OUR DOMESTIC ANIMALS.

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DOMESTIC ANIMALS

IN

HEALTH AND DISEASE.

FIRST DIVISION.—ORGANS OF DIGESTION: THEIR FUNCTIONS AND DISORDERS.

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.

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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 2½ lbs. 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 accurate 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 deadly. 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 by 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

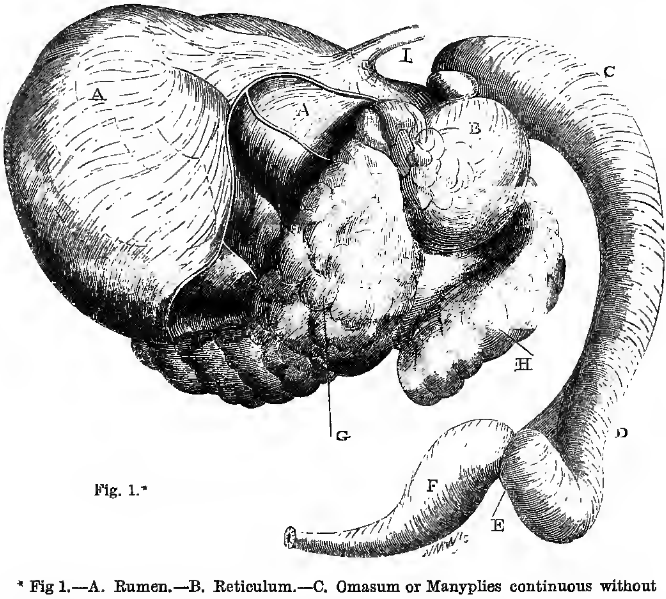


Fig. 1.*

* Fig 1.—A. Rumen.—B. Reticulum.—C. Omasum or Manyplies continuous without demarcation with the Abomesum 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.

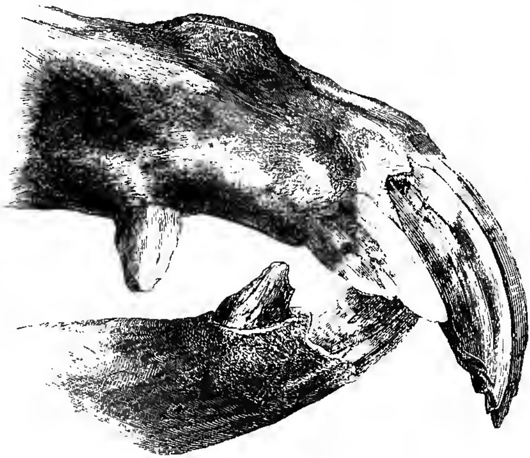


Fig. 5.

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.

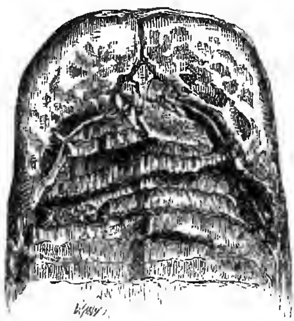


Fig. 6

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

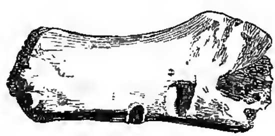


Fig. 7.

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 may 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.

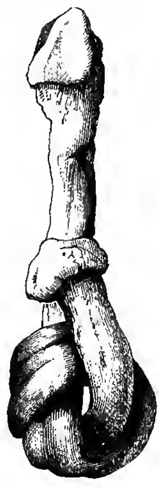


Fig. 9. (DALTON.)

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_3 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 mastieation. (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.

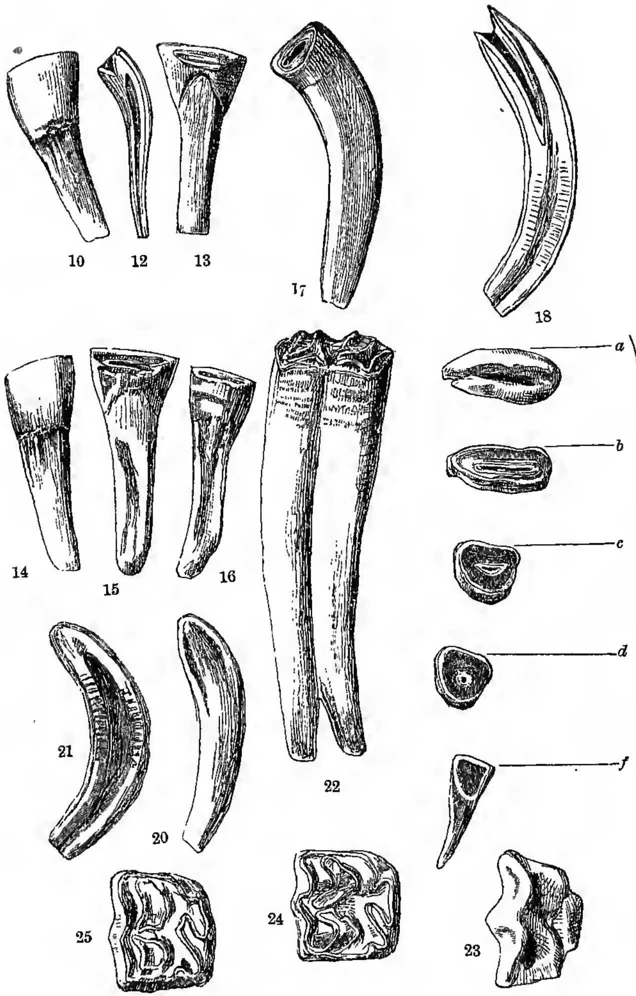


Fig. 19.

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.

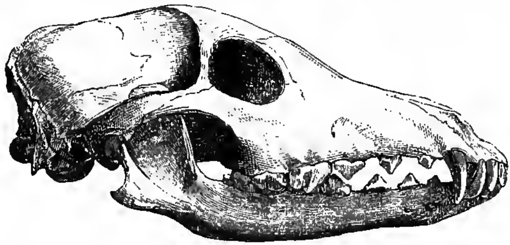


Fig. 26.

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

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

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.

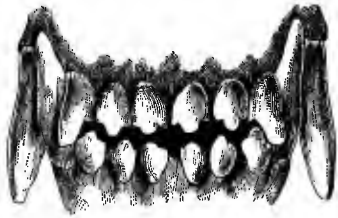


Fig. 28.

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 tnree 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 versa*. 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.

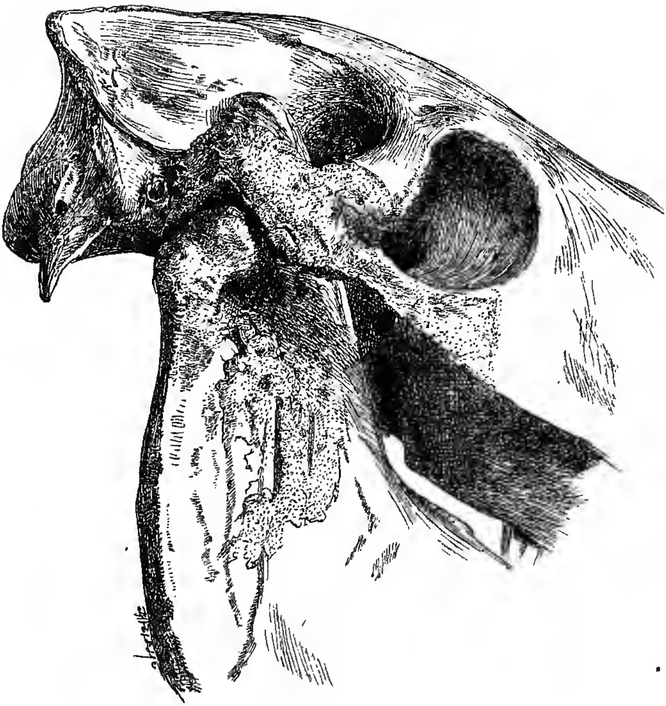


Fig. 32.

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.)

