FAC-SIMILE OF THE HANDWRITING OF JOHN HUNTER.

It would appear that weakness in any thing that has powers of action within itself, produces or stimulates the parts so weak to take all advantage of colateral support. Even a Bean which when strong, seems to depend intirely upon its own powers yet if it grows weakly, as when not in the sun or any other cause acting to hinder strength when growing In such if a stick is put into the ground close by it, it will twin around it in loose spiral turns

FAC-SIMILE OF THE HANDWRITING OF DR SOLANDER.

I have made a hasty calculation of these as follows, viz.

Somniferous plants	448
Caule volubili	195
Caule radicans	16
foliis cirrhiferis	107
affected by the touch	6
having self motion	1
	773

ESSAYS AND OBSERVATIONS

ON

NATURAL HISTORY, ANATOMY, PHYSIOLOGY, PSYCHOLOGY, AND GEOLOGY.

By JOHN HUNTER, F.R.S.;

BEING

HIS POSTHUMOUS PAPERS ON THOSE SUBJECTS,

ARRANGED AND REVISED, WITH NOTES:

TO WHICH ARE ADDED,

THE INTRODUCTORY LECTURES
ON THE HUNTERIAN COLLECTION OF FOSSIL REMAINS,

DELIVERED IN

THE THEATRE OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND,

MARCH 8TH, 10TH, AND 12TH, 1855:

By RICHARD OWEN, F.R.S., D.C.L.,
SUPERINTENDENT OF THE NATURAL HISTORY DEPARTMENTS, BRITISH MUSEUM;
FULLERIAN PROFESSOR OF PHYSIOLOGY IN THE ROYAL INSTITUTION OF GREAT BRITAIN;
FOREIGN ASSOCIATE OF THE INSTITUTE OF FRANCE, ETC.

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CONTENTS.

OBSERVATIONS ON COMPARATIVE ANATOMY.

Introduction to Comparative Anatomy.

* "P.S. There are some big news from the East Indies. I don't know what, except that the hero CLIVE has taken Mazulipatam and the Great Mogul's grandmother; I suppose she will be brought over and put into the Tower with the *Shahgoest*, the strange Indian beast that Mr. Pitt gave to the King this winter."—*Horace Walpole, letter to Sir Horace Mann*, dated "March 4, 1760." Collected ed. 8vo. 1857, vol. iii. p. 294.

ESSAYS AND PAPERS.

OBSERVATIONS ON COMPARATIVE ANATOMY.

INTRODUCTION TO COMPARATIVE ANATOMY.

COMPARATIVE Anatomy is fit only to be read by those that understand a good deal of the human body and the general animal economy; for if they do not understand the standard, they cannot understand the variations from it. It is too great a task for any individual to make it any way perfect, for he must dissect most animals to be able to class them, and arrange them in such order as to make them intelligible and easier for others to pursue this species of knowledge. For example, if we find that all the lion-tribe are the same [in structure], it will save others from dissecting all this class, or it will enable us to dissect or examine them with much more accuracy.

When I compared the human with the quadruped (not considering the intended uses of [the parts in] each, which would make me admire them equally), it always put me in mind of two machines of the same kind, one made by an artist, the other only an imitation of it made by a novice.

The human body is not a standard in every part for Comparative Anatomy; for though the brain may be a standard, yet the teeth are not; for they are of the mixed kind in the human; therefore we must either begin with the true herbivorous or carnivorous animals, and the human comes in between. The human, however, seems to have most of original forms, or fewer forms in common [with those of other animals].

[Subkingdom VERTEBRATA.]

On the External Form and Skeleton.

In Comparative or Universal Animal Anatomy it would be, perhaps, the most natural way to begin with the most simple animal, and proceed to the most complex. But by considering that the most compound are either ourselves, or those we are most conversant with, and therefore know most of (the others being in a state of obscurity, much beyond their simplicity of structure), it becomes necessary that we should perfect ourselves in that we are most acquainted with: like the necessity of perfecting ourselves in our native language, which we know a good deal of, although it is very complex, before we enter upon another, although very simple in comparison, of which we know nothing.

The bones may justly be reckoned the basis upon which the whole is built, and they give nearly the shape of the animal to which they belong; for the other parts are built upon, and chiefly depend on them. The motions of the body depend on them, and a good deal of the manners of the animal and external configuration, such as claws for catching prey, a tail for climbing, &c.; therefore it is the bones we are chiefly to consider, by which means we shall be able to account in a great degree for the differences in the blood-vessels and nerves in different animals. The bones are so much the shape of the animal, that most people would say when they saw the skeleton that it belonged to such or such an animal.

The brain, heart, abdominal viscera, and parts of generation do not depend on the formation of the skeleton, therefore must depend on something else. Perhaps the different formation of the brain gives rise to the difference in the animal principles; and I dare say the different manner of living gives rise to the different formation of the viscera[1].

The external form of the quadruped gives us a much more accurate idea of the economy of the animal than [does] that of Birds; especially the part that concerns digestion. From the external parts of the quadruped, in which may be included the teeth, we can give a pretty good guess at the formation of most of the other parts. But when we view the heron and the crane, we should suppose them of the same genus; finding, however, the digestive powers of the crane the same with the swan, goose, turkey, &c., what shall we determine?

By the general figure and construction of the different parts of an animal, by the formation of the joints, shape of the head, teeth, situation of nipples, one may form a general idea of its natural history.

Those parts of animals whose uses and actions are immediately employed in the internal operations of the animal, such as the organs of digestion, secretion, &c., are generally in size in proportion to the kind

[1] [Is it not "That the viscera are adapted originally for the kind of food on which the animal is to be supported?"—Wm. Clift.] A question still under controversy. The advocates of the 'Transmutation' or 'Natural Selection' hypothesis may take Hunter's words in their literal sense, and claim him as of their party.—R. O.

of food and size of the animal; but those that are mediate, or concern external matter, which are to be our guides, such as eyes, ears, nose, &c., bear not the same proportion, but relate to the way of life that each animal is adapted to. Some small animals, for example, have large ears, and *vice versâ*: the same of the eyes. But the ears seem to vary most both in internal and external structure as well as size, more than any of the other organs of sense.

Parts of many animals differ greatly in size from one another when compared with the size of their bodies. The head and legs of a lion are too large for the size of its body, if an ox, for instance, were our standard of proportion. The size of parts often becomes a peculiar characteristic of the perfection of a species in a genus: a lion has the largest head and the largest feet of the whole genus, which points him out as the most perfect of that genus. A white man has the largest head and hand and foot of any of the human genus, which points him out as the most perfect of that genus. We see that this is so far a perfection, that, as the hand becomes perfect in use it increases in size, [use and size] bearing a kind of proportion to one another: the same of the foot. The negro from Africa has both a small head, and very small hands and feet.

Fishes have the largest head in proportion to size of body, of any animal. This is owing in a great measure to the gills being placed on the sides of the head in many of them; but it is a general rule which extends even to those that have no gills [Cetacea]; for in them Nature seems to have added fat to give shape. This increase of head is most likely for the purpose of swimming, to adapt the shape of the whole body for cutting the water: their want of neck, and the whole body being one uniform piece, is to answer the same purpose.

Quadrupeds are the next in [regard to the] size of the head. Their head seems to be only adapted for the purpose of life, independent of the motion of the animal; and as the head is very little resisted by the air in progressive motion, Nature has given it a freer motion upon the body than in fish.

The head of a quadruped is the seat of the brain, of the senses, and [of the organs] for mastication. The sense of smell in these animals being the informer of proper food, &c., and therefore more acute, the nose makes a large part of the head. Mastication being carried on in the head in these more than in any other animal, room for teeth and muscles is another cause for the size of head in quadrupeds. These two causes for increase of size of head in quadrupeds is more than can be said for that of the fish.

Fowls have the smallest head in proportion to the body, of any [vertebrate] animal. They have not the above reasons for size of head, because the head will not be adapted for the progressive motion of the animal, as in fish: the organ of smell is not so large, and mastication is not carried on in the head, as in quadrupeds.

Fishes have fewer and smaller bones than any other animal, and, except the bones of the spine and head (but what we call head, is head, mouth, lungs, and thorax), the others bear no sort of proportion to the size of body.

The reason of this is very evident; first, they have no extremities; secondly, the ribs in most of them have no motion for respiration, so that they only serve for fixed points for muscles for the motion of the trunk, independently of respiration; and, thirdly, the body does not require that support which it does in land-animals, because sea-animals float in a medium of the same gravity with their bodies: the blubber [*Medusa*] is an instance of this. A body will float easily in water, or a fluid nearly of its specific gravity, without the assistance of bones, which would collapse in air; so that the ribs of fishes that breathe are smaller in proportion. However, the spine is much larger in fishes than in any other animal. This does not seem to be for the support of the soft parts, as many fishes have no spine [*i. e.* no ossified vertebræ], but for the progressive motion and quick turns of the animal; for the body is the chief cause of its own motion, therefore requires a strong centre-pin to regulate all its motions. But, upon the whole, I should suppose that there was not so much bony matter in a fish as in a quadruped. The cetaceous fishes would seem to grow to the largest size of any animal: the shark comes nearest [to them][1].

From what has been said of the bones of fishes, we may see that quadrupeds have more in number, and the reason is that their progressive motion is different. The motion of their body contributes little to it, therefore they are obliged to have parts for this purpose, whose strength is to counterbalance the different specific gravity between animals and air—the medium they move in. If an animal were light as air, there would be no occasion for legs. As quadrupeds move in a medium much more rare than themselves, and therefore have a greater tendency to the earth, and likewise to themselves, it was necessary to have bones or hard parts to support each part, so as to overcome this attracting power. The solidity of the earth in some measure compensates for the rareness of the air. However, many of the bones of the quadruped that are in some measure similar to those of the fish, are smaller in proportion. The spine of the quadruped has nothing to do

[1] [The basking-shark (*Selache maxima*, Cuv.) has been captured in the British channel 36 feet in length; fossil teeth of the *Carcharodon* from the 'Red Crag' of Suffolk indicate individuals of this extinct shark of 60 feet in length.]

but support the weight of the animal: it has very little to do with its motion.

Fowls seem to have more bone in them than either fishes or quadrupeds, and it is very evident why it should be so; because they are to have strength enough not only to stand upon the ground and support themselves against gravitation and self-attraction; but to move themselves through a medium much lighter than themselves by means of that medium, and to overcome the attraction of the earth. This requires strength and firmness of body for the wings to act upon.

[Class Mammalia.]

Of the Skeleton.

All quadrupeds have seven vertebræ to the neck, and generally five to the loins; but the monkey has six. The back is not so determined, as some have more ribs than others. Bones are not a basis to all animals: there are, perhaps, more without than with them.

The fore- and hind-feet in quadrupeds are more like one another than the hand and foot are in the human. The thumbs of quadrupeds are not a counterpoise to the fingers as in the human and monkeys, but to supply the place of these they have claws, as the lion, &c.; and those that have not long claws for holding generally make use of both hands, as do bears, raccoons, &c., or [they avail themselves of] some resisting power, as by holding something between their feet and the ground, &c., as the dogs do.

Of the Pericardium, Heart, Thorax, &c.

Two ligaments for the attachment of the pericardium to the diaphragm is, perhaps, to keep it more fixed; and, as there would be a vacuity between them, nature has formed a lobe of the lungs to fill it up.

The heart of quadrupeds is suspended in the middle between the back and breast. The shape of the heart is generally owing to the shape of the thorax. The flat chest has a flat heart, and the two auricles are more parallel and similar [to one another], making often two apices. The deep-chested animals, such as hares, dogs, horses, &c., have more rounded hearts. The right ventricle almost surrounds the left obliquely, and is not so low, so that it makes no part of the apex [of the heart].

Thorax.—The upper part of the thorax in many quadrupeds is so narrow from right to left as not to allow the common trunk of the left subclavian to be longer than the right; so that the superior vena cava comes down nearly in the middle, just before the trachea. The vena cava inferior is much longer in brutes than it is in the human subject;

and the reason is evident, for the axis of the heart (which is much longer in the brute) is in the direction of the body; therefore the apex is at the diaphragm, and the basis is forward in the thorax. Now, as the auricles are at the basis, and there the veins enter, the inferior vena cava is obliged to pass forwards the whole length of the ventricle to get to the auricle.

[Subclass GYRENCEPHALA.

Order QUADRUMANA.]

From the structure of the parts of monkeys for progressive motion they are ill adapted for distances on even ground. They are much better adapted for climbing and walking upon uneven ground, where there are banks or risings upon which they can raise their fore-feet higher than the hind. Their walking is very similar to that of a child who has hardly the power of supporting the centre of gravity; but it must be allowed that these very motions are performed with a cleverness which takes off the awkwardness.

They walk on the ends of the metacarpal bones of the hand or fore-foot, which adds to the length of the fore-extremity. The tarsus and metatarsus make a little bend, and then the toes make another angle with the metacarpus; so that when they walk it is sometimes on the metatarsus with the toes often tilting on the ends of the metatarsus; but I believe seldom or ever on their tarsus.

All of the monkey tribe, with all their gradations, as the sanguine[1], mongoose[2], &c., have thumbs on their hind-feet. The great use of this would appear [to be] to fit them better for climbing trees; for in the act of moving from bough to bough, it is just as necessary that they should hold the bough on which they move their hind-feet, as it is to hold that bough on which they move their fore-foot or hand; for they do not so much set their foot on the bough, as they lay hold of it and pull themselves up by it. This part is not only of service in climbing up but in coming down, if not more so; for in coming back they can lay hold of a branch to secure themselves: but it is also of singular service in coming down sideways or head foremost, for it supports the body when coming down sideways, by a hand and foot of one side holding above, while either the hand or foot, or both, of the other side are in search of a hold below: also when coming down forwards; for

[1] ['Sanglin' of Edwards's 'Gleanings in Natural History,' p. 15. pl. 218: 'Sagouin,' of Jonston's 'Quadrupeds,' p. 143: it is a species of *Jacchus*, probably *J. vulgaris*, Geoffroy.]

[2] ['Mongooz' of 'Edwards's 'Gleanings,' &c. p. 12. pl. 216: it is the *Lemur Mongoz*, Linn.]

while the fore-feet or hands are in search of a hold below, the hind-feet are holding on above.

It would appear in some instances, that a thumb on the hind-foot was of more service than on the fore; for in the opossum the thumb is placed on the hind-foot, and the corresponding toe on the fore-foot is similar to that in many common animals, as the raccoon, rat, &c.

This situation of thumb must assist greatly in climbing, especially when assisted by the tail, which answers to a third leg; from which we may observe that the holding, and the points from whence certain motions are derived, are behind. These three parts being fitted for alternate motion and holding, fits them very well for sitting erect; a position probably they give suck in; and if this operation is performed in a tree, it appears very necessary.

Of the Brain of a Monkey.

The dura mater in a monkey does not adhere to the pia mater along the longitudinal sinus, but by means of veins of the pia mater. The veins pass into the sinus, some at a right angle, others at acute angles, with regard to the current. There is no 'additamentum' [cornu posterius] to the ventricle. The corpus striatum is more rounded, and does not pass so far back over the thalamus. The thalami are more united. The cerebellum sends two lateral processes of dura mater, and above the seventh pair of nerves. The medulla oblongata is more flattened. The optic nerves unite nearer the foramen opticum than in the human. The pineal gland is smaller in proportion, and lies quite between the two testes [hinder bigeminal bodies], which are larger in proportion. The vertebral arteries have a small canal of communication going between them.

[The Chimpanzee (*Simia Troglodytes,* Blum., *Troglodytes niger,* Geoffr.).] *The Oran Utan,* sent from Sierra Leone by Mr. Dubois.

This animal was a young one: its mother was shot. Mr. Afzelius[1], who brought it home, said there were many, and which were near 5 feet high. She fell, when shot, from a tree; and in the fall still held the young one to her, which also brought it down, and in the fall it broke its arm.

[1] [Dr. Adam Afzelius, a Swede, born in 1750, was a pupil of Linnæus: he made a voyage to Sierra Leone in 1792, and Sir Joseph Banks became possessor of part of his Natural History collections. In 1796 he was Secretary to the Swedish Embassy n London, and in 1812 was made Professor of Materia Medica at Upsal.]

	inches.
From the crown of the head to the tuberosity of the ischium	18
From the connexion of the clavicle with the sternum to the tuberosity of the ischium	11
From the connexion of the clavicle with the sternum to the elbow-joint	18
From the elbow joint to the hand	6½
Length of the hand	4½
From the head of the femur to the os calcis	12½
From the head of the femur to the knee-joint . . .	6½
From the knee to the os calcis	6
Length of the foot	5½

In the extended posture the fingers reach below the knee[1].

[The Gibbon (*Hylobates Lar*, Geoffr.).]

A large black monkey, from Lord Shelburne[2], of the spider-monkey kind, but has two thumbs[3]. His hair is black and strong: it is not longer on one part than another, excepting on the top of the head, where it is also thickest. Without a tail.

The liver is exactly similar to the human. The gall-bladder is smaller than in the human, and is somewhat contorted.

The stomach is similar to the human, but rather more globular.

The duodenum exactly similar to that of the human. No valvulæ conniventes. The last part of the mesentery adheres to the back and to the psoas muscle, on the left side, as in the human. The cæcum is situated, and adheres, as in the human. The appendix [cæci] is about three inches long, and half an inch in diameter. There is no meso-

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[1] [The following Hunterian preparations are of the individual above noticed:—Nos. 1421, the hand; 1422, the foot; 1424, the head; 2573, the external male organs of generation. In a young chimpanzee of similar size, I found the weight of the brain to be 7 oz. 1¾ drachm. As Tyson had published his anatomy of the *Simia Troglodytes* (Anatomy of a Pigmy, 4to. 1699), Hunter appears not to have recorded the results of his own dissections.]

[2] [Lord Shelburne was Prime Minister in 1782; resigned February 24th, 1783; and became Marquis of Lansdowne, November 30th, 1784: Hunter's dissection was, therefore, most probably performed before that date.]

[3] [Meaning that there was a thumb on the hand as well as on the foot, whereby this monkey differed from the true spider-monkeys, which Hunter knew to be deficient in the thumb of the hand. Parts of the animal here described are preserved in the Hunterian Collection, and were marked as belonging to 'Lord Shelburne's monkey.' From these I determined the species to be a gibbon (*Hylobates*, Kuhl, probably *Hyl. Lar*, or the 'Long-armed ape' of Pennant). The preparations include —the cranium, No. 5030, Osteol. Catalogue, p. 757; the kidney, No. 1233, Physiol. Catalogue; the tongue and larynx, No. 1523, *ib.*; the external ear, No. 1620, *ib.*]

cæcum. The colon passes up the right side, as in the human, then crosses the body to the left, passes down the left, where it is closely connected to the neighbouring parts as in the human, and passes over the left psoas muscle, but has no sigmoid flexure. From thence it passes backwards into the pelvis, and forms the rectum. If there is any difference between the situation and adhesions of these parts described, from those in the human subject, it is that the adhesions here are not so strong nor by such broad ligaments.

The scrotum is more a natural bag than is common in monkeys. The penis has a prepuce adhering nearer the glans than commonly found in monkeys; but not so near as in the human. The tunica vaginalis is common to the testicle and spermatic chord, and communicates with the cavity of the abdomen. There is a small bone in that part of the penis which is between the glans and the adhesion of the prepuce to the penis[1].

The kidneys are pretty nearly of an equal height, the left rather higher than the right, the same as in the human, which is contrary to most other monkeys and brutes. Each kidney has but one mammilla[2].

The lungs of the left side are divided into two lobes as in the human; on the right side into three, also having the small lobe going behind the vena cava. The pericardium adheres to the diaphragm very nearly as much as in the human. The vena cava inferior is very nearly as short as in the human. The os hyoides has three bones, as in the human. There is an uvula[3].

[HYLOBATES[4].] *Trunk of a Monkey*, from Mr. Lavers.

The heart is flat, and turned a little to the left: the lower surface lies on the diaphragm, but not so flat as in the human; so that the lower vena cava is a little lengthened. The lungs are divided into two lobes on each side; the uppermost on the right has a fissure on its posterior surface, and the lower lobe sends in a small process behind the vena cava.

The liver is exactly as in the human; also the gall-bladder, the stomach, duodenum, jejunum, and ilium are the same [as in the human].

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[1] [This is a significant mark of the inferior grade of the gibbon to the chimpanzee and orang-utan in the quadrumanous series.]

[2] [Prep. No. 1233.]

[3] [The instances of greater similitude, than in the tailed monkeys, to the human structure, in the gibbons are equally or more strongly manifested by the orangs and chimpanzees.]

[4] [Hunter preserved the bones of this specimen; they are No. 5029, Osteological Catalogue, and show it to have been a gibbon by the breadth of the sternum and other characters.]

The duodenum is only seen a little before it passes through behind the mesentery; it is attached to the back below the passage of the duodenum, although not quite so low as in the human.

An appendix cæci about 3 inches long[1]. The cæcum is not attached, nor is the ascending colon, to the loins, but to the right edge of the mesentery as they pass up. At last the colon is attached to the kidney, and then to the duodenum, where they cross one another to go across the spine: as the colon passes down on the left side it makes a turn or fold upon itself, which may be called the sigmoid flexure, only here it is higher than in the human; however, the pelvis going higher may be one reason. No valvulæ conniventes. The pancreas much as in the human. The uterus, &c. lay in the pelvis, like a child's.

[The Green Monkey (*Cercopithecus Sabæus*, Geoff.).]

In a pretty large she monkey of a dun colour mixed with green:—

The colon did not adhere anywhere but at the beginning of the transverse arch, and had a very broad mesocolon everywhere excepting at the beginning of the arch, where the adhesion was. There was no particular sigmoid flexure.

The œsophagus is longer below the diaphragm than in the human.

The liver does not adhere so firmly as in the human, or by so broad a surface.

The clitoris is situated much as in the human: there are no nymphæ. The meatus urinarius is much as in the human. The os tincæ is prominent and rough with rugæ; within the os tincæ are two prominences, a lower and an upper, the highest is the largest[2]; from thence upwards the uterus becomes very small, and there dilates into the fundus, which becomes thinner in its coats towards the end, and terminates in two rounded corners which project a little further than the middle between them, which is one beginning step to the quadruped.

In a he one of the same kind[3], the liver was divided into four lobes; the left was small and most detached, the right was but very little detached, and passed in to make the spigelian lobe.

The little epiploon is more membranous and not so loose as in the human. The thyroid gland does not unite before the trachea. The arytenoid cartilage has two small cartilages standing upon it, which makes two points. The os hyoides does not go to the head as in many brutes, but approaches nearer [in form to that of] the brute. Very

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[1] [In the chimpanzees and orangs this 'appendix' has the same relative length as in man.]

[2] [Hunt. Prep. No. 2817.]

[3] [The skull of this monkey is No. 5016, Osteol. Catalogue.]

large salivary glands, as large as [those of the] human. An uvula, which I never saw before. The muscles of the larynx very like [those of] the human. The digastricus passes through the stylo-hyoidæus. It has a trochlearis muscle [of the eye-ball] as in the human.

The pericardium adheres by a broad surface to the diaphragm, therefore there is a short vena cava inferior. The heart is not so flat as in the human, but more so than in the quadruped. The auricles are more rounded on their anterior appendixes. There is a fourth lobe to the lungs which lies between the heart and diaphragm, so that the heart was some way from the diaphragm.

The fundus of the gall-bladder appears in a fissure on the convex surface of the liver; the internal surface is vastly rugous, and the papillæ of these rugæ are large and hard.

There is a bone in the penis, in length between the glans and attachment of the prepuce. The tunica vaginalis communicates with the abdomen.

The length of the small guts are three times the length of the animal from head to heel, and [that of] the great [gut is] just once [the same length].

[The Wanderoo (*Macacus Silenus*).]

In a long-tailed monkey there is one panniculus carnosus that arises from the os humeri just at the insertion of the pectoralis major, and from the fascia that the muscle throws over the biceps. This panniculus passes back with the panniculus carnosus, spreads and is lost in the skin of the back insensibly, taking the same direction with the latissimus dorsi, so that it covers that muscle. The other panniculus carnosus is the platysma myoides; the anterior of which is as in the human, and is very strong, decussating each other at the chin. Its posterior edge is continued back, and joins the outer part of the occipito-frontalis, so that that part of occipito-frontalis and this portion make but one muscle; and this muscle is lost in the skin of the neck just above the termination of the other panniculus carnosus; so that these two panniculi carnosi of each side will make a kind of raphé in the skin down the back.

The occipito-frontalis, the elevatores auriculæ, and the platysma myoides make but one muscle, and this is the reason that those animals can move their ears and skin of their head so much as they do. The buccinator muscle makes a bag, just before the masseter muscle, and before the lower jaw.

The ears are a good deal like the human, but, as it were, irregularly formed, thin and black; and when the animal is erect, the ear is as in the human as to situation.

The eyes are as large as the human, and of the same shape. The tunica conjunctiva is black round the cornea for a quarter of an inch, and then becomes transparent so as to show the white tunica albuginea. The tunica albuginea is very thin and transparent, so as to show the black choroid through it; but at its anterior part it becomes thick and opaque, and thickest at edge of the cornea where it is covered by the black conjunctiva. The cornea is pretty thick, and is not quite round; is elliptical with one angle towards the nose, the other outwards. The choroid coat has the nigrum pigmentum on both sides, and is very black, and round the edge of the crystalline lens the internal edge [of the choroid] adheres to the edge of the crystalline and enters part of the vitreous humour for near three-eighths of an inch: this adhesion is very strong.

The ligamentum ciliare is very strong and white as in the human, so much so as to allow the choroid being torn all round it; and the iris the same; so that the ciliary processes are left like a ring round the cornea.

The iris is of a strong orange colour anteriorly, but is very black posteriorly, which shows that the colour of the iris is not from the nigrum pigmentum: it dilates on pressing the cornea, but contracts again.

The optic nerve is smaller than in the human, is a little serpentine, and enters much about its common thickness on the inner side of the axis of the pupil; where it passes through the sclerotic and choroid coats, it is nearly as large as at any other part: when you look upon its termination on the inside of the eye, it appears to be of a brownish colour[1] with a little spot in the middle. When entered the eye, it divides into two lamellæ, the exterior of which is very tender and thin, so that there is no preserving it, and it adheres more firmly to the choroid than to the other lamella; the other [lamella is] thicker and is a good deal denser, but becomes thinner and thinner forwards; it has the blood-vessels in it, and adheres pretty firmly to the vitreous humour; so much so, that, if you take hold of it, you will raise the vitreous also. I could trace it on to the edge of the circular nigrum that covers the anterior part of the vitreous humour, but there they seem to be blended. The crystalline lens is very flat.

The muscles of the eye are as in the human. The brain is very like the human brain[2]. The thyroid glands are two, and are very thin; one lying on each side of the trachea, but not joined over the trachea as in the human, and are very long, reaching from the cricoid cartilage to the thorax. The sacculi laryngis are very thin and deep, and at the

[1] [Has Hunter here mistaken the 'foramen of Soemmerring' for the contiguous termination of the optic nerve?]

[2] [The skull, with the calvarium removed, is No. 5003, Osteol. Series. It shows the specimen dissected not to have been full-grown.]

root of epiglottis there is a cavity that leads forwards to the space between the thyroid cartilage and the os hyoides, which is largest at its bottom.

The right lung is divided into four; the left into three lobes. The contents of the thorax are as in the ass.

The heart not so pyramidal and round as in the quadruped, not so flat and obtuse as in the human.

The stomach and intestines are very much like the human, but the œsophagus below the diaphragm is rather longer and more visible; but the mesentery is thinner and the mesocolon loose, so that the colon is not bound down save at the beginning of the transverse arch, and that is chiefly to the duodenum. The appendix cæci is about half an inch long, and is of a pyramidal figure[1]. The lymphatic glands in the mesentery are very few, and are chiefly at the root of the mesentery.

The length of the animal was 2 feet 2 inches; the length of the small intestines 7 feet 4 inches; the length of the great intestines 1 foot 8 inches: which is four times the length of the animal. There were valvulæ conniventes, but they were very small.

The situation of the colon is not so regular as in the human, which perhaps is the reason that the epiploon is not attached to the whole length of the transverse arch. The epiploon is pretty large, is attached to the stomach anteriorly as usual; but posteriorly, and on the left, to the lower edge of the pancreas, and on the right to the beginning of the transverse arch of the colon.

The liver adheres to the diaphragm, as common. It is divided into three lobes, besides the lobulus Spigelii. The middle lobe is the largest, which is partly divided, as in the human, by the ligamentum rotundum. The gall-bladder adheres to the middle lobe on the right of the ligament: it has no cyst-hepatic ducts, and very little length of cystic duct.

The kidneys are conglobate; they have only one mammilla.

The uterus is very like that of the human, but the angle is rather more sharp. The round ligaments as they pass out of the abdomen have a little sheath made up of the peritonæum, which goes with them for half an inch, and terminates in a blind end: afterwards the ligament goes as in the human.

The bladder is a little more pendulous than in the human, and therefore more of the shape of the quadruped.

Upon the ossa pubis are placed two swellings, one on each side of the clitoris, making a kind of prepuce. From these two there pass backwards two ridges which swell again, and make the two labia, between

[1] [Probably an example of a variety.]

which runs a groove leading from the clitoris to the vagina. Between these two labia passes in the common vagina[1], about an inch in length: then begins the true vagina, at the mouth of which is the meatus urinarius, and a sort of hymen or caruncula myrtiformis. The vagina is pretty much like that of the human. The clitoris is pretty long, and its end prominent, which is a little bifurcated. The plexus retiformis is much as in the human[2].

[The Wanderoo (*Macacus Silenus*, Linn.).]

In another large one [full-grown] that I examined at the same time, I found only these differences. There were not the two swellings on the sides of the clitoris, nor was the clitoris so long; but instead of swellings there was a kind of prepuce that surrounded the clitoris, but it was very long and wide; and as the clitoris was not so long nor so protuberant, they did not lie so far on ossa pubis.

The bladder was not so pendulous. The pubis was larger, so that its contents was more as in the human subject to appearance. There was not the least sign of an appendix cæci. The cæcum was as in the human.

The length of the animal was 3 feet; the small intestines 8 feet; the great intestines 4 feet, which is four lengths of the animal.

The heart is more like that of the human, that is, not so round, broader at its basis, and more obtuse at its point. The hearts of both specimens were pretty much fasciculated, as in the human.

[The Brown Monkey (*Macacus nemestrinus*, Linn.[3]).]

In a pretty large male monkey I observed the digastric muscle; and in this animal it seems clear that the posterior belly depresses the lower jaw, for it makes but a very little angle with the anterior belly.

There was a cartilage on each side loosely fixed to the root of the arytenoid cartilage, where the sacculus laryngis is fixed, passing up to the rimula laryngis, making a point between the epiglottis and the point of the arytenoid cartilage: this is a little more like [the larynx of] the dog than [of] other animals. There was a congeries of small glandular bodies placed in a row under the tongue, and in its direction making a small protuberance along the surface: I imagine these to be similar to the [part called the] 'worm' [in the dog].

The heart was pretty much like the human, but with not so much of

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[1] [The vagina in advance of the urethral aperture.]

[2] [Hunt. Prep. No. 2816.]

[3] [The skull of this specimen is No. 4828, Osteol. Catalogue.]

that flat surface: it had a long vena cava inferior. The pericardium does not adhere to the diaphragm: there are two arteries arising from the curve of the aorta.

The duodenum is not anywhere entirely covered as in the human, where it passes behind the colon and mesentery; for the colon is loose everywhere, excepting that it is rather more bound at the transverse arch than in the angle. The cæcum is rather longer than that of the human; there is no appendix cæci; the colon [measured] one length and a quarter [that] of the animal; the small guts two lengths and a half. I could not observe any valvulæ conniventes. The liver is made up of four lobes. The gall-bladder is attached to the third from the right lobe, which is the largest. The left kidney was a little lower than the right. The capsula renalis has much of the texture of that in the human.

The scrotum is not very large, and not so distinct from the other skin and cellular membrane as it is in the human, so that when the testicles are squeezed out it is pretty flat. The penis is something like the human, but has a much longer preputium, more like that in brutes[1], for it is attached to the penis half-way down, so that the angle of reflection is about the middle of the penis; and, when it is brought over the glans in the flaccid state of the penis, all the skin of the penis is likewise brought over, so that the penis is entirely hid, as it were, in the common skin.

The testes, tunica propria testis, and the tunica vaginalis of the spermatic chord, are all like those in the brute. On the right side it seemed to be diseased, and there was a kind of hernia made by the epiploon, and just above the tunica propria there was the septum as it is called. But I suppose all this was from disease, as there was nothing of this sort on the left side.

The erectores penis are very large, and do not seem to take their origin from the ischium, but from the body of the crus, and are inserted into it again; so that they are farther on the penis than common, and between them is almost hid the urethra. The acceleratores seminis are very strong, are not lost in the body of the penis, nor do they come so far up as the erectores do, so that between the erectores is only the urethra. The membranous part of the urethra is pretty long, because the ossa pubis are broad, and the membranous part is plainly muscular. Cowper's glands are very large, but I could not find their ducts. The urinary bladder is more prominent than in the human; there is a pretty thin adhesion between the bladder and rectum, not by such

[1] [Meaning ordinary quadrupeds, *e.g.* the dog.]

broad surfaces as in the human, so that the vesiculæ seminales may be seen.

The prostate gland is very like that of the human. The vesiculæ seminales are pretty large, are much like the human, and [their ducts] enter like [those of] the human[1].

The muscles of the anus are like [those in] other brutes.

[Albino Variety of a Macacus.] *Bailey's Monkey*, of which I have a painting[2].

The cæcum is loose and pendulous. The colon is attached to the right side, just where it is going to make the transverse arch; it then goes across the body in very loose convolutions, and goes down the left side without any attachment; but on the mesocolon it is also thrown into very large convolutions. The mesocolon is very long, which admits of the colon varying its situation. The colon has three longitudinal ligaments upon it.

The epiploon is attached anteriorly to the spleen on the left, which is rather lower down than common; also to the great curve of the stomach, to the beginning of the duodenum, to that part of the colon which is fixed, and to a little part of the transverse arch: it then attaches itself to the root of the mesocolon continued to the left side along the lower edge of the pancreas near the spleen.

The liver is principally on the right side, is divided into four lobes, the three anterior making up the body of the liver, the posterior being the lobulus Spigelii. Of the three anterior lobes, the left is the smallest and thinnest. The right lobe is the next in size, and is thick; the middle lobe is the largest, into which passes the round ligament into a pretty deep fissure. Upon the right edge of the third lobe is attached the gall-bladder.

The anterior mediastinum is a pretty broad membrane, so that the heart is some way from the sternum. The lungs on the right side is divided into three lobes, besides the lobe which passes between the heart and diaphragm. The left lung is divided into two lobes.

The tunica vaginalis testis communicates with the abdomen.

The buttocks were covered with a bright red skin inclining to pink or Modena, under which the tuberosities of the ischium are covered with a great quantity of fat of a hardish texture, covering the bones like a cushion, while the other parts are but lean.

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[1] [Hunt. Prep. No. 2569.]

[2] [This painting is preserved in the Royal College of Surgeons, London.]

[The Pig-faced Baboon (*Papio porcarius*, Kuhl).] *Mr. Gough's Monkey*, of which I have a painting[1].

The duodenum passed to the right as in the human, then downwards, sinking behind the beginning of the transverse arch of the colon to which it adhered, then emerging below the posterior surface of the root of the mesentery to which it is attached as it is turning to the left; it then gets upon the left edge of the mesentery, and becomes a loose intestine, forming the jejunum and ilium, which were without valvulæ conniventes.

These small intestines gradually pass from the left above to the right downward in various convolutions, and their termination, or ilium, enters the cæcum just before the right psoas muscle. Between the ilium and the cæcum there is a mesentery of the whole length of the cæcum, which is just opposite the common mesentery.

The cæcum was loose, unattached, excepting by the mesentery, which was the right edge of the common mesentery.

The colon at its beginning is loose also, except where it is attached to the same mesentery. At the upper part of the colon, just before it crosses the abdomen, it is attached to the loins, duodenum, &c., then, crossing the body, it becomes a very loose intestine, having a very broad mesocolon. This transverse arch of the colon is of considerable length, and is therefore thrown into a number of convolutions. When got to the left side it passes down unattached to anything but its mesocolon, which is becoming narrower and narrower as it approaches the rectum, which is at last attached to the sacrum by a broad surface, and as it passes over the left psoas muscle it is thrown into larger convolutions: it has three longitudinal bands, as in the human subject, but not so broad.

The epiploon is attached anteriorly to the great curvature of the stomach, but not to the left or great end; it is connected on the right to the pylorus and duodenum, and to the beginning of the transverse arch of the colon. Then it seems to bend round to form the posterior part, for posteriorly it is attached to a little part of the beginning of the transverse arch of the colon below the above; then to the root of the mesocolon and lower edge of the pancreas on the left to the spleen. It is a broad flat membrane, making one large pouch, covering the whole intestines, having its loose edges tucked in behind them all round the fat accompanying the vessels, and of course it is very thin between.

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[1] [This painting is preserved in the Royal College of Surgeons, London.]

The liver is divided into three lobes, besides the lobulus Spigelii. The middle lobe of the three is by much the largest, and the left the smallest. The middle lobe has a fissure in it, into which passes the ligamentum rotundum as in the human, from which along the upper surface passes the falciform ligament. On the right of this fissure, and on the under side, is attached the gall-bladder, much as in the human.

The spleen is a flat triangular body, not situated so high up and backward as in the human. One angle is attached to the stomach, another to the kidney, and the other to the epiploon. The kidneys were conglobate, and the right stands about an inch higher than the left. The mediastinum is about an inch broad. The pericardium adhered by a broad surface to the diaphragm, therefore the inferior vena cava is short.

The lungs on the right side are divided into three lobes, besides the lobe that lies behind the vena cava inferior, which is small on account of the shortness of the vena cava inferior. The lungs on the left side are divided into two lobes, the uppermost of which is half divided.

The bladder is connected anteriorly and laterally to the surrounding parts, as in the human subject. The bladder and vesiculæ seminales adhere to the rectum by a broad surface. The scrotum is placed a considerable way down between the thighs, to which it is attached laterally through almost its whole length, so that it does not hang pendulous. The testicles are large, connected posteriorly to the tunica vaginalis by a thin membrane. The spermatic chord is long, and is connected in the same manner to the tunica vaginalis through its whole length; but where it passes through the abdominal muscles, this attachment is very narrow; but when it has emerged from the belly, it becomes broader and broader as it approaches the testicle. Upon this membrane passes up the vas deferens; the testicle has the artery running under the tunica albuginea in convolutions the same as in the quadruped.

The tunica vaginalis communicates with the abdomen, and at its beginning, where it passes through the abdominal muscles, it is small, but from thence becomes larger and larger to the testicle. The cremaster muscle, which is very strong, is spread on the external surface of the tunica vaginalis. The penis in its flaccid state lies between the two testicles, the prepuce not projecting beyond the scrotum, all making one flat surface between thigh and thigh: there is no frænum. The perineum is continued from the anus down to the lower edge of the scrotum.

The penis, as it comes out from the pubis, rather descends; it does not come along the pubis as in the quadruped; and, as the direction of the pubis is more in the line of direction of the animal, the penis in a flaccid state comes out from it at right angles, and, afterwards bending down, its direction becomes the same as the surface of the scrotum.

There are two small muscles which arise from the crura penis, which run along the body of the penis, and are inserted into two small tendons which continue the same course along the back of the penis, and are at last lost or fixed into the penis near the glans.

The clavicles, instead of being placed horizontally, rise obliquely upwards towards the shoulders, which gives the animal the appearance of having a short neck. Their connexion with the sternum is looser than in the human subject.

The two swellings on the lateral and upper parts of the head, covered with white hairs, are the temporal muscles, which must be very strong for their size[1].

[The Black Baboon (*Cynocephalus sphingiola*, Herm)[2].]

In a large baboon monkey the contents of the thorax were much as in the dog. The vesiculæ seminales were seen in the pelvis without dissection. There are two small muscles [compressores venæ dorsalis penis] on the fore-part of the penis near the root, as in the squirrel. There was a small bone in the penis near the glans. The tunica vaginalis communicates with the cavity of the peritoneum as in most brutes. The cremaster is lost on that part of the tunica vaginalis that adheres to the lower end of the testes.

The testes, and the ramifications of their vessels, are as in brutes. There is an attachment of epiploon to each testis by a very small elongation of it: this attachment is to the same part of each testis, and the very same sort of attachment in each.

[The Mandrill, or Rib-nosed Baboon (*Papio Maimon*, Linn.).]

The Ali-Masca or Satyr[3].

The lungs are divided into four lobes on the right side, two large, viz. the upper and lower, and one smaller or middle and anterior, and the lobe behind the vena cava which is a very small one, not passing down between the heart and diaphragm: there are two lobes on the left [side of the chest]. The pulmonary cells are larger than those of the human or most other animals.

The trachea is not closed behind, but [the ends of the rings are]

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[1] [The skull of this baboon is No. 4723, Osteological Catalogue.]
[2] [The skull of this baboon is No. 4747, Osteological Catalogue.]
[3] [The skull of this baboon is No. 4721, Osteological Catalogue.]

much nearer than in the human: the rings are partly bony and partly cartilaginous.

The heart is not so broad at the base as in the human, nor so flat; and the two ventricles are more twisted or plaited upon one another. The left ventricle is long, and to appearance a rounded distinct body, the obliquity [of the heart is] nearly equal to that in the human; therefore, to appearance, there is but a very short inferior vena cava; but it passes a little way along the diaphragm before it perforates that part.

From the curve of the aorta arises two arteries; the first, a large one, is the common trunk of the right subclavian and of the two carotids, the second is the left subclavian.

The duodenum is very much as in the human: it is first covered by the beginning of the transverse arch of the colon; then by the mesentery, which is attached to the back, below the transverse turn of the duodenum. There are no valvulæ conniventes. The ileum passes to the right and enters the colon. The cæcum is not attached to the right psoas muscle, but is loose. There is no appendix cæci; but there is a point where it would be in the human.

The colon is attached to the right edge of the mesentery, both of which are attached to the right loins, kidneys, &c.; it then crosses the spine, being attached to the duodenum at its beginning to cross; from thence it continues its course, becoming looser and looser as it approaches the left side, beginning first to have a mesocolon where it leaves the duodenum, which mesentery becomes broader to the left. When [the colon has] got to the left loins it passes down to the pelvis, whose direction is more backwards than in brutes. The colon has three longitudinal bands, and consequently is sacculated.

The liver is large and thick; it is partially divided into four lobes; what answers to the left lobe in the human being half divided, the right lobe also being half divided; and there is a lobulus Spigelii, making in all four. But, according to the idea of the human liver being of two lobes, then this animal should have five; for, of the three lobes, the middle is the largest, and has the fissure on its middle part for the round ligament.

The gall-bladder lies in a shallow sulcus of the middle lobe, on the right of the sulcus; it is of an oblong oval figure, very similar to that of the human, with its thick end at the edge of the liver. There is a ductus hepaticus and a ductus cysticus, and of course a ductus communis choledochus. The pancreas is exactly as in the human, which is owing to the duodenum being as in the human. The spleen is very similar to the human spleen.

The epiploon is very similar to that in the human: its anterior attachment is the same: its posterior attachment is to the colon on the right side, as in the human; but it leaves the colon and passes along the upper surface of the mesocolon to the left side, and on the left is attached to the diaphragm, spleen, &c. It was divided into two bags, a right and a left, by a partition; but whether this was from disease or was natural, I cannot say.

The kidneys are conglobate; not quite so flat as in the human, although not much rounder; therefore somewhat more prominent, and also not quite so much fixed to the loins. There is but one mammilla, which is long, but the beginning of the medullary substance was somewhat separated.

The skin of the penis is projecting and inverted, forming a prepuce when not erected, but covering the elongated penis by [this] being pushed into it when erected; it is fixed to the penis by close cellular membrane for an inch and a half behind the glans; but is loosely connected to the penis from that on to the common skin of the belly, which loose connexion admits of the formation of the prepuce when the penis is in a state of rest. The glans seems to be something superadded, as in the human, and something of the same shape: it is split almost into two for a little way at the end and lower part. The corpus spongiosum urethræ is not continued along the membranous part of the urethra as in many quadrupeds: the corpus cavernosum comes forward to near the glans, the remainder of which is in part taken up with a bone: this bone passes on into the glans, beyond where it is slit, so that the bone is continued into one side of the urethra.

The vesiculæ seminales appear in the pelvis: a great part of them are covered with the peritoneum: they are very large, and consist of one main duct, sending off a number of others which again are subdivided, and at last terminate in cells like those of the lungs. The duct of the vesicula and the vas deferens communicate some way before they enter the urethra. It would appear that there are two kinds of prostate glands, viz. one, as it were, enclosing the bladder, and another close upon that: their structure and colour are different[1].

The scrotum is not so pendulous and circumscribed as in the human, not having that determined neck which the human scrotum has, being much broader and flatter, so as not to be in a line with the abdomen.

The perineum is very long, and may be said to take in the lower part of the scrotum; or that the anterior surface of the scrotum terminates at once, or makes an angle with the perineum.

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[1] [Hunt. Preps. Nos. 2567 and 2568.]

The testes are larger than a man's: the spermatic vessels make a thicker body before they enter the testes than in man, and the entry appears contorted on the tunica albuginea, as in the quadruped. The tunica vaginalis communicates with the abdomen: it is very thick at the lower part where it covers the testis, but very thin near the abdomen. The cremaster muscle is lost upon it, is very strong, and is capable of pulling the testis as high as the abdominal ring.

On the fore-part of the neck, immediately under the skin and platysma myoides, there is a large cavity [sacculus laryngis] extending from the upper and fore-part of the breast to above the os hyoides or angle of the neck and the chin. At the lower part it extends outwards before the anterior ends of the clavicles for more than half their lengths before the lower ends of the sterno-mastoideus muscles to their outer edge, crossing them obliquely upwards, as the muscles pass obliquely backwards in their passage upwards; its extent laterally at the upper part is in the sides of the larynx towards the outer belly of the digastric muscle. The anterior side of this cavity is the skin and platysma myoides. The posterior side is made up at the lower part by the upper part of the sternum and clavicle, by the lower half of the sterno-mastoideus, and laterally, above, by the sides of the larynx, the anterior part of the neck and the vessels going to the head, &c. The sterno-hyoidei muscles approach one another as they pass up, and as the os hyoides projects forwards over the thyroid cartilage: these muscles at their insertion make a prominent ridge, behind which there is a communication between the right and left sides of this cavity; from thence there is a passage into the larynx, just at the root of the epiglottis: the passage will admit a finger. As this passage is above the glottis, it can have no effect upon the organ of sound.

The arm and fore-arm are extremely strong. The arm is thicker than that of a man's. The hand is extremely small. The nails upon the thumbs are very much like that of the human; those of the fingers are narrower and more convex in every direction, especially from side to side. The palm of the hand is a compound between that of the human and of many brutes; but is most like the human. The small ball of the hand, or that opposite to the thumb, is placed further up the arm than in the human, and is more circumscribed. The balls on the ends of the fingers are thicker.

