeting at Liskeard, in Cornwall, held on the 14th of September, 1860, that the plan he adopted was as follows: "The lambs were put into a house as air-tight as possible, in lots of about forty. The ingredients—viz., tar, sulphur, and spirits of turpentine—were put into a pot of burning coals, whereby a gas was evolved which completely filled the house. The pot was suspended by a chain from the ceiling, and was brought as near to the heads of the lambs as convenient. An addition of the ingredients was made when necessary, to maintain a regular supply of gas. They were kept in this situation about twenty-five minutes each time. This treatment was repeated thrice, and no further loss sustained."