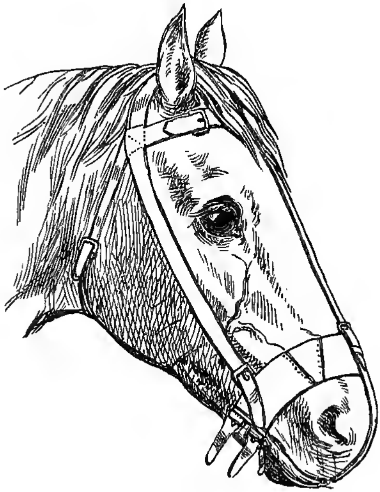


Fig. 33.

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:—

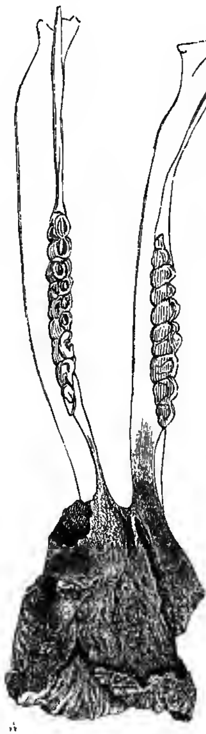


Fig. 35.

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

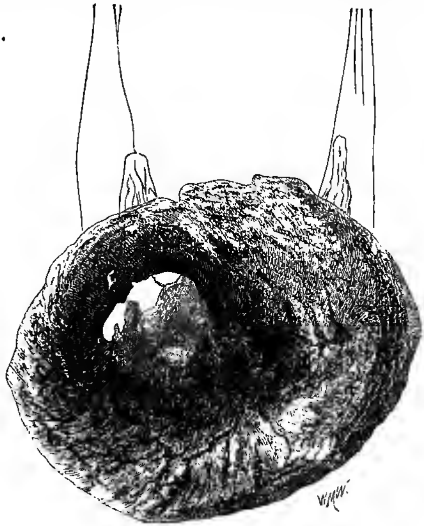


Fig. 36.

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

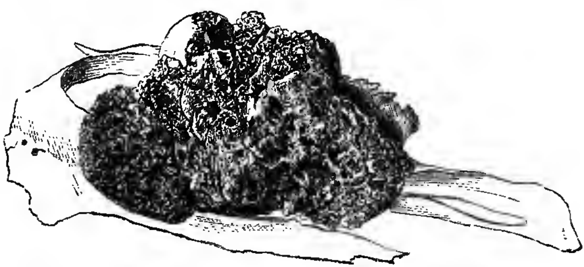


Fig. 37.

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

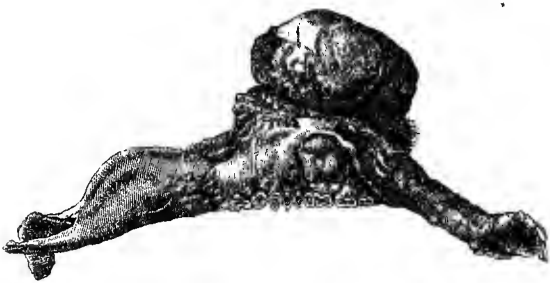


Fig. 38.

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:—

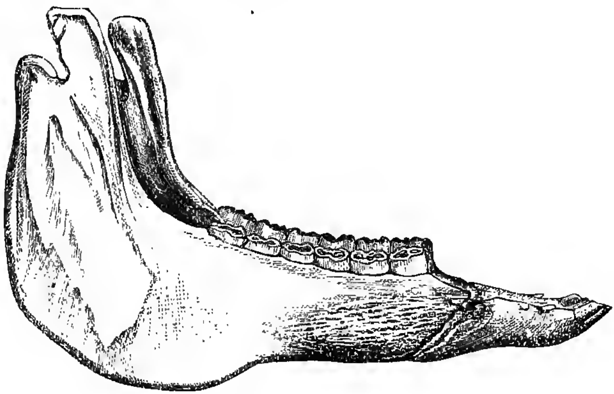


Fig. 40.

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-

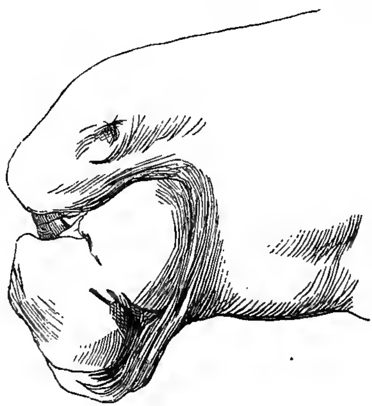


Fig. 41.

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

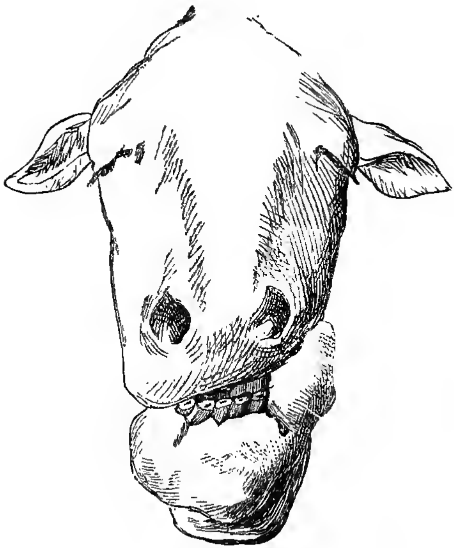


Fig. 42.

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

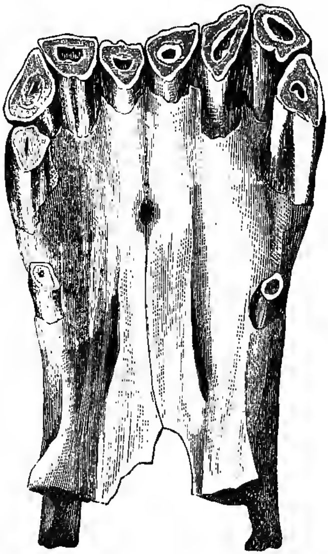


Fig. 44.

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; aud 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. Macrops 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.

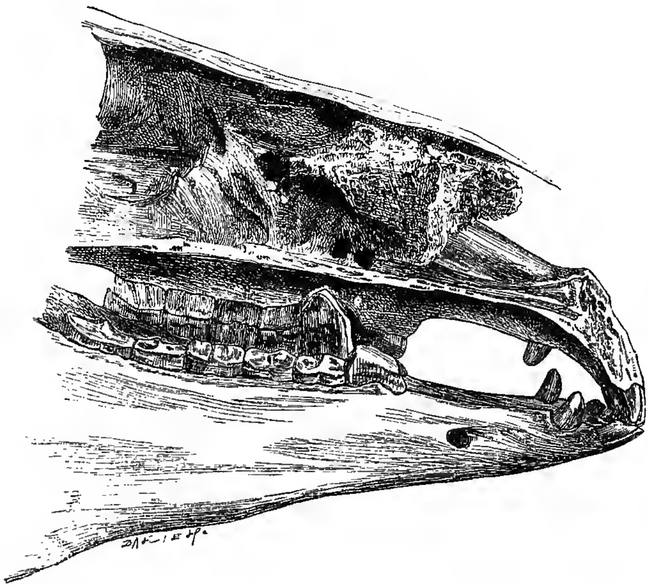


Fig. 46.

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 the 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 alveolns, 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 degenetion. 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.

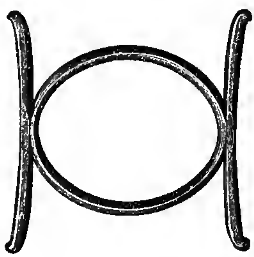


Fig. 47.

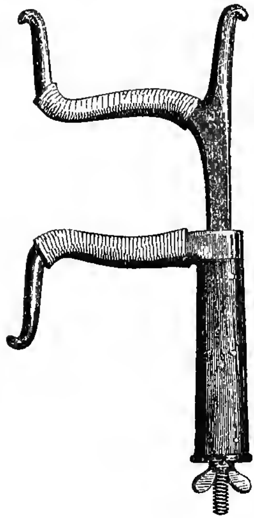


Fig. 48.