As the hand and fingers were extremely small in proportion to the powers which moved them, it is natural to suppose that they were not intended for any great variety of motion, but just to hold. It would not appear that they have any great variety of motion. The arms are short in comparison to many other [Quadrumanes].

The foot is larger in proportion to the size of the hand, for a basis to stand upon. It is made for climbing or holding, having a lateral motion to the thumb.

In examining another specimen the heart seemed flatter, and not so much twisted; and the epiploon was only one bag.

In a she monkey [*Papio Maimon*] that they called a 'woman tiger[1],' there is a digastric muscle. It does not make the angle that the digastric in the human does, nor is it bound near so firmly to the os hyoides: the principal binding is to the other muscle on the other side by a thin fascia. However, the stylo-hyoideus encloses it as in the human. The thyroid gland is much as in the human: they [the lobes] have a very short [intercommunicating band?].

The lungs are divided into three lobes on each side, owing to the axis of the heart being more in the direction of the animal's body. The pericardium is connected to the diaphragm by a thin membrane, about half an inch broad: this membrane is single, so that there is no cavity for a lobe of the lungs, as in brutes. The situation of the heart is a good deal as in the human, so that the broad surface can rest upon the diaphragm when [the animal is] erect. This seems to be the cause for the situation of the heart in the human subject. The duodenum is pretty much as in the human, but rather more loose; for, after it has got below the beginning of the transverse arch of the colon, it can be seen in its whole course behind the mesentery by turning the mesentery up, so that the mesentery does not adhere to the spine below the duodenum. There are no valvulæ conniventes. The cæcum does not adhere to the right side, but is loose; and the colon on the right side only adheres, as in the human, at the angle where it is going to make the transverse arch; so that it is only at the upper part of the winding portion that it adheres. The colon has three ligaments, [longitudinal bands] which terminate on the rectum as in the human.

The liver is divided into three lobes, besides the lobulus Spigelii: the middle lobe is the largest, and has a fissure in it, like the human, for the fœtal vein, and has the gall-bladder attached to it: the duct of it is like the human. The lobulus Spigelii is continued to the right, out from behind the little epiploon, and makes a little lobe there. The pancreas is just as in the human; so is the epiploon.

The contents of the pelvis are a good deal as in the human, but more

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[1] [In Bradley's 'Philosophical Account of the Works of Nature,' p. 117, the mandrill is called the 'Man-tiger from Africa.']

forwards or nearer the middle of the pelvis, as the pelvis itself is not so deep, being more like that in the human fœtus.

The uterus was longer than in the human, and much smaller in proportion, and approached to that of the quadruped.

She died in what they called 'in heat;' for the external labia and all about the anus and perineum were very much distended, larger than one's two fists. The *glans clitoridis* was become quite smooth by the distension, and the vagina was become very large and rugous. This distension was owing to a fluid that had got into those parts; for, when cut into, it was just like a watery scrotum. The clitoris was very large and long, about 3 inches in length, much longer than at other times. I should imagine it did not communicate with the plexus retiformis; for, by distending it with air, none of it got into these places, nor did any of the injection that I injected it with. There was no hymen, nor any carunculæ myrtiformes: indeed I never saw a hymen in any[1]. The plexus retiformes were pretty circumscribed bodies on each side of the vagina: they did not communicate with one another, and were very prominent. The internal surface of the vagina very rugous, all the other parts were much as in the human.

This monkey was said to have been in her courses a little while before she died. I observed all round the os tincæ a dark ring, which was no more than a fullness of the vessels there.

There was on each side of the ischium a thick cuticula, like that on the sole of the foot, but rather stronger. This was to sit upon; and underneath there was a yellow fat, the cells of which were ligamentous.

[Family *PLATYRHINA*.]

[The Spider-monkey (*Ateles paniscus*, Linn.).]

In a pretty large black monkey, with a very long tail, the face almost bare, very broad and flat. The external ears were the same with the human, excepting that the lobe was not detached and pendulous. There were but four fingers and no thumb on the hand: the toes were very long, as long as the fingers, and there was a thumb to the foot[2].

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[1] [See, however, the remark at p. 14; probably recorded after a dissection subsequent to the present.]

[2] ["*Simia paniscus*; totus niger: facie livido-cupreâ, maniculis rudimento pollicis nullo."—Fischer, Mammalia, 8vo. p. 39. The skull of this monkey is No. 4691, Osteological Catalogue, and the rest of the skeleton is preserved in the Hunterian Collection.]

The heart lay very near the diaphragm, but there was a space betwixt them. The liver had five lobes: the right of all passed in and made the lobulus Spigelii. The gall-bladder adhered to the middle lobe.

The duodenum for length and course was much as in the human, but is seen through all its course by raising the mesentery. The right edge of the mesentery, where it degenerates into a mesocolon, was not tacked down to the loins as in the human, which exposes the duodenum through its whole length. There was a pretty long cæcum; and a mesocolon through the whole length of the colon, so that the colon did not adhere anywhere; but its situation and course were much as in the human: there was no sigmoid flexure. The rectum is straighter than in the human subject. The bladder and uterus were more in the abdomen than they are in the human subject.

A Capuchin Monkey [*Cebus Apella*, Linn.].

His thoracic viscera are like other animals, only that there is not a cavity behind the œsophagus, as in the otter, leopard, &c. The abdominal viscera are a good deal like a dog's, only the duodenum is not so long nor so loose. There is not so much difference between it and the human [duodenum], only that it is somewhat longer and looser, and is not so much hid by the root of the mesentery: one can see its whole course when the mesentery is raised up, and it does not pass so far to the left side as in the human. The cæcum is long and somewhat conical: the colon and rectum are much as in a dog, but rather larger. The epiploon on the left side is attached to the pancreas, which is loose at that end: so is the spleen; and on the right side [the epiploon] is attached to the beginning of the transverse arch of the colon. The liver is divided into four lobes, besides the lobulus Spigelii; and the gall-bladder is attached to the third from the right side, which is the largest, in a sulcus of that lobe. The pancreas is in a middle shape between that of the brute and the human; on the left end it is loose; it then becomes a little more attached to the back, but not so firm as in the human, and lies in the curve of the duodenum, being a little longer than in the human; the little pancreas is likewise a little longer, being a degree towards the brute.

The tunica vaginalis of the spermatic chord was obliterated only a little way, so that it leads a pretty way up the chord from the tunica vaginalis of the testis, and a little way from the abdomen. The urinary bladder is as in other brutes.

Of the Sanguine [*Jacchus vulgaris*, or *Jacchus penicillatus*, Geoff.].

The sanguine[1] seems to be a small mocock or mongoose; in shape and manner it is just the same; and the make and structure of the parts are very nearly the same; only that I think this animal is rather nearer the brute; however, not more so than what many monkeys are nearer to the brute than what some others are. So that the difference in monkeys from one another is as much as what the differences are in these from one another, therefore may be with the same justness made one class, and the second from the human[2]. The hair, skin, and fat under the skin, the same as in the mongoose.

The hand and foot are very much like that of a monkey; only there are claws instead of nails, like the mongoose and mocock; excepting on the thumb and what answers to the great toe, there we find nails. The thumb is not quite so like the human as the monkeys.

The lungs on the right side are divided into four lobes; on the left side into two only: one of the lobes on the right side lies between the heart and diaphragm, as in the mongoose or mocock, or most quadrupeds.

The stomach is more of a globular figure than the human, having the œsophagus passing in at the middle, between the two ends, much as in the mongoose or mocock.

The duodenum passes as usual, or, as in the mocock, is not covered by the root of mesentery, but only adheres to the angle of the mesentery and loins, becoming loose on the left side, and then it enters the colon upon the right.

The colon passes up the right side, and then crosses to the left, and from thence down to the pelvis. It does not adhere to any place, but is attached by means of the mesocolon, which is shorter on the right just where it is going to make the transverse turn. There are two ligaments that run along the colon, one at the insertion of the mesocolon, the other opposite to it.

The length of the small guts is twice the length of the animal; that of the colon, &c. is just once the length of the animal[3]. There are two pancreases; the one answering to the human, and the little pancreas

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[1] [See Note, p. 6.]

[2] [This is given exactly as written. Hunter obviously means, that in comparing monkeys with brutes, or lower quadrupeds, the monkeys do not differ from each other more than brutes differ from each other, and that monkeys have with their differences so many similarities in common, as to show them to form one natural group.]

[3] [Home, Comp. Anat. i. p. 443.]

lying in the curve of the duodenum. The epiploon adheres to the great curve of the stomach and to the root of mesentery, not to the colon.

The liver has four lobes; one on the left of the gall-bladder-lobe, and two on the right, the lowest of which, or the most to the right, is carried in behind the vena portæ, and has the lobulus Spigelii standing upon it. The gall-bladder adheres near to the aorta, not coming nearly so low as the edge of the liver. The kidneys are as in the monkey. The urinary bladder is very long.

[THE SQUIRREL-MONKEY, or Naked-tailed Monkey of Shaw, 'General Zoology,' vol. i. p. 77 (*Callithrix Sciureus*, Linn.).]

An animal something larger than a sanguine; not so much hair on its head and cheeks: has a longer tail, which has but very little hair upon it; but the hair on its body is similar to that of the sanguine. Its manners and way of life seem to be the same with those of the sanguine.

There are claws on all the fingers of the fore-foot or hand[1], therefore the thumb is in a line with fingers, and is not a counteractor to the fingers. There is a nail on the great toe; therefore it is in some measure a counteractor to the other toes.

The lungs are as in the sanguine.

The stomach, duodenum, and colon are similar to those in the sanguine. The cæcum is a pouch about an inch long. The pancreas and epiploon are as in the sanguine. The spleen is a long body lying in the epiploon, pretty close to the stomach.

The liver is as in the sanguine, only that the lobe on the left of the gall-bladder-lobe is somewhat attached to that lobe. The gall-bladder-lobe has a deep fissure in it, for the vein. The gall-bladder is situated in the same way [as in the sanguine]: it makes some turns upon itself near the neck.

The kidney is conglobate and pretty prominent. The capsula renalis stands on its upper end like an apex.

The penis is prominent, like the human, although more coverable by the prepuce, which does not run along the belly. The scrotum is shallow, which does not allow the testicle to go far beyond the penis. There is a tunica vaginalis communis [*i. e.* it communicates with the peritoneal cavity, from which it was originally derived].

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[1] [Hunt. Prep. No. 1420.]

[Family *STREPSIRHINA*.]

[The Lemur[1]; it may be *Lemur Mongoz*, Linn., *Lemur Macaco*, Linn., or *Lemur Catta*, Linn.]

The Mongoose or Mocock.

This animal seems to be an exact degree from the monkey to the brute in its external shape. It has the ears and head of the monkey, but the mouth is smaller, like that of a raccoon. Its hands and feet are quite those of a monkey's, only the nails are sharper, especially those of the hind-foot. However, the nails of the thumb, both of the fore- and hind-feet, are broad, especially those of the hind; for the thumb of the hind-foot is more a counterpoise to the other toes than that of the fore-foot is.

In Mr. Da Costa's[2], the mouth was pretty full, or close-set with teeth. There were four grinders, pretty much like those of a bear, not so sharp or wedged as a dog's: two teeth with sharp points and with pretty thick bases, especially the backmost: these are between the grinders and tusk tooth. The tusks [canines] are thin and curved, the convex edge forwards; those in the upper jaw are the longest. In the lower jaw there are six fore-teeth, the outermost the largest and the innermost the smallest: they stand not perpendicularly, but shelving like those of the hog, and the outermost approaching towards a point, or inclining towards one another[3]. In the upper jaw there are only four front teeth standing through the gum at some distance from one another, especially the two last[4].

These animals are one remove towards the carnivorous animals.

The body is more like that of a quadruped than that of a monkey. The viscera are a good deal like those of the monkey, but still they are a degree further removed than the monkey. The uterus is between that of the monkey and of the common quadruped; or it is what may

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[1] [The skeleton, Nos. 4641—4651, preserved in the Hunterian Collection, is of the *Lemur Catta*: the skull, No. 4637, is of the *Lemur nigrifrons*; and the skull, No. 4639, is of the *Lemur albifrons*, Geoffr. I have dissected all the above species at the Zoological Gardens, and their anatomy does not vary from that described in the text.]

[2] [The author of the 'Syllabus of a Course of Lectures on Fossils,' quoted at p. 297, vol. i.]

[3] [These 'outermost' teeth are the true homotypes of the upper canines: the dentition of *Lemur* being:—$i\ \frac{2-2}{2-2}$, $c\ \frac{1-1}{1-1}$, $p\ \frac{3-3}{3-3}$, $m\ \frac{3-3}{3-3} = 36$. See the Editor's 'Odontography,' p. 438. pl. 114. fig. 5.]

[4] [The skull prepared to exemplify the dentition of the Lemur is No. 4637, Osteol. Series, and agrees with that of the *Lemur nigrifrons*, Geoffr.]

be called the first stage towards the quadruped's or double-horned uterus. This seems to be exactly the same with the mongoose.

['Woolly Macauco,' Pennant, *Lemur Mongoz*, Linn.]

The hair of the mongoose is almost as soft as wool or beaver, and is very thick. The skin is thin, and it is not connected to the muscles by a ductile cellular membrane, but is lined everywhere with pretty white and hard fat. But this is only when the animal itself is fat, so that it degenerates into the adipose membrane as in the human; yet this fat does not run into the interstices of the muscles, or muscular fibres as in the human, but comes off from the muscles entire with the skin, so that the skin is still loose on the muscles as in other animals.

At the bottom of the eye there is a light green [pigmentum].

The tongue has a part underneath in shape of that of a bird's tongue, so that it might be called double-tongued.

The contents of the thorax are much as in brutes, only the heart is not quite so pendulous, for the pericardium adheres by a little bit of its surface to the diaphragm, just at the apex of the heart; for the axis of the heart is much more in the direction of the body than in the human; and, as the axis of the heart is pretty horizontal, the vena cava above the diaphragm is shorter than common in brutes, but much longer than in the human; so long as to allow a small lobe of the lungs to pass behind it, and to lie between the posterior part of the heart and the spine. The cartilages of the trachea are complete rings.

The stomach of a mocock is very spherical, or rather oval, having the œsophagus passing into one side; and the pylorus answers to the small end of the egg, so that there is little or no small curvature; by which means the stomach is not bent, or is very little so. The small end of the stomach is not continued so long and small as in the human, so that it is pretty short and obtuse, which makes it more of the vegetable-eater than in man.

The pylorus or valvular part is not so closely or firmly connected to the spine as in the human. It is a smooth regular stricture or ring, not pushing more into the gut than into the stomach, but is much more like the human than in any other animal.

The duodenum is shorter than is commonly found in other beasts; but not so short as in the human or monkey; and, as it crosses the spine, it is more attached to the ascending part of the colon, but is not attached to the spine or kidney at the loins and for a longer way than in the brute, but not so much as in the former. The ileum passes into the colon upon the right side. The cæcum is very long, about 7 inches; it is small at the blind end, and becomes larger and larger to the colon, and is a little bent, having a narrow mesocæcum: it is not attached to any part of the body. The colon is a continuation of the thick end of the same size; it is attached to the psoas muscle a little below the transverse turn of duodenum, something similar to the human, but not near so much attached; and is not attached to the loins.

The ascending part of the colon is attached to the right edge of the mesentery, so that they lie more loose in the abdomen than in the human, or even the monkey. The colon makes a turn across the spine, where it is attached to the root of the mesentery, and to the duodenum and pylorus; but, in its way to the left, it becomes looser and is bent back upon itself towards the right near its whole length; that is, near the beginning of colon: this bend is on the underside of the former, and is fixed by a narrow mesentery. It is then bent back again upon the last described part towards the left; but not so far as the former reflection, being attached to the former and root of the mesentery, but not in contact with it. Then it passes back towards the spine upon the left of the root of the mesentery attached to it, and to the last part of the duodenum, as the duodenum passes to the left behind the mesentery: then passes down the loins in the middle of the body to the pelvis pretty straight. There is something ligamentous about the beginning of the colon and termination of the cæcum, which makes it a little pouched there, but nowhere else; and here it is much the largest. There are no valvulæ conniventes in the small intestines. The length of the small intestines is three times the length of the body of the animal; but not one and a half of the body and tail: the length of the colon is about one and a half of the length of the body[1]. The epiploon is pretty broad, a good deal like a dog's; it is attached to the whole of the great arch of the stomach, to the colon upon the right of its posterior lamella, and on the left of that, to the spleen and pancreas.

The liver is divided entirely into two lobes; but the right of these is subdivided into four, which may be called five lobes in the whole, if we count in that way: the left is the largest, and so on less and less to the right, which is the smallest, and is partly behind the mesogaster, and may be said to be the lobulus Spigelii, as is the case in many other animals. The ligamentum rotundum passes into the sulcus between the second left of the four lobes. The gall-bladder is between the middle of the four lobes, so that there are two on each side of it belonging to the large right lobe. The gall-bladder lies in a sulcus of the liver, contrary to the common manner, for the fundus lies forward or toward the diaphragm, and is in view upon the convex side of the liver;

[1] [Home, Comp. Anat. i. p. 243.]

from thence it passes down between the flaps of the liver, and is seen through its whole length, and, when got as low as the lower edge of the liver, it turns up upon the posterior or concave side in a contorted manner, becoming smaller and degenerating into the cystic duct, which joins the hepatic duct at the vena portæ. There is a small hepatic duct that enters the cystic before the large hepatic duct enters. The common duct enters the duodenum about three inches from the pylorus. The bile is very thick and of a yellow green.

The pancreas is pretty small, not reaching so far as the spleen; and the small pancreas is smaller than in brutes, on account of the duodenum being shorter; but it is larger than the human or monkey, on account of the duodenum being longer than in them.

The spleen is as common in quadrupeds.

The kidney is conglobate; the right one was the highest.

The external parts of generation were cut off before I examined these parts. The proper vagina seems to be the only one; it is very rugous. These rugæ may be divided into the large and the small; the large runs the whole length of the vagina, and the small are mostly about the beginning of the vagina, and are more irregular and a little penniformed.

The os tincæ is pretty prominent, most so at the posterior lip. The uterus is about as long as the vagina: it is very small at the neck, becoming much larger where it is divided into two kinds of horns; but each of these horns is as large as the uterus before division; and only about one-third of the whole length of the uterus, and they end in an obtuse end which is rounded. These two horns are very near one another, and are united in their whole length, having a little notch above, like the heart as it is painted upon cards: all the inside of the uterus and horns above the cervix was lined with a soft spongy or pulpy coat. We had reason to suspect that she was beginning to be pregnant, as she had taken the male some days before death. From these two horns, which seem to be the common fundus uteri, passes out the Fallopian tube [which runs] in the middle of the broad ligament; not upon the edge as in the human: however, it comes closer and closer, and at last terminates upon the edge of this membrane, at the end furthest from the uterus, which is indeed very short, not an inch long. This edge answers to the capsule of the ovarium in other animals.

The ovarium is a pretty thick roundish body attached to the uterus, as much as in the human, by a doubling of the peritoneum, which is pretty strong; and the most distant end is attached to the membrane of the Fallopian tube or broad ligament.

The urinary bladder is pendulous, as in other brutes, and is connected to the abdomen by a thin ligament that is perforated.

[The Slender Lemur, *Stenops* (*Nycticebus* and *Loris*, Geoffr.) *gracilis*, Illig.[1]]

The Fairy.

The situation of the stomach is as common. The shape, &c. is seen in the preparation[2].

The duodenum is loose, having a mesoduodenum as it passes behind the mesentery; it is fixed to it. The cæcum is on the right side (see the shape of it in the preparation, with the whole colon and almost all the rectum)[3].

The liver is divided into five lobes: the left is the largest; the gall-bladder-lobe is the next in size; the second on the right is the smallest, excepting the lobulus Spigelii, which is very small. The spleen is as in a dog. The epiploon adheres to the stomach, spleen, and colon.

The kidneys as in a dog. The urinary bladder is oblong and loose as in the brute. The penis is covered by the prepuce; but this prepuce does not lie along the belly as in a dog, but points out from the belly, and is a little projecting at the orifice. The penis is very short, and has a bone almost its whole length: the bone is the most projecting part of the glans, and the urethra terminates about the sixteenth of an inch from the termination of the bone. The membranous part of the urethra is short and pretty close to the crura penis.

The prostatic glands are two, [or the gland is cleft] at the basis, like the heart on playing cards. The vesiculæ seminales are two bags of a pyramidal figure, rugous on the inside like the human vagina, thick in their coats, filled with a brownish mucus, and have hardly any length of duct, as they end in a point which opens on the root of the caput gallinaginis. The vasa deferentia open on the points of the caput gallinaginis, so that they do not communicate. The preparation[4] has four bristles with it, one in the whole length of the urethra going across the vagina, into the bladder; one into the duct of the bags with the butt end out, and two in the vasa deferentia with their roots out.

This animal is of the sloth-kind, which is some degrees from the monkey, mocock, mongoose, and the sanguine. It hardly retains any of the monkey, excepting the hands and feet. The viscera have but little of the monkey in them. The duodenum is not so long as in many animals, and the colon and cæcum are rather larger than in some brutes.

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[1] [The skeleton of this animal is No. 4632, Osteological Series.]
[2] [Series of Dry Preparations.] [3] [Ib.]
[4] [No. 2564, Physiol. Catal. vol. iv. p. 101.]

[The Slender Lemur (*Stenops gracilis*, Illig.).]

Lemur tardigradus, ecaudatus, dorso concolore, Linnæi[1].

The stomach is round. The pylorus is almost close to the right of the entrance of the œsophagus. The duodenum passes to the right and down that side, without passing to the left, but forms jejunum and ileum, which [latter] passes into the colon. The cæcum is long, and terminates almost in a point, and looks like the appendix cæci in the human, especially the appendix in the fœtus. The colon makes turns upon itself one within the other[2].

The external parts of generation consist of vagina and clitoris. The opening of the vagina is about half an inch from the anus, just at the root, and behind a protuberance like a nipple, on which stands the clitoris, and is rather a transverse slit than one in the long axis of the animal. The clitoris stands protuberant on the point of a conical body projecting near half an inch beyond the general surface of the other parts of the body, in which is also the urethra, as in the rat, at the point of which is an opening which is both urethra and preputium clitoridis. This protuberant body has a few long strong hairs on its pinnacle. The vagina is long and small, and divides into two short horns, which are probably the only uterus, as in the rabbit, there being no os tincæ. The capsula ovarii is not very complete, having a wide opening[3].

The kidneys are conglobate: the capsulæ renales are large and prominent. There are two nipples between the fore-legs. The eye is large, and the cornea makes nearly the anterior half of the eye. The ears are flat, thin, and a good deal convoluted[4]. This animal may be called a *Quadrumanus imperfectus*. The hair is very soft, much of it, and about an inch in length. The hands are bare on the palm.

[The Slow-paced Lemur (*Stenops tardigradus*, Illig., *Loris* and *Nycticebus*, Geoffr.[5]).]

Lemur vittatus, caudatus, vitta dorsali subfusca, Linnæi[6].

This appears to be one of the tribe or genus of the *Lemur tardigradus*: there is in a great many respects a considerable similarity.

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1 [There is no species of *Lemur* so defined in the 'Systema Naturæ.']

2 [Home, Comp. Anat. i. p. 443.]

3 [Hunt. Prep. No. 1706.]

4 [Ib. No. 1612.]

5 [The skull is No. 4634, Osteol. Series.]

6 ["*Lemur tardigradus, ecaudatus*, statura sciuri, *subferruginea, linea dorsali subfusca*."—Systema Naturæ, ed. xii. Holmiæ, 8vo. tom. i. p. 44.]

The general character of the two are very similar; so much so, that if not viewed together, they might be supposed to be the same species. However, when critically compared, there is a considerable difference, and probably that is in the length of the extremities. The *Lemur tardigradus* approaches nearer the monkey[1]: the terminations of the extremities, or what are called hands or feet, are the same. The face is short, and of a singular shape; a broad forehead pointed at the nose, and the lower jaw sloping off quick, so there is no chin. The face is pretty straight from forehead to nose, only a little hollowed at the root of the nose: from the eyes being very prominent and looking almost directly forwards, they make a part of the face. No tail[2]. Ears prominent, thin, and with many processes on the hollow side. Nails on all the fingers and thumbs, excepting the fore-finger of the feet, which is a claw[3], as in the other [viz. *Lemur gracilis*?][4].

The œsophagus is pretty long below the diaphragm[5]. The stomach is round or globular. The pylorus arises near to the termination of the œsophagus, but not so close as in the other. The duodenum, as usual, goes in some degree to the left and becomes a loose intestine. The ileum passes into the colon on the right. The whole small intestines are not long: there are no valvulæ conniventes in the intestines. The cæcum is long, but not so pyramidal as in the other [viz. *Lemur tardigradus*]. The colon passes up the right side, and where it is going to cross the abdomen, it makes a slight fold on itself, then passes to the left, and down close to the back, to the pelvis, where it becomes the rectum, without any sigmoid flexure[6].

The epiploon is attached to the great curve of the stomach and transverse arch of the colon, as also to the crus of the diaphragm, between the stomach and colon.

The spleen is a long small body, as it were suspended in the epiploon, along the left and lower curve of the stomach.

The liver has four lobes, besides the lobulus Spigelii: the left lobe is the largest; the second from the left, or that which has the gall-bladder attached to it, as also the round ligament, is next in size, and is nearly in the middle of the abdomen; and where the round ligament enters there is a small lobe.

The left end of the pancreas is, as it were, suspended in the posterior

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[1] [In the *L. gracilis* the fore-arm and leg are longer and more slender.]

[2] [The tail is represented by a mere stump ("cauda brevissima," Fischer): in *L. gracilis* this rudiment is absent.]

[3] [Hunt. Prep. No. 1417: the hand is No. 1416.]

[4] [Ib. No. 1418.]

[5] [The tongue is preserved in Prep. No. 2518.]

[6] [Home, Comp. Anat. i. p. 442.]

part of the epiploon. The kidneys are conglobate: the capsulæ renales are prominent and pretty large.

The two ventricles of the heart are long, and nearly of the same thickness at the base and point: the right auricle is the highest.

The lungs on the right side are divided into three lobes, besides the lobe behind the vena cava inferior. The left lung is divided into two lobes.

The external parts of the organs of generation in the female are the clitoris and opening of the vagina or vulva. The clitoris stands upon a prominence which is common to it and the urethra, as in the other [tardigrade Lemur]. The clitoris has two prepuces, one within the other. The meatus urinarius opens just behind the clitoris on the same point. The vagina opens just at the posterior base of the clitoris, about an inch below or before the anus; it is pretty large at the opening. The vagina is very long, but does not project further beyond the bladder than is common in other animals, owing to the urethra being very long and being attached to the inside of the abdominal muscles nearly throughout its whole length, which throws the bladder more into the belly; the symphysis of the pubis being very short. The vagina is thrown into longitudinal folds. Os tincæ none. The cornua uteri short and a little bulbous. The ovaria appear as if compounded of small bodies. The meso-tubæ-Fallopianæ ['broad ligaments' of anthropotomy) hardly makes a capsula [for the ovarium][1].

The eyelids are almost transverse. The eye is large and prominent in the head. The cornea is large, so that the tunica sclerotica is hardly ever seen. It is a segment of a smaller circle than the sclerotic, although a larger segment than in most animals. There is a great deal of pigment on both sides of the choroid.

[Order Carnivora.

Section Digitigrada.

Family *FELIDÆ*.]

Of the Lion and its gradations.

Lions, tigers, leopards, &c., are all said to be of the cat-kind, and indeed from their shape, manner, disposition, and way of life, it seems very reasonable to suppose so. Yet I should suppose that there are two classes of them (and perhaps many more). One reason for this opinion is, that their voices differ; and we find a difference in their organs of voice, which is most likely the cause of that difference in the

[1] [Hunt. Prep. No. 2812.]

voice itself. As to the voice, the lion, tiger, and leopard are nearly allied, and are the same in the structure of the organs of voice.

This class [the animals of this group of Felidæ] do not purr like a cat, nor do they mew. The leopard makes a noise something similar to the mew of a cat, but it is very hoarse, and not so loud. They utter the guttural or hollow sound when angry very strongly; viz. that which is made in the glottis without any articulation. The lion has this last; the cat also; besides, this is common to them all. The he-lion often in the evening makes a noise like a common saw, when sawing a hard piece of wood; so that every one that hears it first supposes it to be somebody sawing. The she-one has the same voice, but not so strong. They only use this kind of sound by way of call; for the he-one only does this when separated from the she; and the she-one does this when she is separated from her young, or when she hears her young ones call. However, the lion's voice differs from that of all the others: the calling noise is like that of a bull: but his fierce noise is just like that of a leopard or tiger.

All of this class [Felidæ], with their gradations, lick themselves with their tongues, by way of scratching; and therefore have their tongues very rough on its upper surface.

In the lion, tiger, leopard, &c. this roughness is the most considerable, and falls off gradually in those which fall off from the lion in other respects. For this purpose they have a great deal of motion in their whole tongue, and in every part of the tongue itself. Their larynx is farther removed from the head than in the cat, and the os hyoides is not attached to the head by a bony continuation, as in the cat, and in most other animals, but by a ligament. The first class [or group of Felidæ] are the strongest made, especially in their limbs and feet, in proportion to the size of the animal. Their ears are broader and shorter than those of the cat-kind. The pupil is round in the first [group], but elliptical in the last, whose long axis is perpendicular.

The last phalanx of the toes is turned up and crooked, and is always kept in extension by elastic ligaments: there are two or three of these: the innermost arises from the root of the second phalanx on its middle, and is partly lost in the same side of the claw, and partly into the skin on the side of the claw. The other arises from the outside of the second bone, and is inserted into the opposite side of the same claw. But the chief one arises from the anterior end of the second phalanx where the third is articulated, and from its outer edge, and is inserted into the convex edge of the third phalanx[1].

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[1] [Hunt. Preps. Nos. 287, 288. I have shown the difference in the disposition of

Besides these elastic ligaments, there is a tendinous one that is fixed to the head of the second bone, and passes along the upper surface of it to the third, and is fixed to the third at the articulation. The intention of this seems to be, not to let this joint be too much bent: this is only a continuation of the tendon of the 'extensor digitorum communis.' The skin that covers the last phalanx is very loose; and where this phalanx is drawn up or back, the skin covers a great deal of the root of the claw, like the prepuce.

All of this class of animals have the practice of sticking their claws into wood, leather, or any such thing that will admit them: the intention of this seems to be to force off any splints or old external surface of the claw, which becomes soft and irregular. They are all (as far as I know) retromingent, and this has its gradations as much as the other parts of this class of animals[1].

THE LION [*Felis Leo*, Linn.][2].

The surface of the tongue is studded with small bodies, each very near an eighth of an inch in length, ending in a point. These are longest, and thicker in the middle, about an inch and a half from the anterior end. On the side of every one of these next to the root of the tongue,

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the elastic ligaments in the fore- and hind-foot, in my preparations Nos. 287 A and 288 A, and the descriptions, p. 76, vol. i. of the 'Physiological Catalogue,' 4to. 1832.]

[1] [In the 'Philosophical Transactions' for 1781, Forster records the following remarks on the subdivision of the Felidæ:—

"The greater and more numerous the different genera of animals are, the more difficult it must be to the natural historian properly to arrange the whole of such an extensive division of animals, especially if they are not equally well known. To form new genera, in order to dispose and arrange them under, is a remedy which increases the evil, instead of curing it. The best method, therefore, which can be devised is to make great divisions in each genus comprehending those species which, on account of some common relation or character, have a greater affinity to one another. The genus of cat, to which the animal belongs we are going to speak of more at large, offers three very easy and natural subdivisions. The first comprehends animals related to the cat-tribe, with long hair or manes on their necks; secondly, such as have remarkably long tails without any marks of a mane on their necks; lastly, such as have a brush of hair on the tips of their ears, and shorter tails than the second subdivision. The first might be called in Latin *Feles jubatæ*; the second subdivision should be named *Ælures*; and the third and last, *Lynces*. To the first subdivision the *Lion* and the *hunting Leopard* or Indian *Chittah* belong. The second subdivision consists of the *Tiger*, the *Panther*, the *Leopard*, the *Ounce*, the *Puma*, the Jaguar, &c., the Jaguera, the *Ocelot*, the *Gingy* of Congo, the *Marakaya*, the *Tiger-Cat* of the Cape, or the *Nsussi* of Congo, the *Tibetan Tiger-Cat*, which I saw at Petersburgh, the common *Bush-Cat of the Cape*, and lastly, the *wild Cat* and its domestic varieties. To the third division belong the *Lynx*, the *Caracal*, the *Serval*, the *Bay Lynx*, and the *Ghaus* of Professor Gueldenstedt."]

[2] [The skeleton of the lion is No. 4475, Osteol. Series: it is followed by several other Hunterian specimens of the osteology and dentition of the species.]

is placed a horny substance in the shape of a claw, whose convexity is forwards, fixed to a body on their convex edge for near one half of their length, the other half is projecting[1].

As the larynx is at a greater distance from the common cavity of the mouth than is common in other animals, the tongue is obliged to be long in proportion; but the anterior part of the tongue is what may be called 'true tongue,' and that is only attached to the larynx by a continuation of substance, although not of the same kind of surface, nor is it near so solid.

The os hyoides in a cat is as in a dog, and there is not that distance between the tongue and os hyoides in either as in the lion. The voice of the lion is a hollow roar. The roof of the mouth is very rough, having transverse rugæ, which are turned backward, stronger anteriorly; they are somewhat papillous, with a number of papillæ between them. The 'worm' in the tongue is very small, as small as that in a cat.

The parotid gland is but a small one, but there is one of the same kind placed on the inside of the temporal muscle at the bottom part of the orbit, which is not bone in this animal. The duct of this gland passes out round the posterior tooth in the upper jaw and enters the inside of the cheek, upon the outside of the last grinder.

A very long styloid process, which is similar to that part of the os hyoides which is attached to the head in other animals, is bent, passing first inwards along the basis of the skull, then forwards or downwards in this animal, and is connected to a graniform cartilage by a ligament; whereas in a dog they are connected by bones articulated. As there is a great distance between the tongue and os hyoides, the velum pendulum palati is broad in proportion, or rather long, to cover the aperture of the larynx, which is at a considerable distance; there are two elastic muscles in the direction of the velum pendulum palati, so that there are two long membranous canals passing from the head to the larynx, viz. the upper part of the œsophagus, and the passage from the nose to the larynx. There is no uvula. The rimula laryngis, which is continued from the epiglottis in man and in the dog, is not so in the lion, for the ridge from the epiglottis is continued out on the outside of the cricoides, and is lost insensibly in the root of the cricoid. The ridge from the tip of the cricoid is carried forward to the upper part of the thyroid at the root of the epiglottis, and just above the ligament of the larynx; the ligaments [chordæ vocales] are very broad, and arise from all the anterior edge of the cricoid, so that the ligaments and the ridge from the cricoid arise at the cricoid both together[2].

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[1] [Hunt, Preps. Nos. 1512, 1513.]   [2] [Ib. Nos. 1172, 1500.]

The six fore-teeth in the lower jaw of the lion, although they make a pretty regular line at their base, yet they make a zigzag one at the fangs, which increases to the points. The necessity of this arises from the want of room at this part of the jaw, between the two tusks, for the points of the six teeth to make an even line. The lion, according to the teeth, is at the head of the carnivorous animals.

The aspera arteria is much longer in the lion than in the dog, in proportion to the size of the animals, and the two edges formed by the ends [of the tracheal rings] overlap one another, but the intermediate ligament is so elastic as to allow of a considerable distance between these two edges, which enlarges the trachea considerably. It is reasonable to suppose that this can be but of little service in common respiration, as the trachea is at all times large enough to allow a free passage for the air, which is proved by its being larger than the glottis.

The lung of the right side is divided into three, besides the lobe passing behind the vena cava. The left lung is divided into two lobes, and the uppermost is partially subdivided into two. The lower lobe is fixed by its lower and inner edge to the posterior mediastinum by a thin and pretty round membrane. On the right of the œsophagus, before the heart, there is a cavity which is made up of the posterior mediastinum on the left side, in which the œsophagus passes, and on the right side it is made by the attachment of the lower lobe of the right lung to the particular lobe [that behind the vena cava], and to the spine upon the right side, and by the attachment of the particular lobe to the mediastinum by a broad membrane, all of which make a pouch. The trachea is large in proportion to the animal, so are the bronchiæ and the pulmonary cells.

The pericardium is not thick, but very dense and strong. The heart is very much fasciculated, like the human. The arteries are very strong, not having the appearance of those of a bullock. There are two pulmonary veins from the left, and one from the right lung: in the dog there are three from the left lung and two from the right.

The œsophagus becomes very large just before it passes through the diaphragm[1]. The stomach has a strong band of muscular fibres running along its great curve, something like one of the ligaments [or longitudinal bands] of the human colon, but not so distinct.

The stomach is bent towards its small end; for at first sight it seems to be as much in the right as in the left [half of the abdomen]; but then the small end is bent upon itself, so that the pylorus is in the

[1] [See the Hunt. Preps. Nos. 64 and 451, and the additional preparation No. 451 A, with its description (Physiol. Catal. 4to. vol. i. p. 124), for a demonstration of the peculiarities of the lion's gullet.]

middle of the body, and this doubling is so close as to bring the bent parts in contact. The pylorus is very large, having a mesopylorus nearly half a foot long, in which lies some of the pancreas with its ducts, vessels, &c. The valvular part of the pylorus is not so prominent nor so regular as in the human subject.

The duodenum was loosely attached by a broad mesentery, and measured in length about 12 inches: the length of the small intestines was 18 feet; their circumference was uniform throughout, 2½ inches. The cæcum was 2 inches long, and the same in circumference; its form being that which is met with in the domestic cat. The length of the large intestines was 2 feet 10 inches; their circumference 4 inches. The muscular coat of the intestines was thick throughout their whole extent.

The duodenum is very long and loose, having a broad thin meso-duodenum. At the lower part of the duodenum, where it is passing across the spine, it is attached to the spine by a thin doubling of the peritoneum, which doubling is fixed to the spine and to the kidney of the right side, by which it attaches the right lobe of the liver to the kidney; this doubling is attached to the mesocolon upon the left, and the whole is of a semilunar form, whose concavity is upwards; besides this attachment, the duodenum is attached to the posterior part of the root of the mesentery, which is firmer than the former [attachment], and then it becomes loose.

The ileum passes into the cæcum upon the right, but does not cross the body in the same regular manner as in the human, and it is likewise a good deal higher; from thence the colon passes to the left, having a broad mesocolon; it then passes down, getting more into the middle of the body, to the pelvis. The mesocolon is just a continuation of the mesentery, so that the colon is as loose as the other intestines every where, and on this account there is no precise situation for the colon[1].

The mesentery and mesocolon are long and very thin, lined with fat where the vessels pass, and along the attachment to the intestines. The mesenteric glands are large at the root of the mesentery: there are some in the mesocolon, especially about the cæcum; and the vessels of the mesentery do not anastomose as in the human, making but one arch, a good deal similar to the vessels of the mesocolon in the human subject.

The mesogaster is very irregular, not inserted into the stomach in one straight line, but being in some measure scolloped, so that some parts are inserted near the middle of the anterior surface of the stomach; and, upon the posterior part of the concave arch of the stomach, there is another mesocolon; but this is only attached to the stomach just

[1] [Home, Comp. Anat. i. p. 437.]

running across the arch. It is hollow, and is a conductor of the vessels to the posterior surface of the stomach; and the vessels coming to it are from the left end.

The omentum was loaded with fat, and extended about two-thirds of the distance to the pubes.

The great epiploon is very broad, covering the whole anterior surface of the guts, and is folded and reflected round the lateral, lower and posterior parts of them; it is very thin at some parts, and very thick at others, with fat; the fat parts of the posterior lamella of the epiploon passing in between the convolutions of the intestines like the internal part of the pia mater. Perhaps it is for this use that it is made double, that these folds of it may vary as the convolutions of the intestines vary. It is attached to the whole convex arch of the stomach anteriorly, and posteriorly to the pancreas, and on the left to the spleen.

The liver is divided into five lobes, besides the lobulus Spigelii, or in other words there are six: and the gall-bladder is in a large fissure in the middle [lobe], between the two middle lobes [those to the right and left of the gall-bladder-lobe]. It was in a contorted manner long before it forms the duct.

The pancreas is almost as in other brutes, having two lobes, but with this difference,—that the small one, after it has passed along the curve of the duodenum to the passing of that gut behind the mesentery, joins the right side of the root of the mesentery, or rather the trunk of the vena portæ, and passes up with it as high as the pylorus, or rather as high as the large pancreas which crosses the vena portæ. At that part the two pancreases join one another, so that the little pancreas makes a complete ring, with a little bit of the head, or beginning of the large one. The duct likewise makes a complete circle, for the duct of the small pancreas communicates with the large at two different places. The ducts of both unite into one at its attachment to the duodenum, and [the common duct] enters that gut, with the biliary ducts, about 4 inches from the pylorus.

The length of the small intestines is something above four times the length of the body of the animal; that of the great intestine is about two-thirds. The cæcum is about 3 inches in length[1]. Their coats are very dense and strong, not of a flexible or soft texture, but rather like half-boiled tripe[2].

The bladder is very loose in the pelvis. The prostate gland is situated

[1] [Hunt. Prep. No. 724. The difference in length from the cæcum noticed in the preceding page, shows the observation to have been made on another subject: the anatomy of both the male and female is here given.]

[2] [Ib. Nos. 693–696.]

behind the neck of the bladder; none of it lies upon the sides of the bladder as in the human. The urethra is very long between the bladder and the bulb; it is very muscular, becoming more so towards the bulb, and becoming thicker. There are two erectores penis on each side; a large external one enclosing almost the whole crus, and part of which is inserted by a broad tendon into the pubis; and a second much smaller one which lies between the penis and the os pubis, where the crus adheres to that part and passes on towards the symphysis, where it seems to join its fellow on the other side by a strong tendon, just under the symphysis, and then passes over the vena magna; they look as if they would compress it.

There are two transversales [or acceleratores urinæ] on each side, one external and one internal. The external is inserted into the beginning of the bulb below Cowper's glands, and the other above these glands; but both are in contact with the gland. Cowper's glands are very large, and are covered by the acceleratores, which makes a kind of pouch for them. There is a strong muscle arising from the hollow of the os sacrum which spreads on the posterior and lateral parts of the rectum; part of it is lost in the sphincter ani, and the rest in the common insertion of the sphincter and accelerator urinæ. Two small muscles run over the bulb, and along the under side of the urethra, to the reflexion of the prepuce, and there seem to be lost in the skin of the glans. The use of those muscles is to draw the penis back in the soft state, and bend it back or curve it as the flexor tendons of the fingers do them. The penis, after it has passed forward and a little upward, makes a turn backward, viz. that part which seems to be prominent, so that they are 'retromingent.' There is but a little of the penis covered by the prepuce, only the glans as in the human; but all the skin of the penis is covered with hair, excepting that part of the prepuce that is in contact with the glans; so when the prepuce is brought back over the penis, there is only about 2 inches of penis that seems fit to enter. The construction is a good deal like the human.

Of the Female Parts of Generation.—The bladder is pendulous, and is attached to the abdomen by a thin ligament. The urethra is very long, and at its entrance into the common vagina, it is covered by a thick strong muscle common to it and to the common vagina. Of the clitoris, the crus on one side does not communicate or unite with the other, and therefore it seems to have no body; it is vascular, as in the human, but does not stand so prominent in the common vagina; it is a little rugous; which rugæ are penniform, having a little hole just at the external part. The erector muscles are inserted into the clitoris, and arise each by a strong tendon from the pubis near the symphysis; by which means they compress the crus against the symphysis. The common vagina is about 3 inches long, is longer than the true vagina, is covered by a strong circular muscle which becomes stronger and stronger towards the mouth of the vagina, or erector clitoridis: the common vagina has a number of rugæ running parallel, which rugæ are villous: the diameter is about three-quarters of an inch. Then begins the true vagina, which is very rugous on the inside, and those rugæ are parallel [and longitudinal]. The length of the vagina is 4½ inches, about the width of a goose's quill, and at the os tincæ it is smooth on its upper side, and a little pouched there. The os tincæ is very prominent and papillous. The uterus is rather thicker than the vagina, but the cavity much of the same size, and that divides into two horns, each as big as the [common] uterus, and longer. The cavity of the uterus is pretty smooth, the rugæ being very flat; each horn is about 4½ inches long, and then terminates in the Fallopian tube, which is very small, and runs along the surface of the capsula [broad ligament] to get to the opposite side of the capsula where the ovarium is, and then opens in the edge of the mouth of the capsula, which is pretty large. The fimbriæ are two membranes attached to the mouth of the capsula, or rather to where the mouth splits into two edges opposite to the ovarium, and passes along the edge of a ligamentous substance that connects the ovarium to the abdominal muscles round the convexity of the kidney. This bag makes a sort of capsula for the ovarium, but is open in its whole length, not by a small orifice as in some.

The ovarium is oblong, with one end attached to the end of the [uterine] horn, and [the other by its ligament is] attached to the kidney and side of the abdomen. The ligamentum rotundum arises from the horn of the uterus about an inch from the termination; it is not so broad as in the bitch, nor does it take out an elongation of the peritoneum with it.

Of the Eye of the Lion[1].—To the orbit of those animals that have not a complete bony orbit, there is added a ligament that surrounds the eye. The eye of the lion is vastly larger than the human eye: it has ten muscles; having four supernumerary ones between the common muscles and the globe, placed a little further back: they are smaller than the others. The sclerotic coat is the thickest at the anterior part. The optic nerve is smaller than in the human eye, and, at the entrance of the optic nerve, pass blood-vessels which are continued in the substance of the sclerotic coat for some way, becoming fainter and fainter forwards; so that in dipping deeper and deeper in the coat, the vein runs serpentine, so as to put on the appearance of a suture: one is on the

[1] [Hunt. Preps. Nos. 1710, 1730, 1731, 1732.]

outside, the other on the inside. There is a part white [shining, viz. the tapetum] in the bottom and upper part of the eye.

The lion and the cat have more than one or two young at each impregnation, each horn of the uterus having three or four young ones in it, every one of which has a distinct placenta and membranes. The placenta consists of a broad flat circular mass or ring, within the area of which lies the fœtus, as a horse in a girth[1].

Upon its outer surface the placenta adheres everywhere to the uterus: from the two edges of this broad flat ring pass out membranes which also line the uterus for some way; they terminate in blind ends, which makes the whole a complete bag. Within this bag, made of placenta and membrane [chorion], lies the fœtus enclosed in another bag [amnion] which adheres nowhere but to the umbilical chord: it is thin and transparent, containing some water. Besides this bag immediately enclosing the fœtus, there is another smaller one which seems to be entangled in the umbilical vessels, and lies as it were between the second described and the placenta or insertion of these vessels. This is a kind of tunica vaginalis of the umbilical vessels, or capsula of the allantois. Within this bag is another which is much smaller, and as it were floating in it, which is called the allantois: this bag is of a triangular shape, and is attached by two of its angles to the placenta, and by the other angle to the fœtus, which is called the urachus. The arteries of the uterus pass from it to the placenta, and there ramify both upon the external and internal surfaces; but they deposit their contents into the substance of the placenta, from whence the veins arise to carry it back to the heart of the mother: so far exactly similar to that of the human. The umbilical artery of the fœtus ramifies everywhere through the substance of the placenta as in the human; but, besides this, it ramifies everywhere on the first described membrane [chorion]. The umbilical vein everywhere corresponds to the artery. Here then is a mixed communication between the mother and the fœtus: so far as regards the membranes, it is like those that have no placenta, as, *e.g.*, the mare, &c.: so far as regards the placenta, it is like the human subject. It is very probable that this is the kind of communication between mother and fœtus through all the gradations [of the Carnivora], for it seems to be the same with the bitch.