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

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

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

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

"*Dec.* 16*th*.—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.

"19*th*.—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.* 3*rd*, 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.

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

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

"*Appearance of the head after dea'h.*—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.

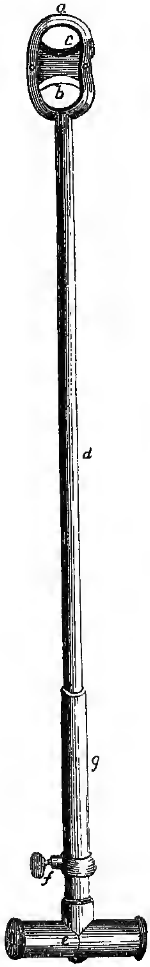


Fig 50.

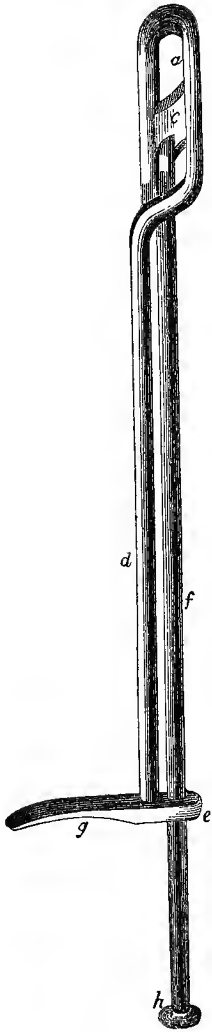


Fig. 51.

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

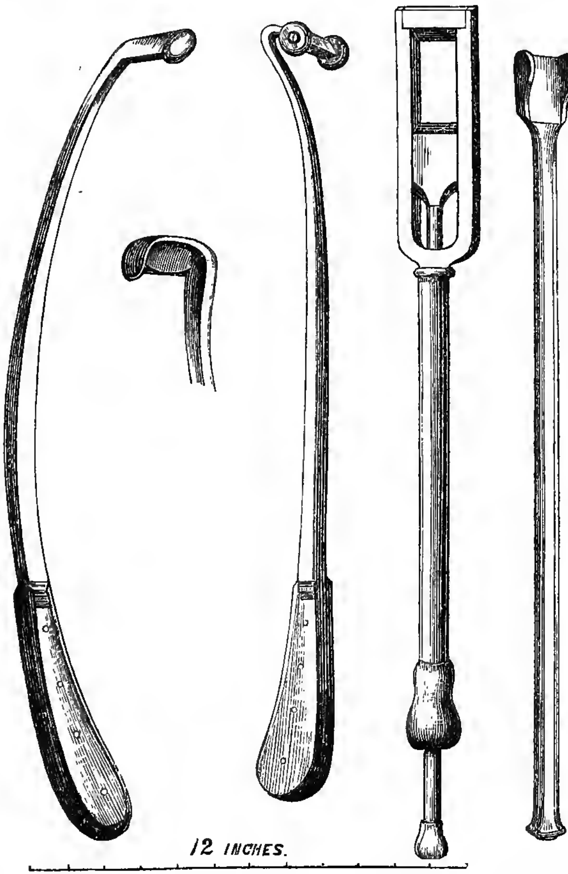


Fig. 54. Fig. 55. Fig. 52. Fig. 53.

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

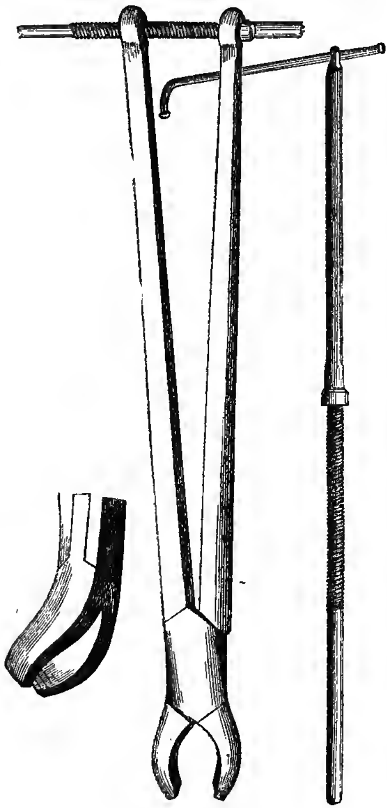


Fig. 56.

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.

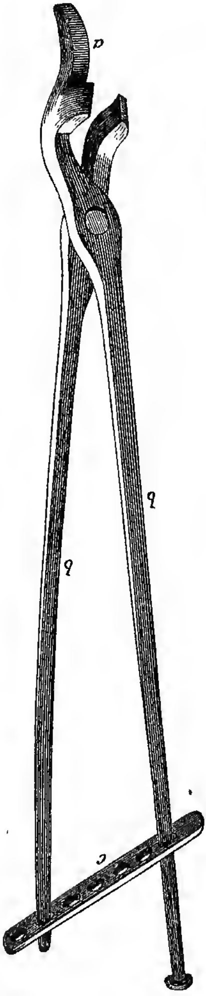


Fig. 58.

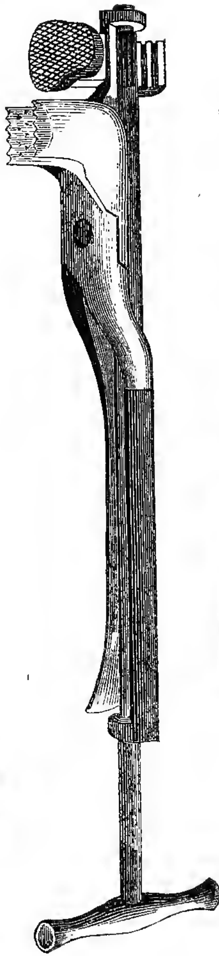


Fig. 59.

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.

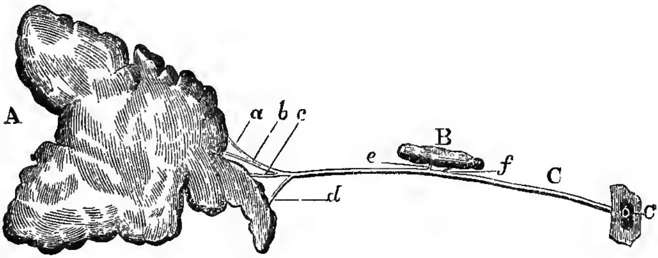


Fig. 62.

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.

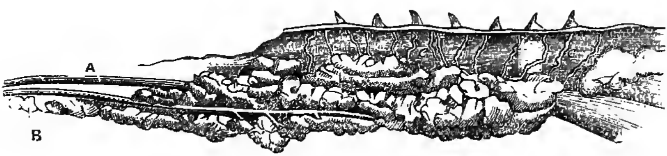


Fig. 63.

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.)

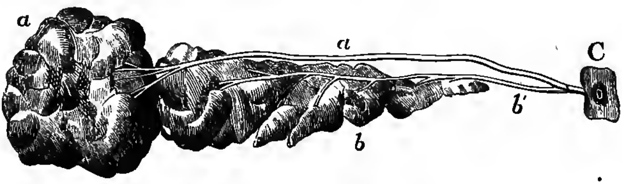


Fig. 64.

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

* *Lecons 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

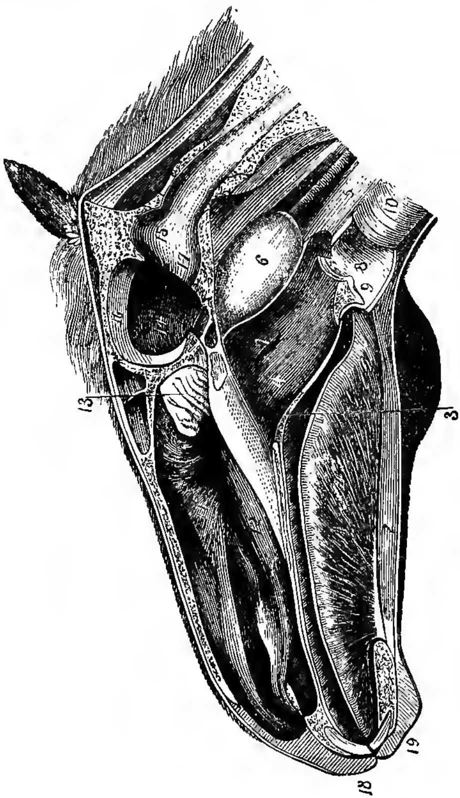


Fig. 65.

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

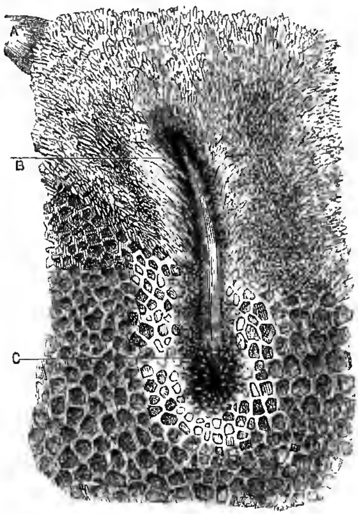


Fig. 66.

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 lef 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.*

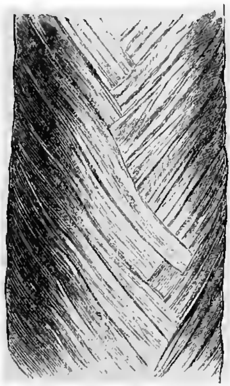


Fig. 67.

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

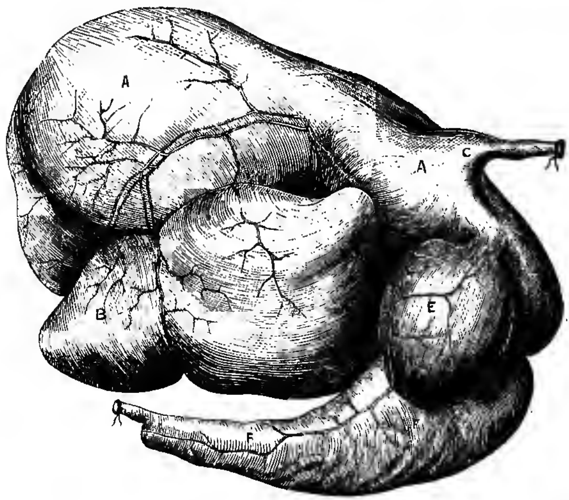


Fig. 68.—(Colin.)

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

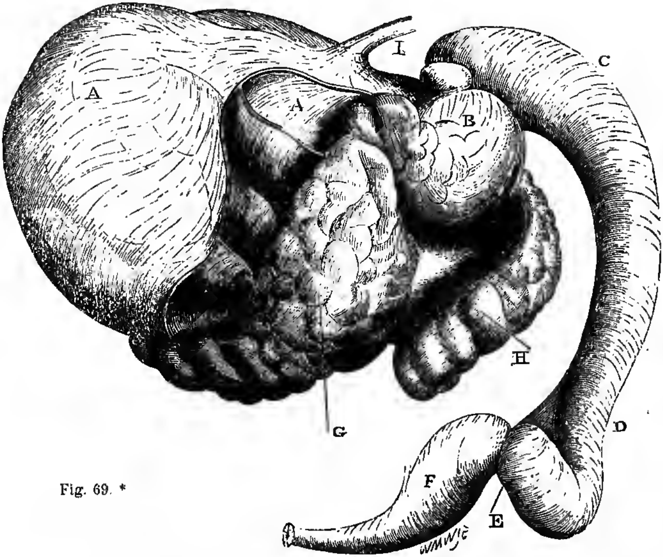


Fig. 69. *

* 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.

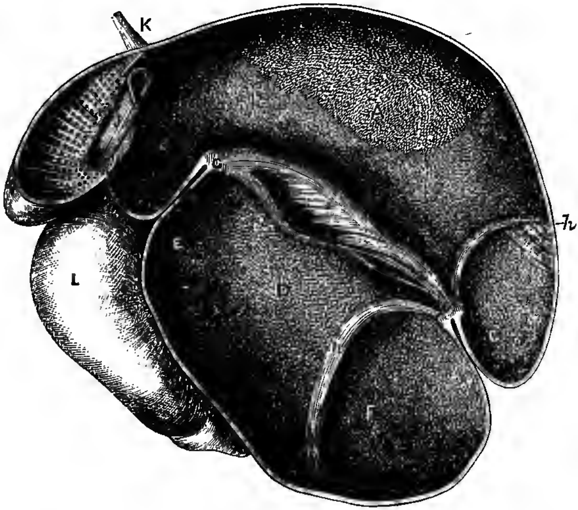


Fig. 70.—(Chauveau.)

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

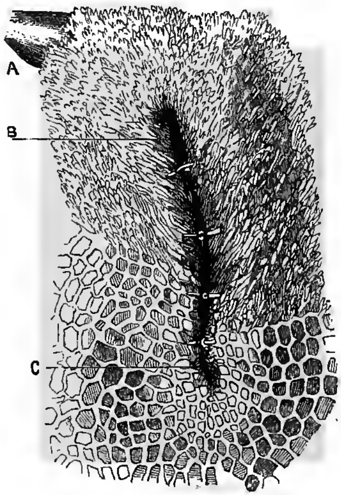


Fig. 71.—(Colin.)

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

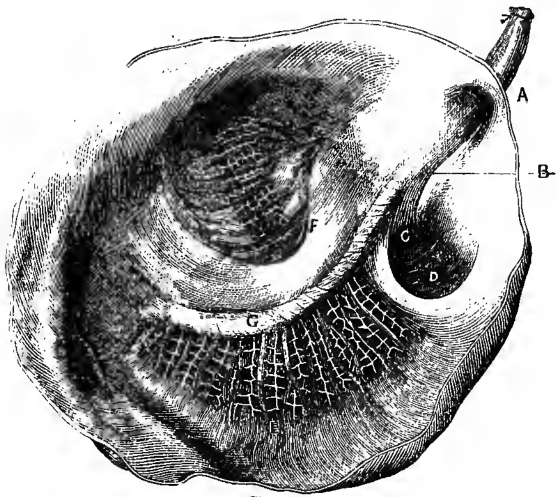


Fig. 72.

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

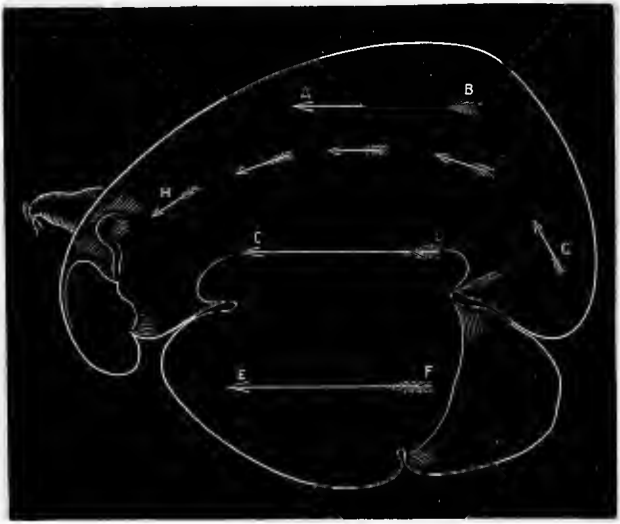


Fig. 73.

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 lbs. weight even in sick animals that had not fed for some time, and he found 150 lbs. in the rumen of a bull that had not taken food for twenty-four hours, and 200 lbs. 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.)