The lion, the leopard, and the cat, when going to receive the male, lie flat on their belly with the rump raised. The he-one gets upon them with his feet on their back and sides, which makes them raise their rump still more, and then he inserts. A she-one of this kind is

[1] [Hunt. Preps. Nos. 3562—3566.]

very fond of having her back stroaked: she immediately raises her rump whenever anything touches her back.

The Leopard [*Felis Leopardus*, Linn.][1].

The tongue, fauces, pharynx, larynx, trachea, lungs, heart, and œsophagus are exactly similar to those in the lion; only that the os hyoides is rather farther from the thyroid cartilage. There is a [serous] cavity on the fore-part of the œsophagus, as in the otter, which is made by the edges of the lungs adhering by a thin membrane to the œsophagus laterally, and also by their membranes to the pericardium and the anterior part of the œsophagus.

The stomach is almost parallel with the body, and then makes a quick turn up, as in the lion. It has two orifices, which are much nearer one another than in the human; but the great arch is much more convex, and the great end is not so sharp. Its vessels do not pass into it at its small curve, but go on a good way on its surface, as far as they dip into its coats.

The duodenum passes on to the left, in every other respect like the lion's; for it passes down the right side, and at the attachment where it did not pass to the left, it becomes looser, and throws itself into convolutions: the turns of the jejunum become more towards the right and downwards, just in the direction of the human jejunum: the ileum passes up on the right side of the mesentery, and dips into the cæcum on the right side, which was just like the lion's in shape, and about 1½ inch long.

The colon passes a little way up towards the root of the mesentery, having a mesocolon through its whole length to the rectum; and then makes a turn to the left side across the root of the mesentery down to the pelvis. I could easily turn the intestines so as to make the duodenum pass to the left or right at pleasure, and I could easily turn the cæcum to make it pass from the right to the left. The length of the small intestines is twice the length of the animal, measuring from the head to the tip of the tail: the great intestine is about one-third the length of the animal.

The pancreas does not adhere to the neighbouring parts as in the human, but is rather in the mesoduodenum or in the epiploon. But the pancreas does not lie flat within the epiploon, but is only attached by one edge, viz. the upper, and at the small end of the pancreas it is a little way from the epiploon: so that there is a doubling passing along

[1] [Hunter preserved the skulls of two leopards, Nos. 4542 and 4543, Osteol. Series.]

the great curvature to the œsophagus; but it is attached to the stomach on the posterior surface at the cardia[1].

As the gall-bladder does not adhere to the under surface of the liver or to the under part of any of the lobes, but lies between the two lobes, or rather in a deep sulcus of the liver, it is by that means not so pendulous as in the human, and of course does not make that sharp turn or angle with the ducts, but only a gentle curve.

The clitoris is a little prominent, terminating in a point: the erectores are very strong, and are partly inserted into the crus, and partly pass on to the pubis to be inserted there as in the mare; but the clitoris is cavernous. Cowper's glands are very large, and enter above the middle of the common vagina, and are covered by the sphincter vaginæ: this muscle is at one part as in the human; but above that part it is very strong, and goes round the common vagina its whole length, and round the meatus urinarius at its termination.

The common vagina and the true vagina are as in the lioness. The longitudinal rugæ are three in number, one terminating at the os tincæ posteriorly, and the other two laterally; and at the mouth of the true vagina it is thicker and more rugous. The os tincæ is just behind or rather above the upper part of the pubis. The fimbriæ are not continued along the suspensory ligament, as in the lioness: the capsula ovarii is very thin, as in the lioness, not fat as in the bitch; and this was a pretty fat leopard. The uterus is as in the lioness[2].

The two lateral bags, one on each side of the anus, are as large as a walnut, and are covered by a sphincter ani. When cut into there are two white spots on the inside, which seem to be glandular, but are very small when compared to the bag. But as this juice is only required, perhaps, when going to stool, there were only required glands to secrete enough between times. When looking on the internal opening of these bags into the anus, it has the appearance of the human os tincæ[3].

The anus has a depressor and a levator muscle. The depressor arises from the tail just above the verge of the anus: it is very narrow; it passes up, and when just above the union of the levator it spreads on the posterior surface of the rectum. The levator arises from the middle of the os sacrum and passes down and a little out; then unites with its fellow behind the anus, just below the depressor, and is lost on the side of the anus and vagina; but these muscles are elastic in some measure; whether the elastic fibres mix with the muscular or not, I do not know.

The eye of a leopard is very large[4]. The optic nerve is small in comparison. The sclerotic is thickest at the anterior part, especially

[1] [Hunt. Prep. No. 833 (spleen).]
[2] [Ib. No. 2795.]
[3] [Home, Comp. Anat. i. p. 438.]
[4] [Hunt. Prep. No. 1733.]

near the cornea, and more especially at the insertions of the muscles. The cornea is very thick. The tunica choroides has a pigmentum nigrum both on the outside and on the inside: that on the inside lines the processus ciliares and the iris, and is there thicker. It ends round the optic nerve, but not equally as in the lion, racoon, &c. Then the tunica albuginea begins, which is a little greenish round its edge, as if the pigmentum nigrum was shaded into the white, and this point is very smooth: that on the outside terminates about the ligamentum ciliare. This is not smooth like the other, for, as the choroid is attached to the sclerotic by a kind of cellular membrane, the pigmentum nigrum seems to be mixed with it. The ligamentum ciliare is very broad and a little way behind the cornea at the anterior part. The beginning of the iris is some way from the sclerotic, so that the ligament is of some length, but becomes more closely attached backwards: the anterior part seems to be made up of short strong fibres or strings, very close to one another, just like the gelatinous fibres passing between the cutis and cuticle in the sole of the foot. The iris is thicker than the choroid, and has no point on the anterior part, and is of a yellow colour. The trochlearis muscle is not so fixed to the upper part of the orbit as in the human; for the trochlearis is at some distance, and its origin is nearer the bottom of the orbit than the insertion.

I observed in a leopard, when it shut its eyelids, that the membrana nictitans came about half-way over the eye. This I plainly saw when it opened the lids[1].

[The Tiger (*Felis Tigris*, Linn.).]

Of the Bengal Tiger.

This animal is nearer to the lion than the cat; its legs are thick and strong, like the lion's. The feet are broad and clumsy like those of the lion. It is thinner in its body than the lion, or than even the leopard; but, like the cat, the os hyoides is attached to the head by the chain of bones[2].

[The Chittah (*Felis jubata*, Schreb.).]

Of the East Indian Hunting Tiger.

This animal is spotted. The hair is rougher, and not so sleek as in

[1] [The kidney of a leopard, with the veins injected, forms the Hunt. Prep. No. 1202.]

[2] [In a tiger which the Editor dissected at the Zoological Gardens, he found the hyoid attached by an elastic ligament about 3 inches long, and extensible to 5 inches: in fact very similar to that in the lion, only the ligament was not so long.

Of the tiger Hunter preserved the following parts:—No. 1203, the kidney, with the veins injected; No. 1284, a section of the suprarenal body; No. 1324, the brain; No. 1966, a section of the lip, showing the roots of the whiskers; No. 2147, the anal glands.]

the leopard. The head is shorter than in the lion, and the line of the head and nose forms one curve. The ears are short. The body is rather rounder than in the leopard, tiger, or cat. The legs are longer in proportion and smaller, even smaller in proportion than the cat's: the foot is not so broad and clumsy as in the lion, tiger, leopard, or cat.

The claws are midway between the lion's and the dog's, perhaps nearer the dog[1]. It is retromingent. The viscera are like the lion's, &c.; only I think that the cæcum is not quite so long. The os hyoides is attached to the head as in the cat.

Of the Cat-tribe.

Cats are one degree removed from the lion, leopard, and tiger, &c. The differences are known, but are small. Their legs are smaller in proportion to the body, but more especially the fore-legs. The ears are not so broad, are longer, and terminate in a point. The iris is elliptical, and the os hyoides is attached to the head by bones continued between them, which in some degree confine the motion of the larynx; this is likewise nearer the root of the tongue or head, which makes a difference in the voice.

Cats never show any signs of lewdness, either the he or the she, excepting when she is caterwauling. Cats are subject to vast anger; as their danger increases their fear changes into rage and becomes furious. They cannot bear to be teazed, but fly immediately into a passion: neither can they bear to be severely punished without retaliating. As they feed upon animals that they kill, nature has endowed them with the proper methods, which to appearance would be called slyness or cunning.

[The Margay (*Felis tigrina*).]

A cat about the size of a common cat, is spotted something like a leopard, but rather darker, and what answer to the dark spots in the legs are not round but oblong, and much in the direction of the ribs; and the tail is annulated with the two colours. Mr. White[2] has a drawing of it. The os hyoides is fixed to the head by a continuation of bones as in the common cat; so that it is higher or nearer the jaws than in the lion. The trachea, the contents of the thorax, the stomach, and intestines are the same as in the lion.

[1] [In a live Chittah at the Zoological Gardens, I observed that the fore-claws were retracted so as not to touch the ground; but yet were not concealed in the duplicature of integument and hair, as in the typical *Felinæ*; the hinder claws, by the action of the *Flexor longus digitorum pedis* in progression, are drawn out so far as to touch the surface on which it walks and produce a clatter.]

[2] [Probably Gilbert White, the Historian of Selbourne, is here referred to.]

The liver is divided into five lobes, besides the lobulus Spigelii. The gall-bladder is almost hid in the middle lobe of the liver, which is the longest lobe; its fundus is seen in the middle of the convex surface of that lobe, as in the [tiger, jaguar and opossum], and its apex is seen near the vena portæ; it is convoluted near the neck as in the lion, and its duct enters the duodenum about an inch from the pylorus, and receives the duct of the pancreas near its passage into the gut.

The kidneys are [like those] of the lion kind. The coat of the kidney of a common cat has not the veins running in its substance as in the lion.

[The Ocelot (*Felis pardalis*, Linn.).]

A large cat that I had from the Tower was spotted, but not so light as a leopard, nor so round in the spots, they were oblong as in a panther. He was pretty thick made, more so than mine. He had very large testicles, larger than a lion's. He was of the cat-kind; for there was not that distance between the os hyoides and what may be called the styloid process, and they were connected together by a stout bone as in other cats, or dogs, &c.; so that the os hyoides was connected to the head by three bones on each side.

Mr. Banks's Sierra Leone Cat [*Felis servalina*, Jardine?].

[Copy of a Note appended to this MS.]

"If you will step in at Banks's[1] in Soho Square, you will find the corpse of the fine Sierra Leone cat, the inside of which is at your service. The skin is to be stuffed for the British Museum."

Small legs and feet: the hind- and fore-legs nearly of the same size. The os hyoides continued to the head. The ductus communis choledochus, where it enters [the duodenum], swells into a small bag. All the viscera are similar to those of the cat or lion.

The skin of this animal is stuffed and in the British Museum[2].

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[1] [Subsequently Sir Joseph Banks, P.R.S., whose town-house, afterwards occupied by the Linnean Society, was in that square. As he was raised to the Baronetage in 1781, the reference in the text gives a clue to the date of the dissection.]

[2] [At this period, and for many years afterward, there were no glazed cabinets in the British Museum for the stuffed quadrupeds, which, being exposed to the London atmosphere, have perished. No specimen answering to the above has existed in the Museum within the period of the conservancy of the zoological department by Dr. Gray. My experienced colleague is of opinion that the specimen dissected by Hunter was the *Felis servalina* of Jardine, of which skins have been received at the Museum from Sierra Leone and Senegal.]

[The Caracal (*Felis Caracal*, Schreb.).]

Of the Shargoss[1].

This animal is about the size of a common fox. It is of the genus of the cats. It comes nearest the lynx of any of this genus, more especially in its ears, having long hair on its edges and tip.

The stomach is very much as the lion's, having its vessels entering the side rather than the small curve of the cavity. The duodenum passes to the right, and then down the right, getting soon a mesentery, which is thin; and, when got to where this gut commonly passes behind the root of the mesentery, it is only closely attached to its right edge, and then passes down along its right edge, then upon the left edge of the same membrane: when got pretty high, it terminates in the colon and cæcum. Although this was the position of these intestines, yet the mesentery admitted easily of being turned, so that the duodenum could be easily made to pass to the left behind the root of the mesentery, which turned the cæcum forwards and more to the right. The cæcum is short, pointed at its termination, or by what might be called its beginning: it is nearly of the shape of the lion's. The colon is larger than the other intestines; passes almost directly down the left side to the pelvis. It is attached to the left side of the loins by a broad meso-colon. The whole length of the small intestines is only one length and two-thirds of the animal from the anus to the forehead; and the colon is two-thirds of the same length.

The liver is divided into five lobes, besides the lobulus Spigelii; the middle lobe having the gall-bladder attached to it. The pancreas lies in the curve of the duodenum, and also passes across, towards the left, in the posterior fold of the epiploon, &c., to near the spleen. The spleen is long and small, and is placed in the left of the mesentery. The kidneys are very prominent, owing to the cavity of the belly being narrow. The veins run on the surface. The parts of generation as in the rest of the tribe.

In a cat that I had from the Tower of a brownish dun, and was something like the shargoss; for it had long hair on the tip of the ears. The ears were rather longer than common. This animal was somewhat longer than a common cat, and its anatomy was entirely like that of the cat, viz. the os hyoides higher than in the lion-kind, and attached to the head by bones.

[1] ['Siyah-gush' or 'Black-ears,' Charlestoni Exercitationes de differentiis et nominibus animalium, fol. Oxon, 1677, p. 21. Home refers his abstract from Hunter's notes to the "Shargoss," (Comp. Anat. i. p. 438); and, as usual, without an attempt to determine the species so named.]

[The Lynx (*Felis Lynx*, Linn.).]

Of the Lynx.

The lynx is of the cat-kind, having its os hyoides attached to the head by a bony connexion; the only differences (if there are really any)[1] is that the colon and rectum are shorter than the lion's; but this may be owing to a greater contraction of the longitudinal fibres; for in the lynx the cæcum lies rather in the left of the mesentery, something similar to the civet-kind; one of which is called *Genetta* (vide description of it); but not near so short as in that animal. The tail is short, the ears long and pointed like a cat's, with a small tuft of hair on the tip, which terminates in a point, and which makes the ear look sharper than it really is. The hair is longer on the side of the jaws than anywhere else.

[Family *VIVERRIDÆ.*]

[The Zibet (*Viverra Zibetha*, Linn.).]

It is of the civet-kind, and it seems to be one (or perhaps more) removes from the cat.

It is an animal nearly of the size of a cat, but longer in body and neck, and smaller, especially forwards; having its neck longer, smaller, and more in the line of the body; with its head long and small, more in the line of the neck, and terminating in a point at the nose. Its ears are short, with a rounded edge, and broad, with little motion in them. Its whole fore-part approaches nearer to that of a pole-cat in shape. Its legs are small and short; its toes rather longer than those of a cat of the same size: the claws are like those of a cat, but not quite so large, and not quite so well defended by not being pulled so far up when not used. There is a thumb-toe, as in a cat, which is pretty strong. It has not so much motion, especially at the root, in the tail, which is not so long as in a cat: the tail is annular, yellow and brown alternately. The animal is spotted like a leopard at the lower part of its sides; at the upper part the spots are not so distinct nor so round, approaching to stripes, like those of a tiger; yet somewhat broken or interrupted, but less so to the back where they are continued. They do not pass across the body, but are in the direction of the body, most regular near the back, having one long dark one on the back.

The hair is short and pretty strong, and of two kinds; one fine or woolly, which is the shortest; the other much stronger, pointed at the end, like the American porcupine's quill, longer than the other; and each hair is of two colours.

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[1] [Home, Comp. Anat. i. p. 438.]

There are two swellings [anal glands] on the perineum, one on each side, making a hollow there, between the anus and vagina, in which rises the edge of the vagina. The ducts of those glands open into this hollow. These two glands appear like the testicles of some animals, such as the bear. It has four nipples, two between the hind-legs, two on the belly. The tongue is a little rough, but not so much so as a cat's. The mouth is almost filled with teeth; more of the bear-kind than of the cat.

The stomach is a good deal of the shape of a lion's, pretty much bent upon itself near the pylorus. The duodenum passes down the right side to near the pelvis, bending round the root of the mesentery to the left of it; then becoming loose again, and thrown into convolutions; it approaches to the right again on the edge of that membrane, and then gets upon the fore-part of the root closely connected to it, the duodenum being behind, as it were crossing one another: when [the small intestine has] got to the left of the mesentery again, it passes down towards the pelvis, and enters into the colon or rectum. The cæcum is short, very much the shape of a cat's, is on the left of the ileum where it enters, and it stands in the direction of the rectum, which is straight from the point of the cæcum[1].

The liver may be said to be divided into five or six lobes: one on the left, one in the middle, which is almost divided into three by the falciform ligament and gall-bladder, two upon the right side, which are the smallest, and the lobulus Spigelii: this lies behind the little epiploon, filling up exactly the curve of the liver, like a tongue. The epiploon is attached to the stomach, pylorus, duodenum, pancreas, and spleen. The pancreas has no process or small pancreas passing in the curve of the duodenum; but the body of the pancreas which crosses the spine is rather thicker than in animals of the same size which have the small pancreas. The kidneys are similar to those of a cat.

At the sides of the anus there are two bags, as in many other animals, with two glandular bodies in each. The interior coat is like white silk, whose ducts enter or open just at the termination of the anus. The contents are a thin yellow liquor, very fœtid, and has a kind of deposit. On each side of the mouth of the vagina are placed two oblong glands, which make two swellings there; with the lips of the vagina at the bottom of the sulcus made by these. These glands have a vast number of ducts ramifying through their substance, which opens on the inside of the sulcus. These ducts are filled with a thick substance

[1] [Home refers his transcript of these notes (Comp. Anat. i. p. 438) to the 'Genetta,'—the name applied to the animal by Hunter; but the description and parts preserved show that it was the Zibet.]

which has a strong musky smell. The gland when cut into seems as if injected with a firm wax[1].

This animal comes nearer to the hyæna than any that I know.

In one at Mr. Brookes's[2] [the anatomy was] exactly the same; it had an elliptical pupil with the long axis turned upwards and downwards, similar to that in the cat.

[The Genette (*Viverra Genetta*, Linn.).]

In one sent me by Mr. Jennings, which was a male, I observed a dark line of hair arising from the head just above and behind the ears and passing along the side of the neck, and a little downwards towards the side of the shoulder. There was a dark place on the side of the neck under the ear. The lower surface of the neck was spotted.

Another of the very same kind [probably the nearly allied *Viverra tigrina*, Schreb.] was sent home from the Cape of Good Hope to Mr. Aiton at Kew, who gave it to me.

Of the Male parts.—The external appearances are as follows:—Pretty close to the scrotum is a protuberance which is not pendulous, and which is covered with short hair. Immediately before the scrotum is a pretty considerable rising, as it were coming gradually out of the pubis; it is covered with hair, which becomes shorter towards its summit. In the most prominent edge of this rising, and in the direction of the body, there is a slit of above an inch long, which divides it into two halves, a right and a left: the sides of this slit are covered with a cuticle and some hairs. At the anterior end of this tumour is the orifice of the preputium, which is turned a little backward, and just within lies the glans penis, which is also bent downward and a little backward, but not so much so as in the lion or cat[3].

The Civet [*Viverra Civetta*, Schreb.].

This is one of the links of gradation from the lion. It appears to be the same with the genette, only differing in size. The head is very much in the direction of the neck, and there is almost a gradual increase of size from the nose to the shoulders, the body then becoming more so to the hips; it is pretty long. The legs are short: the hind-legs rather the largest. The hair is of two kinds, a soft and a coarse. The coarse is in considerable quantity, the soft not so much so as it is in many

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[1] [Hunt. Prep. No. 2797.]

[2] [A dealer in rare animals, father of Joshua Brookes, F.L.S., lecturer on Anatomy and founder of a considerable museum of Human and Comparative Anatomy, which was dispersed by auction.]

[3] [Hunt. Prep. No. 2514.]

animals, and both are pretty long. The coarse hairs become longer and stronger towards the back, where at last they make a kind of hog's mane, which extends along the neck, back and tail; but what is very singular, when it has got upon the tail, it twists round the left to the underside of the tail, and arrives there about the middle; and then proceeds along the under surface to the tip. The bones of the tail take the same twist.

The inferior vena cava is in contact with the upper or convex surface of the diaphragm for some way: this increases the length of that vein within the thorax; although it is not owing to the heart's being at such a distance as one would imagine from the length of the vein. The length of this vein in quadrupeds is owing to two circumstances; first, because the apex of the heart is turned more downward than in the human, so that the basis of the heart is further removed; secondly, because the heart is further from the back or spine than in the human; and, as the vein is obliged to lie on the spine in the abdomen, when it perforates the diaphragm, it passes forward and upward to the right auricle.

The lungs are divided as in most quadrupeds. The stomach is very like the cat's, only that the vessels do not pass unattached for so long a way before they enter its coats.

The duodenum passes a little up, and then down the right loins; it gets on the right of the mesentery at the root of that membrane, which becomes longer and longer to about the middle between right and left; then becomes shorter and shorter to the left; along the edge the intestine is attached. When the small intestine has got to the root of the mesentery, on the left side, it bends down the left side and enters the colon, which passes down in a straight line to the pelvis, and there forms the rectum[1]. The cæcum is shorter than in the lion or cat. Here then we have no zigzag turns and crossings in the line of the intestines, as in many other animals. But this most probably arose from the mesentery being untwisted; for in another which died in perfect health, the duodenum passed to the left behind the mesentery as common; but I could easily have untwisted the mesentery, and produced the same effect as in the above described one.

The epiploon is attached to the great curve of the stomach before, to the duodenum on the right, to the pancreas behind, to the spleen and diaphragm on the left.

The pancreas has only one lobe, as in the genette, lying across the spine.

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[1] [Home, Comp. Anat. i. p. 439.]

The liver is divided into four lobes, besides the fissure for the ligamentum rotundum. The small one on the right side lies before, and as it were encloses the upper part of the abdominal portion of the vena cava inferior, the left side of which is behind the mesogaster, and becomes the lobulus Spigelii. The spleen is as in the lion, cat, dog, &c. The kidneys are as in the lion, cat, genette, hyæna, &c.

The female parts are very similar to those of the lioness. The ovaria were attached to the sides of the abdomen by a muscular ligament which arises insensibly out of the peritoneum where the diaphragm and transverse muscles join; this passes down along the surface of the peritoneum on the lateral posterior parts of the abdomen, where it is lost. This muscle would appear to counteract the ligamentum rotundum, which is also muscular, and is inserted about one inch below the ovarium. The capsula ovarii is not so complete as in the lion. At the anus there are two bags as in the lion, cat, dog, &c. The anus and vulva recede from one another by the common vagina bending downward, as it were, round the pubis, which gives space between these parts for a considerable fossa, which has externally two protuberant lips, the direction of which is upward and downward, similar to the labia pudendi. The bottom of this fossa divides into two lateral bags, which lie a little on the sides of the vagina, where it is bent downward, and are covered by the sphincter of that part. The coat of these bags is a gland which secretes the essential oil called 'civet.' These bags and fossæ have hair on their inside; the bags are generally full of this oil, which is mixed with dirt, &c. that gets into the fossæ.

[The Suricate (*Viverra* (*Rhyzæna*) *tetradactyla*, Schreb. and Illig.).]

From Mr. Banks.

It can walk on the whole foot, both on the fore and the hind; but commonly walks on the toes of both. The nails are much longer on the fore-feet than the hind: only four toes[1]. Head small, terminating in a pretty long sharp nose, which projects as in the mongoose: the outline is rather concave: its whole head is very like that [of the mongoose] animal; but the eyes are not so large. The ears are small and a little projecting, but are flattened back. Its body is made like a ferret's; but is not so long, and is rather thicker: the tail is longer than a ferret's. The hair is thick and short about the neck and shoulders, becoming longer, thinner and stronger on the back, which grows more and more so to the tail. The lines of the palate are sections of circles

[1] [This remark serves mainly to determine the species: the rest of the descriptiou agrees with the character and structure of the suricate. Home abstracts nothing from the notes on this, to him, unknown animal "From Mr. Banks."]

forwards, but they would appear to be only the ends of these circles remaining backwards. It has a snout like a hog, but not so projecting: this terminates in an edge all round, which is a little hard, and the greater motion of the snout is chiefly in that edge. The hair is like the rat's; there is none on the soles of the feet or palms of the hands; and very little on the back of these parts: so far it is like the rat; but all along that edge which terminates [defines] the back of the foot and toes from the sole, and the hand and fingers from the fore palm, there is a row of hair much stronger and lighter than anywhere else, excepting on the tail. The tail is covered with pretty soft short hair above and below; but on the sides and end it is stronger and whiter. The tail would appear to stand up like the hare's. There are three grinders, and two cuspidate instead of two bicuspids[1]. The tusks are round, but a little flattened, and pretty long: six incisores. The grinders are as a line, having two rows of points.

The stomach is like the ferret's or pole-cat's, large or thick at the left end, but does not project much beyond the entrance of the œsophagus. The duodenum has a pretty broad mesentery; and this, as the duodenum passes behind it, becomes pretty loose, and immediately becomes looser, forming the mesentery of the ileum. The ileum passes up the right, and before the root of the mesentery; or rather upon the right, it passes into the colon. The cæcum is above an inch in length, is a little bent, having on the concave side a [patch of glands][2], which terminates in an oblong end. The colon passes to the left before the root of the mesentery, to which it adheres by a narrow mesocolon, and then bends down to the pelvis, having a mesocolon: it is pretty large.

The anus, or rather rectum, terminates in a round broad concave surface, which is glandular on its whole surface: this part has no hair, is something like that in the badger, but is not so deep; and is also like that in the hyæna, but also is not so deep. The small intestines are something more than three times the whole length of the body of the animal: the large gut is more than half that length. The great epiploon is not attached to the colon; it is pretty broad, so as to cover the whole intestines.

The spleen is a pretty long flat body, and not very narrow. The liver has four lobes, the second from the left being the largest; it has a long fissure in it for the passage of the round ligament. The right

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[1] [Of the five teeth of the molar series two only are true molars, three are premolars, displacing as many deciduous teeth, on each side of both jaws: the dental formula of *Rhyzæna* is:—$i\ \frac{3-3}{3-3},\ c\ \frac{1-1}{1-1},\ p\ \frac{3-3}{3-3},\ m\ \frac{2-2}{2-2}=36.$]

[2] [This I observed in the dissection of a suricate at the Zoological Gardens, London.]

portion of this lobe has the small gall-bladder attached to it. The pancreas lies across the body, in the epiploon. The kidneys are conglobate, having some veins running on the external surface, which is an approach towards the lion, &c.

The scrotum is pretty large, but not pendulous, as in the bull, &c. The penis rises out of the anterior part of the scrotum like a nipple, similar to the cat's: I should suppose the animal to be rather retromingent[1].

The bladder of urine is pendulous. The urethra opens on the point of the clitoris, as in the rat.

Around the pupil there is no pigmentum album. The membrana nictitans is broad, and is capable of covering the whole eye.

[The Striped Hyæna (*Hyæna vulgaris*, Desm.).]

Of the Hyæna[2].

The hyæna is some degree removed from the lion towards many of the other Carnivora. It seems to be one remove from the civet-cat kind. It has nothing of the external figure of the lion, nor is it exactly similar to any other. The extremities are mostly those of a dog; but there is rather more motion in the joint of the wrist and ankle; and the head and ears have a great likeness to those of that animal; only that the ears are mostly erect, and have no hair upon them. The neck is shorter and thicker; the hair is longer on the upper part of the neck and along the back than anywhere else, something similar to a horse's mane, or to the bristles of a boar. In its manner of feeding the hyæna is not similar to the lion; for the lion eats no bones excepting they are small, such as the bones of a fowl, &c., but only chooses to eat the flesh: the hyæna likes to gnaw the bones and swallow them much more than what dogs do; and its jaws and teeth are perhaps the best adapted for this. Give a hyæna a sheep's head, and he will crunch the whole; whereas a lion will only eat the flesh.

There is no thyroid gland[3]. The loins are short, and the ribs come very low, which shortens the abdomen vastly. The crura of the diaphragm come very low, so as to oblige the kidneys to lie upon the brim of the pelvis, especially the left.

The stomach, duodenum, jejunum, and ileum, are the same as in a

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[1] [I believe the preparation of the male organs, No. 2515, to be of this animal; those parts from the suricate dissected at the Zoological Gardens, are placed by the side of the Hunterian preparation for comparison: see No. 2515 A. Physiol. Catal. vol. iv. p. 84.]

[2] [The skull and many bones of this specimen are Nos. 4449 *et seq.*, Osteol. Catal.]

[3] [The hyænas, both striped and spotted, dissected by me, possessed the thyroid gland in two separate halves or lobes.]

lion; the cæcum is rather longer, but is similar to that of a lion[1]. The colon and rectum are the same as in a lion. The liver and gall-bladder are much the same. The kidneys are exactly the same as in the lion[2]. The heart is very similar to that of the lion; also the vessels going off from the curvature of the aorta.

The eye is like a lion's, having the pigmentum album [tapetum lucidum] above the optic nerve. The sclerotic coat is thickest at the anterior part. The membrana nictitans is a thick cartilaginous substance in the middle, but is ligamentous on the edges. It is dark on the inside towards the edge, especially the middle space between the two extremes; it is also black on the external surface. Is this to prevent any rays of light from passing through when the eye is drawn inwards and hidden behind this membrane?

The penis is continued along the belly, is easily pulled out of the prepuce, and the prepuce then seems to be continued all along the penis to the end, and much of the same colour. This is not the same as in a dog, and most other animals; for the penis in them would seem to be a distinct body when pulled out of the prepuce[3].

The anus opens externally in a sulcus below, and in the hollow of a semilunar curve of a sulcus that is between the anus and the tail. This sulcus has the opening of a duct into each end, which leads to two bags that lie on each side of the anus. These bags are larger than a hen's egg, are pretty round, and contain a yellow substance somewhat harder than common butter, which smells like musk. They are always distended with this matter, and but very little of it can escape in substance. It would seem as if it was only meant as a smelling bottle[4].

Of the Female parts of Generation.—Below the anus opens the vagina; there are no external lips ending in a projecting point, as in many other animals, but a round hole similar to an anus. Just within this is the clitoris, which points forwards like a short blunt tongue. The common vagina is but short, about 1½ inch long: the proper vagina is about 5 inches long, of a livid colour, and has a vast number of loose folds or rugæ running in the direction of the vagina. Near the os tincæ, on that side next the bladder, there is a process or a flat pyramidal minence which has a small loose floating body attached to its apex about an inch long[5].

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[1] [Home, Comp. Anat. i. p. 438.]

[2] [The kidney, with the superficial veins injected, is the Hunt. Prep. No. 1206.]

[3] [The testicle of this Hyæna is the Prep. No. 2516.]

[4] [Hunt. Preps. Nos. 2148—2151.]

[5] [Hunt. Prep. No. 2796: it is doubtful whether the appendage continued from one of the longitudinal folds be a natural structure. Physiol. Catal. vol. iv. p. 180. The tongue and larynx form the Hunt. Prep. No. 1514.]

EXTRACT *of a Letter concerning the two Hyænas which fought and died in the Tower in* 1792.

"Gibraltar, 15th Dec. 1791.

"He has also on board two young hyænas, whelped last April, and which I have had since they were two days old. You need not be afraid of them; for, in spite of what authors say, they are as tame as puppies, having always lived loose in the house, dined at table with the dogs, and usually in my lap or bed. I have put six sheep on board for them, as they love raw meat. Their usual allowance here was a bullock's pluck without the liver; and the bones at table."

[Family *CANIDÆ.*]

[THE DOG (*Canis familiaris*, Linn).]

Of a Dog.

There are two panniculi carnosi; one arises from the upper and lower lip, passing back over the lower jaw under or behind the ear; then passing up, covering almost the whole neck; and, on the side of the neck, it loses some of its fibres on the skin; it then proceeds on and is inserted into the ligamentum colli, the whole length of the neck. Besides this there are thin fibres that arise from the skin down along the lower part of the neck, as low as the sternum, which pass almost directly upwards, and join the other. The second [panniculus] arises in conjunction with the insertion of the latissimus dorsi, and another part of it arises in conjunction with the insertion of the pectoralis; these two pass downwards, covering the whole side of the body. The uppermost edge is as high as the latissimus, from the buttocks forwards on the belly, making what is called the flanks, but comes no further forwards. Besides these, it is joined by thin fibres that arise insensibly from the cellular membrane that covers the pectoral muscle, which join the lower edge of the former: these are inserted into the skin of the back from the shoulders to the rump.

The thyroid glands are on each side the cartilage of the aspera arteria below the cricoid, and are pretty round bodies. The sacculus laryngis is very large, and has a process of the anterior part of the arytenoid cartilage passing half-way forwards, so that they can be dilated by the motion of the cartilage, or shut in the middle by the two points that come forwards; so that the sac may affect the voice. The arytenoid cartilage divides into two processes at the upper part, the anterior of which stands up half-way between the posterior and the epiglottis. There is no uvula, but a broad palatum molle[1].

The contents of the thorax are as in the ass.

The œsophagus is about 2 inches long below the diaphragm. The stomach is situate pretty much like the human; at the small end it makes a small turn upwards towards the liver, which may be owing to the great distension and curvature, and ends in the pylorus 3 inches below the liver[2].

The duodenum makes a pretty sharp turn downwards on the right side before the right kidney, and before the upper part of the Fallopian tube and ovarium; then makes a turn across the spine towards the left; it is very loose, having a long mesentery; and where it passes across the spine it is more fixed to the root of the mesentery, and at the same part it is attached to the mesocolon where the colon is going to make the rectum. The same intestine becomes loose on the left side, having a long mesentery, and is called jejunum[3]. The ileum[4] passes towards the right and into the cæcum, adhering for about 2 inches to the cæcum.

The cæcum and beginning of the colon are not bound to the psoas, iliacus, and quadratus lumborum as in the human; but in the wolf they are closely connected to the right of the root of the mesentery; the colon has a long mesocolon; it is shortest at the part where the ileum enters, and goes as high as the duodenum, and goes before it where the duodenum crosses the spine. The colon passes across the spine towards the left; from thence it passes down the left side; it is not bound down as in the human subject, but has a long mesocolon; it then goes on to make the rectum[5]. The mesentery is in general very loose and thin; the fat attending the vessels.

There is a muscle arising from the lower surface of the tail, which passes upwards and is spread upon the posterior surface of the rectum and is lost in it. There are two elastic ligaments that arise from the sacrum passing downwards, and are lost insensibly upon the sides of the anus. At each side of the anus there is a cavity about the bigness of a pigeon's egg, that seems to have a cuticular lining. These cavities have an opening just at the verge of the anus, where two or three hairs are studded. These bags do not seem to answer any purpose in going to stool; for we can easily see these bags discharge their contents in a dog when he is at stool, but at the same time distinct from the fæces, and the fluid is squirted out with some force. Indeed, when the anus is in this position, viz. pushed out, the orifices of these bags are a

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[1] [The tongue of a dog is No. 1515.] [2] [Hunt. Prep. No. 535.]
[3] [Hunt. Prep. No. 701.] [4] [Ib. No. 758.] [5] [Ib. No. 725.]

good way from the angle that the gut makes with the outer skin, and therefore this fluid or mucus cannot have any effect on the operation of expulsion.

The epiploon is attached to the whole great curvature of the stomach, to the left crus of the diaphragm, and to the mesocolon upon the left side; posteriorly the epiploon is attached to the lower edge of the pancreas; on towards the right, where it joins to the anterior, it was attached to the stomach, being very broad, enveloping the whole intestines. The ramifications of fat attend those of the arteries: the membranous part is not complete, but is rather a network. The small epiploon is very large and loose.

The length of the small intestines is 19 feet, the length of the great ones is 4 feet 3 inches[1].

The liver is pretty thin, lying close to the diaphragm; the lower edge does not pass down before the stomach as in the human: it is divided into five lobes, besides the lobulus Spigelii. The gall-bladder is attached to the third lobe from the right, which is the middle lobe; and this is partially divided into two, having the gall-bladder betwixt them; the biliary ducts enter the duodenum about 3 inches below the pylorus, by the same nipple, but by two distinct orifices. The ductus cysticus is pretty large, and looks like the stem leading from the gall-bladder to the duodenum; and the ductus hepaticus has branches dipping into it, three or four in number.

The pancreas is about a foot long; 5 inches of which lie across the spine attached to the splenic vessels upon the left, but is loose, or only attached by a thin membrane to the mesocolon: the remaining part lies in the right side in the doubling of the mesentery belonging to the duodenum; so these two portions make a pretty sharp angle with themselves, and this angle adheres closely to the duodenum, where the ducts enter. The two ducts of the pancreas unite into one, and that trunk enters by the hepatic.

The spleen is an oblong body, near a foot long, 3 inches broad at some parts, not above half that at others, and is attached to the stomach by the epiploon, and to the back also, in [the duplicature of] which pass the splenic vessels.

The kidneys are conglobate, and much looser than in the human subject[2]. The capsula renalis is very small. That of the right side

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[1] [These admeasurements would apply to a dog measuring 3 feet from the muzzle to the root of the tail: in a wolf the small intestines were 15 feet; the colon 2 feet: see Home, Comp. Anat. i. p. 441.]

[2] [Hunt. Prep. No. 1236.]

adheres to the vena cava, not to the kidneys; that of the left side adheres closely to the aorta.

The sclerotic coat is pretty thick, but becomes thickest at the cornea. The pigmentum nigrum is both on the outside and inside, excepting where the choroid is white; it is not there on the inside. This white colour on the inside is not tendinous, as it appears to be, but is an album pigmentum.

Female parts of Generation[1].—From the external labia to the beginning of the vagina measures about 3 inches; in a wolf not 2 inches. Just at the lower angle of the external vagina [a groove] leads on to the clitoris, which is a broad rugous surface surrounded almost with a doubling of the internal membrane which is like a half valve. The beginning of the true vagina is pretty narrow, about an inch in diameter, becoming very large just behind the pubis; from thence it becomes smaller and smaller to the os tincæ, where it is little more than half an inch in diameter. The internal surface is thrown into longitudinal rugæ like those of a contracted stomach, which become very high, and go on to the os tincæ. The length of the true vagina is about 8 inches. The os tincæ stands pretty prominent in the vagina and is thicker than in any part of the uterus, with a number of rugæ on its inside. The uterus is but very thin, becoming of a darker colour towards the fundus, and is somewhat villous upon its inner surface. It is about 4 inches in length, and seems to divide into two Fallopian tubes; each passes towards the groin of the same side, as high almost as the kidney, and is attached to it by a fatty ligament. The cornua uteri are a quarter of an inch in diameter. The inner coat is as dark as the venal blood, which is owing to the blood in the vessels, for by being exposed to the air it became florid. They are about a foot long, and have a vast number of flat eminences close together on the inner surface. The cornua end in a blunt cæcum, which does not admit air to pass; and, where they end, there is a large bag surrounded with fat with an opening on one side of it, not at the end. On one side of this opening, which is about the bigness of one's thumb, is placed the ovarium; and on the other side of the opening is the morsus diaboli, which seems to be no more than a red villous surface for the side of this opening; and as the orifice is always shut, the morsus diaboli and ovaria are always in contact, and the termination of the Fallopian tube is at one of the angles of the opening. The broad ligaments are very large, extending from the sides of the

[1] [Hunt. Prep. No. 2800. The fœtus and fœtal membranes form the Preps. Nos. 3567—3571, 3715, 3716.]

pelvis to the lower end of the kidneys; the broad ligament is very like the epiploon.

From the termination of the Fallopian tube passes the round ligament, which becomes broader by degrees as it passes downwards, about half a foot broad, and it passes out of the abdomen at the common place, but takes a process of the peritoneum with it to the groin, for about 3 inches in length. This ligament is like the broad ligament; but all along the edge it is thicker, something like the ligamentum teres in the falciform ligament of the liver. This thick part passes through, and in its passage it has a thin attachment to the sides of the tunic. This tunic has a muscle [cremaster] like the tunica vaginalis testis in the male, but is not so strong. The spermatic vessels are shorter than in the human subject.

The whole of the urinary bladder is almost exposed in the cavity of the pelvis, and the urethra enters near the meatus, and a ridge passes in them a good way in the meatus. The urethra is muscular at its termination externally, which [muscle] is very strong, and surrounds [the urethra] at the beginning of the true vagina.

Of the New Holland Dog, or Dingo.

This dog is like the shepherd's dog in most countries, that is, approaching the original called the wolf. He is not so large as the wolf of America, Russia, or Europe; especially not so high on his legs. His ears are short and erect, and his tail is rather bushy. He is of a reddish dun, and his hair is pretty long and thick, but straight. He barks, although not so readily as the European dog; he snarls, howls, and moans, like the dog in common, and is very ill-natured.

From all accounts this is the only dog of the country, and is found perfectly wild; as also tame in some degree, although not very much so; for even the tame are obliged to hunt their food, not having enough from their masters, and only stay with them for what they can get. This dog then is only the wolf tamed, without having yet produced a variety, as in some parts of America.

It is asserted by those who have been in New Holland, that it is hardly possible to tame them even when taken very young. This I can easily believe in part; for I can conceive that an original or natural ferocity will be difficult to be got entirely the better of, although it may. And we may also observe that when [dingos are] taken, they must be old enough to feed themselves, by which time they have acquired a degree of shyness which leads to defence and offence; which requires great attention and constant practice to be got the better of.

Loose note.—Mr. Lind informs me that there are dogs in the Malacca islands, belonging to the governor, which have hair similar to the feathers of the silken hen.

A Fox [(*Canis Vulpes*, Linn.)[1].]

I have compared this animal with the dog, so that what I have not taken notice of, is to be found in a dog.

The mouth and larynx as in the dog. The roof of the mouth black. A worm in the tongue. No length of the œsophagus below the diaphragm. No elastic ligament to the anus, as in a dog. The cæcum folded on itself[2].

The clitoris not cavernous, but of a soft glandular substance, as in the dog; the termination of which is spongy, and seems to be a continuation of the plexus retiformis, and terminates like the corpus sesamoideum in the valves of the aorta. Hardly any erector clitoridis; and, from the nature of the clitoris, there was hardly any use for them. The uterus not red, but blackish. The orifice of the meatus a little prominent in the common vagina at the upper part, and there is another prominence on the lower part just opposite the other[3].

Has three nipples on each side.

The aorta ossified in some parts, and at these parts formed sacs; which might be the cause of the [aneurismal condition of the] aorta of the hog [described in] Tyson's 'Anatomy[4].'

[A Virginia Fox (*Canis Vulpes*, var. *Virginianus*).]

A pretty large worm in the tongue. A black roof of mouth. The larynx as in a dog. The thyroid glands are as high as the os hyoides, just on the inside of the maxillary glands, but a little further back. The œsophagus does not adhere closely to the aorta, but is some distance from it; there is a membrane that passes from the anterior surface of the œsophagus, its whole length, below the curve of the aorta, over its left side, not adhering to it; and is by its other edge attached to the aorta, near its adhesion to the spine; and the lower edge of this membrane is attached to the diaphragm: the right side of the œsophagus is attached to the right side of the aorta. By these means there is a complete bag, having no opening into it; which I should imagine was for the motion of the œsophagus, as it is pretty loose. The same bag I saw in the other. The stomach as in a dog. The duodenum stronger than any of the other intestines, excepting the colon: situated as in a

[1] [The skeleton is No. 4328, Osteol. Series.] [2] [Home, Comp. Anat. i. p. 441.]

[3] [Hunt. Prep. No. 2802.]

[4] [Tajacu, or Anatomy of the Mexican Musk-hog, Philosophical Transactions, vol. xiii. p. 359.]

dog: is pretty fast to the root of the mesentery where it passes to the left.

The cæcum is pretty long, about half a foot, and a good deal contorted. The colon is not large, but thicker in its coats than the others, which increases to the anus: near its beginning it passes across the root of the mesentery, to which it closely adheres. The small guts are three times and one quarter the length of the animal; the great, or colon, not half that length. The epiploon adheres as in the racoon. The liver is divided as in a dog: it has three hepatic ducts passing into the cystic. The spleen is as in a dog.

All the parts of generation and anus are like the dog's. The penis has a bulb in the middle, a bone, and two veins passing from that bulb on the upper surface. And when one blows into the veins they distend the bulb, but don't fill the part of the urethra that encompasses the bone before this bulb; but when we blow or inject the urethra, the bulb is filled with air or injection; so if the blood gets into the bulb from the urethra, it cannot get back, but must go by the veins mentioned above.

The two muscles that go from the tail to the urethra are inserted into the lower surface of the bulb. The prepuce is attached round the bulb. It has no vesiculæ seminales.

[The Fennec, or Long-eared Fox (*Canis Zerda*, Zimmerman; Pennant, 'History of Quadrupeds,' vol. i. p. 267; Rüppell, 'Reise im Nord Afrik,' tab. ii.).]

A small animal, much less than a fox, but in shape, manner, &c. as like as possible; of an ash-coloured [above] white [beneath], with very long ears, and, I should suppose, pretty long hair; for the hair was pretty much matted. It was said to have been brought from the East Indies[1].

The viscera were exactly like the dog's.

The penis had a bulb on the root of the glans, somewhat similar to that in a dog; but it did not surround it equally on all sides; nor was it at an equal distance from the end of the penis, but somewhat like a ring put on obliquely. There was a bone, in the glans part, with a groove, in which lay the urethra.

[1] [The species has not been found, save in Africa.]

[An Ichneumon (*Mangusta Herpestes*?).]

Banks's *Sine cæco.*

An animal about the size and shape of 'Jack's wife[1], with short legs, having no hair on the carpus, nor on the tarsus; and walks principally on the toes and fingers. Five fingers, the thumb rather the strongest and shortest; the fore- and ring-fingers of an equal length; the little finger something shorter. The nails sharp. Toes and fingers a little bent, but not so much so as in the dog, nor so straight as in the racoon. The balls of the fingers are four, and are horny; there are two balls behind these, and the ball of the pisiform bone is larger. The thumb of the hind-foot is very short, having no nail, but a substance on it like what is on the balls of the toes or fingers of the four toes: the two middle are the longest, and are of an equal length.

The ears are thin, and pretty flat in their most projecting parts; but there is a singular process within the concave part, viz. in the concha[2].

The stomach is almost a round cavity, the small end as thick and short as the large. The termination of the duodenum, or beginning of jejunum, is loose, or has as long a mesentery as any other part of the intestines. There is no cæcum[3]. The liver is divided into four lobes. The kidneys are conglobate.

[Family *MUSTELIDÆ.*]

The Martin-Cat [*Mustela Martes*, Linn.[4]].

The feet are rough only where they tread, that is upon the five toes and ball.

The duct of the parotid passes over the masseter, with a branch of the seventh pair of nerves.

The tongue is pretty long. The sacculus laryngis is similar to the racoon's, in its passing over the os hyoides; but its beginning is like that in the badger, and so is the termination of the epiglottis. These parts are alike in both these animals only in this: the sacculus passes over the os hyoides, as in the racoon. There is a very small worm [lytta] in the tongue.

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[1] [A characteristic example of the elucidation of the 'ignotum per ignotius.']

[2] [Hunt. Prep. No. 1613. The skull of the *Mangusta Mungo* is No. 4307, Osteological Series.]

[3] [The second of the nine folio volumes of Hunter's MS. notes of Dissections of Animals, testified to by Mr. Clift (see vol. ii. p. 344), was entitled "Animals *sine cæco*;" and included, with the *Mustelidæ*, *Ursidæ*, and other plantigrade Carnivora, the Shrew, Mole, Hedgehog, Sloth, Pangolin, and Porpoise.]

[4] [The skeleton of this specimen is No. 4152, Osteol. Series.]

The right lung is divided into four lobes, the left into two; that is, the right has a lobe below the heart between the two ligaments which attach the heart to the diaphragm, which the human subject has not.

The œsophagus is about half an inch long below the diaphragm. The stomach is pretty much like the human or dog's. The intestines, as to situation, are the same as in a dog. It has no cæcum, [being in this respect] like the bear, racoon, stoat, hedgehog, and badger. The rectum becomes a little larger and stronger towards the anus.

The length of the intestine is three times and a half the length of the animal. It has those bags on the sides of the anus[1]; and about the verge of the anus there are a great many sebaceous glands. The muscle of the anus is like the racoon's.

The 'pancreas Asellii' is very complete, and all the mesenteric vessels pass through it; besides which there are a great many small lymphatic glands on the mesocolon.

The liver is divided into five lobes and the lobulus Spigelii; the gall-bladder is fixed in a very deep fissure in the middle lobe; and on the vessels that pass to the liver there are two lymphatic glands. The ductus cysticus seems to be the stem, and the hepatic duct a branch, as in the badger or racoon, and the common duct enters [the duodenum] about an inch beyond the pancreatic, as in the badger. The spleen is as in a dog: also the pancreas and epiploon. The right kidney is higher than the left. The capsula renalis is as in a dog.

The eye is like the racoon's, only I cannot find any pigmentum nigrum on the anterior surface of the iris.

The parts of generation in the male are a good deal like the racoon's, only that the bone [of the penis] is not of the same shape, and there is no loose membrane on the end of the penis. There are no vesiculæ seminales; but there is a small cavity between the two vasa deferentia, at their entrance into the urethra, which will admit the small end of a small blowpipe: but I could not find any natural opening into it; for when I cut into the most distant part of it from the urethra, I could not blow air into the urethra, nor pass a bristle through; nor could I find any communication between it and the vasa deferentia.

The parts of generation of the female are like those of a badger.

THE FERRET (*Putorius Furo*, var. Cuv.[2]).

The larynx is as in a racoon. The tongue is pretty rough, but not so much as in the cat or lion, but is of that sort of roughness. It has no worm [lytta].

[1] [Hunt. Prep. No. 2142.]
[2] [The skull of this specimen is No. 4214, Osteol. Series.]

The contents of the thorax are as common: the left lung has two lobes, and these distinct at the root for some distance; the right lung has three lobes, besides the uncommon one [lobulus azygos, between the heart and diaphragm].

The œsophagus below the heart passes through the posterior mediastinum, but in no [special pleural] cavity, as in some animals. The stomach has hardly any pylorus, only a constrictor, and that a very small one. The duodenum, as it passes behind the mesentery, and upon the left of it, is closely connected; as it is likewise to the mesorectum and to the loins, by a thin membrane. The jejunum, colon, and rectum are as in other animals. The colon does not adhere to the root of the mesentery so closely, as it passes before it; but has a shorter and stronger mesocolon there than in any other part of its course. The length of the whole [canal] was three times and a half the length of the body; what we may call colon, [being] within one-half the length of the animal. There are two large bags, at the sides of the anus, filled with a yellow but very fœtid smelling matter[1].

The liver is exactly as in other animals, and is divided into five lobes, besides the lobulus Spigelii; and there is a small lobe, about the bigness of a pea, lying upon the vena portæ, near the liver. The gall-bladder is not to be seen, lying in a hole of the middle lobe. The epiploon and the pancreas are as in other animals. The spleen is much as in a dog, but rather shorter in proportion. The right kidney is a good deal higher than the left. The capsula renalis of the right side is attached to the mesenteric vein, or to the vena portarum.

The eye is as in the white racoon. The skin about the edge of the eyelid is white. Two puncta lacrymalia. Hardly any tarsus. The glandula lacrymalis is oblong, situated at the inner canthus, like a bird's, and the duct is very short and pretty wide; it opens at the inner canthus behind the membrana nictitans, as in the bird. There is a membrana nictitans, but not so complete as in the bird: it is in the middle somewhat cartilaginous through its whole breadth, which cartilage is very thin at the edge of the membrane, and seems to keep the membrane from being thrown into wrinkles when it is drawn over the eye. It is upon the posterior part of this cartilage, near its attachment, where the duct of the [Harderian] lacrymal gland enters.

When we look at the eye of a ferret it seems to shine, and the pupil is very much contracted, as it is of an oval figure; it comes so close as to represent a line. Still we can see into the cavity of the eye through the iris, so that the iris is semi-opake, which enables the animal to see

[1] [Hunt. Prep. No. 2140. Home, Comp. Anat. i. p. 431.]

in some measure in the light. This iris is very vascular when injected, and is not at all red when living, which would show as if the red blood did not enter these vessels.

There is no pigmentum nigrum, not even upon the processus ciliares, which would seem as if the [pigmentum] nigrum was not the dunghill of the humours, as is supposed. The [ciliary] processes are pretty prominent. There being a process here, would show as if these processes did not serve to stop the rays of light, as they are not covered with black; and if there was no occasion to stop the light here, then there was no occasion to have the processes here, if their use be to stop the light. I could hardly observe any album pigmentum; but as I made preparations of them, I did not choose to examine them closely. The retina seems to be very thin.

The penis is a good deal like the racoon's, only the loose membrane at the end of the bone is not a cavity as in the racoon, but it is cellular; however, this is not known till you cut into it to inflate it, for it is as loose to appearance, before inflation, as it is in the racoon.

The uterus, Fallopian tubes, and capsula ovaria are as in other animals; also the urinary bladder.

The Stoat [*Putorius vulgaris*, Cuv.].

The thyroid gland is very small; the lower edge of the sacculus laryngis is continued forwards from the tip of the arytenoid cartilage.

The heart and lungs are as common. The stomach is as in other animals, only there is a pretty long œsophagus below the diaphragm. The intestines are as in the bear, racoon, &c. The liver is divided into six lobes. The gall-bladder had a small lobe before it, so that it lies between this little lobe and the middle or third from the right. The ductus hepaticus passed down on the left of this little lobe, and the cystic passed round on the right, and the second joined [the other] below the lobe.

The pancreas is as usual; also the spleen and epiploon.

The female parts of generation were as in the lioness, I think, but they are very small.

[The Zorille, or Cape Stoat (*Mustela Zorilla*, Desm., *Mephitis Zorilla*, Lichtenstein).]

Banks's[1] *Sine cæco.*

This animal is of the polecat kind; long and small, like the ferret,

[1] [The body of the animal had been presented by Mr. (afterwards Sir Joseph) Banks to Hunter, who had found it devoid of a 'cæcum coli.']

polecat, &c. The ribs come very low or near to the ossa ilii. The hair is strong and long. The legs are short and strong, similar to those of the badger. The toes are five in number. In the fore-foot the middle toe is the longest, the rest becoming proportionally shorter to the little toe; but the thumb is shorter in proportion to the fore-toe. In the hind-foot, the middle toe and the ring-toe are of one length. The claws are short, both before and behind, but are pretty broad at their roots.

It walks on the whole carpus, metacarpus, and toes, in the fore-feet; but only on the toes and part of the metatarsus of the hind-feet.

The head is pyramidal, but does not terminate in a very sharp nose[1]. The outline of the head is rather convex. The ears are something like the lion's; the concha is large.

Teeth, six incisors; two tusks; four cuspidati, the last of which is the largest, and is a little studded backwards at the root with tubers; two squeezers [carnassials] in the upper jaw, as in the lion; but its correspondent in the lower jaw has an internal process coming nearer [in shape] to the grinder[2]; and two grinders, each of which in the upper jaw is out of the line, to be opposite to that of the lower. In the lower jaw the grinders are in the lines, making sixteen in each jaw. The teeth are not long, but strong and round.

The colour of the animal is dark, striped with a light brown[3], somewhat like a badger. The whole contents of the belly is exactly similar to the ferret.

A bag on each side of the anus lined with a pretty thick cuticle. The penis passes along the belly as in the ferret, and has a pretty long bone in it. There is hardly any scrotum. The testicles are beyond the sides of the pubis, and are small.

Query: What time of the year was it caught?

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[1] ["†† *Rostro abbreviato*; unguibus maniculorum crassis, &c. *M. Zorilla*."—Fischer, Synopsis Mammalium, p. 218.]

[2] [This is a character distinguishing the Zorille and Grison (*Galictis*) from the European stoats. Hunter's enumeration of the teeth includes those of both sides of the upper jaw. If the reader compare the description with the figure of the molar series of the *Galictis vittata* in my 'Odontography,' pl. 128, figs. 1 & 2, he will readily trace the agreement of the description in the text with the characters there shown: fig. 2 exhibits the 'internal' process, which makes the lower carnassial or 'squeezer' similar to a grinder. The minute terminal grinder of the lower jaw appears to have escaped Hunter's notice. The dental formula of both *Zorilla* and *Galictis* is:— $i\,\frac{3-3}{3-3}$, $c\,\frac{1-1}{1-1}$, $p\,\frac{3-3}{3-3}$, $m\,\frac{1-1}{2-2} = 34$.]

[3] ["*Mephitis Zorilla*, Lichtenstein"—"dark-brown, with four yellowish-white stripes along the back, and one on each side."—Van der Hoeven, Handbook of Zoology, vol. ii. p. 716.]

The Otter [*Lutra vulgaris*, Erxl.].

The hair is of two kinds; a long and strong hair, and a short and soft hair, which thickens it; and the short is defended by the long hair.

The external ears are very small and flat. The tongue is not rough like a cat's, and has no worm.

The edges of the epiglottis terminate between the arytenoid and the inside of the thyroid, so that there are two ligaments joining from the arytenoid and thyroid; the uppermost is the mouth, as it were, of the sacculus laryngis: this is not large, much as in the human. The trachea is round, so that the edges of the cartilages meet, and when they are squeezed they overlap one another: their edges are thinned for this purpose. It has the œsophagus behind it at the upper part, but at the lower part it is a little on the left. Where it passes behind, the trachea is a little flattened by the left edges of the cartilages continued some way within those of the right, as .

There are two very small thyroid glands some way from the trachea, and a very large thymus. The anterior mediastinum is very thin and broad, and is perforated with many holes like lace. The membranes that pass between the pericardium and diaphragm are very loose when the lungs are in a flaccid state, which allows of their dilatation: they are united anteriorly to the mediastinum. The right one is united posteriorly to the vena cava; the left posteriorly to the œsophagus. The posterior mediastinum is double, from the basis of the heart down to the diaphragm; above that it does not so much deserve the name. The cavity of this doubling contains nothing. The pericardium is very thin and transparent.

The heart has (I imagine) no foramen ovale, for no injection got from the right into the left auricle. There is no fat upon the heart, although the animal itself was very fat.

The lungs seemed to be divided into three lobes on both sides: the right side seemed to be as common; but, on the left, and backwards, there was no cavity; this I had destroyed before I observed it: I imagine that this held the third lobe on the left. There were two lobes on the left side, and three on the right (in another subject). The third lobe is the middle or azygos lobe; they are very elastic, and firmer in texture than common: they sink at once in water. Is this peculiar to diving animals[1]?

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[1] [In an otter I dissected at the Zoological Gardens, the left lung had two lobes, and the right lung four lobes. The position of the lobulus medius or impar probably deceived Mr. Hunter in his first dissection. All the lobes swam in water; they were, however, gorged with blood, the animal having been drowned under the ice of its pond. The pulmonary veins were distended with coagulum.]

The œsophagus [at the upper part of the chest] lies in the division of the thorax made by it, by the trachea, the vessels of the heart, &c.: below, it lies in the doubling of the left posterior mediastinum, as the colon does in the peritoneum.

The stomach is much shorter than the human, and is bent near the middle like a lion's; so that the great and small curves are angular. The great end is not so projecting as in the human; the small curve, instead of being semicircular, is oblong.

The epiploon at the great end of the stomach is attached to the posterior surface of that viscus, and is continued into the little epiploon at the œsophagus. The vessels pass to the stomach much as in the lion, &c., but not quite so far on the anterior and posterior surfaces.

The duodenum is as in other animals: where it passes across the spine it is pretty closely connected to the root of the mesentery, and by a thin and broad membrane to the meso-rectum. The jejunum, ileum, colon, and rectum form one continued canal; but, near the end of what we may call ileum, [the intestine] takes the usual turn, as the colon does, and from thence it becomes stronger and a little larger to the rectum: near the rectum there are a vast number of small glands that appear through the peritoneum. In another otter they were not to be found. The [intestinal canal] is about three times and one-fourth the length of the animal[1]. There are no valvulæ conniventes. The mesenteric glands lie at the root of the mesentery. The peritoneum is very thin.

The muscular coat of the rectum, at its posterior side, is inserted into the tail, passing between the two that arise to enclose the anus as they pass to the urethra; but these two last-named are lost in the side of the perineum, blended with the sphinctores ani et vaginæ.

At the verge of the anus there are two very large bags filled with a yellowish thin matter, covered by the sphincter ani; their openings are at the verge of the anus, so that when squeezed, the contents come outwards; and besides, there is a white matter as thick as common paint, and very rancid to the smell. At the beginning of the duct leading from this bag, is a glandular substance surrounding it with a number of folliculi on it[2].

The liver is divided into four lobes, besides the lobulus Spigelii: this lies half behind the little epiploon, and half before, as in a squirrel; and it is rather longer than common for an animal of this size. The gall-bladder is situated between the two middle lobes, and is something uncommon in its position; for the fundus or most distant part from the ducts is highest, placed between the two lobes, so that it makes no curve

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[1] [Home, Comp. Anat. i. p. 431.] [2] [Hunt. Prep. No. 2145.]

in its duct; for both pass in one direct line about 2 inches from the pylorus. The second lobe from the left is to be considered as one loose lobe, having two large fissures in it; one for the umbilical vein, the other for the gall-bladder. The ligamentum latum is very thin, and is perforated like a net. The duct enters the duodenum, but before it enters it becomes pretty large[1]. The gall was thin, and of a light yellow. The lobulus Spigelii is a good deal the shape of a spleen or dog's tongue, and lies in the curve or bend of the stomach just fitting that place.

The great pancreas lies across the spine only in the doubling of the epiploon, which might be called mesopancreatic. Along the lower edge of the pancreas there is a membrane which is like a net, and bends the pancreas; it also unites it on the right to the vena cava. The other pancreas is in a doubling of the mesoduodenum, close to the gut in its whole course: then the most distant part from the head of the pancreas leaves the duodenum, where it is going to pass across the spine, and passes up behind the root of the mesenteric vein, and joins the lower edge of the transverse pancreas, which is only seen on the posterior surface. The pancreas is somewhat triangular like the spleen, having a posterior surface and an anterior one, which are broad; and an inferior surface, which is narrow. The great epiploon is attached to the inferior and anterior edge, and there is a very thin membrane that is attached to the inferior posterior, which is attached to the left of the mesentery, or attaches the spleen to it. The two ducts unite into one just at the duodenum, and enter by the ducts of the liver.

The spleen is long and large for the size of the animal; it is very much detached from the stomach.

The little and large epiploons are like a net. The large one covers all the intestines, and passes a little behind them, round the circumference of the whole; it is attached to the large curve of the stomach, to the beginning of the duodenum; and to the lower edge of the transverse pancreas and to the spleen, to the diaphragm above; and from the upper edge of the pancreas and the spleen, it passes on to the back.

The otter has very small eyes. There is a 'membrana nictitans' that can cover the whole eye, which is attached to the brim of the orbit. The lower lid has muscular fibres and tendinous ones. The caruncula lacrymalis is a gland, and the orifices of the ducts open on the most prominent part of the caruncula. There is a pigmentum nigrum on both sides [of the choroid, forming a] distinct coat on the inside.

The kidneys are conglomerated like the bear's.

[1] [I found a similar biliary receptacle, with thick coats, in the otter dissected at the Zoological Gardens. In the same animal the spleen was 4½ inches long, flat, and notched at both extremities.]

The urinary bladder is very pendulous: it is attached to the abdominal muscles by a thin ligament, like that of the liver.

The vasa deferentia, before they enter the urethra, become spongy on the inside, and thick in their coats. Between the two there is a small body or canal which enters the urethra at the caput gallinaginis, but not with the vasa deferentia. The loose skin on the glans penis of an otter is something like the lungs of a tortoise when inflated: in the inflation of it we can easily raise the lymphatics on the penis. That part of the penis that is between the bone and crura is very elastic. There is a scrotum covered with hair not pendulous[1].

The clitoris is within the common vagina, enclosed in a preputium, and the two lateral edges tucked in, making, with the edge of the perineum, a kind of vulva. The common vagina is 2 inches long, and hardly distinguishable from the true, excepting by the orifice of the urethra.

A uterus with two horns, and the ovaria enclosed [each] within a thin but pretty strong bag, having the Fallopian tube passing quite round it, and opening into this bag just at the termination of the horn. When I made a small hole into this bag, the air escaped by the sides of the pipe and got into the tube.

[The Grison (*Galictis vittata*, Bell).]

An animal about the size of a coati mondi, having a head something like that of a badger, with hardly any external ears, the cartilages only making flat ridges: it is pretty long and round in its body, with short and thick legs, longish toes, and close, and with rather straight and long nails, especially upon the fore-toes.

With a grey forehead which runs back over the neck and shoulders to the tail, making a straight line on each side 4 or 5 inches broad on the back. The hair black on the belly, but very little of it. The hair of the animal is short and strong.

The viscera as in the bear, racoon, badger, and polecat. At the verge of the anus is an irregular surface, which is neither rectum nor true skin, about the breadth of half-a-crown. The penis runs along the belly: the prepuce projects a little downward, and is a very loose skin.

The testicles lie between the anus and the orifice of the prepuce, in a small scrotum just large enough to hold them: they are not pendulous with one end down, as in an ox, &c., but lie more flat on the pubis.

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[1] [Hunt. Prep. No. 2519.]

THE SKUNK [*Mephitis Chinche*, Tiedem.].

This animal is very similar to the East India animal which we called Moses [*Ratelus*]. The shape of the head, of the body and legs, are nearly the same. The general properties of its colour are the same, viz. light above and dark underneath. The ears are short. The greatest difference is in the tail; it is longer, and has more and longer hair. It is as like in shape, &c. as a polecat is like a ferret. It has a pretty thick compact body, being pretty round. The legs are rather short. The metacarpus is short; it therefore treads on the metacarpus, which is bare. The metatarsus is longer; it therefore treads on the ends of the metatarsus, which are also bare.

The back from the crown of the head in a straight line between the two ears to the sides of the tail, and about half-way down on each side of the body, is white; there is also a narrow white stripe down the face. All below this is black; besides which there is a black line goes up from the tail along the middle of the rump. The quantity of white in some is larger than others, viz. the stripe is narrower: the white along the back does not go so far down the sides, nor is it continued into the tail, which, in such, is mostly black, having a few white hairs at the tip. The tail is more bushy in some than in others. The hair is longest on the back, becoming gradually shorter to the belly; also shortest forwards, becoming longer towards the posteriors; and longest on the tail. The hair consists of the long hair and the fur; but the fur is pretty long: there is no fur about the head or legs.

There were six nipples on one side, seven on the other.

The stomach and pylorus are very much like the dog's: the stomach appears a little shorter, but this may be owing probably to contraction.

The duodenum passes down the right side, having a pretty broad mesentery, and becomes fastened to the psoas muscle, brim of the pelvis, and mesorectum; but this attachment is pretty long: then it becomes a loose intestine, being strung upon the edge of the mesentery, which is continued down into the rectum; where the only difference is, that the intestine becomes a little larger and thicker in its coats[1]. The mesentery is pretty broad; and, with the vessels, there is a good deal of fat.

The liver is divided into four lobes: the second from the left, which is the largest, has two considerable fissures in its lower edge, almost dividing it into three lobes; into the left of which passes the ligamentum rotundum: in the right division lies the gall-bladder. The right lobe, which is the smallest, ends in the lobulus Spigelii.

The epiploon is attached, forwards, all along the great curve of the

[1] [Home, Comp. Anat. i. p. 433.]

stomach; on the right to the beginning of the duodenum, posteriorly to the rest of the mesentery (in which attachment lies the pancreas), to the left side of the mesentery and mesocolon, and to the left crus of the diaphragm along the spleen and its vessels.

The spleen is similar to the dog's, lying on the left part of the epiploon.

The pancreas is composed principally of the transverse portion. The kidneys are conglobate, not so much attached to the back as in most other animals; the right is the highest. The lungs on the left side are divided into two lobes; the right into three, besides the middle lobe.

The uterus is small and divides into two pretty long horns, each passing up to their respective loins, having pretty broad ligaments. There is hardly any projection of the os tincæ, it appearing as if the vagina contracted at once. The anus is a little protuberant, but that protuberance is broad or thick. The vagina is about an inch from the anus. The symphysis of the pubis is very narrow.

Ovarium is enclosed in a capsule.

Upon each side of the anus are placed the musk-bags, whose ducts enter the rectum just within the verge of the anus. The termination of each duct is by a nipple, which nipple does not project into the anus, but has a kind of sulcus, or a kind of prepuce all round. These bags contain the musk, which is of a yellow colour, is fluid and very pungent, so much so as to make the eyes water when they are held over it[1].

[The Javanese Skunk (*Mydaus meliceps*, F. Cuv.).]

The Skunk from the East Indies, from Sir Joseph Banks[2].

The stomach has a good deal the shape of the human, only that it is rather longer, and the small end bends a little quicker on the great end, which obliges it to go a little higher and towards the left again: this makes the lobulus Spigelii of the liver longer and smaller than in the human; as also it makes but a narrow mesogaster, whose use seems to be to confine the bends of the stomach to their proper curves or shapes.

The course of the duodenum is as common. No cæcum; the intestines making a sweep around the fore-part of the root of the mesentery to form the rectum. The epiploon encloses almost the whole of the intestines.

The liver is large for the size of the animal, and is divided into four lobes, besides the lobulus Spigelii. The two smallest are on the right: the right of all is moulded on the right kidney: the third lobe is the

[1] [Hunt. Prep. No. 2144. Home, Comp. Anat. i. p. 433.]

[2] [The skeleton of this animal is No. 4111, Osteol. Series. The dissection must have been made after the year 1781. See note to p. 49.]

largest, and has two deep fissures in it, the right fissure for the gall-bladder, the left for the ligamentum rotundum. The left lobe is about the size of the two on the right. The lobulus Spigelii is a long small lobe.

The pancreas is very loose, and might in one view be considered as lying in a doubling of the posterior part of the mouth of the epiploon. It passes from the spleen on the left towards the right; and, when got to the beginning of the duodenum, it makes a pretty quick turn towards the left again, which is attached to the posterior surface of the vena portarum: this may be called little pancreas.

The spleen is pretty large, having both the anterior and posterior part of the epiploon attached to it; as if it were fixed upon the epiploon.

The kidneys are conglobate; the cortical substance is of a lightish dun yellow, and is fibrous, all passing towards the circumference of the tubular structure. The tubular is of a brownish red, much the common colour in other animals. There is but one mammilla, whose internal part or surface begins by several roots, as if different mammillæ were uniting into one[1].

The heart is rather flat, the right ventricle forming a faint apex. There is a long vena cava between the heart and diaphragm.

The lungs are divided into three lobes on the left side; the lower lobe is attached to the œsophagus by a thin membrane: on the right side they are divided into four, including the lobe that passes between the pericardium and diaphragm, which is a pretty large lobe in this animal, owing to the heart's being some way from the diaphragm: this lobe has three processes or points.

There are two bags at the anus, one on each side, which open by their ducts just within the verge of the anus upon a small nipple. The glandular parts of these bags are attached at the end next to the opening, and the duct passes through the gland. The substance secreted is thin or watery, and has a very pungent smell, of the garlicy kind, so that the nose can hardly be held over it. It is the same smell as that of the American skunk.

[The Ratel (*Ratelus mellivorus*, Storr).]

Moses[2].—This animal is called, in India, 'Scea-Gosh,' *i. e.* Black Ears[3].

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1 [Hunt. Prep. No. 1223.]

2 [When forming the Osteological Catalogue and arranging that part of the Museum of the Royal College of Surgeons, I found, among the Hunterian unexhibited stores, most of the bones of this animal, labelled:—*Skeleton of 'Moses;'* they now form the specimens Nos. 4114—4131, Osteol. Series.]

3 [A similar name has been given to the East Indian lynx or caracal; see p. 50.]

He is about the size of a badger, and so much of the general shape, that he was always taken for a badger of a particular kind; but was of a stronger make, and more compact in all his parts.

He had most of the manners of a ferret in his walk, though few of the dispositions: he had uncommon latitude in the motion of all his joints, being able to turn himself into any position, and could climb very dextrously. The skin was very loose on him, so that he could turn himself almost round in it. The fore-feet are armed with four long sharp claws, with a smaller side one, and they are much longer than [the claws of] the hind-feet. They seemed to be for burrowing, for which he showed a strong disposition.

Contrary to many animals of this make, he was awake in the day and asleep at night, though his eyes were constructed for seeing in the dark, like those of the cat-tribe. He was extremely tame and sociable, so that he chose always to be with people; he was extremely lively and full of play, and when he had nobody to play with, would play with himself, as with his feet, or would play with the straw, by hugging bundles of it; and in this way he would go on for hours: but when at his victuals he would be very jealous, and would bite anybody that came near; and so strongly had he the disposition of procuring food, that he was unwearied in any method to get it if near it, or if it were within his sense of smell: this was very acute, so that he could smell at some distance.

'Moses' was very cowardly in disposition: anything that showed the least resistance frightened him; so that he never attacked anything but by stratagem; and if the animal, as, *e. g.*, a cat, small dog, or rat, made any defence, he would suddenly start back, or put his head between his legs to secure his throat, of which he was always very careful. At times, when he durst not face, he would present his back and thrust his antagonist into a corner, and would with great circumspection get his mouth to the back part of the animal's head, and gently get his jaws open and over the back part of the skull, and when he thought he had a proper hold, would at once bite suddenly with all his strength. If he did not seem to have hurt the animal materially, and it made any resistance, he would abandon it with great precipitation, and would again attack it as before with all the cunning imaginable.

If an animal was put into the same house, which he durst not attack boldly, nor play with freely, he was almost constantly at work, night and day, either to kill it or play with it. If an animal was put into the next chamber in his house, so that he either smelt or heard it, he hardly ever ceased endeavouring to get to it; and if at any time he laid hold of a tail, foot, nose, &c., he never would let go his hold till he was obliged by force, as by opening its jaws; for beating availed but little. When attacked or suddenly startled, he would erect all his hair, and would snarl and snap with great vehemence.

The eyes were small and not prominent; not projecting beyond the surface of the body. The ears were also without any projection, being almost quite level with the surface of the head; nor did the orbits project, the head being one line in every direction from the nose upwards.

The voice was a grunting, or a noise resembling sawing, so much so as to deceive people who did not see him. When he drank, he did not lap like a dog, nor suck like a horse, but it seemed to be a mixture of both actions.

Internal Structure.—The stomach is much the same as in the dog; its coat seemed thin, principally upon the left side: the pylorus is almost in the middle of the abdomen. The duodenum passes to the right and down over the right kidney to near the brim of the pelvis; and is there tucked down to the back, and then becomes a common loose intestine, which is continued on to the rectum. The length of the intestinal canal from the mouth to the anus was 9 feet 9 inches. The length of the animal from the tip of the nose to the anus or root of the tail was 2 feet 1 inch: the length from the mouth to the pylorus was 1 foot 4 inches.

The epiploon enclosed, or was wrapped round, the small intestines; it is fatty and membranous; it is attached to the curve of the stomach all round upon the anterior side; the posterior edge is attached to the transverse pancreas, and passes from the pancreas to the back, so that the pancreas may be said to lie in the doubling of the epiploon.

The anus projects beyond the bones of the pelvis two inches at least. The bags at the anus are beyond the outside of the pelvis. There is a great deal of fat about the anus and inside of the thighs.

The liver is divided into four lobes, besides the lobulus Spigelii. The second from the left, or large lobe, has a large fissure in it for the round ligament; a little on the right of that is a small fissure for the fundus of the gall-bladder. The gall-bladder was large and contorted; its duct was folded up upon the bladder, afterwards making several turns upon itself: it enters the duodenum about an inch beyond the pylorus.

There are two pancreases: the large one passes across the body to the left side; the smaller one passes down to the curve of the duodenum, taking the sweep of that gut, gets behind the vena portarum, and at its ends joins the large or transverse pancreas.

The kidneys are very low in the body, almost down to the brim of the pelvis. The ovarium lies as high as the kidneys. The uterus has two horns, as in the bitch. There are only four nipples, two on each side, which were on the lower part of the belly, about 1½ inch or 2 inches asunder[1].

The lungs have three lobes on the right side, besides the middle one, and only two lobes on the left side. The mediastinum is a broad thin membrane. There is only one vena cava superior. The eyes are small, and the inside is lined with an album pigmentum, like the lion, &c.

The Wolvereen [*Gulo luscus, Ursus luscus,* Linn.[2]].

The animal itself was black, with some white spots on the toes. Its head is flat, very much like an otter's, and the whole animal lies squat upon the ground: it has but small eyes, and a short tail. Its feet were broader than usual in animals of this size, and the toes were easily spread out, and were a little webbed. It lived upon fish and flesh, and would dive for fish: the colour, the shape, the way of life, made me imagine that it was an otter peculiar to the place it came from, but it was somewhat larger than ours.

Upon dissection I compared it with the otter. The eyes were a good deal the same; the pigmentum album also, which did not come lower than the optic nerve.

The tongue I have saved for a preparation with the cartilages. The os hyoides is attached to the head as in most animals; the superior ring of the trachea is broad and thin, passing up on the inside of the cricoid; but is not contiguous to the inside of the cricoid, excepting at the lower edge of it; for it flies inwards, and there is a circular space all round the upper part of this cartilage, and inside of the cricoid. The rings of the trachea meet at their ends in their most natural or easy position; but when they are opened they can fly asunder nearly half an inch, and are connected by a thin membrane. The trachea is large. The thyroid glands are very small: there is one on each side of the trachea at the upper part, or rather opposite the larynx, and about an inch from it; the lower end is small; they are of a yellow colour.

There is a cavity between the head and atlas which makes the anterior part of the capsule of that joint, as in the badger, &c. The contents of the thorax are much as in the otter, or in other animals: however, the ligament of the pericardium, lungs, &c. is not perforated as in some animals.

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[1] [It would seem from the name given to the beast, and the common use of the masculine pronoun in its description by Hunter, that he had not known the sex until after its death and dissection.]

[2] [The skull and other parts of the skeleton of this animal are Nos. 4133—4148, Osteol. Series.]

The heart had some fat upon it. There was no thymus gland, nor any foramen ovale [between the auricles of the heart]. The stomach is much as in the otter, is stronger in the coats than in the human, and is bent near the pylorus, as in the lion-tribe; so that the œsophagus passes in nearer the great end than in the human subject. The stomach in them [the lion-tribe] is generally bent, and the bending is generally more in a line with the body; so that it will be obliged to make a quick turn up, to allow of the pylorus being near the liver; for the pylorus is at the [same?] distance from the liver in all animals in proportion to the size of the animal.

Duodenum, jejunum, ileum, colon, and rectum are the same as in the racoon, badger, otter, and bear; only that the duodenum is very glandular in its coats between the insertion of the ducts and the pylorus[1].

The liver is divided into five lobes, besides the lobulus Spigelii. The gall-bladder lies in a deep sulcus of the middle lobe: it is almost round, and the cystic duct passes out at the most anterior part, or what would seem to be the fundus, from its beginning: it creeps or lies along the under posterior surface of the bladder, towards the vena portæ, where it joins the vessels of the liver, along which it passes, receiving the hepatic ducts, at last becoming [?] and entering the duodenum about 3 inches from the pylorus.

The pancreas is as in the otter; but the membrane that is attached to the posterior inferior edge is much broader, and the epiploon is attached to that membrane instead of to the pancreas, towards the small end of the pancreas.

The kidneys are conglomerate: their veins are, some on the external surface, and some in the centre. Those on the external surface are not connected to the capsule of the kidney. Some of the internal veins pass quite through and ramify on the external surface; passing out from a centre and anastomosing with the external ones.

Female Organs of Generation.—The clitoris is pretty large, enclosed in a prepuce, which is a bag with a small opening into it, so that the clitoris cannot be pushed out: it adheres to this bag on one side near its whole length, something like the tongue in the mouth.

The common and proper vagina are of equal length. The uterus is nearly as long as both: it then divides into the two horns, the left of which has a little process or cæcum, which I suppose is a lusus naturæ. The ovaria are enclosed in a capsule; the orifice of which is very small,

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[1] [Hunt. Prep. No. 763. This has been entered in the Hunterian MS. Catalogue as 'rectum,' and is so called in my 'Physiological Catalogue,' 4to, vol. i. p. 226. Home Comp. Anat. i. p. 432.]

close to the end of the horn, on the opposite side to the origin of the Fallopian tube.

The muscles of the anus are as in the otter. The bags at the anus are very large[1].

Section Plantigrada.

Family *MELIDÆ*.]

The Badger [*Meles Taxus, Ursus Taxus*, Linn.[2]].

The soles of the feet are like the racoon's. Part of the deltoid arising from the neck is as in the racoon. There is no worm in the tongue. The edge of the epiglottis loses itself in the membrane between the thyroid and cricoid cartilages, so that there are two ridges coming from the arytenoid to the thyroid; one from the tip of the arytenoid, the other from the root; and, between these two, is the opening of the sacculus laryngis, next to the thyroid cartilage. This is a pretty large sac, not extending forward over the os hyoides, as in the martin-cat or racoon, but into all that space between the opening and the side of the thyroid cartilage, and backward as far as the upper edge of the cricoid and outer angle of the arytenoid; it is covered only by a thin membrane as it extends upwards, where the edge of the epiglottis is lost. The thyroid gland is very small and flat, lying close to the upper part of the trachea, as in the martin-cat and racoon.

Some part of the roof of the mouth is black. The œsophagus below the diaphragm is very short. There is a mark where the fauces terminate, and where the œsophagus begins—a sort of stricture.

The situation and figure of the stomach, intestines, spleen, pancreas, epiploon, and kidneys, are the same as in the bear, racoon, stoat, and martin-cat. There are very large glandular parts in the ileum[3].

The liver is divided as in the dog, the gall-bladder lying in the middle lobe. There are two hepatic ducts, the uppermost the smallest, as in the racoon, which comes from the left side: the ductus communis choledochus is the stem or union of the whole; it enters the duodenum about 2 inches beyond the pylorus, and about an inch from the pancreatic duct.

The pancreas is of a triangular figure, as in some other animals, having superior and inferior mesopancreatic membranes, which are fixed to the superior edge, and the inferior posterior edge, the epiploon being fixed to the anterior inferior edge.

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[1] [Hunt. Prep. No. 2146.]

[2] [The skeleton of this animal is No. 4091, Osteol. Series. No. 1955, Phys. Series, is a portion of the skin, showing the fur and hair of the badger.]

[3] [Home, Comp. Anat. i. p. 430.]

The female parts of generation are as in the racoon, only there is no knob on the tip of the labia, and the clitoris is entirely hid by a preputium like the white bear's, which is also very rugous on the inside. The external vagina was very red.

The bag at the verge of the anus is pretty long, but at that half which is next to the anus it is very thick, and covered with a very thick glandular substance[1]. The racoon has a little of this.

The Carcajou [*Meles Labradoria*, Sabine[2]].

The body of this animal is long, especially the thorax, which is not deep. Both the fore-legs and the hind are extremely moveable on their first joints, as is also the scapula, by which means its movements become very extensive in the motions of those parts, and [the animal is] of course very active. The legs are short and strong, so that the belly is almost flat on the ground. The hand or fore-foot is very much [like that of] the bear, and has a considerable rotatory motion in it. The hind-foot is broader; the toes spread much, and are considerably webbed, like the other; therefore we may suppose it swims. The whole appearance of the animal is something between the otter and bear; not so flat as the first, nor so thin and high off the ground as the other.

The head is a good deal of the otter; it is flat and wide, but rather more bent than in that class of animals, being rather shorter. The teeth are more of the lion's than most of that class of animals. Six incisores, two cuspidati, two breakers or squeezers, and two grinders in each jaw[3].

The stomach is much as in common. The duodenum passes down on the right, having a mesentery; then passes across behind the mesentery, where its mesentery becomes not so broad; then, on the left, the mesentery becomes broader or longer, on which the jejunum and ileum are attached. The gut passes up the right towards the root of the mesentery, and crosses it on the anterior surface, as the duodenum passes behind, having a shorter mesentery at this part; and, when got to the left side, it gets a longer or broader mesentery, and passes down forming the rectum.

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[1] [Home, Comp. Anat. i. p. 430.]

[2] ["Jam enim constat *Ursum* et *Melem* Americæ, licet satis similes nostris, indole tamen et specie distinctos esse; et forsan *Gulo americanus* non est varietas nostratis." —Pallas, Zoographia Rosso-Asiatica, p. 9.]

[3] [This number applies only to the upper jaw: there are three 'breakers' in the lower jaw. The dental formula of *Meles* is:—$i\ \frac{3-3}{3-3},\ c\ \frac{1-1}{1-1},\ p\ \frac{3-3}{4-4},\ m\ \frac{1-1}{2-2} = 36$. Sometimes the first premolar is present in the upper jaw. The carcajou differs in the more carnassial character of the carnassial teeth, and a smaller size of the upper true molar.]

The liver is divided into five lobes, including that of Spigelius: the second from the left is the largest, having the ligamentum rotundum entering a pretty deep sulcus and the gall-bladder lying in another deep sulcus. The gall-bladder can be hid in this sulcus: it would appear as if bent over a part of this sulcus.

The spleen is long, and lies in a doubling of the epiploon. The pancreas lies in the doubling of the epiploon, almost reaching the spleen on the left, and on the right it joins the mesoduodenum and passes downwards in the curvature of that gut; then makes a turn up by the vena cava on its right side, when it becomes small, ending in a point. The kidneys are conglobate, having one long mammilla or ridge, with lateral ridges going from it into lateral infundibula.

As the chest is long, the superior and inferior venæ cavæ are long. The lungs on the right are divided into three lobes, with one going behind the vena cava: on the left they are divided into two lobes. The œsophagus is wide, corresponding to the teeth.

The hair is very much that of the black bear.

The common vagina is smooth. The os tincæ is projecting, so that air does not enter it from the vagina: the uterus divides into two horns. The ovaria appeared as if made up of small glands covered by a smooth coat: when cut into, a great deal of mucus came out: the capsula ovaria had a very small opening. The above parts were very like the cat's in form. The clitoris has a cartilage in it: the preputium clitoridis is pretty deep on the under side, or what would be the upper in the human subject.

[Family *PROCYONIDÆ*.]

The Racoon [*Procyon Lotor*, Storr; *Ursus Lotor*, Linn.[1]].

It walks on the whole carpus and metacarpus, and on the toes or fingers of the fore-foot; and the same of the tarsus and metatarsus in the hind-foot; and all this part is thick, lined with fat, and is bare, having no hair. The last phalanx of the toes is kept up by an elastic ligament, which is fixed to the root of the second phalanx; and is at the other end fixed to the upper part of the last, where the nail is; but this is not nearly so strong as in the cat.

It has no clavicle, so that that part of the deltoid, which arises from the clavicle in those which have that bone, arises from the vertebræ of the neck in this animal. It has two sorts of hair; one is short, thick

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1 [The skeleton of the male racoon here described is No. 4051, Osteol. Series: that of the female is Nos. 4053—4055.]

and soft; the other is long, thin and strong, and of a whitish colour; the former is brown[1].

The female has a hole between the nose and upper lip; but [there was] none in the male: the nose projects near an inch over the mouth. It has a worm in the tongue, but it is small.

The orifice of the sacculus laryngis is very small, close to the thyroid cartilage at the root of the epiglottis, and opens into a long bag, extending to the arytenoid cartilage, between the thyroid and the os hyoides, and over it; so that the base of the tongue is only a thin membrane: there are two ligaments passing forwards from the arytenoid cartilages, having a muscle passing between them on that part next to the arytenoid cartilages, and the orifices of the sacculi are on the other part. The upper ligament is inserted into a knob of the thyroid cartilage. The arytenoid cartilage has two points, one on the middle way between the arytenoid and the epiglottis. The thyroid gland is as in the dog, but is rather flatter. The os hyoides is attached to the basis of the head. The duct of the parotid gland is as in the human.

At the beginning of the œsophagus the internal membrane is corrugated, making a kind of valve. The length of the œsophagus below the diaphragm is about an inch. The epiploon[2] is as in a dog, going round and round the intestines.

The abdominal viscera are just like a dog's, only there is no cæcum, but a little valvular structure not sufficient to prevent regurgitation[3]; [so that there is] but one continued canal, as in the bear, becoming a little larger at the usual place where the cæcum is in other animals; then taking the same course, but the canal does not adhere by contact or broad surface[4]. The rectum is stronger than the other guts, and becomes gradually larger. There is a bag on each side of the anus; but, all round the verge of the anus for an inch in breadth, it is studded with the sebaceous glands[5].

There is but one line of adhesion for the liver, stomach, spleen, and all the intestines, to the body of this animal; except the vena cava for the liver, and the œsophagus for the stomach. This line is from the diaphragm down the back to the rectum; and it is only a thin doubling to the rectum. The whole intestine is about six times the length of the animal.

The lower end of the gall-bladder is only attached by a thin membrane. There are two hepatic ducts: the ductus communis choledochus enters the intestines about 2 inches beyond the pylorus; and the

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1 [Hunt. Prep. No. 1954.]
2 [Ib. No. 1824.]
3 [Home, Comp. Anat. i. p. 430.]
4 [Ib.]
5 [Hunt. Prep. No. 755.]

pancreatic duct enters with it by one orifice; and, indeed, they unite some way before they enter. The situation of the kidneys is as in a dog, viz. the left is lower than the right[1].

The angles of the eyelids are very oblique; the external upwards, the internal downwards. There are two sets of muscles [to the eye-ball], as in the lion. The iris has the nigrum pigmentum on the anterior surface as well as the posterior, but not so thick. The choroid is like the monkey's, and has two veins on it like the lion's: it has an album pigmentum, the lower end of which comes a little lower than the optic nerve. The crystalline [lens is] equally convex on each side.

Male Organs of Generation.—The testicles are situated as a dog's. There is not a very strong cremaster: the tunica vaginalis does not communicate with the abdomen, but is continued a pretty way up the spermatic cord. There are no vesiculæ seminales; but the vasa deferentia enter, as in man, in the middle of the prostate gland: this is pretty large, but does not make, as it were, a part of the bladder; so that the bladder has a kind of neck between the prostate and bladder. The membranous part of the urethra is long and covered by a thin muscle.

The penis has a bone of a peculiar figure, the end of which makes the glans, and is covered over by a thin membrane that is attached about half an inch from the end, and is not perforated anywhere. The corpus cavernosum goes no further forwards than the glans on the bone, which is about 2 inches. The corpus spongiosum begins as in man and passes forwards along the body of the corpora cavernosa, then along the lower surface of the bone, and about 2 inches from the end of the bone it surrounds the bone. There are the same muscles as in man; besides them there are two pairs. One pair arises from the hollow of the sacrum, spreads on each side of the rectum as they pass on, and are mostly lost there; but a small portion passes under the bulb of the urethra, and between the two portions of the sphincter ani that are attached to the bulb; from thence they are continued along the under surface of the urethra. In another racoon they seemed to cross the erectores penis, to get on the upper side of the penis, and to be lost in it where the urethra begins to surround the bone: they seem to raise the anus and bring back the penis. The other pair arise from the under surface of the tail, passing upwards between the two levatores ani; they are spread on the posterior surface of the rectum, seeming to bring the anus down. Cowper's glands could not be found.

Female Parts of Generation.—They are in every respect the same as

[1] [The Hunt. Prep. No. 1222, exemplifies the structure of the kidney.]

in the bitch; but the true vagina is not so rugous nor of a dark colour; and just at the angle of the external labia there was a little knob, about the bigness of a small pea, which contained a brown fluid; but I could not find any duct from it. The orifice of the capsula ovarii would only admit a probe. The ovaria are attached to the kidney and to the abdomen; however, the ligamentum rotundum has not such a broad ligament, and does not convey a process of the peritoneum.

The racoon has two nipples on each side.

In a white animal (or rather yellow like a ferret), just the shape of a racoon, and indeed I believe only a white one[1], I found the viscera just like a racoon's, and that the ileum was inserted valvularly into the colon about a foot or more from the anus, as in the racoon. The colon was rather larger and stronger than the other intestines. The epiploon covers the intestines both before and behind.

The female parts of generation were like the racoon's.

When living, it had the eyes of the ferret, and on dissection I found no nigrum pigmentum, neither on the outside nor the inside of the choroid; nor on either side of the iris: but, at the usual place where other animals have the album pigmentum, this animal had it. The choroid coat was very thin, and almost transparent: the iris was nearly transparent. The retina was much thinner than common. The crystalline humour was very large; its outer part dissolved into a water, but its middle part was very hard. This animal sees best in the dark; daylight is too much for it, and then it can contract its iris so much as to shut up the pupils, and the light is obliged to pass through the iris.

[The Kinkajou (*Cercoleptes caudivolvulus*, Illig.; *Potto*, Bewick; *Yellow Macauco*, Pennant; *Prehensile Weasel*, Shaw).]

An animal (of which I made a Drawing) from South America, given me by Dr. M^c^Kenzie, of Jamaica.