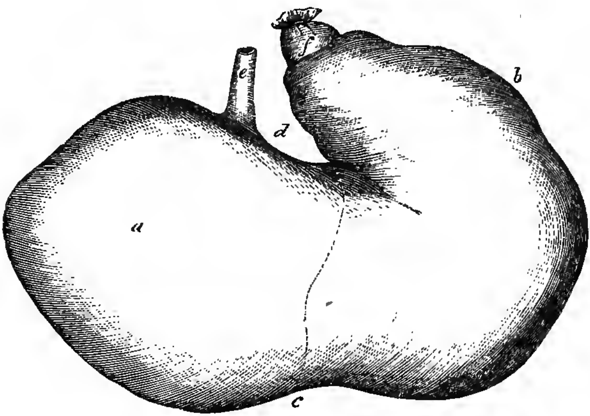


Fig. 74.

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 ℔s. 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

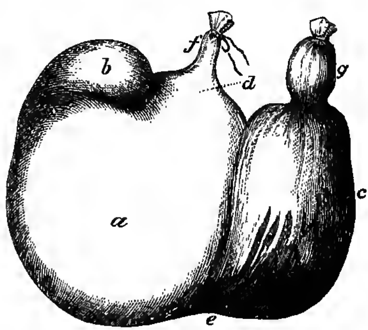


Fig. 75.

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

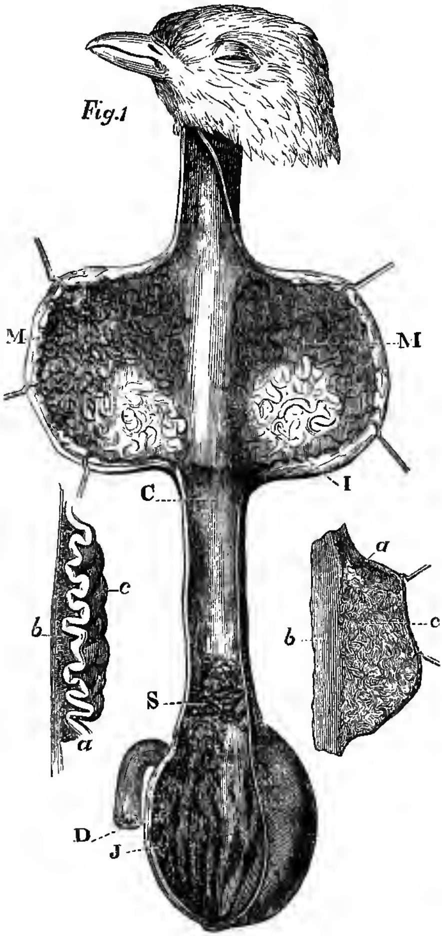


Fig. 76.—(BERNARD.)

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

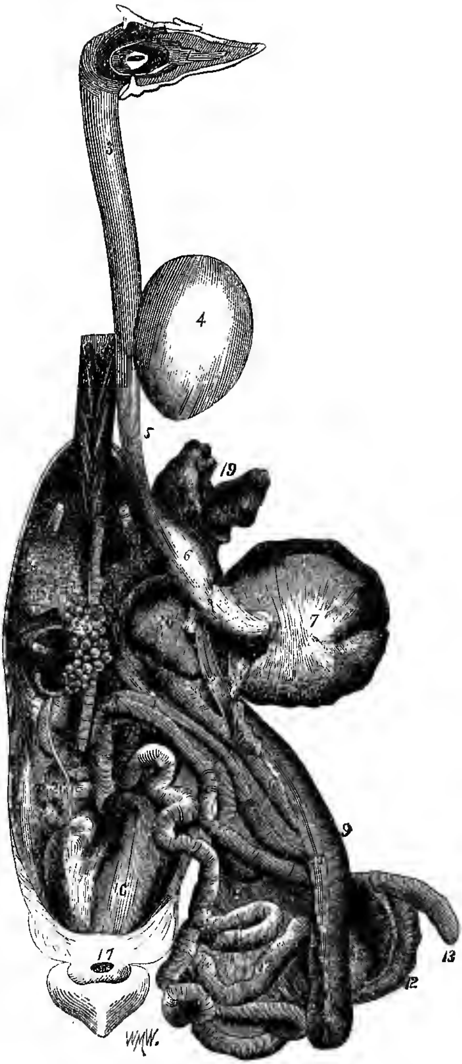


Fig. 77.—)CHAUVEAU.)

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

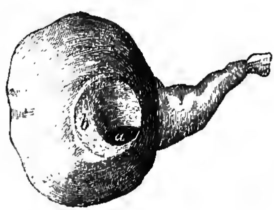


Fig. 78.

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 bronght 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, blood-shot 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.

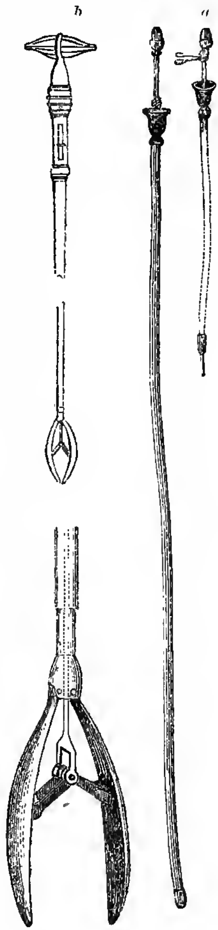


Fig. 81.

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 scarccly 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, } equal parts,
Common salt, }

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 workiug of a coalpit ceased, and a quantity of *débris* was left scattered about, amongst which ropes and other substances thickly smeared with whitc 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,

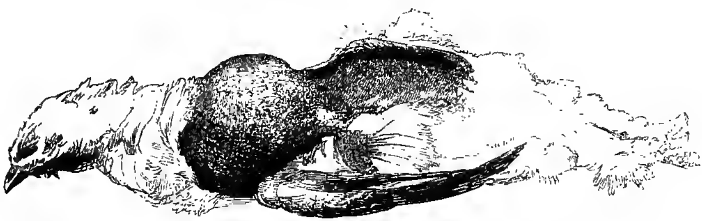


Fig. 82.

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 boid 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

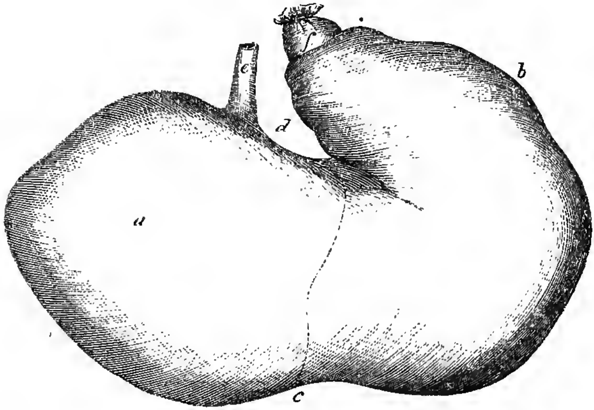


Fig. 83.

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 $\frac{1}{350}$th of an inch in diameter. The eminences, including the polygonal interspaces, vary in shape in the

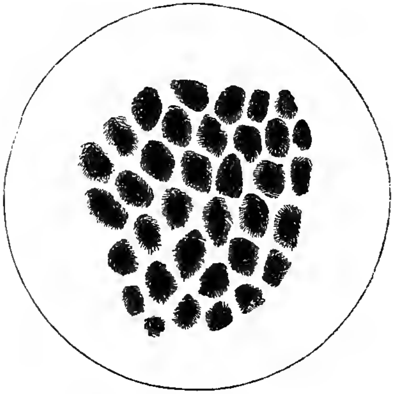


Fig. 84.—(DALTON.) Free surface of gastric mucous membrane, viewed from above; from pig's stomach, cardiac portion. Magnified 70 diameters.