It is rather less than a mongoose, but has a good deal the air of one. It has a short pointed nose, and is pretty broad between the ears, so that the head is a cone. The ears are round, short, and turned almost directly forward. The nose is dark. The lower jaw is a little way under the upper. The body is pretty long. It walks nearly on the whole sole of the feet, but most so in the fore-feet: the soles and toes are bare; those of the fore-feet most so. Its toes are five on each foot;

[1] [Bewick's figure of the carcajou was taken from a white variety in the Menagerie of the Tower of London, in his 'History of Quadrupeds,' p. 284.]

they have a lateral motion in their joints which admit of a greater variety and quantity of motion in them, but they are all in the same line. The second and third toes on the outsides are the longest and strongest in both the fore- and hind-feet. The fourth in the fore-foot is larger than the first, but the thumb is the smallest of any. The fourth in the hind-foot is rather the reverse of that in the fore-foot; it is smaller than the first, and the fifth is still smaller; so that what answers to our thumbs and great toes are the smallest. The claws are like the bear's, and are in proportion to the size of the toe: the first joint is a little bent upwards, the second a good deal downwards, which of course obliges the third to bend up.

The hair is pretty thick or close, short and strong, of a yellowish brown, dark on the back and sides, and lighter on the belly: down the back it is the darkest, almost approaching to a streak. The tail is rather darker than the sides, and at the tip there is something like a ring; the hair is all round it from end to end: the tail is long and curls at the tip, fit to cling round anything.

This animal is either towards the beginning or ending of that class called *Lemur* by Linnæus, or the [Loris or Maki] of Buffon; but I believe that all those have a thumb on all the feet, and a nail on these thumbs.

The œsophagus is about an inch long below the diaphragm. The large end of the stomach is pretty projecting beyond the œsophagus; the stomach passes to the right a little obliquely and then bends up pretty quickly towards the liver, and terminates in the pylorus. From thence the duodenum passes to the right, having a mesoduodenum; then to the left behind the root of the mesentery, where it is a little more fixed; it then becomes loose, and its general course is towards the right: it passes from the right across the upper and fore-part of the mesentery to the left, and then down the left loins to the pelvis. In this course the intestinal canal becomes a little larger, but there is no cæcum.

The liver is divided into five lobes; the left is pretty large; the second is larger, and has two fissures in it, one for the ligamentum suspensorium, the other for the gall-bladder: the third lobe is quite on the right loins, and is small: the fourth lobe is a little lower in the loins, and is connected with the fifth, or lobulus Spigelii, through the passage behind the vessels of the liver.

The pancreas has two [lobes or divisions], the long and the short. The spleen is as in a dog. The epiploon is attached to the stomach, spleen, and pancreas.

The kidneys are conglobate. The testicles are quite out of the belly on the pubis: the scrotum is little more than the common skin. There are no vesiculæ seminales. The penis passes along the belly a considerable way, covered by the common skin, so that the prepuce does not project. There is a bone in the penis which is forked at the end, and is not covered by the glans, but by a thin loose membrane which is cellular, and can be blown up as in the otter. (Query: Is this always the case where there is no scrotum?)

They feed upon fruits and insects.

The Poto[1] [*Cercoleptes caudivolvulus*, Illiger].

Has three grinders like a monkey's; two sharp-pointed teeth which may be called little canines; all these are close together in the upper jaw: six incisores, which are close together in the lower jaw[2]. The talons of this animal are like those of a bear.

The stomach and the whole intestines are as in the bear, racoon, badger, &c.

The liver is divided into five lobes. The bladder-lobe has two very deep sulci in it, which almost divide it into three; one for the ligament, the other for the gall-bladder: there are two lobes on the right of this and the lobulus Spigelii.

The penis lies along the belly, and comes pretty far forwards, and the termination of the prepuce is by a kind of flap or elongation of the lower part; so that, when this flap is applied to the belly, it covers the orifice of the prepuce. The penis lies pretty far back in this prepuce, and when it is pulled to its full length, it hardly reaches the orifice of the prepuce; so that in copulation the prepuce must be driven back from over the penis. The testicles are not very prominent; all these parts are covered with hair, as in the bear, racoon, ferret, coati-mondi. There are no vesiculæ seminales. The bone in the penis is very much like that in a racoon.

The bags by the side of the anus are the same as in the bear.

[The Coati-mondi (*Nasua*, Storr).]

The Swash ['Quasje' of Linnæus].

This animal seems to be only a small coati-mondi[3]. Its external

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[1] [The skull of this animal is No. 4086, Osteol. Series.]

[2] [The three teeth in the upper jaw, like monkey's grinders, are the last premolar and first and second true molars: the two small teeth, like canines, are the second and third premolars: the dental formula of *Cercoleptes* is:—

$$i\,\frac{3-3}{3-3},\ c\,\frac{1-1}{1-1},\ p\,\frac{3-3}{3-3},\ m\,\frac{2-2}{2-2}=36.$$

See my 'Odontography,' p. 500. pl. 129. figs. 16, 17.]

[3] [Parts of the skeleton of this animal form the specimens Nos. 4069—4079,

figure is exactly the same. Its fore- and hind-feet are much the same with the bear, viz. [as to] the nails and the surface that it treads upon.

The nose projects a good way beyond the mouth. The projection of the nose is in the gristly part, and this is as much convoluted on the inside as the bony part of the nose. Why there should be such projection in the nose, more than in a dog, &c. which are obliged to live by smell, I do not know.

The coati-mondi is exactly the same, only differing in size. The contents of the thorax are similar to a dog's. The stomach is as in a dog: the duodenum is the same. There is no cæcum, but the last of the intestines, or colon, where it crosses the mesentery, is attached to the root of the mesentery, and then goes down to form the rectum. There are small bags [one] on each side of the anus.

The liver is divided into many lobes. The gall-bladder is attached as usual, and the ducts passed into the duodenum near the pylorus. The spleen and kidneys are as in a dog: the bladder likewise. It has no vesicula seminalis. The penis has a bone in it, but projects beyond the belly about an inch, because the prepuce will not allow it to pass further.

It has a cavity between the pharynx and the first and second vertebræ of the neck, which is pretty large, and seems to communicate with the canal of the medulla spinalis between those vertebræ. This is the same in a racoon; and in them it lies upon the cuneiform process of the second vertebra of the neck and the os occipitis. It communicates with the cavity of the joint between the os occipitis and the first vertebra: it sends a process between the first vertebra and the rectus capitis anticus muscle, which, when blown into, swells on the outside of that muscle towards the transverse process of the atlas.

There are two of these [sacs or cavities] divided by a septum; but this septum is not complete, being only attached to the occiput, the first and second vertebræ, at three different places; so that there is a communication between the two lateral sacs; but, between these attachments, it seems to be analogous to a sacculus mucosus [bursa mucosa].

The eye is much smaller than a cat's or a dog's of the same size. The muscles are as in a lion. The humours are as common. The coats as in the racoon.

The duct of the parotid gland passes over the masseter.

Osteol. Series. Sir E. Home notices the anatomy of this animal under the name of 'the Swash.'—Comp. Anat. i. p. 431.]

Of a Bear [*Ursus arctos* and *U. americanus*[1]].

The trunk is that of a quadruped; but the extremities come nearer the human, and more so to the whole four feet. They have no clavicles, although many of their actions are such as would incline us to believe that those bones would be necessary; but these actions are not so extensive as to require such projectors.

The œsophagus is pretty small in its beginning, but becomes larger and larger down to the diaphragm, where it is again contracted to the size of a common finger: the largest part is in the thorax, and is nearly as large as the thick of one's arm: at this part it is smooth on the inside and not strong; but this enlargement was probably accidental or from disease. As soon as the œsophagus passes through the diaphragm, it dilates into the stomach, which is nearly the shape of the human stomach, but is very strong in its coats: it has nearly the same situation [as in the human subject]. The duodenum passes to the right, then down, and from that to the left behind the root of the mesentery. The intestines are one continued canal from the pylorus to the anus, so that there is no cæcum or colon. The intestines have no valvulæ conniventes[2], and are not so firmly fixed by mesentery as [are] the human. At the sides of the anus there are two bags, one on each side. They are very small; their ducts or openings are just at the verge of the anus[3].

The lungs on the right side are larger than those on the left, and are divided into three lobes; on the left side into two only. The trachea is large; the cartilages are pretty thick at their fore-parts or middle, and become thinner backwards towards their ends, where they terminate in a thin edge. Their disposition and union are in alternate pairs; the upper and lower edges of every other one, at the fore-part, overlap the edges of the others; but at their posterior ends they are overlapped by those which were overlapped in their middle; their posterior ends come very near one another, and can easily be squeezed one over the other. The bear has a pulmo-azygos[4].

The liquor pericardii was slimy like synovia: whether this arose from disease or not, I cannot possibly say.

The liver is divided into three lobes, with the lobulus Spigelii. The gall-bladder has three hepatic ducts: the ductus communis enters with

[1] [In the next dissection Hunter refers to the anatomy of both the 'Russian' and 'American' bears. The skull of an American black bear (*Ursus americanus*) is No. 4015, Osteol. Series.]

[2] [Hunt. Preps. Nos. 698, 699, 700.]

[3] [Home, Comp. Anat. i. p. 430.]

[4] [The 'azygous' lobule of the lung, interposed between the heart and diaphragm, may here be meant.]

the pancreatic duct into the intestine. [Supplemental Note.] (Not in all; for in one bear they entered separately, and by two distinct ducts.)

The pancreas lies in the curve of the stomach and duodenum, having two arms transverse and descending: the transverse one passes to the left behind the stomach, and before the vessels of the mesentery; the other, or descending arm, passes in the hollow curve of the duodenum, the extremity of which passes up along with that gut as it is approaching to the left side, and joins the transverse one on the left of the mesenteric vessels. There are two ducts which communicate with one another in the substance of the gland[1].

The kidneys are conglomerated, or made up of smaller kidneys, each of which terminates in a point which is a mamma, and is enclosed by an infundibulum[2].

They have no vesiculæ seminales: at the entrance of the vasa deferentia there is a glandular or muscular body[3] which these ducts pass through before they enter the urethra. The urethra is nearly as in the human, only the membranous part is longer. The penis is cavernous at the beginning, as in a dog, but has a bone at the anterior end, about 5 or 6 inches long, on which bone is placed the glans.

The thoracic duct had a coagulum in it as low as the lower part of the thorax, and this coagulum was tinged of a red colour; therefore it is reasonable to suppose that there were veins that had entered this duct lower than the thorax.

Mr. Varelst told me, at Mr. Walsh's[4], that there were black bears in India, but they were small. He had seen several of them.

[Large Black Bear (*Ursus labiatus*, Blainv.), which came (as it was said) from Patna (Upper province of Bengal).]

It had more of the Russian bear in it than of the American, especially in the hair: however, this was even longer than that of the Russian,

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[1] [Hunt. Prep. No. 781.]

[2] [Hunt. Prep. Nos. 1259—1260 (*Ursus arctos*), 1261 (*Ursus americanus*): the suprarenal body of *Ursus arctos* is No. 1283.]

[3] [It is an elliptical dilatation of the vas deferens itself, the parietes of which are thickened, and have small tortuous sinuses or cells developed in them; the ducts are very wide, which leave these glandular dilatations, and converge to open on the verumontanum. Each dilatation is distinct both as to its cavity and as to its substance; they are only united by cellular dense tissue. There is a thin layer of a glandular substance surrounding the beginning of the urethra, which represents the prostate.]

[4] [Probably John Walsh, Esq., F.R.S., residing in 1772 at Chesterfield Street, London; author of the observations on the electric property of the Torpedo, prefixed to Hunter's Paper on the electric organs in the 'Philosophical Transactions,' vol. lxiii. 1773.]

more especially about the neck, where it was very long, and of a much darker colour. On the lower part of its chin the hair was white, and it had two lines of white which originated on the sides of the neck just at the part that joins the fore-end of the scapula to the neck, which is called the setting on of the shoulder in the human subject. These two white lines passed down to the breast, or, what would be called, between the two fore-legs in this animal, converging, and meet in a point on the breast a little way above the end of the breast bone: these two white lines were about an inch broad. Perhaps this was the most singular circumstance attending this animal.

I think the nose projected further beyond the upper jaw than in the common bear; but, as it had lost all its fore teeth, it is probable it might only appear so[1]. Anatomically it appeared to be exactly the bear.

The above animal, Mr. Gough, on Holborn Hill [dealer in animals], had for many years.

The White Bear [*Ursus maritimus*[2]].

The tongue is smooth at its anterior end, excepting in a middle line, which is a small sulcus, dividing the tongue into two halves, viz. right and left. The middle part between the ends is rough, something like that of a lion, but not nearly so strong: there is a muscle between the tongue and epiglottis. The edges of the epiglottis are continued into the tips of the arytenoid cartilages, but there is a little prominence between these parts which is caused by a rounded cartilage, pointed at the ends and bent into a semicircular form with the two ends turned forward, toward the epiglottis: the longest end is toward the root of the epiglottis; the other towards the top, which causes the prominence above-mentioned. The long end makes a pretty high ridge upon the inside of the larynx just above the ligaments of the glottis, and parallel with them, making to appearance the mouth of the sacculi laryngis; but there are none. The ligaments of the glottis at their anterior ends are partly fixed into the thyroid cartilage, and partly contiguous to one another, but this is only at their upper edges. The os hyoides is attached to the head by a bone, as in most animals.

The cartilages of the trachea are very thick, especially at the upper

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[1] [In the skulls of the *Ursus labiatus*, Nos. 4037, 4038, 4039, 4040, Osteol. Series, Mus. Coll. Chir., the upper incisors are more or less defective with obliteration of their alveoli.]

[2] [Hunter's specimens of the bones of *Ursus maritimus* are Nos. 3980, 3984, 3988—4011.]

end, and become gradually thinner downwards: they describe a circle when in their most natural state; but are capable of being made much more straight.

The pericardium is some way from the diaphragm, between which parts there is a bag. This is made up of the pericardium forwards or above, the diaphragm being opposite to it; and of two very thin membranes laterally: these last are so loose as to allow of a large distension of this bag, and will likewise admit of the apex of the pericardium (if I may so call it) touching the side of the diaphragm; but it will not allow the basis, for that is tied on one side by the vena cava inferior; and on the other side the membrane becomes not so loose, and stronger, so as to be only stretched between them. The mouth of this bag is on the right between the vena cava and the back.

The lung of the right side is divided into three lobes, besides the lobe that is situated in the above-mentioned bag; which lobe is a continuation of the right lung, and is something like the lobulus Spigelii of the liver. On the left side the lung is divided into two lobes only.

The distance between the diaphragm and the upper part of the thorax is greater than in the human, which is the reason that the heart is at so great a distance from either, and is the reason why the superior and inferior venæ cavæ are so long; likewise the carotid arteries, for the curve of the aorta is as near the heart as in the human. This increase of length in the thorax is to increase the size of the lungs, to make up for the smallness or narrowness of the chest in quadrupeds.

The œsophagus is pretty nearly of an equal size through its whole length, and has a capsule between the heart and the diaphragm; which capsule has the lower two lobes of the lungs of each side adhering to it by broad membranes.

The eyelids have both a raiser and depressor: the depressor is a very thin muscle coming from the bottom of the orbit. The membrana nictitans is of a darkish colour, and differs very little from those of other animals; it has part of the depressor muscle of the under eyelid inserted into it. There is one punctum lacrymale, which is on the inner side of the under eyelid, a little way on the inside of its edge. The edges of the eyelids are of a darkish colour all round. The trochlea of the trochlearius muscle is not close to the orbit, as in the human subject. The orbit is different at its upper end and other parts, through its whole length, and is of considerable breadth. This place or notch is filled up with a muscle and ligament, but this muscle does not arise from the edge of the bone, but from the lower surface of the orbit by a thin origin nearly the whole depth of the orbit, and passing outwards round all the muscles and fat of the eyeball, it is inserted into an elastic ligament which is fixed into the upper surface of the orbit nearly its whole breadth. The use of this muscle seems to be to squeeze the fat and muscles behind the eyeball, which will throw the eye forward, as it cannot pass backwards.

The optic nerve will allow of this motion, as it runs in a serpentine course in its natural state. The eyeball is small, having a black ring round the beginning of the cornea, which serves perhaps for the deficiency of black round the eyelids, as the hairs are there white, and as it seems necessary to have black upon the outside of the eye when the pigmentum nigrum is black within. This pigmentum is very black, both on the outside and inside of the choroid, and the same upon the iris. The pigmentum album surrounds the optic nerve, but is broadest above, and has a mixture of green in it. The crystalline lens is not remarkably convex.

The external parts of generation are pretty much like those of a bitch, but these parts are so covered with hair that there is hardly any seeing them. The common vagina is about a third longer than the proper, and is of a dark colour, becoming so gradually the further in, so that it is almost black at the termination. The meatus urinarius ends in a prominence which is lost in the form of a ridge along the common vagina. Within the vagina, just at the peaked part, is the clitoris, which is a very uncommon one. Upon opening the vagina, it is not seen, being enclosed in a sheath: to expose it, you must slit up this sheath its whole length at one edge. The clitoris is a pretty long and rounded body, about an inch in length, and is attached through its length to the internal membrane of the vagina on its external surface: it is something like the tongue in the mouth. The internal surface of this bag or sheath of the clitoris is thrown into the longitudinal rugæ, and is of a dark colour. The spongy part of the clitoris does not extend further than the exposed part; so that in coition it cannot be touched by the penis, but must be rubbed against the internal surface of its own sheath. The internal coat of the proper vagina is thick and soft, and is thrown into irregular rugæ, which are very flat, and were of a florid red colour. Near its termination in the uterus it is very much contracted; and there puts on the appearance of an os tincæ, but that is a little higher. The body of the uterus is very small, and is something longer than the vagina; it divides into, or sends off two horns, the openings of which are about half an inch from what appears externally to be the fundus uteri; each of these horns is longer than the uterus; they are attached by the broad ligaments, which are attached at their upper ends to the kidneys[1].

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[1] [The kidney forms the Hunt. Prep. No. 1262.]

What answer to the round ligaments are here pretty broad, crossing the broad ligament. The ovaria are enclosed in a capsule which has a very small opening into it. The fimbriæ are on the inside of these bags, but close to the opening[1].

The bags at the anus are very small; and the openings are nearly as large as the bags themselves; by which means they are easily to be inverted so as to look like piles externally.

Captain Cartwright says that white bears do not sleep in the winter; they come further south as the white foxes do. He has, at Labrador, seen the tracts of their feet in the summer: he was told by the Indians that they go into caves to avoid the heat in summer. A gentleman shot one swimming, and when he had skinned it, the four quarters weighed 70 score pounds. He had not weights to weigh it at once, but by pieces, 20lbs. a piece (1400 lbs.).

Section Pinnigrada.

Of a Seal [*Phoca vitulina*, Linn., and *Phoca grœnlandica*, Linn.[2]].

The tongue is pretty broad at the base, becoming rapidly narrower towards the apex, where it is bifid[3]. There is no uvula. The os hyoides is attached to the head by a ligament. There is the muscle passing between the tongue and epiglottis. The edges of the epiglottis are attached to the tips of the arytenoid cartilage by the rimula laryngis. There are no sacculi laryngis. The two thyroid glands, one on each side of the cricoid cartilage, lying upon the neck, are of an oval figure.

The lungs are rather long and small: [on] the right side they appear as if they were made of two lobes united by a loose cellular membrane: on the left side of three lobes united in the same way: they are of a florid red: the cells do not seem to be larger than in the human. The thymus is very small.

The pericardium is very thin, adhering to the diaphragm by a broad surface; but this adhesion is by a ductile cellular membrane, so that it is moveable upon the diaphragm in some measure; yet the inferior vena cava is pretty long, for the apex of the heart is turned down so that the basis is a good way from the diaphragm, and the pericardium adheres posteriorly to the vena cava; and, between it and the œsophagus, there is a thin membrane.

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1 [Hunt. Prep. No. 2805.]

2 [The skeleton of one of the seals dissected by Hunter is of the harp-seal (*Phoca grœnlandica*, L.), No. 3961, Osteol. Series.]

3 [Hunt. Prep. No. 1508.]

The œsophagus is pretty large, becoming larger near the stomach, which is more a continuation of the œsophagus than in the human; that is, it enters nearer the great end. It is pretty long and small. Its situation is pretty much as in other animals, but would seem to be a little more oblique, especially at the great or left end, which is pretty straight: but, that the pylorus may be near the liver, it makes a quick turn up, and a little to the left, upon itself, about 3 inches from the pylorus: this serves for that continued or gradual bend that is in the human and other animals.

The duodenum passes to the right and downwards, and is so quickly bent as to be attached a little way to the right of the last-mentioned turn of the stomach; as it passes down the right side it lies upon the right lobe of the liver, and at the lower part upon the right kidney; then it makes a turn to the left side, and a little upwards behind the mesentery, having a mesentery through its whole length, but is shorter where it passes behind the great mesentery. Where it passes from behind the mesentery upon the left, it is attached to the mesocolon or rectum; it then becomes a loose intestine, as common. This intestine at its termination passes upwards, and is lost in the cæcum, which lies behind the bend of the stomach, before that part of the duodenum which passes to the left[1]. It projects nearly two inches over the insertion of the ileum, and is not very large in proportion to the small guts. As the cæcum lies so high the colon cannot ascend, but passes directly to the left, having a short mesocolon; from thence it passes down upon the left side of the kidney, and then dips into the pelvis. This mesentery, mesocolon, and mesorectum are very thin: the mesentery is very long. There is a large lymphatic gland in the root of the mesentery about 4 inches long, which is but small: one end of it is in the root of the mesentery, the other passes along the right of it towards the insertion of the ileum; besides this there are other small ones.

The small intestines are about sixteen times the length of the body of the animal; and the great intestine is somewhat more than one-half of the length of the body of the animal[2].

The epiploon is very thin: anteriorly it is attached to the whole length of the stomach, to the diaphragm and spleen upon the left, and posteriorly to the pancreas. There are the large and the little pancreases: the latter is very little, but passes as far down the mesoduodenum as in other animals. The large pancreas, as to size and situation, is as in

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[1] [Home, Comp. Anat. i. p. 439.]

[2] [The structure of both small and large intestines is shown in the Hunt. Preps. Nos. 697, 761, 762.]

common; but is divided at the right end or slit for the passage of the mesenteric vessels, so that it is both before and behind them.

The liver is divided into four lobes, besides the lobulus Spigelii; the second from the left is by much the largest, and its lower edge is divided into three by pretty deep notches: the gall-bladder lies in the right notch, the umbilical cord in the left; it is some way from the diaphragm. The gall-bladder is pretty long and small: the cystic duct is very short, and pretty large; only about three-eighths of an inch in length: there are three hepato-cystic ducts which are very small, and enter the bladder near its opening into the cystic, upon that side next to the liver: there are three hepatic ducts, all of which enter or join with the cystic at one part. The ductus communis is short, and enters the duodenum about an inch from the pylorus; it runs some way in the coats of the intestine, and then communicates with the pancreatic duct, and these two make or open into a little bag[1], which has an opening into the duodenum.

The veins of the liver are very large; so is the vena cava, especially where they all unite between the diaphragm and liver (but whether I was deceived or not I won't pretend to say[2]): however, it [the inferior vena cava] is very small before it passes into the heart, for it will hardly admit one's little finger. The inferior vena cava divides just at the liver, and the emulgents are inserted into these two, viz. vena cava and iliac vein.

The spleen[3] is a good deal the shape of a dog's.

The membranous or muscular parietes of the abdomen are attached or inserted along the outside of the thigh and knee of the animal, then across the head of the tibia, from thence quite across the pubis; for the knee is no lower than the pubis, so that the fore and inner part of the thighs, with the knee, make part of the abdomen, and of course are seen in its cavity upon each side of the pelvis, or upon the spine of the iliac bones.

The legs, from the knee to the heel, are attached to the sides of the pubis, and are at equal distances from the ossa pubis; so that those bones are opposite to the middle of the legs.

The Eye[4].—The glandula lacrymalis is but very small, as we may suppose that there is no occasion for tears; but when the animal is upon land, it is situated as in common. There is no punctum lacrymale, and

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[1] [This structure is noticed in the account of the anatomy of the walrus, in the 'Philosophical Transactions' for 1824, p. 233.]

[2] [Hunter truly discerned the large hepatic venous reservoir, which is a constant structure in the seal tribe. See Hunt. Prep. No. 805.]

[3] [Hunt. Prep. No. 832.] [4] [Ib. Nos. 1694, 1778.]

of course no sac nor ductus ad nasum; so that the tears must pass over the cheek or be washed away in the water. The membrana nictitans is pretty broad, but not transparent, having a cartilage in its middle passing from its edge towards the inner canthus of the eye: and upon the common surface of this membrane, near its root or inner canthus of the eye, is placed a gland[1] longer than the lacrymal, the ducts of which penetrate through the membrane, and open upon the concave surface of the membrane. The number of the eyelids is properly only one, for it surrounds the whole eyeball, with its muscles arising from the bottom of the orbit, passing forwards and diverging to be inserted equally everywhere into the upper and lower eyelids. The uses of this muscle must be various, and as if there were many [muscles]; for, according to the different part of it that acts, it will have different uses; *e. g.*, if the whole acts it will dilate the whole eyelids, both upwards or downwards; to the nose or from it: but, if the superior acts, it will raise the upper eyelid only; if the inferior, it will depress the under eyelid: if the outer portion acts, it will draw the angle outward; the reverse if the inner portion acts.

This muscle arises in conjunction with the straight muscles of the eye, and seems to be only an expansion of the external part. There are two oblique muscles, as in the human subject. The eye is very large; as large as that of a calf six months old: it is pretty globular, being only a little depressed behind, having a little circular depression round the termination of the sclerotic coat. The cornea is broad, and seems to be nearly a segment of the same circle with the sclerotic. There are six large veins passing into the posterior part of the sclerotic; their direction through that coat is very oblique. The sclerotic coat is much thicker at its beginning and termination than what it is in the middle: the cornea is of an equal thickness throughout. The nigrum pigmentum is everywhere upon the external surface of the tunica choroides and iris: it is only upon the anterior part of the inner surface of the choroides, being at the posterior part of that surface white; but it lines the iris wholly on its posterior surface. The posterior part of the inner surface of the choroid [tapetum lucidum], round the entrance of the optic nerve, is equally and pretty broad on all sides. This is a little uncommon, its being white [the tapetum extending] equally all round the optic nerve; but it is perhaps owing to the eyelids being opened equally on all sides; for in other animals it is generally broadest above, and in them they only open the upper eyelid. The processus ciliares are pretty deep, and the iris is pretty broad, so that the dilatation and

[1] ['Glandula lacrymalis Harderi.' Hunt. Prep. No. 1778.]

contraction will be greater. The crystalline lens is equally convex on both sides, and much more so than in the human; it is nearly spherical, so that the prominences of the humours and of the cornea do not correspond. Query: Whether it has a power of altering the convexity of the cornea? This eye was not stale, so that it could not be flattened; for it was examined on the day that the animal died. The optic nerve is small in proportion to the eye, and passes in a serpentine course.

The Ear.—There are no loose external ears, excepting a point or rising of one of the cartilages, which is at the anterior part of the ear[1]; besides which it has an orifice just behind the eye, which goes down in a serpentine course by the side of the head for about a couple of inches, being made up of four different cartilages which move one upon another, and serve the same purpose as an external ear, and may be considered as a fixed one.

The superior maxillary nerve is remarkably large, going to the upper lip.

Female Parts of Generation.—The external parts are close to the anus, the division terminating in an edge; so that there is no length of the perineum, and both the vulva and anus are continued some way under the tail, projecting beyond the pubis, as in birds. The common vagina begins by nearly a circular hole, something like the anus; not nearly so much peaked at the lower part as in a bitch.

Upon the internal surface of the peaked part is an irregular surface, which is the termination of the clitoris. This part is long, on account of the projection of the vulva beyond the pubis; it is spongy; the crura are short. The common vagina is of the same length with the proper, but is considerably wider, and has some longitudinal rugæ, especially at the termination, where it seems to be drawn together like a stricture, which makes a kind of hymen. The meatus urinarius terminates in a nipple-like projection. The internal [proper] vagina is thrown into longitudinal rugæ, and the internal membrane, which is pretty thick, is so loose as to be easily thrown into either transverse or longitudinal folds. The os tincæ is pretty prominent. The uterus has two horns, each of which, after their division [external separation from each other], is nearly of the length of the [apparent] common uterus; but the openings into these are not what we would call the 'fundus uteri,' but are very near the os tincæ; so that the part of the uterus that is common to both is very short; and what appears to be the [common] uterus is only the union of the two horns for a little way. The common is

[1] [This shows that the species dissected was a true *Phoca*, not an *Otaria* of Cuvier. The structure of the organ of smell is shown in the Hunt. Preps. Nos. 1557—1559.]

thrown into the longitudinal rugæ; likewise the horns, but not so much. The ovaria are pretty near the ends of the horns, and are large, of the shape of a French bean, and smooth. They are enclosed in a loose capsule, which adheres to the concave edge [of the ovary] like the tunica vaginalis testis: it has an opening at one side of the adhesion, the edge of which is the external edge or the circumference of the fimbriæ: this bag goes close to the horn of the uterus. Upon the bag runs the Fallopian tube, which opens upon its side near the opening. The vessels are convoluted near the ovaria, like those of a bull's testicle, and pass in at the concave edge. The ovary has a pretty broad ligament; the round ligament adheres to the fore-part of the thigh, instead of going out at the pubis. The urinary bladder adheres to the inside of the abdominal muscles.

They have but one young at each time of impregnation.

The flesh is very bad, and the cellular membrane that attaches the skin to the muscles is very strong, much like the cavernous part of the penis; or just like the cellular membrane of a whale. The abdominal viscera of this animal resemble those in the lion more than any other land-animal I know of.

The internal mammillary veins that pass along with the arteries are but small, for they send large branches down by the right side of the pericardium that empty themselves into the inferior vena cava.

The neck bends just like a fowl's, so that it seems to be capable of lengthening the neck and shortening it.

The hair[1] of the head, neck, and shoulders was turned forwards when alive (when I saw it), but, when dead, it was turned backwards as in common, with the other; so that this must have been done by the panniculus carnosus.

The upper bone of the sternum is long and pointed, and lies on the trachea; or if the trachea slip to one side, then it lies on the neck.

There are muscles arising from the pubis, and inserted into the foot or tarsus.

Male Parts of Generation.—It is almost impossible to say, before dissection, whether a seal is a he or she, excepting by the want of the beginning of the vagina; for there is no scrotum, and the testicles are not to be felt. The penis is under the skin which comes smooth over it, and is there as thick, and in every other respect the same, with the other skin of the body; and the opening of the preputium is hardly observable, the surface being there as smooth as in other parts. Whether these appearances, or rather want of appearances, be owing to the

[1] [Hunt. Prep. No. 1953.]

animal's being young, I do not know. The testicles lay between the upper part of the legs and os pubis, and as if they had come through the ligament [of the abdominal ring], for there is a similar ligament to that arising from the knee and inserted into the pubis. There is a tunica vaginalis communis. The vasa deferentia lead into the pelvis behind the bladder as in common, and enter much as in the human. There is a thin prostate, but no vesiculæ seminales. The urinary bladder is pendulous, as in other animals[1]. The crura penis are short, and closely connected to the pubis; the corpus cavernosum is short, not reckoning the bone of penis: the bulb is pretty large; the glans covers the bone of the penis.

The muscular parts of the rectum and its posterior surface arise from the under surface of the tail. There are no bags at the anus.

Of a Sea Cow in a fœtal state [*Trichecus rosmarus*, Linn.[2]].

The stomach has little or no great end. The duodenum passes much as in the human, only lower down. The cæcum is as in the seal, and lies exactly before the spine. The pancreas, two; the descending a pretty large one. The liver divided into lobes, besides the lobulus Spigelii: the second from the left has a large fissure passing all along the upper surface to the diaphragm in which is the falciform ligament, which fissure at the lower surface of the liver is divided into two: in the left division is the ligamentum rotundum; in the right is the gall-bladder. This fissure may be said to divide this lobe into two; therefore this animal has six lobes besides the lobulus Spigelii.

The lungs on the right divided into two; the lower lobe divided at the anterior edge, and sends in the lobe above the diaphragm. On the left side are two lobes, serrated on the anterior edge, and the posterior thick part has one fissure in it. This plan of serrating is for the motion of the anterior part of the chest. The kidneys are conglomerated[3].

I should very much suspect this to be the sea cow, but more probably a seal; for the stomach, cæcum, and liver are more that of a carnivorous animal[4].

In comparing the above description with one sent me from St. John's Island, which was a fœtus, and above 4 feet long, they agreed perfectly, excepting in the cæcum. The cæcum of the animal from St.

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[1] [The kidney of the *Phoca vitulina* is No. 1207, Hunt. Physiol. Series.]

[2] [A fœtus of a walrus, which has been dissected, is No. 3729, Physiol. Series. Hunter appears subsequently to have received Nos. 2559, 2560, 2561.]

[3] [Hunt. Preps. Nos. 1264. 1265.]

[4] [Such is the structure of those parts in *Trichecus*.]

John's was hardly projecting, for I compared the two cæca together. They were both females. The clitoris is an oblong round projecting body.

Order Cetacea[1].

The Porpoise [*Phocæna communis,* Cuv.].

The duodenum does not pass behind the mesentery as in most other animals of this class. There are longitudinal valves running through the whole length of the intestines, from the pylorus near to the anus[2]. The guts are a great length, about fifteen times the length of the animal: it has no large gut nor valvular apparatus. The epiploon, which is attached to the stomach before, and to the spleen and pancreas behind, but is not so long as to cover the intestines, has no fat in *the most fat* porpoise; nor is there fat in the mesentery. The liver [consists of] one lobe, having a small sulcus where the ligamentum rotundum passes: there is a hollow in that part of the liver next to the diaphragm. There is no gall-bladder. The pancreas is a pretty thick oblong body, lying behind the second and third stomach, and attached on its right end to the pylorus, duodenum, &c.

There are a vast number of absorbents[3] coming from the intestines, which pass through the lymphatic glands at the root of the mesentery: these glands are very large, and there is a great number of them. These absorbents pass into the thoracic duct, which divides and reunites as it passes through and enters the subclavian [vein]. The chyle was white, and thick as cream.

The spleens are two, in some five or six, in number, and small for the size of the animal; one was about as large as a very large walnut, the others small; they lie in the epiploon, not on the left of the stomach, but on the right of the lower end of the first stomach. There is a passage behind the vena portæ, as in the human.

The diaphragm has no middle tendon, but is interspersed in the middle with tendinous fibres; it is very oblique in its lateral parts, owing to the ribs going much lower than the sternum.

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[1] [The following notes on the anatomy of the Cetaceous order are interesting chiefly as being part of the original materials from which the valuable paper entitled "Observations on the Structure and Economy of Whales" was compiled for communication to the Royal Society. They are here, therefore, given as exemplifying Hunter's mode and style of annotation during the dissection of a rare animal. The structures preserved as preparations are passed over with little or no notice in these MSS.; but they are fully described in the printed paper, and will be found in my edition of the 'Animal Economy,' 8vo, 1837, pp. 331 *et seq.*]

[2] [Hunt. Preps. Nos. 704, 739.]

[3] [Ib. No. 860.]

There is a vast number of glands about the neck and heart, especially along the attachment of the pericardium to the diaphragm; whether lymphatic or not, I am not certain. The veins of this animal are very large and many. There are a great many plexuses of the arteries among the muscles of the neck and head, running in a contorted manner. The intercostal arteries arise from the aorta by three trunks, and are subdivided into three intercostals. There is a vast plexus of the arteries that lie between the pleura and ribs, just at the angle of the rib all along the spine. The eyes are smaller in proportion to the size of the body than in any other fish; and more so than those of the land animals of their class[1]. The coats of the eye are very much like the human, or most land animals of their class; only that the sclerotic coat is much thicker, especially the nearer the optic nerve. The crystalline humour is nearly round, if not quite. [The right eye; the outer or rather the posterior part cut off. The gland at the inner or anterior angle; no puncta lacrymalia, nor sac[2].]

The external ear is only a small flattened canal leading from its opening in the skin (which only appears to be a little aslant in the skin) to the organ of hearing[3].

The brain of the porpoise[4] is, in its parts, similar to the human and animals of this [mammalian] class. In general it is much shorter, broader, and flatter than in any other animal. It consists of cortical and medullary substance; of cerebrum, cerebellum, and medulla oblongata. The cerebrum consists of two hemispheres: the convolutions are irregular. There are two lateral ventricles, with plexus choroides[5], and corpora striata; also thalami optici, third ventricle, and infundibulum. I could not observe the 'nates' or 'testes,' nor the pineal gland, those parts being very putrid. The cerebellum is convoluted as in the human. There was a fourth ventricle, and the arbor vitæ. The medulla oblongata is flat; the corpus annulare was not so perceptible as in the human. There were no olfactory nerves. The optic nerves unite and make a very sharp angle at their union.

The medulla spinalis[6] is in most respects similar to the human. The nerves arise in pairs, and each nerve arises by two portions; one from the upper or posterior surface, the other from the lower or anterior surface. The dura mater is connected to the nerves near their origins all the way down; therefore the cauda equina is on the outside of the dura mater, not within it, as in the human subject. They pass out

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[1] [Meaning the amphibious, as the seal-tribe.]

[2] [Hunt. Preps. Nos. 1677, 1678, 1688, 1773—1775: this last is the preparation above defined.]

[3] [Ib. Nos. 1582, 1587—1592.]

[4] [Ib. Nos. 1332, 1333.]

[5] [Ib. No. 1334.]

[6] [Ib. Nos. 1359, 1360.]

mostly transverse at the neck, becoming more and more oblique downwards, and at last passing longitudinally, and by this means forming the cauda equina at the lower part. It seems to bear nearly the same proportion in size with the brain as the human medulla spinalis does.

The female parts of generation[1] of the porpoise are, in general, similar to those of this [cetacean] class. The external parts consist of an irregular slit forming two labia, one on each side, which are in the direction of the trunk. Between the two anterior ends of the thin labia is a ridge, which is the clitoris; the crura of it are attached to two bones answering to the two branches of the ossa [ischii] in other animals; just as the crura penis are [attached] in the male porpoise. From the middle of this slit passes forwards the vagina. The coats of it are firm, like those of the human, extremely rugous on the internal surface; and near the os tincæ there are two folds or transverse plates, whose edges or eminences are turned towards the mouth of the vagina. The os tincæ is very prominent, having a great many longitudinal rugæ upon it. The common uterus is but short, dividing into two horns, which decrease or fly off from one another in a circular form. Their coats are soft, and have small longitudinal rugæ on the internal surface. At the ends of the horns are the Fallopian tubes which run on a membrane or bag, becoming wider by degrees. The ovaria are long bodies. The urinary bladder lies between the vagina and abdominal muscles; it is largest at the fundus, becoming smaller by degrees towards the meatus. The meatus opens at the anterior part of the beginning of the vagina, just at the posterior end of the clitoris.

The milk-glands are two, lying along the belly, one on each side of the linea alba. The gland is, in texture, the same with those in other animals. It has only one duct, which passes through its centre backwards, and opens externally in a small projection or nipple on the side of the external opening of the vagina. This nipple lies in a sulcus or slit, so as to disappear occasionally.

The parts of generation, both in a male[2] and female, are almost exactly similar to those of the bull and cow, only that the testicles are not external, and there are no external parts in the female.

I should suppose that they have but one young at a time; because, in one that I had, there was all the appearance of her having had young very lately, for the vagina was very large, and one of the horns of the uterus and the ovarium of that side had one calyx only[3].

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[1] [Hunt. Preps. Nos. 2785, 2786.] [2] [Ib. Nos. 2520—2522.]

[3] [In the latter end of the month of October, I found in the uterus of a porpoise, a fœtus of 2 inches in length. A female porpoise dissected, June 16th, 1838, by Alexander Shaw, Esq., F.R.C.S., had a fœtus in utero, or rather in the vagina, of

The liver of the fœtus or young porpoise[1] is very small in proportion to the size of the body when compared with the human fœtus. As a proof it is air they breathe, they have no organ for smell in the blow-hole[2].

As porpoises have no hinder extremities, and no bones of the pelvis, the lower part of the belly is much narrower than in those animals which have them.

WHALE, from Mr. Jenner[3], from Gloucester [*Delphinus Tursio*, Fabr.[4]].

The œsophagus is large, having a strong muscular coat, a white ligamentous coat or cutis, and a cuticle[5]. It dilates nearly equally on all sides into the first cavity of the stomach. The stomach all along its small curve is attached to the liver and vessels of the back very firmly; and the first stomach, or cavity, is attached to the diaphragm, on the left posteriorly, by a very broad surface. The stomach, in its shape, number of cavities, &c., is similar to that in the common porpoise.

The duodenum is not bound down anywhere, nor does it go to the left as in most other animals, but becomes loose almost immediately. The rectum, as it passes down the back, is hid between the kidneys[6].

The liver is very much of the shape of that in the human subject; the only difference is that the left lobe is nearly as large as the right. There is no passage behind the porta of the liver, therefore the cavity of the epiploon and cavity behind the stomach form a circumscribed cavity. The duct of the liver passes down and enters into the substance of the head of the pancreas, receiving the pancreatic ducts into it, which for some way in the pancreas are tinged with the bile; and it would appear to pass upwards and enter the cavity of what may be

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2 feet in length. There was milk in the mother's mammary glands, which were largely developed. I was indebted to Mr. Shaw for the opportunity of inspecting this specimen; I conclude, therefore, that the period of gestation in the porpoise is nine months. A female grampus was killed off the Isle of Portland on the 2nd of May; she had a young one in utero 3 feet long, and was accompanied by the young of the previous year, which was 10 feet long, and in which the teeth were just beginning to be formed.]

[1] [The heart of, probably, this young specimen is No. 3717, Hunt. Phys. Series.]

[2] [See Hunt. Preps. Nos. 1541—1544.]

[3] [Afterwards Dr. Jenner, the discoverer of vaccination: he was one of Hunter's house pupils.]

[4] [The skull of the parent of the young specimen here described, is No. 2486, Osteol. Series.]

[5] [Hunt. Prep. No. 454.]

[6] [The structure of the intestine is shown in Preps. Nos. 705, 740, 741.]

reckoned either the end of the stomach, or beginning of the gut, some way before that cavity terminates in the last valvular part. There is no gall-bladder.

The pancreas is a thick body lying across the spine, as in the quadruped; the head of which lies in [the curve of] the duodenum, having a fissure in its lower edge, in which passes a large blood-vessel. There is no little pancreas. The spleen is a round body placed on the right side of the first cavity of the stomach: it has veins running on its exterior surface; and, near it, is another small spleen as large as a nutmeg. The epiploon is attached anteriorly to the lower arches of the different cavities of the stomach, and posteriorly to the pancreas and spleen. There was no fat in the epiploon.

The mediastinum is short, and strongly ligamentous; therefore the heart is nearer to the sternum. There is no *cartilago xiphoides*. The diaphragm on the fore-part comes down some way on the inside of the abdominal muscles, being attached to them there instead of to the sternum, &c. It is very concave, especially from side to side, arising from the shortness of the sternum, and the great length of the ribs. There is no pelvis, the lower part of the belly coming to an obtuse point.

The pericardium is attached to the diaphragm by a broad surface; and, as the diaphragm is attached some way down on the inside of the abdomen, the pericardium of course comes also some way down on the inside of the abdominal muscles.

There is only one lobe of the lungs on each side; and, from the shape of the thorax, they come down amazingly low. At their lower anterior edge they are attached to the diaphragm and lower part of the pericardium by a glandular body, which I suspect to be a lymphatic gland; for there is a chain of them going along that attachment to the back, which, evidently, are their lymphatic glands. There is no lobe of the lung going behind the vena cava inferior, as in the quadruped. The lungs at their anterior edge are only like a thick membrane. They are more solid than we commonly find them in other animals, and are very elastic[1].

The inferior vena cava is, between the heart and diaphragm, very short, as also is the superior. There is a thymus gland.

The uterus, ovaria, &c.[2] are placed in the lower part of the belly, much like those in the quadruped.

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[1] [The structure of the larynx is shown in Prep. No. 1170; that of the tongue in No. 1486; that of the urinary bladder and ureters in No. 1275; that of the organ of hearing in Nos. 1583, 1593; that of the skin in Nos. 1852—1855.]

[2] [Hunt. Prep. No. 2787.]

The brain weighed three pounds and a half.

The medulla spinalis is much firmer than in any other animal[1]. There are no puncta lacrymalia. They have an orbicularis palpebrarum muscle. The dilatores muscles of the eye are very strong. The globe of the eye is widest in a transverse direction, as is also the cornea. The sclerotica is not a regular circle in the perpendicular section of the eye, being very much flattened forwards[2].

The head of the os humeri is rather further forwards than the upper part of the sternum. The middle part of the head of the os humeri and the top of the sternum are equally near the head. There was no fat in the cellular membrane between the interstices of the muscles, nor on the mesentery. The ends of the ribs are cartilaginous, to which the cartilages going to the sternum are united by ligament through the whole surface, as the vertebræ are.

The two abdominal muscles, which I only reckon the transverse and oblique, in this animal are but thin, and close to the peritoneum. But the straight muscles, or recti, are extremely thick, being about 2 inches thick for the progressive motion of the animal.

The breasts of the large one, the mother of the present, were full of milk, and made no external projection or prominence. Ludlow and myself both tasted of the milk, and we agreed that it was exceedingly pleasant and rich; more like cream than milk. The milk was contained in large reservoirs or cavities within the breasts, into which it was poured by the secreting vessels: what I mean is, to compare them [the reservoirs] with the pelvis of a kidney[3].

The length of this young one was 7 feet 6 inches. The circumference round the thickest part or chest, 3 feet 8½ inches. The length of the intestinal canal, from the stomach to the anus, 108 feet—about sixteen times longer than the animal[4].

The Fin-Back, or Grampus [*Delphinus Orca*, Linn.[5]].

The nose, or spouthole of the fauces, is only one canal, is membranous, and pretty straight: but, as soon as it comes to the bones of the head, it is divided into two, through these bones: then, on the upper surface,

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1 [Hunt. Prep. Nos. 1361, 1362.] 2 [Ib. No. 1776.]

3 [The justness of this simile is shown in the preparation, No. 3742.]

4 [Home, Comp. Anat. i. p. 432. Hunter availed himself of Jenner's young Cetacean to illustrate the development of the teeth, as in the Preps. Nos. 327, 328, and 389.]

5 [The skull of this animal is No. 2515, Osteol. Series. The eyeball is preserved in No. 1693.]

it unites again, and passes on as one canal, but is very irregular on the internal surface.

The heart and lungs lie in the thorax, as in the brute; but there are no subdivisions [of that cavity] as in other animals.

The stomach is lined with a pretty thick white coat, which seemed to have no direction of fibres, but tore in any direction with ease. It was corrugated by the muscular coat of the stomach. There is one large and loose gut from the stomach to the anus. The rectum gets behind the root of the penis, between the two cartilages contiguous to the bulb and vasa deferentia, as in other animals.

The liver is, as it were, half divided into two lobes, and in the fissure passes the ligamentum rotundum, from thence passes up the falciform ligament, as in the human. I could not observe any gall-bladder.

The testes lie within the abdomen, just at the root of the penis, where it enters the abdomen; and the vasa deferentia pass backwards to the root of the penis.

There are two very large and long muscles that arise from what we might call perineum, or union of the rectum with the bulb, &c., which run over the bulb and acceleratores muscles, and continue along the under surface of the penis. This muscle is similar to those muscles in all those animals which retract the penis.

Of the Bottle-Nose Whale [*Delphinus* (*Hyperoodon*) *bidens*, Cuv.[1]].

The length of the animal, from the mouth to the end of the tail, following the sweep of the external surface of the side, was 24 feet 9 inches. Round the body, at the thickest part, was 14 feet; but probably it had swelled a foot or more; however, probably not more, as it is a skin which does not readily stretch. The tail at its extreme edge was 6 feet wide. The posterior edge of the dorsal fin was about 1 foot 6 inches further forwards than the anus. The vulva was about 4 inches before the anus. The blowhole is of this shape ⌣, and about 5 inches long, across the head[2], and further back than the eye. The opening of the eyelids is larger than that of an ox. The external opening of the ear was about 5 inches behind the eye, and about an inch or an inch and a half below the eye; and its course inwards to the skull through the soft parts was rather downwards *.

* A worm was squeezed out at the external orifice.

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[1] [The skeleton of this animal is No. 2479, Osteol. Series.]

[2] ["In those which have only one external opening, it is transverse," &c.—Animal Economy, ed. 1835, 8vo. p. 371.]

The œsophagus was strong and muscular, smooth on its inside, with a pretty thick pulpy cuticle, only separable by putrefaction. This smooth surface terminated all at once into the first cavity of the stomach, whose internal surface is very different. The size of the œsophagus is about 5 inches in diameter.

Of the Stomach.—The stomach is composed of a chain of bags, seven in number, and of very different sizes. The first bag, into which the œsophagus passes, is by much the largest, acting probably as a reservoir for food[1]; the other six would seem to be a series of cavities, becoming larger and larger to the last. The first of these arises, laterally, from the first or reservoir, and may be only reckoned a small pouch. The second arises from this in the same manner, but is considerably larger; so on with the third, fourth, fifth, and sixth, in regular succession. The opening of these bags into one another is by round holes about three inches wide. The stomach contained only the bills of some hundreds of cuttle-fish; which bills were found principally in the last bag but one, which is the sixth cavity of the stomach, and a few were found in the fourth and fifth cavities. There were none of the cuttle-fish bones found in these cavities. There was also found a substance like the inner surface of a gizzard. The pylorus was about an inch and a quarter wide.

Of the Intestines.—The intestines had no cæcum, being one continued canal from pylorus to anus, nearly of an equal size through their whole length, being fully 1½ inch in diameter, appearing upon the whole to be rather short for the size of the animal. The contents were soft.

I shall suppose that the duodenum passes to the right and downwards, and makes a quick turn upon itself to the left. The duodenum immediately swells out into a pretty large cavity, which becomes smaller and smaller towards the quick turn above mentioned. This swell of the duodenum might be reckoned an eighth cavity; but, as the gall-duct enters it, I shall call it duodenum[2]; although there is a similar bag in the porpoise that must be reckoned with the stomach.

Nearly through the whole track of the intestines the inner coat was thrown into large cells, and these at their bottom were again subdivided into smaller. The axis of those cells were not perpendicular to a transverse section of the intestine, but were oblique, so as to form pouches with their mouths downwards, so as to act almost like valves

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[1] [Hunt. Prep. No. 572, showing the abrupt termination of the thick epithelium peculiar to this cavity.]

[2] ["Immediately beyond the pylorus there is a dilatation of the gut, which must be considered as duodenum, since the common duct of the liver and pancreas enter into it."—Home, Comp. Anat. i. p. 254.]

when anything passed in a contrary direction; for when water was thrown into the intestine upwards, it could hardly be made to pass, while it flowed easily downwards. These cells begin at the duodenum before it makes its quick turn, although but faintly, and terminate near to the anus[1].

Of the Liver.—The liver was divided into two lobes, pretty nearly equal in size, united at the bases. Into this union passed the round ligament. There was no gall-bladder. The hepatic duct passed a considerable way between the coats of the duodenum, viz. about 4 inches, before it entered its cavity, which was about a foot from the pylorus.

The Pancreas.—The pancreas lay in the curvature of the duodenum, but of what shape I could not see. Its duct we could not find, and suspected that it had joined the hepatic duct.

Of the Kidneys.—The kidneys lay on each side of the spine, about half-way up the abdomen. They are of the true conglomerated kind, each lobe being perfectly distinct, and having its infundibulum. The ureters came out at the lower ends, and were about a yard long; they appeared to make a turn upwards when near the bladder, and entered that viscus in a direction contrary to that in most other animals. The urinary bladder was small for the size of the animal, not thick in its coats, of an oblong shape, and gradually terminating in the urethra. One can hardly see a reason for a bladder at all. The urethra passed along the vagina and opened in the external sulcus or vulva, on the side next to the head, near to the clitoris.

Of the Circulation.—The vena cava inferior, where it passes through the sulcus of the liver, was about 6 inches diameter. The heart appeared to be small for the size of the animal[2]. The valves of the pulmonary artery and aorta were become so tender as to melt away by a touch, which makes me suspect that they are not naturally so strong as those of the human.

All along the sides of the spine within the cavity of the thorax, also upon the ends of the ribs, and between them, there are convolutions of arteries formed in a pretty thick mass like those of the porpoise.

Of the Tongue.—The tongue is a moveable and projecting one, like most other animals[3].

Respiration.—The blowhole between its opening and the bone of the head is composed of very thick ligamentous substance, having muscular fibres in some parts of its substance, and others inserted into it, probably for the contraction and dilatation of the tube. At the opening

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[1] [Hunt. Preps. 709—712, 742.]
[2] [Ib. Preps. Nos. 925—927.]
[3] [Ib. No. 1488.]

of this tube into the mouth, there is a strong sphincter muscle which grasps the glottis. The glottis is a projecting part passing up through the fauces into this tube, dividing the fauces into two, so that the food must pass on each side of it.

The larynx is composed of cartilage and bone. The trachea is made up of annular cartilages, which are carried through its subdivisions into the lungs. The cells of the lungs are similar to those of quadrupeds.

The eyelids were a continuation of the skin and fat of the animal, which gave them a firmness, and probably they have little or no motion[1]. The orbit consisted of bone on one side, and on the other of the blubber of the animal, which terminated in a regular smooth surface, forming between them a complete orbit. The fat and cellular membrane immediately belonging to the muscles and eyeball was of a pliant moveable texture upon itself, similar to that in the human eye.

Female Parts of Generation.—The vagina [with the common uterus] is about 2½ feet long from the opening in the belly to the division into the two horns, having several interruptions in it similar to valves; the first of these is about 14 inches from the vulva; a little above that there is a semicircular valvular part; and about 2 inches above this, there is another very small one. Below the first valvular part, the vagina is about 10 inches in circumference, but becomes smaller, and is not above 3 inches. It divides into two horns, which are 18 inches long; and are nearly as wide as the last parts of the vagina, or what may be called 'common uterus.' The whole internal surface of the vagina, uterus, and horns, is thrown into longitudinal rugæ, which are pretty broad and thin. At the termination of the horns entered the Fallopian tubes, [the uterine orifices of] which were surrounded with pendulous bodies, as it were hanging loose in the horn[2].

Of the Cellular and Adipose Membrane.—About the head and breast bone the cellular membrane was extremely hard and ligamentous, and more especially in the fins and tail. On the under surface of the neck, the adipose membrane consisted of large circular cells filled with oil, and when cut into, appeared like a water melon[3].

The cartilages of the ribs, which are articulated with the sternum, are five pairs; and at their articulation they have an intermediate cartilage.

The animal in its centre was warm, although it had been dead five times twenty-four hours, and all the muscles in the centre of the body had lost

[1] [The structure of the eye is shown in Preps. Nos. 1689—1692; that of the ear, in Preps. Nos. 1584, 1585, 1586, and 1595.]

[2] [Hunt. Preps. Nos. 2788—2791.]

[3] [Ib. Preps. Nos. 1841—1843, 1847, 1848.]

their fibrous texture, appearing more like red clay; this was similar to the spermaceti whale which I formerly dissected, and which I suspect arises from the muscles being kept warm for so long a time in such large animals before they can possibly cool to the centre. [In this case] I apprehend that the putrefactive fermentation is carried on in a particular manner, viz. by a dissolution of the continuity of the parts without a separation of fixed air, or a formation of volatile alkali.

Loose Note.—The general cavity of the body of the whale is a long oval, terminating in a point, divided into two by the diaphragm. From the shape of the cavity, the small intestines pass more longitudinally than in those [animals] whose abdomen is wider and shorter. The shape of cavities in some degree gives form to their contents, as also direction. The thorax of animals that are long and small is also long and small: the same of the abdomen; and in such, the contents are either long and small, as the lungs of snakes; or their direction is according to the shape of the cavity, as the stomachs of snakes and of many fish, the livers of sharks, &c.

Of the Piked Whale [*Balænoptera rostrata*, Fabr.[1]].

The œsophagus, as in other animals, passes down from the mouth to the stomach: it begins at the fauces or posterior part of the mouth, and, although it is of itself circular, yet it is divided into two passages by the epiglottis passing through it: it is lined with a very thick soft cuticle, which is very white, and which is continued into the first cavity of the stomach. The œsophagus does not enter the upper or thick end, but a little on the posterior part of the upper end, which makes its entrance a little oblique.

The stomach is situated, as in most animals, principally on the left side, and consists of five bags. This series of bags are continued on towards the right, where the last terminates in the duodenum. The two first bags are by much the largest: the other three are smaller, although irregularly so. The first stomach is very much of the shape of a bladder, or of an egg with the small end down: it is lined everywhere with the same kind of cuticle continued, which lines the œsophagus[2]. The second stomach is very large, and is rather longer than the first: it is of the shape of the italic *S*, passes out from the upper end of the first, on its right side, nearly by as large a beginning as the body of the bag; then passes down along the right side of the first; and, at the lower end, bending a little out, to terminate in the third.

[1] [The skeleton of this whale is No. 2444, Osteol. Series.]

[2] [Hunt. Preps. Nos. 570, 571.]

Where the second stomach begins, the cuticle of the first terminates. The whole of the inside of this stomach is thrown into irregular rugæ, appearing like a large irregular honeycomb; [the cells of] which are very deep in many places, and the folds and risings are very thick and massy in many places[1]: this stomach terminates or opens, by a contracted orifice, into the third, which is round, but does not seem valvular. The third stomach is by much the smallest, and would only appear to be a passage of about 4 or 5 inches in length, between the second and the next, or what may be called the third, but which I call the fourth: it has no particular structure on the inside; it terminates on its right in the fourth, by nearly as large an opening as its beginning. The fourth is a pretty large bag, but not nearly so large as either the first or the second. It is not round, but as if flattened between the second and fifth, the third being hardly anything else than a passage. The internal surface is even, but villous[2]. It opens on its right into the fifth by a smaller opening than the one which entered it, which is round. The fifth stomach is round; its coats are thinner than the former, having an even inner surface when distended[3]; it is tinged with bile, and on the right it terminates in the duodenum: the pylorus is hardly valvular[4].

The duodenum[5] passes down on the right side, very much as in the human, but is more exposed, because the colon does not cross it as in the human, lying first on the right kidney, and bending soon to the left side behind the ascending part of the colon and root of the mesentery; it then comes out on the left side, getting on the edge of the mesentery, and becomes a loose intestine, forming the jejunum: in this course and behind the mesentery, it is exposed as in most quadrupeds, not hid as in the human. The jejunum[6] and the ileum[7] pass along the edge of the mesentery downwards to the lower part of the abdomen, and the ileum makes a turn towards the right side and upwards round the edge of the mesentery; it then passes up a little way on the right, as high as the right kidney, and there enters the colon or cæcum. The cæcum lies on the lower end of the right kidney. The colon passes obliquely up the right side, a little towards the left or the middle of the abdomen, and having got as high as the stomach, it crosses to the left; it then passes down and gets a pretty broad mesocolon. At this part it lies upon the left kidney, and, as it passes down, it gets more and more to

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[1] [Hunt. Prep. No. 576.] [2] [Ib. No. 577.] [3] [Ib. No. 578.]

[4] [This description is given almost literally in the 'Paper on Whales,' *tom. cit.* p. 359; with additions from that of the stomach of the porpoise and bottle-nose (*Hyperoodon*). See also Home, Comp. Anat. i. pp. 352–355.]

[5] [Hunt. Prep. No. 706.] [6] [Ib. No. 707.] [7] [Ib. No. 708.]

the middle line of the body; and at the lower part of the abdomen it gets behind the uterus and passes on to the anus. The rectum near the anus, for 4 or 5 inches, is much contracted, and appears to be glandular, which part is covered by a soft cuticle[1]. The anus is very small.

The inner surface of the duodenum is thrown into longitudinal rugæ or valves, which are at some distance from each other which receive lateral abutments. The inner coats of the jejunum and ileum are thrown into irregular rugæ, which will vary according as the muscular coat of the intestine acts; yet I do not believe that their form entirely depends on that circumstance; they rather run longitudinally, and are thrown into a serpentine course, when the gut is shortened by the contraction of the longitudinal muscular fibres of the gut. The colon and rectum have very flat rugæ; these seem to depend on the contraction of the gut entirely.

The length of the intestine from the stomach to the cæcum was 28½ yards; the length of cæcum was 7 inches; the length of the colon from the insertion of the ileum to the anus was 2¾ yards[2].

The mesenteric arteries anastomose by large branches.

The epiploon is mostly a thin membrane; on the right, it is rather a very thin network, but on the left it is a complete membrane, and near to the stomach on the left it is pretty thick in substance, especially between the first and other bags of the stomach. It has little or no fat, excepting what slightly covers the vessels in some parts. It is attached forwards all along to the lower end of the stomach throughout its whole course. On the right, between the stomach and transverse arch of the colon, it is attached to the root of the mesentery; then to the posterior surface of the left or first bag of the stomach, behind the posterior attachment.

The spleen is involved in the epiploon, and is very small for the size of the animal. The liver is nearly the shape of the human, but I believe not so thick at its base: the right lobe is the largest and thickest; its lower edge is not so sharp as in the human, and I think probably not so firm in texture. The falciform ligament is broad; there is a large fissure between the two lobes in which the round ligament passes. The liver from the porta to the left is very much attached to the stomach.

The pancreas is a very long flat body, having its left end attached to the right side of the first cavity of the stomach; it passes across the spine at the root of the mesentery, and, joining the hollow curve of the duodenum near the pylorus, it is continued along adhering to that

[1] [Hunt. Prep. No. 743.]

[2] [Home, Comp. Anat. i. p. 440.]

intestine: its duct enters the duct of the liver near its passing into the gut[1].

The capsulæ renales are small for the size of the animal when compared to the human, as indeed they are in most animals; they are flat and of an oval figure. The right lies on the lower or posterior part of the diaphragm, some way higher up than the kidney; the left lies lower down by the side of the aorta, between the left kidney and that artery. They are composed of two substances; the external has the direction of its fibres or parts towards the centre; the internal seems more uniform, not composed so much of fibres[2].

There is a small doubling or fold of the peritoneum running from the middle of each ovarium towards the kidneys, as in most quadrupeds.

There is but one bone to the sternum, which is at the upper part, and only attached to the upper rib. This bone sends out two processes laterally, which are attached to the upper edge of the first rib about 5 inches from the anterior end: the pointed part of this bone is the lower part. As there are neither length of sternum to oppose the ends of the ribs, nor cartilages, the ends of the ribs are of course detached; but the space is filled up with strong ligamentous, tendinous, and muscular substances intermixed, having a kind of middle tendon in place of sternum.

The two condyles of the occiput are very near each other, and a ligament, which is attached to the concave surface of the first vertebra, passes between the two condyles, like the falx between the two hemispheres of the brain.

The thorax is divided into two cavities by the mediastinum and heart, as in the quadruped. The plexuses of the intercostal arteries[3] go between two ribs near the articulations, and also communicate behind the ligamentous articulation of the rib with the vertebræ.

The pericardium adheres by a broad surface to the diaphragm. The diaphragm is almost entirely muscular, having no complete middle tendon, but is tendinous in several parts, especially where the vena cava passes through; it is remarkably thick in its muscular coat.

The brains in this class of animals vary very much in size from one another, when compared to the size of the animal. In the porpoise I believe the brain is the largest, and it is, perhaps, nearest the human [brain] in size of any. The size of the cerebellum, in proportion to the size of the cerebrum, is the smallest in the human subject of any: in the common quadruped, as the cow or horse, the disproportion in size is

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1 [Hunt. Prep. No. 823.]

2 [Ib. Nos. 1288, 1289: the structure of the kidneys is shown in Nos. 1267, 1268.]

3 [Ib. No. 2058.]

not so much as in the human; and in the whale-class it is still less, but not so little as in the birds, &c.

The brain is composed of cortical and medullary substances, which are very distinct: the cortical is in colour like the tubular substance of the sound kidney; the medullary is very white[1]. The cortical and medullary bear near the same proportion [to each other] as in the human [brain]. The two lateral ventricles are large[2], and are not continued into the olfactory nerves[3]. The medulla spinalis is small for the size of the animal, having a cineritious substance in the centre[4].

Of the Tail.—The mode in which the tail is constructed is perhaps as beautiful a part as any in the animal. It is wholly composed of three layers of tendinous fibres, covered with the common cutis and cuticle. Two of these layers are external, the other internal. The direction of the fibres of the external layers is the same with the general surface of the tail, and they make a stratum about a quarter of an inch in thickness, but varying in this respect as the tail is thicker or thinner. The internal layer is composed entirely of tendinous fibres passing directly across between the two external layers above described: the length of the fibres accords with the thickness of the tail[5]. This structure gives additional strength to the part. The structure of the tail is so firm and compact that the vessels retain their dilated state. The canal through the substance of the tail has passing [through it] a large middle vessel, surrounded with as many smaller ones as can be placed on the external surface of the larger; which are arteries and which are veins I do not know. The fins are only covered with a strong condensed adipose membrane.

Of the Eye.—A transverse section of the eye is a short ellipse, and the cornea is rather a longer one than the globe. The two sides of this ellipse are not equally curved, the superior being the most so. The long axis is in the direction of the animal, and the cornea is very flexible, soft and thick. The external shape of the sclerotic without the cornea, on a lateral view, is a flattened sphere. The cornea is a smaller circle placed upon it, as in most eyes. There are four straight muscles that come pretty far forwards on the eye, and which are not very strong; behind these there is a circular muscle which is inserted into the eye pretty near its greatest axis or middle, but rather behind it. This, although almost circular, yet is divisible into three or four portions at its insertion; it is much stronger than the former muscles. The two

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[1] [Hunt. Preps. Nos. 1335, 1336, "showing a fibrous structure."]
[2] [The 'plexus choroides' is preserved in Prep. No. 1337.]
[3] [Hunt. Preps. Nos. 1545, 1546.] [4] [Ib. Nos. 1363, 1364.]
[5] [Ib. Nos. 1844, 1845.]

oblique muscles are pretty strong and broad, especially at their insertion, which gives a difference in the obliquity of their fibres; they are inserted rather further back than the four first straight [muscles], and [are inserted] before the others[1].

Of the Breasts or Udders.—The glands intended for the secretion of milk are two, placed on the belly at its lower part, one on each side of the middle line of the belly. They are flat bodies lying between the external layers of fat and the muscles of the abdomen, are of considerable length, and in breadth only about one-fourth their length. They are thin, that they might not vary the external shape of the animal. They have a duct which runs the whole length of the gland in the middle, collecting the smaller lateral ducts, which are the trunks of still smaller ones. Some of these lateral branches enter in the direction of the stream, others in a contrary direction, especially those nearest to the last part of the great trunk. This trunk is very large, and would appear to make a reservoir for the milk. It terminates entirely in a projection, which is placed at the bottom of a sulcus or fissure which covers it, and prevents it being a projecting part beyond the general surface of the animal. The lateral parts of this sulcus are composed of parts looser in texture than the common adipose membrane, similar to the opening of the vagina, which probably admits of the elongation or projection of the nipple. The nipples are on each side the opening of the vagina[2], in a small sulcus. On the outside of this there is another smaller fissure, which I conceive is for the greater facilitating motion in all these parts[3].

[Section UNGULATA.

Order ARTIODACTYLA.

Suborder *Non-ruminantia*.

Family *SUIDÆ*.]

THE COMMON HOG [*Sus Scrofa*, Linn.[4]].

Loose Notes on a Hog.

At the entrance of the œsophagus of the common hog, the stomach

[1] [Hunt. Preps. Nos. 1679—1684, 1777.]

[2] [The female organs are displayed in the Hunt. Preps. Nos. 2792—2794.]

[3] [Hunt. Preps. Nos. 3743, 3744.]

[4] [Various specimens of the osteology and odontology of the wild boar and domestic hog are preserved in that part of the Hunterian Collection: Nos. 3254—3327.]

seems half horny or gristly, of a very good white[1]. It [the œsophagus] has a capsule nearly its whole length in the thorax.

In the intestines there is a honeycombed rugosity on the inner surface, even when pretty much stretched. The vena azygos is on the left side. The liver is neither a divided one, nor is it one lobe: on its surface it is lined or divided into partitions. There are a great many valves in the coronary vein.

Loose Notes on a Boar.

The boar is long in copulation, which is contrary to the opinion that animals without the bags [vesiculæ seminales] only are long in copulation.

The matter secreted in the vesiculæ seminales is a whitish fluid, like thin milk. The ducts of the vesiculæ seminales do not in the smallest degree communicate with the vasa deferentia. The prostate is very small. The foramen cæcum[2] is long, passing along the basis of the bladder, and opens by two distinct orifices by the openings of the vasa deferentia.

Immediately under the skin, especially on the belly, there is a little flattened body at the root of each hair, of a kind of pyramidal figure; the small end towards the hair: this end pierces the skin and seems to cover the root of the hair, while the other end is only attached to the cellular membrane which unites the skin to the muscles, &c., by which means it is pretty loose. I could not observe whether they were muscular or not. I think it very probable that they are glandular[3]. There was some essential oil in the bag of prepuce.

Mem. In the next boar, examine the thyroid gland[4].

The Common Hog[5].

The stomach is much more in the middle of the body than other animals: it is of a particular shape, and seems distinguished into two parts; for all that is on the left of the entrance of the œsophagus[6], makes a sort of pouch which is marked out by a sort of stricture: it is thinner in its coats, and not so corrugated upon its internal surface.

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1 [Hunt. Prep. No. 549.]

2 [This is the middle or azygos vesicula, which is a remnant of the 'protometra' of the embryo. See Hunt. Prep. No. 2537.]

3 [Hunt. Preps. Nos. 1960—1965.]

4 [This was done in a subsequent dissection: see p. 124.]

5 [Part, at least, of this account is taken from the dissection of a boar.]

6 [Hunt. Preps. Nos. 452, 453.]

The other portion, which is the largest and seems to be the true stomach, is placed directly in the middle of the body, is very rugous on its inner surface, and is thicker in its coats than the former, which difference is owing perhaps to a greater contraction in this part.

Where the œsophagus enters there is a doubling of the stomach on its left[1], which would seem as if designed to conduct the food towards the pylorus. And there is another doubling in the great end, at that surface where the œsophagus enters, as it were, dividing the great end from the stomach: where these two doublings are, the stomach is thicker and harder in its coats[2]. It becomes thicker towards the pylorus, which is nearly as much in the right, as the other end is in the left. Towards the pylorus, and along the great end of the stomach, it is glandular on the internal surface[3]. The pylorus is very thick, but not so smooth and projecting as in the human subject, and it has one pretty thick eminence in it that is extended a little way into the gut[4].

The duodenum passes directly downwards before the right kidney, being loose and having a thin mesentery, and making a little turn: it then crosses the spine, getting behind the ascending part of the colon, and adheres to it as it passes down. When behind that gut it passes a little upwards, as it were obliquely round it, and when got to the top of the gut it passes forwards and becomes loose. In all this course it adheres to the rectum and other parts.

The jejunum and ileum are small intestines lying convoluted in the abdomen, are pretty nearly of an equal size, and are without valvulæ conniventes: the ileum at the lower part of the belly passes backward the spine and enters the colon. The length of these guts is twenty times the length of the body of the animal.

The cæcum is pretty large, lying just above the bladder, about 4 inches in length, and an inch in diameter; and is attached through its whole length to the ileum by a thin mesentery: it lies loose in the abdomen, having its blind end turned directly forwards, and in contact with the bladder, as it were lying upon it.

Where the ileum, colon, and cæcum unite, they are attached to the spine; from thence the colon passes upwards, before the left kidney, as high as the stomach; then makes a turn towards the right, but is bent downwards, then inwards, upon itself, so as to make a ring: from thence it continues the same turns upon itself for five times, so that it makes five spiral turns like a screw, coming nearer the centre; at the end of which it is bent back upon itself, passing between the former turns as

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1 [Hunt. Prep. No. 548.]
2 [Ib. No. 550.]
3 [Ib. No. 551.]
4 [Home, Comp. Anat. i. p. 153.]

far as the first: but in this retrograde course it gets nearer the centre of the screw, so that it is entirely hid at last, then makes a quick turn upwards, adhering to itself and to the left kidney, as high as the first spiral turn: from thence it passes across and close to the spine, and before the mesentery, adhering to the lower surface of the pancreas, and, as it were, enclosing the fore-part of the root of the mesentery; it then passes down the right side before the duodenum, gets behind the bladder, and forms the rectum. These turns of the colon, with respect to situation, are just the reverse of [what exists in] any other animal that I know; and this spiral turn of colon is singular, and is situated entirely on the left of all the other intestines[1]. The colon has no longitudinal ligaments, but is still saccular; which seems to be owing to its being fixed by a great deal of its surface to itself, and other parts; which adhesion is shorter than the length of intestine, and confines it at these parts, as the longitudinal ligaments do in the human colon[2]. It is not very large in proportion to the other guts; its length is three times that of the body of the animal[3].

The mesentery is very thin, and the vessels make no anastomosis[4]. The lymphatic glands of the mesentery form a kind of chain along the root of the mesentery, much in the shape of the edge of mesentery, or in the shape of a horseshoe.

The epiploon is but small, does not cover the small intestines; but lies, as it were, folded up along the stomach: it is not very fat: it adheres to the whole of the great curve of the stomach, to the pancreas near its whole length on the left, and to the transverse turn of the colon on the posterior edge.

The liver is divided into three principal lobes: the middle one is by

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[1] [Hunt. Prep. No. 734.] [2] [Home, Comp. Anat. pp. 460—462.]

[3] [Mr. Clift has appended the following note, from a dissection:—

"*Of the Common Hog*, at Sir Joseph Banks's, killed at Spring Grove, October 18, 1810.

	ft.	in.
From the nose to the anus in a straight line	4	0
The duodenum, jejunum, and ileum when drawn out of their peritoneal covering	62	0
The cæcum in length	0	9
The colon	14	0
The rectum	1	2

The duodenum, jejunum, and ileum are nearly equal in size throughout, and measured an inch and a half in its circumference. The cæcum is 1 foot 1 inch in circumference. The colon at its largest part is of the same size as the cæcum. It becomes gradually less towards the rectum, where it is scarcely an inch in diameter. The rectum is very distinct from the colon, being more muscular and opaque in its appearance.—W. C."]

[4] [Hunt. Prep. No. 861.]

much the largest, and is divided a pretty way on its thin edge by a fissure: the two lateral ones are of equal size, and are equally on both sides, so that the left lobe passes between the stomach, spleen, and ribs; and the right passes between the stomach, pylorus, and ribs on the right side. The right has a little lobe attached to its inner surface, just at the entrance of the hole behind the vessels of the liver. The ligamentum latum is but very narrow, there being only a little doubling of the peritoneum, and the umbilical vein is not enclosed in it. The gall-bladder adheres to the middle lobe on the right side of its fissure, and pretty near it, by nearly one-half of its surface; it is honeycombed on the inside. The ducts are very superficial, not deep, among the vessels going to the liver: the cystic duct is pretty straight and joins the right hepatic duct some way before the other; but this common duct joins the left, and forms the ductus communis, which enters the duodenum about half an inch from the pylorus.

We observed some lymphatics coming off the gall-bladder down by the side of the ducts, and entering a gland that lay on the right side of these vessels; these were filled with a fluid of the same colour that the ducts of the gall-bladder were. I cut them and tasted it, and it was bitter; but what made it plain that it was the bile, was their filling upon squeezing the gall-bladder, which I did several times, and tasted this, which was the same as before. I forgot to examine the bile after it had passed the gland.

The pancreas is made up of four portions: the largest is placed much as in the human, only it is not attached so closely to the spleen, and it is loose at the small end, which lies before the left kidney: the second portion lies in the mesentery of the duodenum, as in other animals: the third portion lies between the union of the two former and the pylorus, and is pretty close to the duodenum: the fourth portion, which is the second in size, comes from behind the root of the mesentery and descending part of the colon towards the right, and joins the others. The ducts of the first, third, and fourth, all unite where these processes unite and form one duct, which passes through the second portion and enters the duodenum about the middle way between the pylorus and its turn to cross the spine.

The spleen is very long and small, of a triangular form, lying between the stomach and the left lobe of the liver: its attachments are very large, by means of its vessels and epiploon, which are to the stomach, pancreas, and transverse turn of the colon: what answers to the lower end was turned forwards and lay before the stomach, between it and the liver.

The kidneys are conglobate like a dog's; they are of an equal height in position. The suprarenal capsules are little oblong bodies lying between the spine and upper end of kidney.

All the abdominal viscera are much more adhering to the parietes of the abdomen than they generally are in any other animal, as far as I know, excepting the human.

The bladder is prominent and loose, only connected by its neck, and by a sort of mesentery, to the lower part of the abdominal muscles and pubis: it is but thin in its coats. The membranous part of the urethra is long and muscular externally; it is very vascular upon the inside and full of little points.

There are two prostates[1], which are not in contact with the bladder, but seem to be reflected and in contact with the membranous part of the urethra. There is a foramen cæcum in the urethra just at the termination of the membranous part of the urethra, which is perhaps for the entrance of the ducts of two glandular bodies, oblong in figure, lying in contact with the membranous part of the urethra near the bulb.

The penis is long and enclosed in a sheath, which is covered by the common integument, like that of a bull, ram, &c., and lies in a serpentine course when not erect: it has a pair of muscles arising from the hollow of the sacrum, passing by the side of the rectum, round the bulb of the urethra, and then along the urethra its whole length, like what we find in many other animals. The spongy part of the urethra seems to be nothing more than two veins running its whole length[2].

The testicles lie pretty near the anus, and have no scrotum; that is, there is not a bag as in some other animals: they have the corpora pyramidalia, but they are situated out of the abdomen. The tunica vaginalis communicates with the abdomen. The vasa deferentia are united together behind the bladder by a thin membrane, which becomes pretty thick at its edge. They seem to have no vesiculæ seminales[3].

The thorax is a good deal like that in other quadrupeds, only the heart is broader, flatter, and sharper, more of the shape of the human heart, but flatter still.

The pericardium differs from that in other animals by adhering by a pretty broad surface to the sternum, so that there is no mediastinum excepting at the upper part, at the thymus gland.

The lungs are as in other quadrupeds. Their inferior lobes are attached to the posterior mediastinum by a thin membrane.

The œsophagus, after having got clear of the vessels of the heart,

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[1] [These are the homologues of Cowper's glands: see Hunt. Preps. Nos. 2537, 2540.]

[2] [Ib. Nos. 2541—2543.]

[3] [See, however, the notes on a previous dissection of a boar, p. 119; and Hunt. Prep. No. 2540. The female organs are shown in Nos. 3529—3537.]

passes to the diaphragm between the two mediastina, but adheres to the left, so that the posterior mediastinum is double.

The vena azygos passes up upon the left of the aorta, then crosses the aorta below its curve, then wheels round the vessels of the lungs, upon their upper side passes round the left auricle, and is pretty closely attached to it like the left vein [vena cava superior] of a bird: it then enters the right auricle.

The thymus is very large, reaching as high as the thyroid cartilage. The thyroid gland is of a triangular shape, placed before the upper part of the trachea. One side is attached to the trachea, however, but loosely. They have a digastric muscle, but it does not adhere to the larynx. The epiglottis was above the palatum molle, which is very broad, but has no uvula. The epiglottis has a muscle which arises from the os hyoides, and is inserted into its upper convex surface, which raises it[1].

The parotid gland is large; comes forward along the lower jaw; and its duct, which comes out near the anterior end, passes over the lower jaw with the genial artery, and enters the buccinator muscle. There are two puncta lacrymalia, which pass into the bone separately, on the outside of the brim of the orbit, as in the deer. The lacrymal gland lies at the inner canthus, and has one duct, which enters the cavity of the tunica conjunctiva at the cartilage[2].

Of land-animals the hog-tribe appears to be some removes from the ruminants; at least they have some things in common with them: exclusive of these things, they are, in all others, similar to no other animal that I know of.

The first of these, and [one of the] external parts, are the cloven feet.

The stomach, although not a ruminant one, nor having the three preceding bags, yet has a part covered by a cuticle, which is not a digestive part.

The colon, although not coiled up as in the ruminants, and afterwards continued along the mesentery, yet it is coiled up upon itself.

The parts of generation in both male and female are a good deal like [those of the ruminants]; but most so in the male; there being no cotyledons in the female.

They have a great number of young, which in general the ruminants have not[3].

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[1] [Hunt. Preps. Nos. 1491—1493.]

[2] [Ib. (for structure of the eye) Nos. 1703, 1711 (for eyelids and lacrymal apparatus), No. 1781.]

[3] [The peccari has commonly but two at a birth: see p. 127.]

The Peccari, or Tajaçu of Buffon, or Hog from the Coast of Guiana [*Dicotyles torquatus*, Cuv.[1]].

This peccari, or hog, from Guiana, was nearly of the size of the small black hog, but rather genteeler made. The colour was a dark grey, owing to the bristles being in part white and in part black, as in the porcupine's quills. These bristles were stronger than common hog's bristles, were flattened, and not so regular in shape. Over the shoulder, which came down pretty low, was a lighter-coloured part, placed something like the black stroke in an ass.

The legs were smaller than in the common hog, and the feet were more like the deer's. It could run pretty fast, and walked as if upon the watch. It has but one back hoof or toe to the hind-foot, and that is on the inside: the outer [back hoof] is wanting. The ears were short in comparison with those in the common hog. The tail was so short as not to be visible when alive.

I could observe but four nipples: two between the legs, the other two on the lower part of the belly; but most probably it has more.

It made a noise like a goat, and had a way of making its teeth crack together when teased, and was very apt to bite when touched. Its food was either meat or vegetables: it was very fond of roots and fruits.

Its fat was situated like a dog's, not like a hog's; so that the skin was moveable upon the body; so much so, that you could almost turn the skin half round the body.

The stomach is of a very particular shape, for which it would be difficult for us to assign a use. It may be divided into two parts, one a reservoir, and the other digestive. Its inner surface, therefore, is of two kinds; one, viz. the reservoir, covered with a thin, dark-coloured cuticle, the other villous, like the internal surface of the human stomach. The left end, or what is commonly called the great end, is the cuticular end, and would appear to have nearly the same use as the first bag in the ruminant; and the last end of the stomach is thick and glandular in its substance, and takes on something of the appearance of the last or digesting bag of a ruminant's stomach[2].

The duodenum passes down the right side, almost as low as the pelvis: it is a little convoluted, having a mesentery, and then it passes towards the left between the spine and other intestines, viz. the basis of the spine, and turn of colon, and directs its course upwards among those

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[1] [The skull and other bones of the female here described are Nos. 3384—3403; the skull of the male is No. 3381, Osteol. Series.]

[2] [Hunt. Preps. Nos. 552, 553. Home, Comp. Anat. p. 154.]

intestines hidden by them: and, when got as high as the transverse arch of the colon, it then passes to the right, contiguous to that turn of the colon, and then appears on the right side, becoming a loose intestine. Through these three last courses it is entirely hid by the other intestines, as in the hog. The jejunum and ileum lie principally on the right and upper side, as in the hog, are loose intestines, having a mesentery, but no valvulæ conniventes: the ileum passes into the colon, on the right iliac bone.

The cæcum is about 4 inches long, terminating pretty fast in a point, which is turned towards the right side of the abdomen and upwards, as in the hog. The colon lies principally on the left and lower side, as in the hog, passes to the left across the mouth of the pelvis, and is turned round to the beginning of the turns; it continues three times, making a close spiral, and then is bent upon itself, and is just turned back as many times; so that it makes a double screw for three turns[1]: this is similar to the hog. After completing these turns, it gets to the right side and passes up along the root of the mesentery, between it and the mesoduodenum; then makes a turn across the spine obliquely downwards, closely connected, as it passes, to the root of the mesentery, to the stomach and pancreas: as it passes down the left side, it is tied down about its middle by the turns of the colon, similar to the common hog. The mesenteric artery and vein are as in the hog.

The fæces are in some degree knotted; but not so much as in a goat, deer, &c. There is a large pancreas going across the spine to the spleen, and a small one passing down with the duodenum.

The liver has four lobes, two on the right side, small; one on the left is likewise small, but the other is large, which lies pretty nearly in the middle, and has a fissure for the umbilical vein. There is no gall-bladder. One biliary duct, pretty large, passes into the duodenum, about half an inch from the pylorus.

The spleen has much the shape of a cow's; one end is turned to the back, the other forwards, and is attached to the stomach by the epiploon. The epiploon is attached much as in a cow.

Female Parts of Generation.—The vagina is very long, about 10 inches: the common passage is as common: the clitoris is a small body terminating in a point. The vagina runs very serpentine at the upper end, making short turns, so that it is impossible to pass any straight thing into this part of it. The two horns of the uterus are very large.

This animal was in heat when killed, but had not the male, yet I found in each ovarium a body that made that end of it next to the

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[1] [Home, Comp. Anat. i. p. 462.]

morsus diaboli a little prominent; and there was upon each of these prominences a small point that seemed to be hollow, or orifices that led into these bodies. This shows that the female operation is going on without the male, and that the parts are all ready to receive the semen; and it is most likely that this growth or change of parts is the cause of the desire for the male. It also shows that this animal has but two young at each time.

I found a swelling or fullness of blood-vessels in each horn. Could this be owing to the female influence having got down so far to be there impregnated by the male?

Of the Male Parts[1].—The penis lies along the belly under the common skin without making any visible ridge, as in the bull, ram, and common boar. The opening of the prepuce is near to the navel, becoming larger near to the opening, as in the boar, but not so large.

The testicles appear behind, not in a pendulous bag as in the horse, &c., but lie in the perineum, making two tumours, as in the boar and camel. The testicles have a strong tunica vaginalis. The spermatic cord has no tunica vaginalis, which exists in most brutes.

The bladder is attached to the sides of the pelvis by a doubling of the peritoneum, as the human uterus is; and the ureters and vasa deferentia pass into this fold. The vasa deferentia are united before they join the bladder by a thin membrane, the edge of which is thick like a hem: they enter the urethra at the 'caput gallinaginis' by distinct orifices.

Behind the bladder, in exactly the place of what are called vesiculæ seminales in man, are two fat glandular bodies, irregular on their external surface: their duct ramifies through them, and then passes towards the urethra between the bladder and a small glandular part that is at the termination of the urethra on the posterior or rather upper surface of the urethra in them, and is exactly in the place of that part of the prostate in the human, and [the duct] then enters the urethra close by the openings of the vasa deferentia, but does not communicate with them.

That part of the urethra between the bladder and the penis is long as in most animals, and is muscular in its coats. On the sides of this part lie two oblong glands whose ducts open into one canal, which canal opens near the bulb of the urethra. The mucus secreted from these last described glands, is a thick slimy yellowish transparent substance.

Whether we are to call these prostate or Cowper's glands is hard to say; or whether what is in the place of vesiculæ seminales is the

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[1] [Hunt. Preps. Nos. 2532—2535.]

prostate, or whether the small glandular substance at the beginning of the urethra as described above is the true prostate, is not easy to determine.

The penis is long and small, terminating in a point; when not erect, it is bent upon itself near to the bulb: this is done by two small muscles which arise from the sides of the hollow of the sacrum, cross the rectum obliquely, get to the bulb and approach one another, and are inserted into the penis at the bend next to the glans.

[Suborder *Ruminantia*.]

Of Ruminants.

There is perhaps no class of animals more marked than the Ruminants, and perhaps few classes more extensive. Everything that relates to nourishment has a uniformity that runs through the whole. The generative parts in all have a great similarity.

A great and constant characteristic of this class of animals, is their having no fore-teeth in the upper jaw[1]; three reservoirs to, or preceding, the true stomach, which makes four in the whole; a long straight cæcum; the beginning of the colon making spiral turns upon itself, with the last turn following the track of the small intestines; and cotyledons to the uterus[2].

They are of a great variety of genera, each of which are divisible into their species, and those into endless varieties; especially those species that have been civilized, or what are called domesticated; most of which have been so more or less, being, to man, one of the most useful classes of animals we are acquainted with; whether we view them in regard to food, covering, or as affording light when the sun fails us. Their size also, stamps a value on them and all their productions. In the light of food, their utility is very extensive, arising out of the arrangements of civil society; first, we feed on those offspring which would become too numerous if preserved, and then we take the advantage of the natural food of such offspring, viz. the milk; making that into various forms of nutriment, adapted for preservation, which renders its use very extensive.

The cow is of the first importance in the height of civilization; the sheep, the goat, &c. are subservient to the same purposes in less civilized nations.

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[1] [The Camelidæ retain a pair of canine-shaped incisors in the premaxillary bones.]

[2] [The same annectent family resembles the Suidæ in the absence of cotyledons.]

When we consider the wool of the sheep, as also the same in some goats, we cannot the less admire their utility; whilst, like the cow, their superabundant offspring become our food.

The deer form a genus which, perhaps, admits of more variety than any, especially in size, viz. from the elk to the little deer of Africa; certain kinds, the rein-deer, *e. g.*, in some countries, are not less useful, both for their labour, and as food, than are the cow or sheep.

When we consider this tribe of animals at large, that, when rendered unfit for propagation, as the males and superfluous females often are, this both increases their size, and makes them more delicate food; and that their use does not stop here, but that when, by age, they are no longer subservient for labour, yet their skins become one of the most useful articles in our common economy, and even our luxuries, [the value of the ruminants is more fully manifested].

Their external figure varies one from another, but through the whole there is a similarity. In some parts these differences are greater than in others. The head is the part that bears the greatest resemblance through the whole class.

As far as I know they are quadrupeds, and all are cloven-footed, or have a tendency to cloven feet, as in the camel; in general they have two anterior large hoofs, and two small posterior ones.

Most of them have horns, both male and female, although not all; and in some, the males only have horns, as in some deer. The colour varies very much; but, whatever it is, the belly is always white.

The head is, in general, somewhat pyramidal or conical, at the upper part largest, having four sides and as many angles, becoming smaller and rounder downwards towards the mouth, and at the mouth swelling laterally. The axis of the head is nearly at right angles with the neck. The neck is in general long and commonly round, although not in all; and is hollow or curved on the upper part from the shoulder to the head. They are, in general, thin from side to side forward, and swelling out towards the belly, becoming there very round and big: towards the hips and thighs they become rather thinner.

The legs in general are slender for the size of the body, especially the metatarsal and metacarpal bones; and the hind leg generally stands more under the belly than in most other animals.

The horns, of those that have them, generally arise from the upper and fore-part of the head; but, in the elk, they arise just above the eyes, the head rising considerably higher; and they vary from one another considerably. They may be divided, first, into two classes, 'horns' and 'bones' [or antlers].

The ears are pretty large, erect, becoming very broad, forming hollow conical tube, whose mouth or base is cut obliquely; and in some they are flattened, making an oval; in others they do not spread or become wide and flat, but only gradually, becoming a section of a large end of the point.

The tail varies very much in the different kinds both in size and length.

The external parts of generation, both male and female, are very similar in all the different species.

The tuft of hair which hangs down from the orifice of the prepuce is pretty common in this class, and seems intended as a director for the urine downwards: those that have it not, have the orifice projecting, and pointing downwards.

There are eight fore-teeth in the lower jaw, and six grinders on each side of each jaw[1].

The stomach seems pretty similar in all the classes; consisting, first, of a large infusing bag, preceding rumination; the second follows rumination, is honeycombed, and farther prepares the food for digestion; the third is formed with a number of broad valves running parallel to each other, something similar to the valvulæ conniventes in the human, and still farther prepares the food for digestion; the fourth is the true digesting stomach, having some valves running in a spiral direction. The three first bags of the stomach of these animals are covered by a pretty thick cuticle, which is much more easily separated than the common cuticle of the skin; a smaller degree of putrefaction or of scalding separates it.

The spiral turns of the colon make distinguishing marks between some of the different genera.

The dung is of two kinds; one consists of compound, hard, knotted bodies, of an oval figure, which seem to be formed in that part of the colon which runs along the edge of the mesentery; such as is produced from sheep, goats, &c. The other kind is soft, which seems to be owing to the colon taking a shorter course across the mesentery, viz. near its root; this kind is most remarkable in the cow. But there is to be found all the intermediate states of consistence, of which the dung of the nylghau, also that of the elk, are instances: the elk's dung is a good deal similar to that of a horse. The difference in the cotyledons is another distinguishing mark of this species.

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[1] [The dental formula of the true ruminants is:—

$$i\,\frac{0-0}{3-3},\ c\,\frac{1-1 \text{ or } 0-0}{1-1},\ p\,\frac{3-3}{3-3},\ m\,\frac{3-3}{3-3} = 32 \text{ or } 34:$$

the aberrant *Camelidæ* offer some modifications, by which they approach the more general artiodaclyte type. See my 'Odontography,' pp. 527–543.]

The erection of the penis does not make an increase of size and length, as in many other animals.

They hardly ever sweat, when hard worked, or hard run; but have a vast increase of secretion from the mouth and lungs. This observation I made in Portugal[1], where they work their oxen very hard, and in a warm climate.

Their fat, in general, is very hard, or what is called 'tallow[2].'

The other parts of this class are, either in common with those of some other animals, as, *e. g.*, the cloven foot is with that in the hog-kind; or they are not constant in the class, as, *e. g.*, the horns, number of teats, &c.

They all live upon vegetables.

The different cavities belonging to the stomach of young ruminating animals, do not bear the same proportion in size that they do in the adult, or that they do when they feed themselves, or leave off sucking. A calf, for instance, has no occasion for the first cavity or reservoir; nor probably much occasion for either the second or third cavities; but it has for the fourth; therefore this cavity is of full size [in proportion to the body]; but I imagine that the first three cavities soon begin to increase, and much faster than the fourth, so as to bear to it a greater proportionate size.

Many of this class, as the bull, stag, &c., have a tuft of long hair hanging from the orifice of the prepuce, which serves as a director for the urine downwards: the elk has not this hair, but in him the orifice is downwards.

The corpus spongiosum runs along the under surface of the penis; it begins at the bladder, surrounding the membranous part, which is very long, then swells into the bulb, which is pretty thick, and from thence it passes forwards, becoming smaller and smaller, to the anterior end, where it forms distinct veins, ramifying upon the body of the penis and forming a kind of glans. That part which surrounds the membranous part of the urethra is made up of a plexus of veins running parallel to one another, and in the direction of the urethra, communicating freely with one another. The bulbous part has these veins running in a greater variety of directions to make up a thicker body; but, as we trace this body forwards, we find it becoming more distinct, and at last [resolved] visibly into two or three longitudinal veins, running parallel to one another. This structure admits of a freer passage for the

[1] [In 1761-1763: see vol. i. pp. 327, 341.]