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

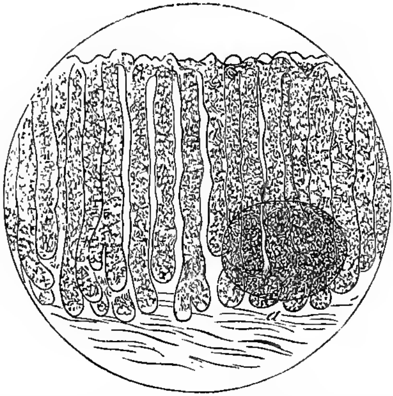


Fig. 86.—(DALTON.) Mucous membrane of pig's stomach, from pyloric portion; vertical section; showing gastric tubules, and at *a*, a closed follicle. Magnified 70 diameters.

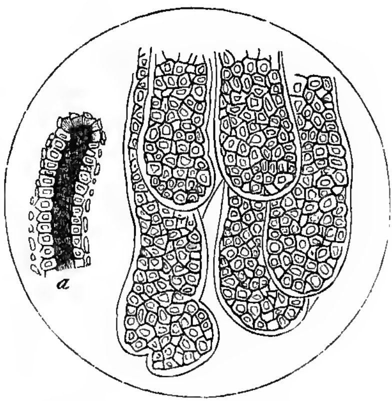


Fig. 87.—(DALTON.) Gastric tubules from pig's stomach, pyloric portion, showing their cœcal extremities. At *a*, a cylindrical cast of epithelium, pressed out from a tubule, showing the size of its size.

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-

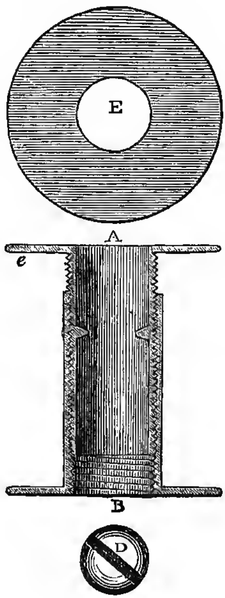


Fig. 88.

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

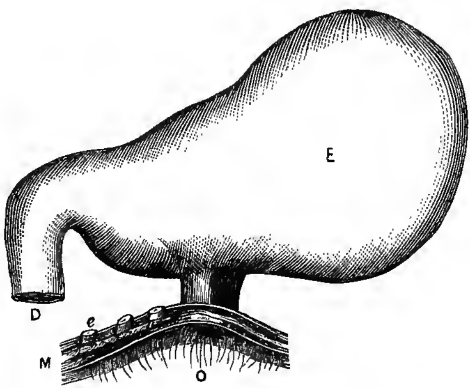


Fig. 89.

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.

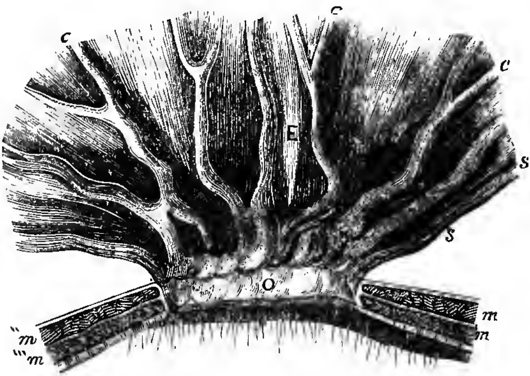


Fig. 90.

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.

ents 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.

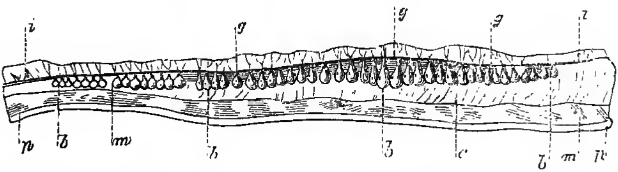


Fig. 91.—Portions of dog's intestine, showing the glands of Brunner, enlarged five times.—Bernard.
i i, mucous lining of the intestine; *g g g*, glands of Brunner; *b b b*, glandular layer beneath the muscular coat; *m m*, muscular coat; *p p*, peritoneal coat; *c*, cellular tissue, which separates the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

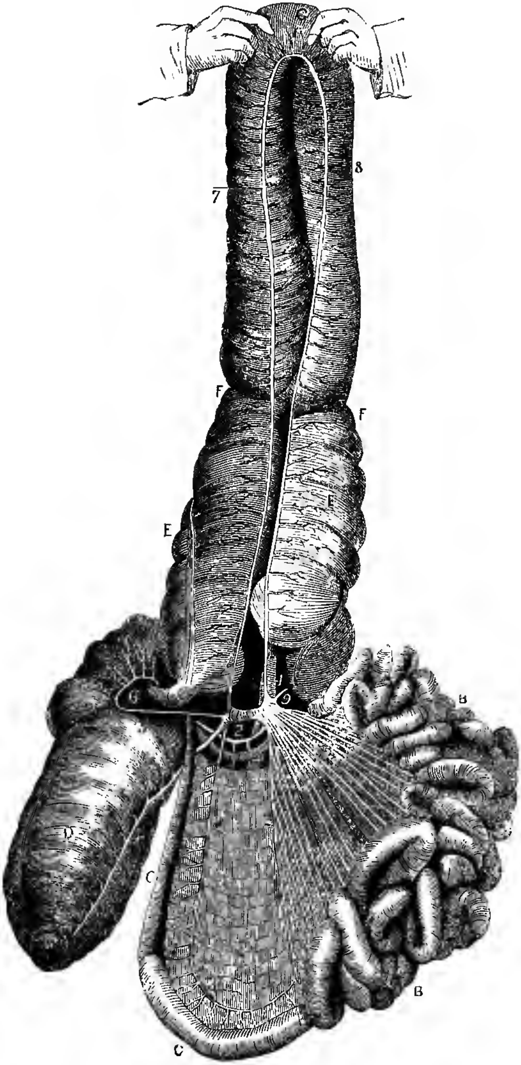


Fig. 92.

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, E, and at the end, H, or rectum.

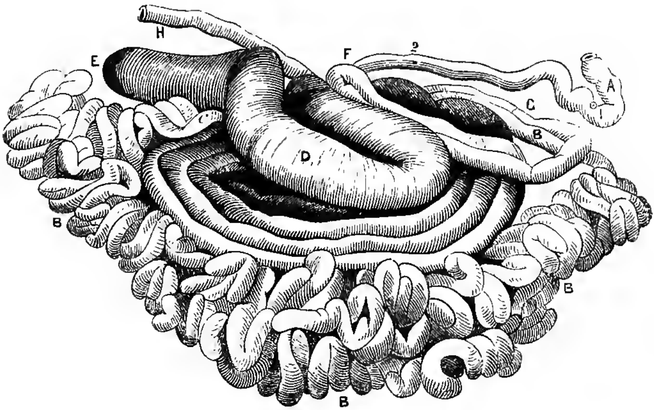


Fig. 93.

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

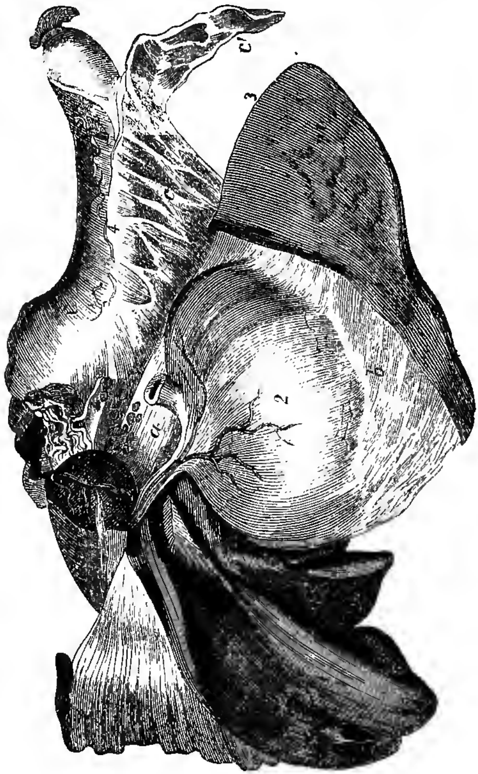


Fig. 94.

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.)