[2] ["I found the elk good, solid, wholesome meat, very like beef, but the fat is disagreeable to eat: it is white and hard, getting cold as it were immediately in the mouth."—'Solitary Rambles,' Palliser, p. 126 (1853).]

blood from the bulb forwards, than if they had run in various directions.

The penis of this class is long, small, and pointed at the end, which is often a little twisted. It lies along the belly its whole length, close to the abdominal muscles, making a ridge, or rising there, similar to a cutaneous vein in a man's arm; and adhering to these muscles for more than one half of its posterior end; it becomes loose, or not attached, at its anterior end. The attached part is only half covered with true skin, or the skin here is to be considered as only laid over it. The unattached part is what may be called 'glans,' or is similar to that body, in not being covered with common skin, and having a prepuce, reflected covering, or hood.

This sheath, or prepuce, is covered on the lower side by the common skin of the abdomen, in the same manner as the other parts of the penis are. At the anterior end of this sheath is a perforation, which is continued through the common integuments a little way behind the navel; at which orifice in some, there is a tuft of hair, as in the bull and deer; in others, a projecting ring, as in the ram. As this sheath is covered by the common integuments, stretched over it in common with the other parts, it has no retracting motion over the loose part of the penis; therefore in an erection the penis passes forwards through the orifice, and inverts the true prepuce; by which means it covers a portion of the penis which lies in the cellular membrane behind the loose end; which makes the loose projecting part seem much longer than what it is in the relaxed state.

When the animal makes water, it makes it into this prepuce, which has a small motion in it, and squeezes it out at this orifice; but with no force: so that the hair, in those which have it, conducts it down; and the projecting ring, the mouth of which is directed down, also guides the water down.

Near its posterior end, the penis makes a turn upon itself, when in the relaxed state, which allows it to lie in a shorter space than it otherwise could do. The penis is made up of two distinct bodies, viz. of corpus cavernosum and spongiosum; although these names do not convey a just idea of the true structure. The corpus cavernosum has a very strong thick tendinous coat, and the fibres which divide the cavities into cells are also pretty strong and tendinous. The communication from cell to cell is not very free.

The muscles of these parts are very strong, as they have a great way to throw both the semen and the column of blood which [in the cavernous and spongy tissues] follows that fluid. The erectores are short and thick, a great part of them arising from the ischium below, passing over the crus, and inserted into the pubis; so that when they act, they compress this body, by bringing themselves into a straight line.

The membranous part is covered by a strong muscular coat which has a kind of seam or middle line, both along the upper and lower surfaces, so that the fibres are semicircular. The acceleratores are very strong, thick muscles, arising from the crura on both sides, and meeting in a middle raphé.

Besides these muscles, which are in general common to all animals of this order, there are two long slender muscles that take their origin from the [anterior commissure of the sphincter ani].

[Family *CAMELIDÆ*.]

Of the Camel [*Camelus dromedarius*, L.].

The hump on the back, in a lean camel[1], is a pretty loose strong cellular membrane, which I suppose is filled with fat: it has, perhaps, somewhat the appearance of being gristly.

There is a membrana nictitans. The inner surface of the eyelids, at the inner canthus, is filled with the orifice of the ducts of glands; but I could not find the lacrymal gland, nor the puncta lacrymalia. There is the light colour [tapetum] at the bottom of the eye.

The cartilages of the first two ribs articulate with the sternum. There is an elastic fascia all along the belly. The pelvis is wide.

The heart terminates in a point at the apex, like an ox's. The lungs have only one lobe on each side, and the lobulus medius, which is [an appendage to the right lung].

The duodenum passes down the right, is long and convoluted, then passes up, in which course it is attached to [the mesentery ?], then crosses the body to the left behind the rectum[2].

The clitoris is external, similar to that of the rat; it is like a kind of nipple; it runs serpentine; and, where it passes along the prepuce, it is attached to it, and is only like a ridge. It has a pretty large prepuce. The plexus retiformis consists of two thick bodies, which become very large when blown into. There is a common uterus, but no regular os tincæ; the uterus begins by a broad semilunar valve; a succession of which valves are placed in the common uterus in opposite sides of the cavity, but not in opposition to one another so as to be in pairs.

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[1] [Hunt. Prep. No. 1840. Hunter dissected and derived preparations from both the one-humped camel or dromedary, and the two-humped or Bactrian camel.]

[2] [Home, Comp. Anat. i. p. 464.]

This is somewhat like the bottom of the vagina in the cow, sheep, &c. There are two horns to the uterus, which are short; the inner surface is pretty smooth; not protuberated, as in the cow[1]. There is a large capsula ovarii, which has a kind of double pouch; one very long[2], the other not so deep.

[PYGMY MUSK-DEER, *Moschus* (*Tragulus*) *Kanchil*? [3]]

A small ruminating animal, from the Prince of Wales's Island, called a Deer: given me by the Duke of Portland.

It is about the size of a common cat, of a reddish-brown colour on the back and sides, but white on the under surface and inside of the legs[4]. It has pretty short and rather broad ears; large eyes; no gland at the inner canthus[5]; tail short; it is cloven-footed, with two back-hoofs: has four nipples. The termination of the vagina is hardly peaked.

It appears to have but two cavities to the stomach: however, the second, although not so distinctly a bag as in many others of this order of animals, yet we can see to be in a slight degree honey-combed: and, if we were to take our account of such stomachs from this, we should not from it alone be led to suppose these to be two cavities. It has no third cavity, viz. the 'book' [lamellated bag or 'psalterium']; but the true stomach, which is the fourth in most, is long. From this account this animal has, in reality, only two distinct cavities to its stomach[6].

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[1] [There are no uterine or maternal cotyledons, no fœtal cotyledons being developed on the chorion.]

[2] [The 'very long' pouch would seem to apply to the space included between two of the longitudinal folds of the aperture of the Fallopian tube, which is expanded to form the pouch. See Hunt. Preps. Nos. 2766, 2767.]

[3] [The skeleton of this animal is No. 3499, Osteol. Series.]

[4] ["*Moschus Kanchil*, Raffles, dorso saturate rufo-fusco,—ventre artuumque latere interno albis."—Fischer, Synops. Mamm. 8vo. 1829, p. 440. The animal may have been brought from Java to Pulo Penang, and thence to England.]

[5] [Hunt. Prep. No. 1786.]

[6] [This modification of the ruminant stomach I found, by dissection of species of *Tragulus*, Brisson, at the Zoological Gardens, in 1837, to be characteristic of that genus of pygmy deer (Quarterly Journal of the Geological Society, 1848): the description of the Hunterian preparation of the ruminant stomach, No. 554, in which the absence of the longitudinal lamellæ, characteristic of the third cavity, is noted, was published in the first volume of my 'Physiological Catalogue,' 4to. 1833; and the structure is there referred to a small ruminant, "probably of the genus *Moschus*, Linn.," p. 165. Sir Everard Home, as usual, merely copies the name of the animal as given in the Hunterian MS., without any attempt to determine the

The duodenum passes down the right, and then makes a pretty quick bend across the spine and up to the left, attached in this course to the turns of the colon. The jejunum and ileum are small and of considerable length. The cæcum is pretty long, and is the largest intestine; it passes up the abdomen on the right side. The colon makes a turn on and behind itself towards the left, behind the root of the mesentery, and passes down behind that membrane between the cæcum and small intestines, and makes two complete turns within itself; but the last passes down behind the others some way[1]. It is then reflected back, making as many turns between the others; sweeps round the mesentery just within the small intestines, joins the duodenum, going back the same course towards the right, and becoming here larger; it then makes a sweep to the left, before the root of the mesentery, and passing down, commences the rectum, which has a cuticle a little way up.

The liver has only one lobe; however, the lobulus Spigelii is pretty distinct. There is a gall-bladder of a globular figure, which is attached by a pretty broad surface to the under flat surface of the liver. The hepatic duct is short, and enters the cystic near the bladder; there is a long small common duct passing to the duodenum. The pancreas shows nothing uncommon, the kidneys are conglobate.

Female Parts of Generation[2].—I have observed that it has hardly any 'peak' at the beginning of the vagina. The vagina is wide, and at the upper part has hardly any of that valvular structure we find in the ruminants. The uterus soon divides into the two horns, which are pretty large and not long; having none of the buttons for the cotyledons[3]. At the termination of the horns there is a fringe, in which the Fallopian tube opens or begins. The Fallopian tube passes on the capsula of the ovarii, in such a quick serpentine course, as to make the edge appear scolloped: the capsula is large.

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species; and writes:—"In the small deer from Prince of Wales's Island in the East Indies, which differs from the rest of its tribe in having no third cavity to the stomach, the cæcum is larger, longer, and the rectum of unusual size."—Comp. Anat. vol. i. p. 466. This modification of the ruminant stomach in the *Moschus* (*Tragulus*) *Javanicus* is described and figured by Prof. Rapp in Wiegmann's 'Archiv für Naturgeschichte,' 1843, p. 43. The true musk-deer (*Moschus moschiferus*, Linn.) has the psalterium normally developed, and this adds to the utility of the distinct generic name for the smaller chevrotains: they may be said to retain, with their diminutive size, an embryonal simplicity of the ruminant digestive organ.]

[1] [Hunt. Prep. No. 735.] [2] [Hunt. Prep. No. 2754.]

[3] [This would imply that the chorion had a uniform villosity, as in the camel-tribe, and be another argument for the generic distinction of *Tragulus*.]

[Family *CERVIDÆ.*]

Of the Deer-tribe.

The parts which are commonly called horns in this animal are in their structure or constituent parts not in the least what is properly called 'horn;' they consist of a true bone, having all the properties of bone, and only partaking of the horn-nature in their use [1].

Deer shed their antlers much about the same time they shed their hair. One sees a good reason for their shedding their hair, more especially in climates where the seasons are very different; but we do not see so good a reason for their shedding their antlers. Indeed, as they do shed them, they become stationary [as to growth] as long as the shedding-hair does; and, therefore, they are obliged to be shed, year after year, till the deer becomes 'full-headed.' But it does not seem necessary after that period; for the horn does not wear out in one year. However, it may be observed, that if a horn breaks, or is worn out, it cannot, from the mode of growth, be replaced but by shedding.

I believe that the exfoliation of horns is owing to the first mode of absorption, viz. interstitial absorption, which renders the attached part soft, so as to break easily off.

When the antler is shed, we find a ridge rises round its root which is the stock or living parts on which the antler forms, becoming vascular and spongy. At this time the head of the deer becomes tender, and he is loath to use his antlers, allowing those to butt him which he butted before. The process of shedding (I have observed) is first, the knob on which the antler is formed becomes soft, and so much so, that the antler breaks off, and the surface bleeds. This is similar to the first process or stage of exfoliation, but it has not the second, or suppuration.

One might suppose, when the [base of the antler] became soft, that from their weight and size, they broke off before the second had time to take place; but the same thing happens when the antler has been cut off close to the head.

When this period comes on, the deer seem to be uneasy, probably the part itches, and they are rubbing the horns against something, and at last knock them off. This is done although the part is tender, which gives me the idea that the part is very itchy.

Soon after the antler is broken off, the ridge which began to rise all round grows thicker, and is, as it were, continued over the surface from

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[1] [On account of this distinction the horns of deer are called 'antlers,' and that technical term will be substituted in the text.]

which the bone came off, till the whole bone is a uniform knob of a dark brown colour.

The first formation of this substance is a soft membranous pulp shooting out from this knob, which is extremely vascular, and is covered by a tendinous or periosteal membrane leading from the periosteum of the head, by a cutis and cuticle also leading from those of the head, and by hair of a particular kind. This membranous pulp becomes more solid and cartilaginous, and a bony construction is set up, first from the knob which shoots a bony matter into this pulp; or, that part of the pulp which is first formed, or next to the knob, becomes first bony. As the body of the antler advances, this pulpy substance is continued to be formed upon it, and then it undergoes the same changes as above described[1].

The most singular circumstance about these parts is, their being changed every year.

Loose Notes.

The deer casts his antlers with his hair. Why he should do this I do not know; or rather, upon what principle. If it had been hair or horn, one could see the connexion. One reason may be assigned: the antlers become dead as the hair does.

Why do all the deer-tribe cast their antlers? They do not appear to break off so easily or commonly as to require a yearly renewal. Is it because the buck might be mischievous to the fawn, and he, therefore, is rendered inoffensive at that season?

When bucks' antlers are growing they are very careful how they run their heads against anything, nor do they then fight with their antlers or heads, but strike with their fore-feet.

We may observe that, in general, the parts of animals which are essential to life or to the animal economy, are constant, and that the female has them as well as the male. But we find that the males have often parts for offence or defence which are not to be found in the female. The great marks of distinction between the two sexes have, generally, an immediate relation to this, viz. offence and defence; where there is not this relation, in parts in which the male differs from the female, it would seem to be beauty alone that nature considered; as in the male such parts are always more beautiful.

The cock has his spurs, which are the immediate parts for offence. He has strength of limb for the use of them; and he has, besides, additional strength of other parts, which are common to him and the female.

[1] [The several stages and circumstances in the development of the antler in the fallow-deer (*Cervus Dama*), are exemplified in the Hunt. Preps. Nos. 163—187 & 1408.]

He has his comb in common with the female; but, as its difference from that of the female renders it more beautiful, it is reasonable to suppose that beauty is the principle of the distinction.

The bull has his horns of offence: the female has them also. His, however, are stronger, and every way better adapted for greater execution. He has therefore his head and neck of strength equal to the shape of his horns: his very appearance carries along with it the idea of irresistibility.

There are animals whose parts of offence and defence serve another and more useful purpose, viz. the procuring their food. In that case, as I said before, such use being one of the essentials of life, therefore the females have them in common with the male, and in proportion to the strength and size of the body. The talons of a lion serve both for offence and defence and killing their prey: therefore the last use obliges the female to have them also.

The horse has his tusk for laying hold of others, which the mare has not. It may be remarked, that although many females have not the parts of offence, yet they fight exactly in the same manner as the males do. For example, a hen fights in the same manner as the cock, and even the bull without horns affects to use them.

Males most commonly, at certain times of the year, are pretty nearly upon a footing with the females, as to offence and defence; they are perfectly harmless with one another. This principle is most remarkable in the wild animals, the females of which have their particular seasons for receiving the male. Most probably we should find the same hold as strictly true with the domesticated animals, if they were left as much to a state of nature: but, in them, the female is better fed; the alterations of the seasons are not so distinct; they are more blended into one another: therefore, the particular inclinations are oftener excited and gratified; the inclinations and vigour of the males are kept more afloat. This is still more remarkable in those males which have a plurality of females, as it is seldom but that there may be one or more females keeping up the disposition in the male; this is most remarkable in the common barn-fowl.

After premising so much, it will not appear far-fetched to say that the antlers of the deer-kind are principally for the offence and defence of the animal in the time of the rutting season,—a time, and the only one, that excites enmity in the males towards one another. They are completely formed by this season, and they soon begin to fall after it; although they do not fall so very soon, yet the preparation tending to this is soon. They are not complete till September, and they are fallen by March.

The antlers of a buck are not always fellows; sometimes one has one or more branches more than the other: when that is the case, the branches, or some one branch, of the antler that has fewest, are, or is, larger than the corresponding branches or branch of the other antler; so that the quantity of bone is pretty equal on both sides.

Mr. Cartwright, Capt. Cartwright's brother, went to see the rein-deer at Hackney, from either Norway, Denmark, or Sweden; and he said that they were exactly similar to those on the coast of Labrador.

THE DEER [*Cervus Dama*, Linn.[1]].

The stomach of the deer is as in the nylghau; also the epiploon and duodenum; only no mesentery[2]. The edge of the [intestinal or true] mesentery is very oblique, almost horizontal. There is one lymphatic [lacteal] gland running along it. The ileum passes into the colon on the right, not on the edge of the mesentery, but on its anterior surface, or on that part which is attached to the cæcum. This is pretty large, about one foot long, and passes up to the colon, attached to the ileum by the mesentery[3]. The colon, at first, makes a pretty quick turn, as in the figure[4], and, as it were, towards the left behind itself, and begins to make very irregular turns upon itself; it then gets on the left and posterior surface of the mesentery, passing up towards the beginning of the jejunum; then follows the course of the duodenum, gets on the right of the root of the mesentery, crosses it on the anterior part to the left, and passes down the back near its middle to the pelvis. The beginning of the colon is large; but becomes small when it is a little advanced in its first turn, and the straight part is also larger: it is in these turns that the fæces get into their divisions or pellets.

The liver is wholly on the right side, is flat, and one body with a fissure for the vein; part of it lies behind the little epiploon, but is not a distinct lobe. There is no gall-bladder.

The right kidney is the highest, and lies before the left of the spine, not in the loins: that space is occupied by the first bag of the stomach. There is one superior vena cava. The vena azygos on the left side passes

[1] [The Hunterian preparations are of this species, not of the red deer.]

[2] [Or rather no 'mesogastry,' or peritoneal folds uniting together the parts of the stomach.]

[3] [Home, Comp. Anat. i. p. 466.]

[4] [This is the figure engraved in Home, *tom. cit.* tab. cxxxi. All the plates of the 'course of the intestines' in this work are from Hunter's original drawings, now preserved in the museum of the Royal College of Surgeons.]

over the root of the left lung, and enters the right auricle as the supernumerary vena cava does[1].

The Hog-Deer, from the East Indies [Porcine deer of Pennant (*Cervus porcinus*, Zimm.)].

The one from which I take this description was a male, castrated. It was not so large as our doe, but much the size of the roebuck in Scotland; also much the same colour. It had no horns, but that was probably owing to its having been castrated. The eyes were rather hollow, which gave it an old look. The ears were large, thick, especially at the root, and pretty broad, much larger than our deer's. Its mouth and the nose were rather flat laterally. The tail was short.

The stomach is very similar to those of other ruminating animals. The duodenum passes down the right side, behind, and a little more to the right than the ascending part of the colon. When got pretty low down it bends upwards upon itself, and then crosses the spine obliquely upwards, towards the left and a little forwards, passing pretty high before it becomes loose: it then forms the jejunum, which is strung along the left edge of the mesentery, which mesentery is rather narrow. On this course it is rather getting towards the right, or perhaps the middle line of the body, and its lower part may be called ileum. This gut winds round the lower end of the mesentery, and gets on its right edge passing up before the spiral turns of the colon, and gets alongside the cæcum, into which it enters on its left side. This last part is pretty straight.

The cæcum was rather higher than common, but probably this was owing to its containing but little. It terminates in the colon, which passes up the right to the crossing backwards of the beginning of the duodenum; then would seem almost to bend down the right side along with that gut, or between that gut and the cæcum. It then bends back behind this descending turn, and passes towards the left and a little upwards behind the root of the mesentery, and begins to make spiral turns on the posterior surface of this membrane; when, having made two complete turns, which are from the circumference towards a centre, it is gently bent back upon itself, in between the former turns, forming two complete turns or rounds back including the one that keeps near to the edge of the mesentery, which might be called a straggling one. The colon then passes towards the right, behind the root of the mesentery, following nearly back again its first turns along with the

[1] [The fœtal membranes and cotyledons of the fallow deer are shown in Hunt. Preps. Nos. 3516, 3517.]

duodenum, and it is immediately bent back towards the left and a little forwards, getting before the root of the mesentery, and winds backwards towards the spine on the left of the root of the mesentery, and then passes down the back, forming the rectum. Besides these turns, spiral from the circumference towards the centre, and again from the centre to the circumference, considering it as if on a plane, they are spiral forming a small cone, being convex on the under or posterior surface; and of course concave on the fore-part, but which is not seen, from the mesentery covering this surface[1].

There is no gall-bladder. The epiploon is attached forwards to the second, third, and fourth cavities of the stomach; and behind, to the first. It is, at these attachments, double; but when these two unite, they seem to unite into one, which encloses the whole intestine, going round and round, wherever they are pendulous.

There are two puncta lacrymalia. The gland at the corner of the eye in some deer[2] is hardly visible in this.

FEMALE SPOTTED DEER, from Mr. SNOW of Harpur Street [*Cervus Axis*, Erxl.?].

The epiploon covered nearly the whole of the intestines; nothing being seen of the intestines, upon opening the abdomen, but the cæcum. It is a bag, or double membrane, whose attachment above, or what may be called its mouth, is not extensive. The anterior attachment is to the stomach; viz. beginning at the left of its attachment to this viscus, which is at the lower part, where the first cavity terminates in a double end. From this beginning its attachment to the stomach is upwards towards the fourth bag; then towards the right along the fourth bag, to the beginning of the duodenum; as also a little way along that gut: it then becomes attached down the right side to one of the ascending turns of the colon for 4 or 5 inches, and makes a quick turn up upon the same gut, close to the other, which attachment is continued a little way towards the left; and from thence it passes up to the posterior surface of the first bag of the stomach to join that part where we set out with our description.

The duodenum, near its beginning, makes a short turn or convolution; then passes down the right side, attached to the right or outside of the [first ascending?] turn of the colon; and, when got below the kidney, it makes a turn upwards and towards the left, obliquely. When got to the left it gets upon the left edge of the mesentery, becoming jejunum

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[1] [Home, Comp. Anat. i. p. 466. tab. cxxix.]
[2] [The Hunt. Prep. No. 2101 shows this gland or sinus in the rein-deer.]

and ileum, which pass down on that edge, making many short convolutions. The ileum passes upwards, and is more straight at its termination than in the rest of its course; and enters the colon on the right side. The cæcum lies on the right side; its lower end on the right of the pelvis.

(*Cervus Axis*, Erxl. fœm.?)

An animal to external appearance of the deer-kind, but rather shorter legs, and broader ears, without antlers, which I suppose was owing to its being a female. Brown like the deer, with lighter spots. The hair somewhat like the musk-deer's, but not so strong. The arm part of its fore-legs was thick and strong.

The stomach is like that of a goat. The duodenum passes down the right, not very loose, and then passes up again behind the root of the mesentery, before it becomes loose. The jejunum is a loose gut, strung to the anterior edge of the mesentery, in a line with the back. The last part of the ileum passes up almost straight, without convolutions, to near the emersion of the duodenum, or root of the mesentery, along the posterior edge of the mesentery; and passes into the cæcum. This is on the right of the mesentery, lying mostly in the direction of the body, having its blind end towards the pelvis; it is the largest part of any of the guts. The colon passes to the left surface of the mesentery, and makes several oblong spiral turns on the mesentery, towards the centre; then is winded back upon the former turns, just describing as many back again. Having finished these corresponding turns, it passes round the mesentery pretty near the ileum and jejunum, to the root of the mesentery; from thence it passes down the back to the pelvis: in this last place it forms the knotted fæces. The colon in this animal cannot be called a reservoir[1]. From the turns of the colon, this deer, in that respect, comes nearest to the goat of any animal that I have dissected.

The liver is but small, of the flat kind, and has but one lobe. There is no gall-bladder.

The kidneys are like those of a sheep, deer, &c. The female parts are like those of a deer. It has four nipples.

There are eight incisor teeth in the lower jaw; but none in the upper[2].

[1] [Probably referring to some expression as to the use of the human colon in the Anatomical Lectures.]

[2] [These notes would seem to have been penned at an early period in Hunter's zootomical researches.]

Of the Rein-Deer [*Cervus tarandus*, Linn.[1]].

The stomach is attached pretty much to the diaphragm. There are four cavities, pretty much the same as in black cattle. The lower part of the first cavity [rumen] is forked, viz. right and left; the left of these two terminations is the shortest and smallest. The villi of the first cavity are very long[2].

The second is the honeycomb cavity [reticulum], but the cells are not deep.

The third cavity, or 'parson's-book' [psalterium], is much as in the other common ruminants. The fourth, or true stomach [abomasus], has the same shape [as an ordinary stomach] and some longitudinal rugæ, as is common in this class.

The contents were finer and firmer in each stomach [as seen from the first to the fourth]: they were very green in the first three cavities; but were more of a yellow colour in the fourth. Whether this was owing to the bile, or to the vegetable substance having become yellow by the gastric juice, I do not know.

The duodenum near its beginning makes a slight fold upon itself; then passes down the right side attached to the first ascending part of the colon; then crosses the body obliquely upwards behind the mesentery along with the colon, where that gut passes to make its turns on the posterior surface of the mesentery.

The duodenum ascends as high on the left as its beginning on the right; it then attaches itself to the edge of the mesentery, along which the small intestine passes downwards and towards the right again, making very short convolutions on that membrane; and before it enters the colon on the right, it rises higher in the abdomen; the whole making a round sweep[3].

The cæcum is a long and almost straight gut, situated on the right and lower part of the abdomen, with its blind end in the pelvis. Its length is about a foot and a half. A continuation of the same gut or colon passes up the right side as high as the liver; then bends quickly backwards and down, and a little towards the right upon itself, attended by the duodenum; and when got pretty low again it passes across the spine towards the left, and upwards behind the root of the mesentery; and then begins its spiral turns on the posterior surface of the mesen-

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[1] [Hunterian specimens of the skull and antlers form Nos. 3517, 3519—3527, &c. Osteol. Series.]

[2] [Hunt. Prep. No. 561.]

[3] ["The whole taking a circuitous course," &c.—Home, Comp. Anat. i. p. 467. tab. cxxxii.]

tery. As it crosses the spine it becomes smaller and smaller, and where it begins to make the turns it is of the size of the small intestine. These turns are, first, six in number, making the most external ones: these are not circular but oblong; more and more so towards the last, so far as for the sixth to run parallel with each other, each turn making a smaller distance laterally, or in some degree within the other, but not so much so at what may be called the ends, although at the lower end they are pretty much so, while at the upper end the second rather projects over the first, the third over the second, the fourth over the third, and so on.

After having made these outer turns, the intestine bends immediately back upon itself, and gets more on the inside of the former, and follows the same course backwards upon the inside and between the former, so as to be seen between each outer turn: when it has finished those internal turns, it emerges, and takes a sweep round the mesentery, surrounding the outer base of the whole former turns, and, pretty close to the small intestines, joins the ascending part of the colon on the right, follows the course of the colon and duodenum towards the left, then leaves them and goes much higher, and then bends down to form the rectum, which becomes larger and larger to near the anus.

Before these turns of colon can be [distinctly] seen, the mesentery, with the whole of the small intestines, must be inverted; for they are on the posterior surface of the mesentery, the mesentery passing over the base of these spiral turns, which can be [faintly] seen through the mesentery.

The epiploon is attached to the right side of the left division of the lower part of the first stomach, and all along the fore-part of that great pouch, about the middle between the upper and lower end, towards the right side: it is there attached all along the fourth stomach, the second and third being too high; then to the beginning of the duodenum; then across the abdomen towards the left, attaching itself to the first bend of the colon, across to the root of the mesentery, &c.; finally to the posterior surface of the right pouch as it did on the anterior surface, and so into itself again. Thus the right division of the lower end of the first stomach, and the posterior surface of the fourth stomach, are included in the cavity of this bag or epiploon. The lower or unattached edge of this bag is somewhat narrower than its middle, by which means it is obliged to be concave on one side, which is adapted to the general size and convexity of the intestines belonging to the mesentery, which, in the ruminants, take in the largest part of the colon.

The liver has one lobe, is flat, has no gall-bladder, and the duct enters the duodenum after that gut has made the first turn upon itself.

It does not enter by a projection, as in the human, but rather like the ureter [as it enters the bladder].

The pancreas I could not make out.

The spleen is broad, and attached closely to the left side of the stomach near the diaphragm, as in this animal it cannot be said to be in a doubling of epiploon.

The kidneys are conglobate.

The 'bearing' [external female part] is like the sheep's, and comes to a point, in which is the clitoris. The urethra enters the vagina about 4 inches from the external opening, or 'bearing.' The vagina is large until it comes to the different projecting parts. On looking on the first of these, we see both first and second, the second projecting through the first. These projections are five in number, becoming smaller and smaller upwards, and then the uterus or vagina divides into two horns. The large or first part of the vagina is soft in texture, but at those projecting parts it is firm. The uterine horns are short, and have cotyledons. The ovaria are oblong. The capsula ovarii is hardly deserving that name[1].

The two toes, also the two back ones, have more motion than is common in other animals. They are capable of spreading very considerably when extended, especially the two large ones; but, in their flexion, they come close together, even overlap, if one comes in first; so that the points touch; and when they are inflected, in walking, the two toes are heard striking against each other, and this stroke is in proportion to the quickness of their motion. In the dead rein-deer this can be produced; for it needs only to lay hold of the flexor tendon and propel and relax it alternately, and the click is produced.

Is the broad foot of this deer for the purpose of walking on the snow? They almost tread on the fetlock joint and the two back hoofs come upon the ground, which increases the breadth of the surface of the tread. The whole foot is well adapted to walking either on the ice or snow. The hoofs are flat and broad, and they admit of a very considerable separation from each other.

[Family *ANTILOPIDÆ*.]

Le Corine, of Buffon[2] [*Antilope Dorcas*, fœm.: *A. Corinna*, Pallas].

This animal is about the size of a common goat, small and round in

[1] [Hunt. Prep. No. 2755.]

[2] [Histoire Naturelle, 4to, tom. xii. p. 261.]

the body, having long small legs; with a short tail rather longer than a goat's, and a long small neck. It is of a red brown with a dark streak along the lower part of the side, where the red hair of the side is terminating in the white of the belly, which extends from the flank forwards to the fore-leg and passes a little way down the back part of it. At the posterior edge of the hip, near the vagina, there are some black hairs. The hair of the belly is white, which becomes darker by degrees along the neck to the chin, and backward to the anus, also to the inside of the thighs and arms. It has long pasterns, which have a motion on one another backwards and forwards; there is, therefore, a cavity between the lower ends of the pastern bones for this motion.

There are two nipples and two udders, with two glands by the udders; but I did not find any ducts to them. On each side of the udder is a cavity which is smeared over with a yellow mucus, like the wax of the ear.

A little way beyond the pylorus the duodenum makes a short fold or doubling upon itself, then passes down the right side, having a short mesentery, which becomes broader downwards; it then makes a turn towards the left, and upwards, winding round to the left, and to the root of the mesentery, and then becomes loose. The jejunum is strung upon the lower or anterior edge of the mesentery, and when got to the right it passes [as ileum] almost directly upwards on the left of the cæcum, and on the anterior surface of the mesentery, and dips into the cæcum. This is long, a little bent or curved, and is the largest intestine, adhering to the right edge of the mesentery, which is its broadest part. The colon passes a little higher and makes a loose turn backwards, round the right edge of the root of the mesentery, and then gets on the posterior surface of it, which is the beginning of the spiral turns. The inward turns are two and a half without the cæcum, three with it; the outward turns are one and near the whole of another. The colon then passes along the mesentery near to the ileum and jejunums nearest to the ileum; and, as it ascends along the mesentery, it recedes from the small guts further; but when near to the beginning of the mesentery it passes round behind it to the right side and joins the first bend of the colon, and then passes to the left before the root of the mesentery, making a complete turn round it: it then passes down to the pelvis.

The liver is flat, having two fissures, the left being for the umbilical vein of the fœtus; there is a lobulus Spigelii. The gall-bladder is very small, lying in a sulcus of the middle portion between the two fissures, and would hardly answer any great purpose. (In the antelope it is not very small.)

The uterus, &c. are like those parts in all this class.

The heart is very much pointed at the apex. There are two azygos veins, the left being the larger.

This animal I have called *Le Corine*, as it resembled a print which is so called by Buffon; but, from comparing that with the male antelope[1], two of which I had from Lord Clive, it would appear to be the female antelope; only in the male the black stroke is not so observable as in the corine. The male antelope has the cavity between the pastern joints; the two cavities on each side of the nipples; there being two nipples.

Both the corine and the above antelope have exactly the same turns of colon as the goat.

The epiploon in the antelope only makes a cover for the lower and anterior part of the cross bag of the stomach; it does not cover the intestines.

The Antelope [*Antilope cervicapra*, Pall.].

The ears are small, like those of a sheep or goat.

The pelvis in both the goat and antelope is more a distinct cell than in many other animals. The iliac bones, in many, make a kind of arch upon the spine; in others, from the sacrum projecting back, the pelvis looks like a cell at the lower part of the abdomen and pubis, becoming more in a line with the spine.

The turns of the colon are not upon the mesentery, as in the goat, but are loose, not quite so circular, but more oblong: they are not so regular towards the centre; some are longer than others[2].

The liver consists of one lobe, with a fissure in it, as in the human, for the umbilical vein: it lies more in the right half of the abdomen, and is thinner in its base, than in the human.

The spleen is like a cow's; the inner edge adheres all along to the right crus of the diaphragm: the outer edge is loose or unattached.

The kidneys are as in a sheep, the right being highest.

The capsulæ renales are small bodies, placed at the upper end of the kidneys, of a cineritious colour.

The male parts are as in a bull. The vasa deferentia do not communicate with what may be called vesiculæ seminales.

The female parts are of the cow-kind. There are two 'crura clitoridis,' or 'musculi clitoridis,' and a middle ligament passes up to the glans in a serpentine course: the glans is just at the peak of the vagina.

The common vagina is about 2 inches long. Just at the beginning of

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[1] ['Gazelle' of Buffon.]

[2] [Home, Comp. Anat. i. p. 465. tab. cxxv.]

the proper vagina is a connexion of the two sides, by a membrane like a thread. The continuation of the uterine horn with the broad ligament runs across the psoas muscle, and is continued to the side of the belly. The round ligament is only a small doubling of the peritoneum, which does not reach so far as the abdominal ring.

There are fore-teeth in the lower jaw only. The horns are like the cow's[1]. The female has no horns.

All along the belly there is an elastic ligament which covers the abdominal muscles, and is thickest towards the pubis.

Ring-horned Antelope (*Antilope cervicapra*).

Intestinal Canal.

	ft.	in.
From the mouth to the stomach	2	0
From the stomach to the cæcum	44	0
From the cæcum to the anus	16	0
Length of the cæcum	0	9
Length of the Body.		
From the horns to the anus	3	3

An Antelope, from the Queen.

(Described by Buffon, vol. xii. p. 215. Comes from Barbary[2].)

This animal was smaller than our common doe, more compact and shorter leg'd: dark brown on the back, becoming rather lighter towards the belly; not gradually lost in the white of the belly, but at once. Also white on the inside of the fore- and hind-legs, extending up the under side of the neck, and also to the root of the tail, terminating in a line up the posterior edge of the thighs.

Horns long, spiral, diverging, with rings or circular ridges, but which do not go round, having a spiral line from the tip to the setting on of the horn where these rings terminate[3]. The hair is short and straight, of a light brown in the body of the hair, but dark at its tip: it is a flat hair in its body, but round at the tip.

Just below the eye is an opening [suborbital sinus] of considerable depth, which has a number of ducts opening into it at its bottom,

[1] [That is, they have a sheath of true horn, and are not entirely bone, like the deer's.]

[2] [The species here described, and figured in pl. 35, is the 'common antelope of Pennant' (*Antilope cervicapra*, Pall.), with the characters of which Hunter's brief description agrees.]

[3] [No. 3666, Osteol. Series.]

from a gland. This opening is very large, lined by the common skin, and having short hairs growing in it. The animal has the power of dilating it; and I conceived it was then angry. I could only find two nipples[1].

The upper lip was continued into the fore-part of the roof of the mouth, there being no fixed ridge similar to a gum: it was moveable here where it turned in; so that, by moving the extremity of the upper lip, it opposed different parts of this lip to the teeth of the lower jaw.

Of a Goat [*Capra Hircus*, Linn.[2]].

The stomach[3], especially the first bag, is more than three times larger than all the other viscera together, filling up almost the whole cavity of the belly: at its upper part, and on the left of the œsophagus, it adheres to the diaphragm.

The duodenum begins on the right side of the stomach, passes back round the 'parson's-book' to the angle between it and the 'honeycomb,' by a mesentery: thence it passes down on the right side, making a fold on itself, and is attached to the head of the pancreas; then it passes behind the mesentery, and comes out on the left side of it, forming the jejunum, which, with the ileum, is attached to the edge of the mesentery, which is a very thin membrane when not fat. These three intestines are remarkably small, but the ileum is rather the largest, which is gradually so to its termination.

The cæcum is about 9 inches long and 4 in circumference: its whole length is attached to the ileum by a mesentery; at the termination of the cæcum and beginning of the colon the intestine is a little smaller. The colon passes upwards, and a little backwards and downwards, making a complete turn at its beginning; and, when got on the posterior edge of the mesentery belonging to the ileum, it becomes much smaller: it makes an oval turn on the posterior surface of the said mesentery, which is continued in a spiral manner within itself, making three complete turns, which makes twelve pieces of gut in any transverse direction. From another goat, where I took a very exact description, I have the following:—"counting across these spiral turns of the colon, including the cæcum, makes thirteen turns, viz. four turns inwards and three back again." From thence the colon turns back again, and comes out in the same manner. It then passes along the mesentery, into the doubling of the peritoneum that makes the mesentery, from right to left, about an inch and a half from the intestines in general, but at some

1 [There are but two in *Antilope cervicapra.*]

2 [The skull is No. 3737, Osteol. Series.] 3 [Hunt. Preps. Nos. 557, 564.]

parts 3 inches, at others 1. When got to the left of the mesentery it passes from the left to the right hand, behind the root of the mesentery, and passes along with the ascending duodenum, making the same turns upwards with that gut. It then makes a turn round the root of the mesentery; by that means gets before the mesentery, but is all this while closely attached to it. When got to the left of the mesentery it passes down, and is attached to the mesoduodenum, which is common to both, leaves it at the same place that the duodenum becomes jejunum, and passes down the back to the pelvis, having a mesocolon. These spiral turns are pretty much upon a flat, but somewhat a little conical; the hollow of the cone is upon the side next to the mesentery.

From the first spiral turn, where it becomes smaller, it is hardly so large as the small intestine, admitting only one knob of fæces; but, from its passing round the root of the mesentery, it becomes larger, on to the rectum.

The fæces begin to grow knobby at the first spiral turn. The small intestines have no valvulæ conniventes, and are ten times the length of the animal. The colon is three times and a half[1].

The epiploon is attached to the stomach from the right to the left, dividing the large bag into two halves, a superior and inferior; it is also attached to the last bag of the stomach, to the duodenum upon the right, and on the right and posteriorly to that turn of the colon that crossed the anterior part of the root of the mesentery. So that it makes the bag enclose the lower half of the large bag of the stomach, one half of the last bag, and all the 'parson's book:' the epiploon did not cover the intestines.

The liver is very small in proportion to the animal, is chiefly placed on the right side, and is flat, lying upon the diaphragm; it is divided partially into three lobes. The gall-bladder is situated on the middle, and the cystic duct runs along a groove in that lobe to the porta: it is not contorted as in the human, but seems to be a little valvular at its beginning, and has two or three small ducts passing into it. At the porta it is joined by the hepatic, which seems to come chiefly from the left side. These ducts are not buried in the liver, but run in a narrow groove.

The pancreas is more irregular, broader, and thinner than in the human subject; it is situated across the body; on the left it is attached to the diaphragm, and posterior part of the stomach: it hardly has a little pancreas, as in dogs, &c.: its duct enters the ductus communis

[1] [Home, Comp. Anat. i. p. 464. He repeats Hunter's remark on the absence of the valvulæ conniventes; a remark which probably indicates an early period in Hunter's comparative anatomical researches.]

choledochus about two inches from the entrance of that duct into the duodenum.

The right kidney is higher than the left; is situated before the spine: they are but small, and have but one mammilla. The capsulæ renales are little oblong bodies situated about an inch above the kidneys; when cut into they have much the appearance of a kidney, but the inner part or substance is turned out, and *vice versâ;* for what answers to the tubular substance is on the circumference, and is fibrous when cut into or torn, all its fibres passing towards the centre, and it has the colour of the tubular part of a kidney; while that which answers to the cortical part is in the middle.

On the mesentery, nearer the root than the first passage of the colon, is a lymphatic [lacteal] gland, making an angle in the shape of the edge of the mesentery, almost extending from right to left.

The erectores penis are very strong; so are the acceleratores. From the lower surface of the tail, just above the anus, arises a muscle which divides into two portions, passing on each side of the anus; they then get to the angle between the bulb and erectores penis, thence pass along the lower surface of the urethra, and seem to be lost insensibly in the cellular membrane on the penis: this muscle seems to throw the penis into wrinkles. The membranous part of the urethra is very long and muscular. The coat of the penis is very thick and strong. The corpus cavernosum is vastly thick, strong, and tendinous, and hardly admitted air. There are four Cowper's glands, which are pretty large, and their ducts enter the urethra on the loose edge of a large lacuna or foramen cæcum, which is situated just behind the bulb of the urethra. There are no vesiculæ seminales. The vasa deferentia become pretty large at their termination, and seem there to be made up of two coats, the external strong as in the human; the internal a spongy soft membrane[1]. There are two prostate glands, which are pretty large, one on each side, almost placed like the vesiculæ seminales in the human subject.

The male goat has an immense quantity of essential oil, which appears to be secreted in the skin almost everywhere; which, as it were, oils the skin and hair, so that one cannot touch him but that the part will be as it were impregnated with it. It smells very strongly, and is to most very offensive.

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[1] [Hunt. Prep. No. 2556. The female organs are shown in Preps. Nos. 2761, 2762.]

The Sheep [*Ovis Aries*, Linn.].

A sheep has but one punctum lacrymale, which belongs to the under eyelid; it is not placed as in the human, but is a little way on the inside: it is pretty large, and is continued on to the ductus ad nasum without any sac. The trochlearis muscle is like the obliquus inferior; and the origins of both are nearer the bottom of the orbit.

Of the Nylghau [*Antilope picta*, Pallas[1]].

The great or first bag of the stomach is at the lower part divided into two, having an anterior and posterior edge; the second bag is the 'honeycomb;' the third is the 'parson's book;' the fourth is the true stomach; the last part of which seems to have most of the digestive power. The food [in the first?] was almost unaltered, only soaked. The great bag is attached to the diaphragm on the left of the œsophagus with the upper end of the spleen. The little epiploon is attached to the first bag [rumen] on the right of the œsophagus; to the second or honeycomb bag; to the 'parson's book;' and to the last bag and beginning of the duodenum at the upper part to the liver. This membrane is a kind of mesentery to all those parts, uniting them in general to the parts above, and each part of the stomach to one another, and the hollow curve of the last bag to itself. The great epiploon on the anterior part on the right, is attached to the duodenum; from thence along the lower edge of the last bag, as in the human, and then crosses the anterior edge of the bag near the upper part to the left. Upon the left of that bag it passes down along it to the division of the lower end towards the apices [of the rumen]; then gets between these two apices towards the right again, forming posterior lamellæ, and there is attached to the root of the mesentery and transverse passage of the colon, and is united to the right, to the anterior lamellæ. The last bag [abomasus] is bent upwards upon itself, somewhat similar to the last part of the stomach, in the human and other animals, and terminates in the duodenum.

The duodenum passes upwards towards the liver, and there becomes rather firmly connected by means of the vessels of that viscus; it then passes down on the right side pretty low and loose, having a meso-duodenum which becomes narrower downwards to the loins; from thence it passes obliquely upwards and towards the left, behind and to the left of the mesentery, and becomes a loose intestine. The ileum passes into the cæcum somewhat on the right, and pretty low down; about a foot and a half from its blind end there is a mesentery which

[1] [The horns are preserved in No. 3742, Osteol. Series.]

passes between one of the turns of the colon and the cæcum. This part is about a foot and a half in length and about 10 inches round. The colon at its beginning is a little folded upon itself, and is there largest: from thence it passes upwards, becoming smaller, and makes six spiral turns upon itself; then runs in between the two lamellæ of the mesentery, half-way between its root and the intestine, towards the left, and upwards; then it crosses the fore-part of the mesentery, is attached to it, making a fold upon itself in the mesoduodenum, still continues to cross, and is attached to the posterior lamellæ of the epiploon; it then gets to the left of the mesentery, just above the beginning of the jejunum, then turns down to the rectum which has a mesentery[1].

The pancreas lies across the spine behind these parts, having no little pancreas lying in the curve of the duodenum.

The liver, lying principally on the right side, is flat and close to the diaphragm; it has a fissure in its lower edge dividing it into two. The gall-bladder is attached to the right of that fissure; and is very small. The ductus cysticus passes up from the hepatic duct through the substance of the liver to the gall-bladder, and these ducts enter the duodenum at the part of the attachment that we mentioned above; a small vessel passes up from the porta to the gall-bladder, which has the appearance of the ductus cysticus.

The vena cava passes along the thick posterior portion and left edge of the liver, in its way to the diaphragm. There can hardly be said to be any of the liver to the left of this.

The pancreatic duct passes into the duodenum just before the gut makes the turn up to cross the spine.

The right kidney[2] is the highest, pretty firmly connected to the loins: the left is very loose. There are two azygos veins, and a seeming remnant of the thymus gland.

The lungs on the right side are partially divided into four lobes; on the left side into three. The testicles are pendulous. There are four nipples. There is a gland below the eye, where there is a duct not covered with hair; and there are ducts opening for the mucus which is there secreted, as in the deer.

[Family *BOVIDÆ*.]

The Bonassus [*Bison Americanus*].

It has four nipples like a cow. The inside of the lips has the same

[1] [Home, Comp. Anat. i. p. 462.] [2] [Hunt. Prep. No. 1237.]

kind of papillæ as in a cow; the tongue has the same sort of roughness upon its surface. The tendons of the abdominal muscles are like an elastic ligament.

Upon opening the belly, the first thing that appears is the stomach, filling the whole anterior part of the belly, so that no other viscus appears. It is covered by the epiploon. The stomach adheres very firmly posteriorly to the loins and diaphragms, and other parts adjacent. The adhesion on the mouth of the epiploon is not to the lower part of the stomach, but to the upper and fore-part, by which means it covers nearly the whole anterior part: the posterior part is attached to the pancreas, and, upon the right, to the loins.

The stomach is bifurcated below the œsophagus, which opens into the largest bag [rumen][1]; this at the most distant part from the œsophagus is bifid like that of a goat, and on the inside to the right, a little below the termination of the œsophagus, there is a large fold. Just by the œsophagus, upon the right side, there is a large and somewhat oblique opening into another bag [reticulum], which has a honeycombed appearance. Upon the right of this cavity there is a small opening that leads into the third bag, which is called the 'parson's book' [psalterium]. From the lower part of this there is an opening into an oblong cavity, the fourth stomach [abomasus], at the end of which the first gut begins.

The aliment in the large bag seemed to be a mass of undigested food, chewed straw, &c. That in the second bag was more uniform; that in the third still more so; and in the fourth the aliment was become thin.