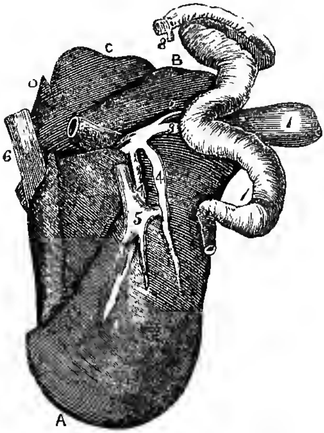


Fig. 95.

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 re-agents, 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

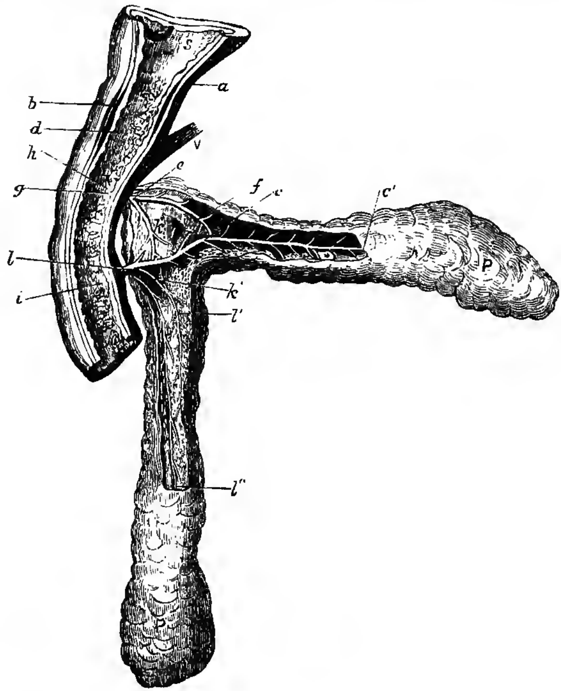


Fig. 96.—Pancreas and pancreatic ducts in the dog.—(Bernard.) P P, Pancreas; *a*, pylorus; *b*, glands of Brunner; *c c'*, large pancreatic duct; *d*, eminence formed by the duodenal glands; *e*, small pancreatic duct at its opening in the intestine; *f*, anastomosis not constant between the large and 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.)

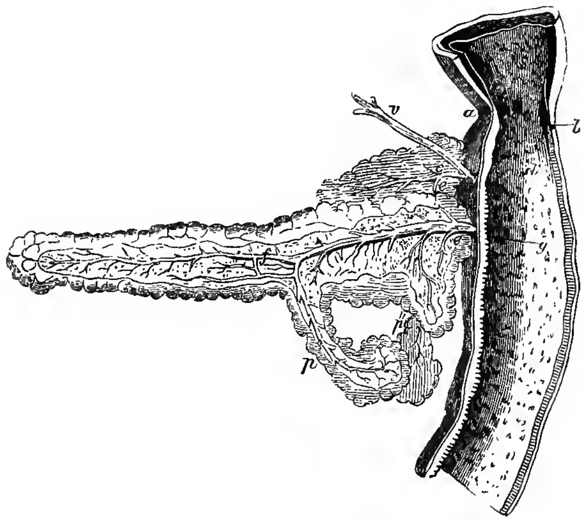


Fig. 97.—Pancreas and duodenum of the cat. *a*, Pylorus; *b*, glands of Brunner; *e*, descending branch of the inferior pancreatic duct; *f*, inferior pancreatic duct; *g*, opening into the intestine of the inferior pancreatic duct; *p p′ p″*, pancreas; pyloric portion of the stomach; *v*, biliary duct.

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

Fig. 98.

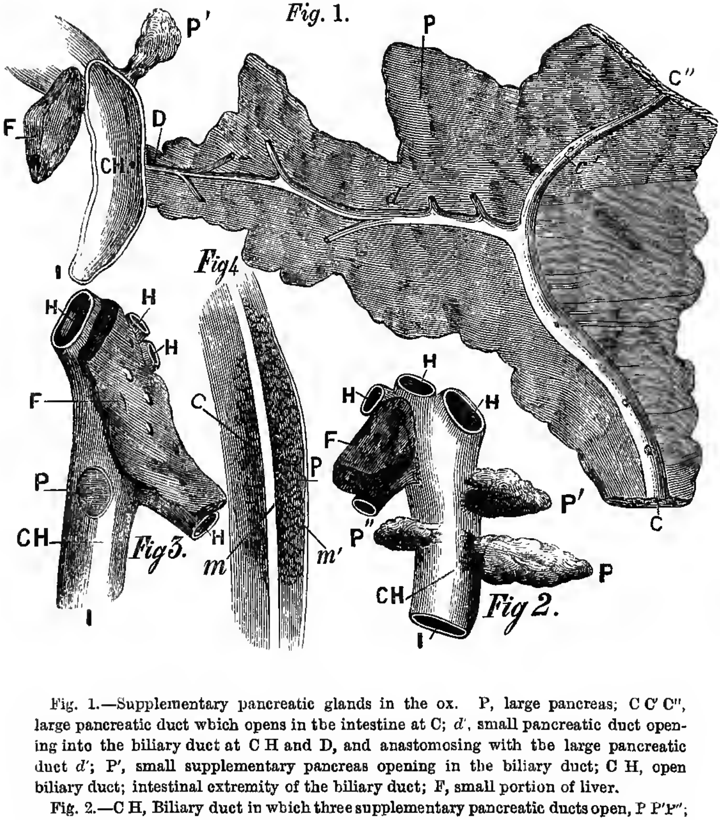


Fig. 1.—Supplementary pancreatic glands in the ox. P, large pancreas; C C' C'', large pancreatic duct which opens in the intestine at C; d', small pancreatic duct opening into the biliary duct at C H and D, and anastomosing with the large pancreatic duct d'; P', small supplementary pancreas opening in 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:—

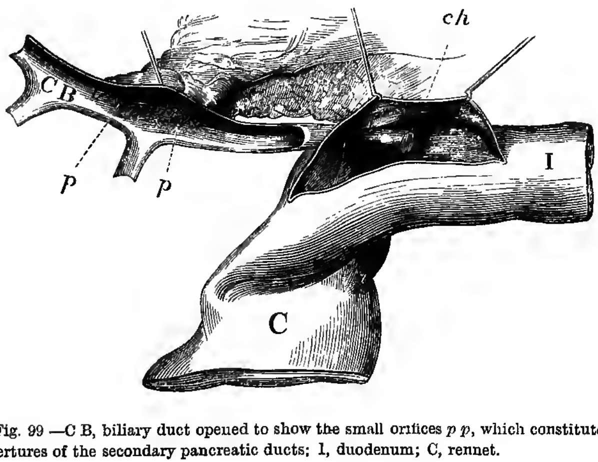


Fig. 99 —C B, biliary duct opened to show the small orifices *p p*, which constitute the apertures of the secondary pancreatic ducts; I, duodenum; C, rennet.

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.

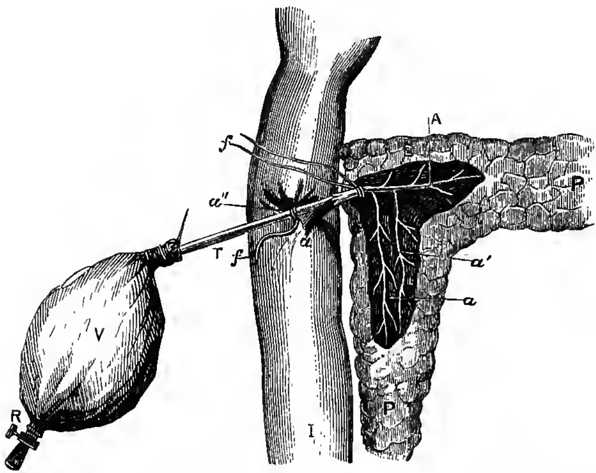


Fig. 100.—A, principal duct of the dog's pancreas; *a*, insertion of the pancreatic ducts into the intestines in which tube T is inserted; *a'*, lesser pancreatic duct; *a''*, ligature fixing the tube; *f f*, string which supports the ligatures; I, intestine; P P', pancreas; V, bladder to collect the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

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 peduuculated 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 . . . . $\frac{1}{2}$ 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.

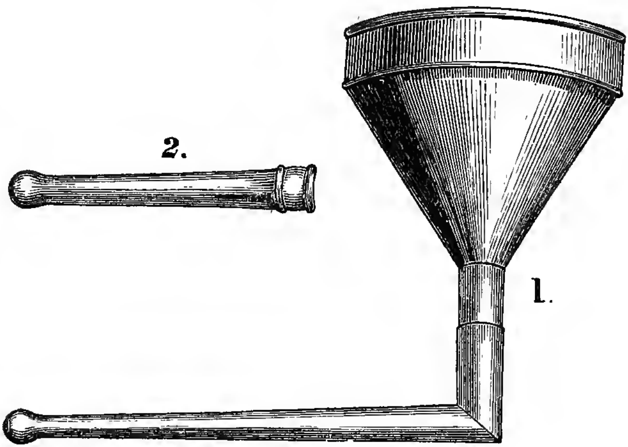


Fig. 102.

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

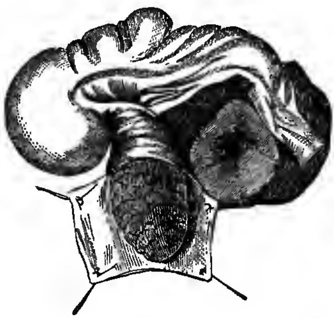


Fig. 103.

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.

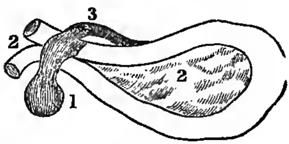
Treatment.—It has been suggested that the abdomen should be opened and the invagination overcome by a manual operation; but this is not safe or practicable in the horse. It has been done in the ox, and even in the human subject. If cases of colic are well treated at the commencement, intussusception 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.*

3 Mesenteric Chord.

1 Tumour.



2 Mesentery lining the interspaces.

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:—

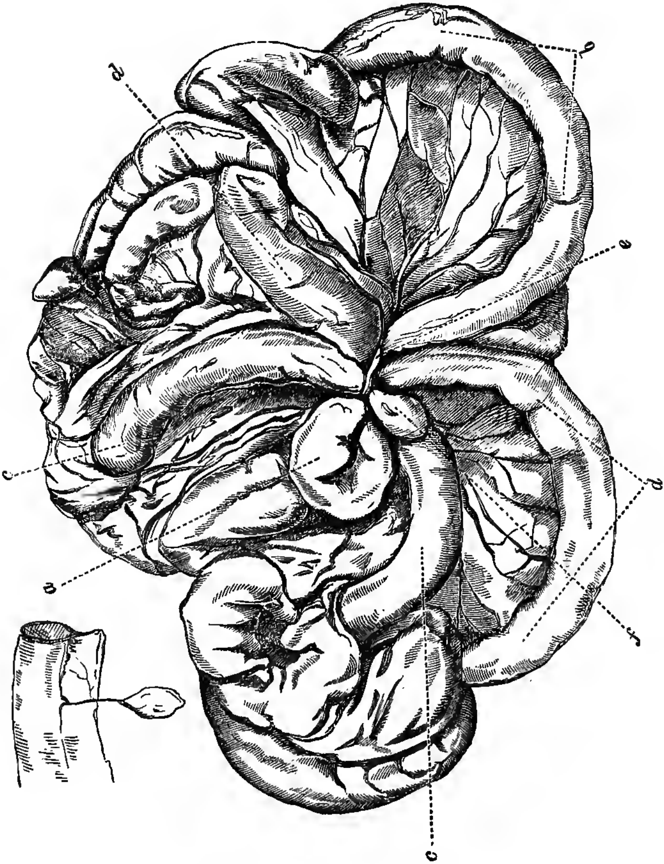
"On the 12th January, 1824, a bay gelding was brought to the hospital, with symptoms as follow:—very frequent pulse —much uneasiness—sitting on the hind quarters—at times snorting severely—belly not full. He was bled immediately, and a mixture composed of ol. lini ℥xij, and ol. croton, gtt. ix, was given; 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:—



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 symtom 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 symtoms. 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	$1\frac{1}{2}$ oz.
Catechu	2 dr.
Powdered opium	$\frac{1}{2}$ 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	$\frac{1}{2}$ dr.
Powdered gentian	1 oz.
Water	4 oz.

To be given in ale or gruel; or

Powdered angustura bark	$1\frac{1}{2}$ oz.
Sulphuric acid	$1\frac{1}{2}$ 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

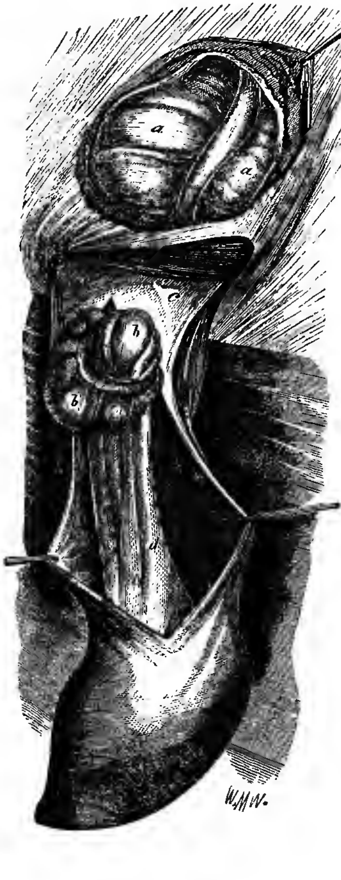


Fig. 106.—(GIRARD.)

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.

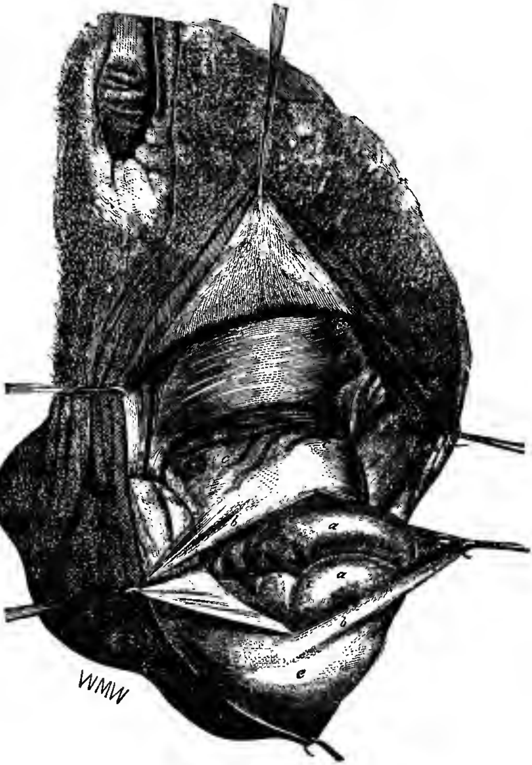


Fig. 107.—(GIRARD.)

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 tunicle 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	$1\frac{1}{2}$ 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 15th*, 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

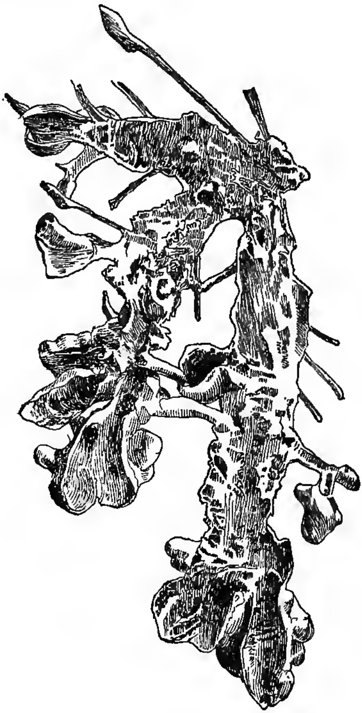


Fig. 108.

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 cholocrome, 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.