The duodenum passes towards the back, and there makes a quick turn down along the loins, adhering to the other guts; and at the lower part of the loins it passes behind these guts, and makes a gentle turn upwards behind; then towards the left, adhering closely to them; and when got upon the left side it pushes out and becomes a loose intestine, being strung upon the mesentery. The small intestines lie principally behind the stomach and in the pelvis. The whole are strung upon the mesentery as in common. The ileum, or termination of the small intestines, passes to the right, and dips into the cæcum, which is in the right part of the loins. The cæcum is bent upon the beginning of the colon, and closely adheres to it through its whole length. The colon passes up to the right side and then makes a turn towards the left, and passes down again, and wheels round to the right again a second time and makes another complete turn round, and a

[1] [Hunt. Prep. No. 560.]

third: in short, it makes a great many turnings and windings which are not at all regular, and in such manner as not to be easily described—indeed not to be unravelled so as to be understood—these turnings and windings lying all together and being closely connected to one another. The rectum passes down seemingly pretty near the middle of the spine into the pelvis [1].

The liver is small in proportion to the size of the animal, and is properly made up of one lobe with a small fissure in it, and lies principally in the right side and middle of the body: it has a detached lobe upon the right side, and has a swelling analogous to the lobulus Spigelii. The gall-bladder lies in a sulcus in the right side of the liver. The cystic duct runs along the same sulcus, and receives a number of small ducts into it as it passes along, and joins the hepatic duct, which seems to come chiefly from the left side; and the ductus communis enters the duodenum where we said it made its first turn obliquely.

The pancreas lies just below the liver, having its larger part, as it were, across the spine; having, however, a process that runs down along the duodenum, between it and some of the turns of the colon, in the centre of which process passes the duct which enters the duodenum about a foot from the entrance of the hepatic duct.

The kidneys are conglomerate. The pelvis of the left had something peculiar in its course, with its ureter; it is corroded [2]. The right had the common structure [3].

The contents of the thorax are like those of other quadrupeds. The apex of the heart is turned rather forwards and a little upwards.

The external parts of generation, and the anus, are just like those of a cow: the internal parts, as they are seen in the pelvis, are, the uterus with the two horns, which horns are a little convoluted at their ends, the Fallopian tubes and ovaria. The tubes run in the broad ligament, not upon the edge as in the human, but some way from the edge: they are very much like the vasa deferentia, for they are not soft tubes as in the human, but hard; and become softer and wider towards the 'morsus diaboli,' which is continued from the opening of the tube to the ovarium.

The ovaria are placed on the posterior surface of a broad ligament, some way from the tube; they are small, hard, and rounded bodies. All that part of the broad ligament on which the tube is placed, and between it and the ovarium, is pretty broad and is pouched; making a kind of capsule for the ovarium, but which does not seem to cover it.

[1] [Home, Comp. Anat. i. p. 463.]
[2] ["Dry Preparation," Physiological Series.]
[3] ["Wet Preparation," Physiological Series, No. 1258.]

The clitoris is a small pyramidal knob just within the peak of the external parts. The common vagina is not above three inches long; and where it ends, or properly begins, there is a sort of stricture. The meatus urinarius terminates in the common vagina, on a pretty long prominence, which has a doubling of the vagina almost surrounding it, in form of a preputium, so that it can be thrust out almost like a dog's penis, but not near so far.

The proper vagina is about eight inches long, and pretty wide and smooth. The os tincæ is very prominent, hard, small, and scabrous, so that it is not easy to know where the opening is. The cavity of the uterus is small, and at or near the neck it is full of prominences, like as many ora tincæ: there are three of them: after which the uterus becomes somewhat wider, and at about three inches from the mouth it opens into the two horns, which are united some way to one another. This last part of the uterus is very rugous, or rather knobby, much the same with the horns: these rugæ [cotyledonal processes[1]] are very soft.

This animal just struck me to be the same in comparison with a cow, as an ass is with a horse[2].

[The Zebu or] East Indian Bull, brought over by Mr. Russell[3] [*Bos Taurus*, var. *Indicus, minor*].

Both kidneys were on the right side of the spine, but this was owing to the left being pushed to that side by the stomach: the lowest was just on the right psoas muscle where it makes the brim of the pelvis. The sulcus where the vessels enter and the ducts come out, was on the fore-part of the kidney. The superior kidney lay as high up as the liver, had its sulcus turned towards the spine, and great vessels. Its duct entered the left side of the bladder.

The stomach has four cavities. The duodenum passes to the right side of the abdomen, and then down that side attached to the first descending turns of the colon; in its course it is somewhat serpentine: it then crosses the spine to the left side, as it were winding and sweeping

[1] [See Hunt. Prep. No. 2756.]

[2] [In the more advanced position of the horns and more slender proportion of the limbs, the Bison approaches nearer to the Antelopes than do the other Bovines.]

[3] [Probably Dr. Patrick Russell, author of a 'History of Indian Serpents,' and of a 'History of Aleppo,' in the 'Appendix' to which he writes:—"Having met with nothing more on the internal structure of the Jerboa, than what is given by Gmelin from M. Buffon (Nat. History, tom. xiii.), I applied to my worthy friend Mr. John Hunter, who very obligingly favoured me with the following circumstances from his *Adversaria*," &c. This is one of several accessory testimonies to the authenticity of the 'Notes' the copies of which are here printed.]

round the first and posterior turns of the colon; it then passes up the left side between this turn and the descending rectum; and, when got so high as where the rectum begins, it passes gently forwards and becomes loose to form the jejunum: the ileum passes into the colon on the side of the abdomen. The cæcum is pretty long, as in most of this class of animals. The colon passes up the right side in the same direction with the cæcum, and, when got as high as the beginning of the duodenum, it makes a quick turn back and down upon itself: in its passage down it has the duodenum attached to it, and then makes a turn across the spine and up on the left or rather before the spine. This sweep of the colon is more than three parts of a circle, and is enclosed by the bend of the duodenum. This sweep comes forward with the duodenum, and then takes a long sweep downwards on the inside of the last ascending turn of the colon (vide figure[1]).

Viscera of a Cow [*Bos. Taurus,* Linn., fœm.].

There are three reservoirs to the stomach: this cavity or true digesting bag is very much in the common place, and is of the shape of the stomach in most animals, but does not extend so far on the left, nor is it so near the spine; it is removed farther to the right and forwards by the other three bags. It is, also, not so large in proportion as the stomachs of other animals, because its whole employment is digestion, and therefore it has not to contain anything by way of reservoir.

The duodenum passes down the right side, makes small turns in its way and gets as low as the pelvis, then makes a quick turn up, and a little to the left along the spine, and along on the right of the rectum; and, when got as high as the root of the mesentery, pancreas, &c., which is at the attachment of these parts to the back, it comes forward and becomes loose. From thence it passes [as jejunum] to the left above, and to the right below, almost back in the same direction, making many convolutions on the edge of the mesentery, and, when got to the right and lower part of the belly, the ileum joins the cæcum and runs up along with it to the colon.

It enters the colon, which is also loose, being only attached to the right edge of the mesentery; the colon makes a bend downwards upon

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[1] [Home, Comp. Anat. i., p. 463, tab. cxix.; the transcript of Hunter's notes in the work cited is referred, as in those notes, to the 'East Indian Bull.' The male organs of the Zebu form the Hunt. Prep. No. 2557: the horns are No. 3843, Osteol. Series.]

the cæcum for a little way, and then begins to make its spiral turns, which are as represented in the figure[1].

The spiral turns of the colon are not seen in the natural state of the mesentery, only the cæcum with the fold of the colon which is upon the cæcum, and the last turn of the colon where it ascends to cross the mesentery. To see the spiral turns, the mesentery must be turned to the right. That part of the colon which runs along the mesentery passes pretty near the root of that membrane, by which means it is much shorter than in many others of this class. There are two azygos veins.

The udder is made up of two distinct parts, viz. a right and a left; each part having two nipples: they are as distinct and independent of one another as the breasts in a woman.

The penis of a slink bull-calf has not the turn towards the posterior end, as in the old bull: hence it would appear that that turn is made by the retractor muscles of the penis, when the penis becomes too long for the distance between the anus and prepuce, even in a relaxed state.

Horns and Claws.—The horns and claws of animals are formed in strata not parallel to their axis, but oblique, tending towards a point in the axis, and which point is towards the point of the horn, &c., as when the horn becomes long, the first always scales off, by which means the point is always kept sharp.

[Order PERISSODACTYLA.

Suborder *Solidungula.*

Family *EQUIDÆ.*]

The horse [tribe] has the fewest in number of species of any: I do not know if we have any more than the horse and ass: whether there are two species of ass I do not know[2].

OF THE HORSE [*Equus Caballus*, Linn.].

The tendons below the os calcis in the hind-foot, and the tendons

[1] [Home, Comp. Anat. i. p. 463, tab. cxviii. Hunter preserved preparations of most of the organs of the common ox. See Physiol. Catal. 4to. vol. v. p. 258.]

[2] [It does not appear whether Hunter was acquainted, at this time, with the zebras and quaggas; or in what light he viewed them. Modern zoologists refer the wild asses of Asia to more than one species.]

below the carpus in the fore-foot [1], are the same; but those in the hind are much stronger; and there is a 'perforatus,' and a 'perforans:' the perforatus makes a kind of theca or annular ligament for the perforans.

The joint between the tibia and astragalus is such that the bones will not remain in the half flexed state, but will jerk either to the extended or the flexed state: [its movement] therefore requires an action of both the flexors and extensors at the same time, although one is to give up to the other, alternately [2].

The larynx lies at the lower part of the angle of the lower jaw which is about the middle of the head; from thence it passes up in the direction of the head towards the vertebræ.

The attachment of the pharynx to the basis of the head is 5 inches from the foramen magnum occipitale, and where this attachment is, there are the openings of the Eustachian tube. These openings are placed laterally, and appear to be slits with the side towards the pharynx-cartilage. At its beginning it [Eustachian canal and aperture] is a foramen, but only for a quarter of an inch; afterwards it is a groove passing upwards and a little outwards, becoming shallower and narrower: on the outside of this groove are the circumflex muscles, and the cartilages are continued up to the bony part on the inside.

Between the two Eustachian tubes is a cavity that leads up for 3 inches, the sides of which are the inner sides of the tubes, which makes the tube a groove, on to the bony part, where it is a foramen; in this [part] there is a large cavity just above the turn of the larynx, the boundaries of which are these: downwards, the œsophagus; forwards, the basis of the skull; inwards, by a septum that divides it from the one on the other side; outwards, by the os hyoides [stylohyal]; above, by the pterygoideus internus; between these two last by a membrane that is on the inside of the condyle of the jaw; and upwards by the recti capitis muscles. This cavity is very irregular, having a process running backwards and outwards towards the external ear, between it and the condyle. The septum is connected forwards to the cavity between the two Eustachian tubes.

To conceive the course of all these parts it must be considered that

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1 [Hunt. Prep. No. 279. The structure of the hoof is shown in No. 284. The structure and development of the teeth are shown in Nos. 333—379.]

2 [In the Preparation, No. 257, 'Physiological Series,' Mus. Coll. Chir., Hunter shows the "strong transverse ligament which passes from the head of one rib, behind the intervertebral substance, to the head of the opposite rib; thus connecting them firmly to each other and to the vertebra."—Physiol. Catal. 4to. vol. i. (1832) p. 57. See 'On a peculiar ligament connecting the opposite ribs in certain Vertebrata,' by Dr. Cleland, communicated by Prof. Goodsir to the Royal Society of Edinburgh, 'Proceedings,' April 1858, p. 101.]

the basis of the skull is turned back, so that it stands perpendicular, not horizontal as in man; so what we say 'runs back' in man 'runs up' in brutes; and to conceive the situation of this better, it must be understood that the pharynx does not come near the ventricles by four or five inches, which allows for the position of these two bags between them.

[*Loose Note on the same structure from, apparently, another dissection.*]

The Eustachian tube is, at its beginning, cartilaginous; but opens into a large cavity just on the inside of the pterygoideus internus muscle, large enough to contain half a pint of water; but, from the beginning of the tube to its termination in the bony part, it is a groove running along the basis of the skull.

The valvula major of the brain [1] is a strong membrane.

The heart is not so fasciculated as the human. The valvulæ mitrales are not two entire valves, but are joined at their bases, which makes a valvular circle round the mouth of the ventricle, but at the part of union it is not so broad as in the human. The tricuspid valves were almost three distinct valves, but were joined at their bases[2].

The lungs are but one lobe on each side, except the lobulus medius; however, at their anterior or rather inferior edges, where they enclose the pericardium, they are a little divided so as to make a sulcus for the heart. This appears to be equal on each side, so that the heart lies in the middle.

The abdomen is surrounded by an elastic membrane like white leather, which is pretty thick, and is on the outside of the muscles.

The stomach[3] is somewhat similar in situation and shape to the human; however, it is rather shorter, the small end not running into so slender a part.

The duodenum passes to the right, then down, and at the last part it is a little convoluted and loose; it soon crosses the spine behind the root of the mesentery and the union of the ileum, cæcum and colon; then comes forward on the left of the mesentery and becomes a loose intestine. The duodenum, jejunum, and ileum, have no valvulæ conniventes. The ileum passes into the cæcum, which is 2 feet long and near a foot diameter, ending in a narrow point. The cæcum has four

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1 [Hunt. Prep. No. 1329.]

2 [The structure of the arteries is shown in Hunt. Preps. Nos. 938—955; of the veins in Nos. 964 and 980.]

3 [Hunt. Preps. Nos. 545—547.]

ligaments and is bent upon the colon, or makes an acute angle with it, and is attached to it by a narrow mesentery. It is principally on the right. The beginning of the colon is attached to the root of the mesentery, and lies between the roots of the mesentery and transverse arch of the duodenum. It is very small, having no ligaments, and makes a twist upon itself. Besides the angle made by it and the cæcum, it becomes loose, lying in the abdomen in no determined situation or direction; it then becomes very loose, continues so for about five feet, having four ligaments; then becomes much smaller and makes a bend upon itself, which is continued back along the former five feet, and is attached to it by a narrow mesentery; it becomes gradually larger towards the end of this attachment. The colon then crosses the abdomen near the root of the mesentery towards the left, and at this part it becomes small almost at once, and is continued on towards the anus much of the same size, having only two [longitudinal bands or] ligaments which are very strong[1]. In this last passage it has a loose mesocolon and is considerably convoluted: this part is about 12 feet long. This fold of the colon upon itself is the first part that appears upon opening the abdomen. The variation of size in the first part and the turns of the colon may depend on the irregularity of the muscular contraction.

The epiploon is attached forwards to the stomach, on the left to the diaphragm; behind, to the transverse turn of the colon.

The liver consists of one lobe at the basis, but has two large sulci which may be said to divide it into three partial lobes, besides which the middle lobe has the sulcus in it for the umbilical vein. On the right side of the right lobe there is a small flap. The lobulus Spigelii is very flat. There is no gall-bladder.

There are two pancreases; one in the curve of the duodenum, the other across the spine towards the spleen. The spleen[2] is a long body, broad at its upper end.

The vesiculæ seminales are much the shape of a gall-bladder, and are muscular. Both these and the vasa deferentia keep open after castration[3].

The urine of a horse goes much sooner into volatile alkali than that of other animals: when it is voided it is extremely offensive, and by

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[1] [Hunt. Prep. Nos. 732, 733.]

[2] [Ib. No. 836. The structure of the kidneys is well displayed in Nos. 1198, 1209—1214; that of the suprarenal body in No. 1285.]

[3] [The structure of the male parts is shown in Hunt. Preps. Nos. 2546—2551: that of the female parts in Nos. 2770—2774: the same after impregnation with the fœtal membranes and peculiarities in Nos. 3548—3558, 3699.]

standing one night it is often too much for the nose or eyes to stand over it. It is from this circumstance perhaps that it is called in common language, 'stale,' or that a horse 'stales.'

A mare has a hymen with two perforations[1].

Of an Ass [*Equus Asinus*, Linn.[2]].

An ass, anatomically, is the same, or very nearly the same, as a horse.

The œsophagus passes into the middle of the stomach: it is of no great length below the diaphragm, just like the human. The great curve of the stomach is directly downwards, so that the œsophagus and stomach make a pretty sharp angle. The stomach lies directly across the spine from left to right: it is something of the shape of the human, but is rather shorter and thicker: it is small in proportion to the animal. In one ass the great curve lay directly towards the abdominal muscles, which I suppose is the most natural position.

The duodenum makes a pretty sharp turn downward on the right side, before the right kidney[3], as low as the brim of the pelvis; it then passes to the left across the brim, and begins to get a mesentery; so that it passes under the mesentery as in the human, but is not bound down, for it is pretty loose. The ileum passes towards the right before the turn of the duodenum that is going to the left: its muscular fibres are very strong, and longitudinal; it dips into the cæcum coli.

The cæcum is about 2 feet long, and very large, nearly 8 inches in diameter: it is attached to a fold of colon nearly its whole length by a thin mesentery about 3 inches in breadth, so that its direction is [that of] the first fold of the colon. It has four ligaments, two of which run into one near the blind end, and are not continued into the ligaments of the colon. The attachment to the colon is at one of the ligaments. At the part where the cæcum and ileum communicate with the colon, the colon and cæcum make a turn upon themselves: then the colon makes a fold upon itself for near 5 feet in length, the bends of which fold are closely connected to one another at their beginning, but towards the retrograde end they are about 5 inches distant. The beginning of the fold, or that which the ileum enters, is smaller, being about 3 inches diameter, and increases to near the turning end, and then becomes smaller, nearly as before, and some way after it has turned it becomes large again, on to the place where it first set out; the two

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[1] [Hunt. Prep. No. 2840. One of the nipples of a mare is shown in Hunt. Prep. No. 1409; and the position of both on the preputium clitoridis in Nos. 3749, 3750.]

[2] [The skeleton is No. 3216, Osteol. Series.]

[3] [The structure of the kidney is shown in Hunt. Prep. No. 1208.]

largest parts are about 8 inches in diameter. The beginning of the fold has two ligaments, and the attachment serves as a third. The first swell has three ligaments, and the attachment serves as a fourth: where it becomes small a second time it has no ligaments: where it swells a second time it has three ligaments, and the attachment serves as a fourth. The course of this fold is obliquely towards the left iliac bone, and it there makes a turn in towards the pelvis.

At this part there are five openings, viz. ileum, cæcum, the fold that goes out, the fold that comes in, and the other part of the colon. This part is firmly attached to the back and loins, surrounded, as it were, with the turn of the duodenum.

From this attachment the colon passes towards the left, forming the transverse arch, which is bound down to the back and is much smaller than the other parts, being only about 3 inches in diameter: when the arch has got to the left side it has a long mesocolon, is very loose as it passes down the left side, and there commences the rectum. This part has but one ligament, and the attachment next to the mesocolon makes two.

The mesentery and mesocolon are very thin and long, so that the intestines are very loose. There are no valvulæ conniventes.

The omentum is very thin and is not large enough to cover the whole of the intestines; it is attached as in man. The foramen into the omentum is behind the descending part of the duodenum.

The pancreas is situated as in man, but adheres firmly to the transverse arch of the colon, as the colon is close to the spine.

The liver is thin and spread out like a leaf, lying close to the diaphragm, but not covering nearly the half of it, being not so large as a common human liver. It is divided into three lobes; the right lobe lies flat in the right loins; the middle lobe is divided into two, lying in the middle, but to the right; the left lobe lies in the middle and to the left. There is no gall-bladder. The liver is small in proportion [to the size of the animal].

The pericardium is about 4 or 5 inches from the diaphragm: it is connected to it by two doublings of the pleura, one on the right, the other on the left; the one on the left arises from the lower and lateral part of the pericardium, from thence to the diaphragm, diverging and is continued from the fore-part back to the spine, so that this divides the right from the left. The right pleural ligament attaches the pericardium in the same manner, but with this difference, that it goes no farther back than the inferior vena cava, to which it is attached. The pericardium, with its two attachments and the diaphragm, make a cavity; and, as the vena cava is not attached to the spine, there is a passage between the vein and the spines, and through this passage enters a lobe of the right lung, and lies there. The vena cava between the heart and the diaphragm is about 4 inches.

The ventricles of the heart [1] are very smooth, having very few fasciculi, only a fleshy column running between the sides of the ventricle.

The length of the ass from its head to [the end of the] hind feet is 8 feet; the small guts are 40 feet; the great ones 17 feet; in all 57 feet[2]. The whole intestinal canal is, therefore, seven lengths and one eighth of the animal.

The erectores clitoridis are as in the human subject. The clitoris is made up of a strong tendinous coat, which is so thick for 2 inches as to make it stand prominent; and along the upper part it is cellular, but still contained in the strong coat. This coat becomes thin, and the cellular body becomes larger, which is a little prominent in the external vagina, and has a number of eminences on its external surface, of a black colour, standing at the beginning of the external vagina. The plexus retiformis is as usual; but the cells are very large, and there seems to be a large cavity in the middle. The sphincter vagina is as in the human, covering the plexus.

At the beginning of the true vagina, and at the beginning of the meatus urinarius, there is a doubling of the vagina, which is very broad, on the lower surface or next the urethra, but becomes narrower towards the anus; so that that part next the urethra acts as a valve, hindering the urine from getting into the vagina. This is the remains of the hymen[3].

From the external labia to the beginning of the vagina is about 4 inches, forming a passage much the size of the vagina itself, but rather larger: it is smooth, has a vast number of orifices of glands up and down it, and it is on this part of it that the sphincter vagina is placed, with the plexus. The urethra is made up of a strong circular muscle through its whole length; the muscular coat of the bladder does not terminate in the muscular coat of the urethra, but as it approaches the neck it becomes denser, and afterwards becomes ligamentous; but where it is lost I don't know. The vagina is about seven inches long, with a great deal of white mucus, like cream. The os tincæ projects about an inch within the vagina, is about as thick as one's thumb, and is not smooth but scabrous. The uterus is about 7 inches long, and of a pyramidal figure; for, from the beginning of the os tincæ, it is becoming larger and larger towards the fundus: it is thickest at the os tincæ, becoming thinner and thinner; at the os tincæ there are a great

[1] [Hunt. Preps. Nos. 928, and 865, 866 (showing absorbents on the ventricles).]
[2] [Home, Comp. Anat. i. p. 451.]
[3] [Hunt. Prep. No. 2839.]

many longitndinal folds, which become smaller and smaller towards the fundus, where they are entirely lost. The cornua are like those of the mare, the uterus dividing into two equal branches, which become smaller as they pass on, till at last they become very small. The ovaria are smooth bodies, a little oblong, and, as it were, bent on themselves, so that their two ends almost meet [1]. Between the sacrum and the first lumbar vertebra there is a considerable motion up and down, but not laterally [2].

The Zebra [*Equus Zebra*, Linn.].

It is at present impossible to say whether the zebra is an ass, horse, or neither; if it be neither, it is of the same genus; for it has been known to breed with one; that is to say, a male zebra with a female ass.

Loose note.—There was a curious circumstance attended this process. He would not have anything to say to the female ass at first; and to entice him (or to deceive him, if it was upon principle), they painted the female similar to himself, and then he covered her; but the experiment went no further [3].

If we consider them anatomically, we shall not be able to determine this question. The zebra has the two cavities on the sides of the fauces which answer to the [faucial terminations of the] Eustachian tubes in the horse and ass.

The cuticle of the œsophagus is continued into the stomach for some way, and principally on the fore part, running towards the pylorus, and terminating in an edge a little raised, as in the horse and ass.

The cæcum is above 2 feet long [4], and is turned up towards the cartilago xiphoïdes, which it reaches upon the fold of the colon, being attached to this fold by a mesocolon. The colon at its beginning is attached to the loins, kidney, &c. and, as it passes up, it becomes loose, still passing up towards the sternum, when it crosses the abdomen, before the

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[1] [Hunt. Prep. No. 2796.]

[2] [Besides the usual articulations there is a concavity at the back part of each diapophysis of the last lumbar vertebra, for the reception of an articular convexity from the fore part of those processes in the first sacral vertebra: this transverse extension of that joint is shown in Nos. 3180, 3181 (Horse), Osteol. Series.]

[3] [Vol. i. p. 194, Lord Clive's zebra. See also, 'Philosophical Transactions,' 1821, p. 20, for an account, by Lord Morton, of the impregnation of a mare by a male quagga, the hybrid offspring of which is figured in an oil-painting now in the Royal College of Surgeons. This, and paintings of the mare's subsequent offspring by an Arabian stallion, are described by the Editor in his 'Synopsis of the Museum of the College,' 8vo, 1850, p. 99.]

[4] [Home, Comp. Anat. i. p. 459, tab. cxv.]

stomach, to the left; the colon is then continued down the left a little way, and is bent back upon itself, going as far back as its origin, becoming rather smaller at the first part of this turn: it is again turned up upon itself nearer to the spine, where it now becomes a much smaller intestine, passes up upon the back, adhering to the parts behind; it, then, crosses the spine to the left, and becomes a loose intestine, having a long or broad mesocolon, which allows the colon to be thrown into convolutions. The large part of the colon has three bands, the smaller only two: one is at the insertion of the mesentery.

The liver is rather small for the size of the body; it is thin and flat. There is no gall-bladder.

The pancreas[1] has two branches; one runs across the body towards the spleen, having the transverse turn of the colon firmly adhering to it; the other lies in the curve of the duodenum. The ducts from each unite, and enter or unite with the hepatic duct, forming one duct which enters the duodenum five or six inches from the pylorus. There is a small duct which comes off from the other, or from that portion of the pancreas that is attached to the hollow of the duodenum, and communicates with the other, which enters the duodenum nearer its fore-part than the large one, but about the same distance from the pylorus. Where these ducts enter there is a circular fold surrounding them, with a projection in its centre by which one would conceive the ducts entered, but they do not; they enter immediately on the inside of the circular fold above mentioned.

The spleen is a long body, not so flat as in the horse; it is attached to the epiploon. This is attached, on its anterior edge, to the convex arch of the stomach and a little to the duodenum, on the right; thence across the spine, posteriorly, to the pancreas, &c., along with the colon, but not to it; so that this membrane appears only to cover the lower and posterior part of the stomach; for, when the stomach is distended, it passes from the curvature to the back.

The kidney is similar to that of the horse and ass. The two lateral processes going from the swell of the ureter are rather shorter and smaller than those of either horse or ass. There are some small arteries coming from the surrounding parts, which enter the body of the kidney on its exterior surface[2].

The capsulæ renales are two oblong bodies, very much of the shape and size of the shell-fish called mussel [*Mytilus edulis*]. They are

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[1] [Hunt. Prep. No. 822.]

[2] [The structure of the kidney of the zebra is shown in Hunt. Preps. Nos. 1215, 1216.]

yellow on their outer or cortical substance, and of a dark ash colour on their inside.

Of the Parts of Generation.—These parts appear to be the same with those of the horse.

The vasa deferentia swell into two canals behind the bladder. The two vesiculæ seminales are large, oblong bags, of a gentle pyramidal figure; the fundus the largest. There is a long small duct[1] between the two vasa deferentia, running in the doubling of the peritoneum that unites them behind the bladder, which is forked at its extreme end similarly to that in the horse; this opens into the urethra between the openings of the two vasa deferentia.

The Tapir [*Tapirus Americanus*[2]].

This animal is about the size of a common-sized hog[3]; and, when seen at a little distance, so as not to see its peculiarities, it would be taken for one. The body is shaped like a hog's; the back is arched; the legs are thick and short; the fore-foot has four toes with small hoofs of a dark colour: I call these hoofs, as they inclose the toe. The hind-foot has only three. The tail is remarkably small and short. The one from which this description is taken measured, from the tip of the nose to the end of the tail, 5 feet 6 inches: the height at the shoulder was 2 feet 8 inches; at the crista of the ileum 2 feet 5 inches. The character of the head seems to be between that of the rhinoceros and the hog. The nose projects about 2 inches beyond the teeth, forming a proboscis, which is muscular; and from the nasal bones arise two considerable muscles, which are inserted into the tip of the nose; all of which must give this part considerable motion; and the two last mentioned muscles must give considerable strength in raising the proboscis, which is probably used in digging up the earth in search of food. The eyes are small and of a darkish colour. The ears project upwards and backwards, and are rounded. The anus is very large, and the common skin of the body terminates all at once in the gut, not becoming gradually thinner and thinner till lost in the intestine[4]: this termination looks like a cut edge in the common skin, and is a little scolloped. The colour of the hair is of a dusky hue, and short, ex-

[1] [The 'protometra:' Hunt. Prep. No. 2544.]

[2] [The skull of this animal is No. 2879, Osteol. Series.]

[3] [The immaturity of the animal is shown by the concealment of the last molar tooth in its formative cavity, in both jaws of No. 2879.]

[4] [Hunt. Prep. No. 754.]

cepting on the back part of the head, and beginning of the neck where it is much longer. There are only two nipples, situated between the two thighs, or lower part of the abdomen. The external part of generation, or bearing, has a peak like the sow. On raising the uterus from the rectum in the pelvis, we find their connexions much higher than in animals in common; even higher than the connexion of the bladder. The common vagina is not long, about 2 inches. There is a pretty considerable ridge at the mouth of the proper vagina which may be called a hymen. The proper vagina is very long, which makes the connexion between the rectum and this part so extensive. It is wide, as also pretty smooth. Its adhesion through its whole length to the rectum is so close as not to be easily separated. The os tincæ hardly projects; it is wide. The common uterus is short, not 2 inches long. The two horns go off laterally, are long and very rugous, which rugæ are parallel with the horn, viz. longitudinal. The ovaria are small and flat oval bodies. The Fallopian tubes run on the membrane, which forms a loose capsule, but does not cover the ovarium. There were little sacculi at the attachment of the ovaria[1].

The lungs appear to be a congeries of small lobes united together and covered by the pleura. The lung on the left side has two fissures in its anterior thin edge; one opposite to the base of the heart, the other near the apex; and in the space between the two the lungs are mostly wanting, to allow of the heart to be placed there. Its upper anterior edge terminates in a process which comes forward toward the mediastinum; and the lower part of the anterior edge, below the lower fissure, comes forward below the heart, toward the mediastinum below. The lung on the right side is nearly the same, but is divided more distinctly into three portions, one corresponding with the upper portion of the left, the middle coming before the right of the heart, and the lower still more forward, below it, or between the heart and diaphragm. A small lobe of the lung is contained behind the inferior vena cava, and lies between the diaphragm and heart. The trachea is not large; therefore the animal probably has not a strong bass voice: its cartilages are very thick and broad. The heart is very large; is shorter, broader, and more compact than in most animals. The thoracic duct is large. The liver is not large, and is divided into four lobes; the left being the largest, and the rest becoming smaller to the right. The middle lobe, which receives the umbilical cord, is divided on its lower edge by three fissures, and is again subdivided into smaller lobules. The right lobe is contained behind the porta, forming the lobulus Spigelii. There is no

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[1] [Hunt. Prep. No. 2778.]

gall-bladder. The spleen is a long body, similar to that of the ox, lying fixed in the doubling of the epiploon.

Kidneys.—Their external shape is much like that of the human, but I believe each is only one gland, not partially conglomerated, as in the human subject: the right kidney is the highest. They have no mammilla; but the ducts open into the pelvis, like that of the horse[1]. The capsulæ renales are oblong, situated on the upper and inner part of the kidneys: when split, they are composed of two substances very like the kidney: the external part is yellow, and the internal a lightish brown: these substances are fibrous, running from the circumference to the centre[2].

The epiploon is fixed to the great arch of the stomach, to the duodenum on the right, to the upper part of the colon below; also to the upper edge of the left kidney. The tongue is long and rather small. The os hyoides is attached to the head. The œsophagus has a capsula between the diaphragm and heart on its fore and right side, which also takes in part of the aorta; and is continued with them through the diaphragm[3].

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[1] [Hunt. Prep. No. 1217: compare with Nos. 1208—1214.]

[2] [Ib. No. 1286.]

[3] [In an American tapir dissected by the Editor at the Zoological Gardens, which measured 6 feet 2 inches from the snout to the vent, the length of the small intestines was 45 feet, of the cæcum 15 inches, of the colon and rectum 12 feet; the girth of the cæcum was 2 feet 8 inches. Mr. Clift has appended to his copy of Hunter's notes the following on the anatomy of the Sumatran tapir dissected by him in the year 1822:—

Sumatran Tapir;
Stuffed, in the Museum, 1822.

Male. The œsophagus measured in length 2 feet. Length of stomach in a right line, which in form very much resembles the stomach of the rhinoceros, 1 foot 8 in.; breadth 9 in. The stomach has the cuticle extending on each side of the termination of the œsophagus. The greatest extent towards the pylorus as in the hog. Length of the small intestines 69 feet. The valvulæ conniventes did not extend so far as in the rhinoceros; but were very distinct towards the cæcum. Length of the cæcum from the entrance of the ileum 1 foot: greatest breadth of cæcum 1 foot. The cæcum is honeycombed internally, and had an appearance of tassels, somewhat like those represented by Mr. Thomas in his paper in Philos. Trans. on the Rhinoceros; nearly of the same form, but not so conical as in the rhinoceros. Length of the great intestines from the cæcum to the anus, 19 feet 6 inches: of which the rectum measured 1 foot 3 inches; the diamteer of the rectum 6 inches. Diameter of colon at its widest part, which is 3 feet below the cæcum, 8 inches. The colon dilates very much about a yard below the cæcum, and then becomes small again as before; is 8 inches wide for about 2 feet in extent, so as to look like a stomach. The colon appeared to have but one band, towards its termination. The spleen was very long and narrow; in length 2 feet 3 inches. The kidneys were conglobate and simple. The heart was as usual in mammalia, viz. two auricles and two ventricles conjoined.]

[Order PROBOSCIDIA.]

THE ELEPHANT [*Elephas Indicus*, Cuv.[1]].

The length of the trunk or body from the anterior part of the breastbone was 3 feet 9 inches. The abdomen is very large for the size of the animal. The thickest part of the belly was about 7 feet 6 inches in circumference. The fore-legs are at a greater distance from each other than common in quadrupeds, although they have no clavicles: this width we may suppose is to allow of the increase of the udder. They have two nipples, one on each side of the sternum, situated between the arms; about the size of those of a common bitch giving suck. The skin is very thick and tough, but is soft to the feel[2].

There is a strong ligamentous substance covering the whole abdomen and thorax, attached also to the spine of the scapula. On the abdomen it is thickest, especially at the linea alba. Besides the tendinous fasciæ surrounding the muscles, as in the human subject, there are other fasciæ of a yellow colour, thicker, and exceedingly elastic[3]. The use of these last is to supersede the necessity of the more frequent contractions of the muscles underneath. The cellular or uniting membrane is generally of a very singular nature: it is extremely fine in texture, and extremely close; so much so as not to be pulled in the form of cells, but rather as if matted: it is extremely elastic. However, it is not universally the same; where considerable motion in the parts is wanted, it is of a looser texture, such as that of the penis and prepuce.

The two ossa ilei are spread wider than what is common to quadrupeds; very similar to those in the human subject, but, instead of the abdominal muscles being inserted into the upper part of the ossa pubis, they are inserted into the lower part, so that the whole length of the pubis is taken into the cavity of the abdomen. I suspect too that the diaphragm is higher than common, especially at the lower or fore part. The peritoneum is united to the surrounding parts by a vast quantity of cellular membrane similar to that which unites the lungs to their surrounding parts, excepting to the diaphragm. The epiploon is attached all along to the great arch of the stomach, spleen, and anterior transverse arch of the colon, and covered great part of the small intestines, as in the dog. It was thin, transparent, forming a bag, as in a young child, and had lines of adeps, in which was some stony matter accompanying its vessels.

The stomach, on the whole, is of the shape of the human stomach,

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[1] [The Hunterian specimens of the osteology and dentition of the Indian elephant are:—Nos. 2658—2660, 2662, 2713, 2724—2744, 2763, 2770, 2781—2821.]

[2] [Hunt. Preps. Nos. 1846, 1898, 1956.] [3] [Ib. No. 74.]

but is more oblong, and not so much curved: it is longer at the great end, and more pointed. It is 2 feet 10 inches long, and as much in circumference at the thickest part. There are some valvulæ conniventes near the great end of it, but these do not go quite round[1]. The valve of the pylorus is not so evident as in the human subject.

The duodenum becomes immediately loose, and is thrown into convolutions: it does not pass far down the right side, but crosses the spine to the left, pretty high, without being obliged to pass upwards, as in most quadrupeds: in this last course it is considerably attached. The duodenum is about a foot long, and 11 inches round; as also [in regard to circumference] the jejunum and ileum when blown up. The length of the small intestines is 17 feet[2].

The valvulæ conniventes are, some longitudinal, others transverse, with all the varieties between them[3]. The intestinal glands are of the aggregate follicular kind[4], as in the ass. The lymphatics on the guts are smaller than the arteries, and the lacteals on the mesentery are smaller than in the human. There are no lymphatic glands on the mesentery; but several at the root of the mesocolon; small, oval, flat, dark red, and buried in fat; not larger than in the human subject. The nerves to the intestines went from large distant trunks; not in plexuses.

The ileum passes into the cæcum, and is there only 9 inches round. It passes in nearly at a right angle. The valve of the colon when dried is an oval opening of 1 inch by half an inch. The cæcum is 1 foot 9 inches long; 2 feet 10 inches round. The cæcum is puckered into cells by longitudinal bands which were soon spent in the colon: the longitudinal ligaments are three. The colon goes up the right side, and crosses the body above the duodenum: at the crossing it adheres closely to the duodenum at the root of the mesentery, and to the pancreas; it then gets behind the duodenum, crosses behind the root of the mesentery, &c. to the left, and then goes to form the rectum.

The liver is an oblong body, lying across the abdomen near the centre: it is small for the size of the body of the animal. The hepatic duct was 5 inches long, and very large: it passes some way between the coats of the duodenum[5], where there is a protuberance made by a sphincter

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[1] [Dry preparation in Hunt. Museum; and see Home, Comp. Anat. i. p. 155, tab. xviii.]

[2] [The animal, from the dimensions of the body, was a very young one.]

[3] [Hunt. Preps. Nos. 702, 703.] [4] [Ib. No. 760.]

[5] [The receptacle which the duct here forms is shown in Prep. No. 825. Aristotle refers to this structure when he states that "the gall is remote from the liver" in the elephant. Camper gives a figure of the duodenal gall-pouch in pl. vii. figs. 1, 2, & 4, of his account of the anatomy of a male elephant, in the posthumous 'Œuvres de P. Camper,' tom. ii. pp. 1–282.

muscle: its opening into the gut is as large as the little finger. There is no gall-bladder. The lymphatics of the liver are most numerous on the under surface.

The pancreatic duct is very large, and was filled with a yellow slimy mucus: it enters the duodenum by a proper orifice a little way from the hepatic[1].

The spleen is a long, flat body, and lies in the doubling of the epiploon; its length was 3 feet 10 inches: its greatest breadth was 8 inches. The kidneys are semi-conglomerate, more so than the human, by which means the infundibula are larger. The mammillæ do not project much, so that the tubuli are easily injected, and are not larger than in the human subject[2].

The thorax is short at the fore or lower part, but goes pretty far down or back towards the spine.

The pericardium adheres to the diaphragm nearly as in the human, but not so closely or firmly, by which means the inferior vena cava is nearly as short as in the human, and also adheres by a vast quantity of strong dense cellular membrane to all the surrounding parts; as to the sternum and anterior parts of the lungs, &c.

The heart is broad at the apex, not pointed as in the ox, &c. The venæ cavæ superior and inferior had [at their meeting in the auricle] a considerable 'valvula nobilis[3].' The remains of the foramen ovale were distinct. There are two valves at the termination of the vena cava superior, but not sufficient to shut up the whole area. The jugular vein and subclavian of the left side do not cross the thorax to the right, but unite into one trunk, which passes down the left side of the heart, winds round the basis of the left auricle, and opens into the right auricle, as in many other animals[4]. The right subclavian and the two carotids arise by one large common trunk which soon divides into the three above mentioned; and nearly all at the same place.

The lungs on the left side are composed of one large lobe; also that on the right, excepting the small lobe, or process sent in between the basis of the heart and diaphragm behind the inferior vena cava, which is small, from the union of the pericardium to the diaphragm, there being no great space for this process or lobe of the lungs to lie between these parts, which we find generally to be pretty large in most qua-

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1 [The pancreas is shown in No. 780.]

2 [The suprarenal glands are shown in Hunt. Preps. Nos. 1287 & 2065.]

3 ['Eustachian valve'; see Hunt. Prep. No. 924.]

4 [Most *Rodentia*, all *Marsupialia*, *Monostremata*, birds, and reptiles. Camper does not notice this anatomical character. It is well shown in the dried and injected preparations of the heart of the elephant in the Hunterian Museum.]

drupeds[1]. In this the elephant is more similar to the human subject. The lungs adhered universally to every part they came into contact with; viz. to the inside of the ribs, the diaphragm, the pericardium, to the trunks and vessels going and coming into the thorax. This cellular membrane is much in quantity, so that the lungs may have a considerable extent of motion in the thorax, but it is extremely fine and close, and very strong.

The mouth of the elephant is extremely small for the size either of the head or the whole animal; owing in a great measure to the lower jaw and lips coming to a point, almost like the lower part of the bill of many birds, and indeed the lower jaw is very small in proportion to the size of the head. It is, at the fore-part, considerably narrower than the upper jaw; and the lip of the lower jaw projects a considerable way beyond the jaw itself, forming a groove to the very point, the edges of which are a continuation of the external lips. In this groove lies the tip of the tongue[2]; besides which it serves as a director for the proboscis, which is the active part. The upper jaw is broader forwards than the lower: the lateral lips of this jaw are at a greater distance from one another than in the lower, and at the fore-part they are continued into the nose or snout, so that at the fore-part there is no distinct lip for this jaw. The tongue is narrow from side to side, especially at the fore-part, but is pretty thick; it terminates forwards in a point, fitting itself into the groove in the lower lip. The projecting part beyond the frenum or attachment is bent downwards, making there an obtuse angle with the posterior part[3].

The eye has six muscles as in the human subject. The iris is round. The nigrum pigmentum is thick and dark on the front half of the cavity of the eye, becoming thinner backwards, and at the posterior part there is none to be found, and the choroid coat is there of a light colour[4]. The optic nerve is long: the end next to the brain is pulpy, but the other end is not. The [Harderian] lacrymal gland is placed on the inner canthus of the orbit, and its ducts get on the inner surface of the cartilage of the membrana nictitans, and open on that surface next to the eye[5]. Besides this gland, there is a chain of glands which incloses the edge of the cartilage, whose ducts enter the tunica conjunctiva just where the glands are placed.

The proboscis[6] of the elephant was 3 feet 3 inches long on the upper

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[1] [The structure of the lung is shown in Hunt. Prep. No. 1135: a section of the trachea with the thyroid gland in No. 2064.] [2] [Hunt. Prep. No. 1489.]

[3] [Ib. No. 1490, showing one of the large fossulate papillæ.]

[4] [Ib. No. 1739.] [5] [Ib. Nos. 1779, 1780.] [6] [Ib. Nos. 2082—2084.]

surface; 2 feet 8 inches on the lower: the circumference at the thickest part was 15½ inches. The skin is very thin and closely attached to the muscles. The muscular fibres on the upper surface are regularly longitudinal; on the lower surface they diverge from a middle line passing forwards and outwards. Beneath these regular strata, the fibres are in all directions, and so mixed, there is no tracing them. In every transverse section these fibres have a whitish appearance near to the centre, which is [due to] the muscular fibres near the tubes running through a white substance: this white substance consists of glistening tendinous fibres running in various directions.

The Brain[1].—The dura mater[2] is remarkably thick, partly owing to a number of sinuses or veins in every part; for the veins everywhere are passing into it from the pia mater, and make a plexus. The course of the principal vessels are in the usual place, to wit, on the convex edge of the falciform and transverse processes. The arteries of the pia mater and brain were very small in proportion: hardly so large as in the human subject. The fifth pair of nerves[3] were apparently larger than in other animals, and it was presumed that this might be for the sake of the proboscis. The glandula pituitaria was oblong in the longitudinal direction; not transverse as in the human subject. It was very loosely connected at its inferior surface, and upon its upper surface had a middle cavity lodging a round body like a worm, which was buried in it longitudinally (supposed to be the continuation of the infundibulum), dividing for some depth into two lobes. The cerebellum is larger in proportion to the cerebrum than in the human; nearly as if the posterior lobes of the cerebrum had been wanting; and the cerebrum was much flatter at its upper and posterior parts, where the fissure between the two hemispheres, down to the corpus callosum, was not so deep as in the human. The peduncles of the cerebellum and the posterior part of the corpus annulare were large in the same proportion. The vertebral arteries are wide, to form the basilary artery upon the medulla oblongata, immediately behind the corpora pyramidalia; and the posterior branch of each carotid runs backwards and then downwards to join its fellow in the middle of the corpus annulare.

In the beginning of the medulla spinalis near the centre there were two columns of cineritious substance, one towards each side[4].

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1 [Hunt. Prep. No. 1331.] 2 [Ib. No. 1346.]

3 [See a figure of the commencement of the fifth pair of nerves in the elephant, in A. K. Boerhaave's 'Hist. Anat. Infantis, cujus pars corporis inferior monstrosa erat,' Petersb. 1754.]

4 [Hunt. Preps. Nos. 1366—1372. The cheek-gland of the elephant is shown in No. 2103.]

	lbs.	oz.
The brain weighed	7	7
A woman's, which was stale, weighed . .	2	2
A man's brain	2	12

Organs of Generation[1].—The external opening of the vagina is between the two hind-legs, just where the udder is placed in the female of other animals, or where the testicles are in the male.

The clitoris[2] is very prominent, appearing externally of a dark colour: the labia are continued round it, making a kind of hood or prepuce. On that side of the clitoris which leads to the vagina, it appears as if the urethra had been continued to the end, but was slit up. It passes up towards the anus along the posterior part of the abdomen, or what would be called the perinæum, similar to the penis in many male animals, and has its two crura attached to the pubis: it is cavernous near to the end where it is covered by the glans, which is spongy, similar to the glans penis in man. There are two muscles, arising in common with the erectores clitoridis, which pass along with the crura, getting upon the upper part of the clitoris, and unite into one; which, running along the clitoris in a sheath, is inserted into the upper surface of the glans. The nerves going to the glans are very large.

The vagina passes along the under surface of the clitoris to the opening of the pelvis, and then bends in towards the cavity of the abdomen or pelvis, where it forms its different parts; the construction of some of which are very different from many, if not all, other animals.

The whole cavity may be divided into four, viz.:—

1. The common vagina, which is common to the urine and penis.
2. The proper, or rather uncommon, vagina, where the penis cannot enter.
3. The common uterus.
4. The two horns.

In this animal the common vagina is the whole length where the penis goes; so that there is no proper vagina for the penis, as in most other animals; for at the termination of the proper vagina its cavity contracts at once, almost into a blind end; in the centre of which there are three small openings, neither of them larger than a crow-quill: the two lateral of these lead to two small sacs [canals of Malpighi] which pass a little way along the sides of the common vagina. The urethra

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[1] [Those in the male are shown in Hunt. Preps. Nos. 2528—2531. In the French translation of Camper's works, the following passage occurs in his 'Description Anatomique d'un éléphant:'—"Le célèbre Hunter de Londres doit avoir disequé deux éléphants en 1775, une année après l'auteur."]

[2] [Hunt. Prep. No. 2777.]

opens into the very beginning or fundus of the common vagina; the middle orifice leads into the uncommon vagina, which soon dilates[1].

[Subclass LISSENCEPHALA.

Order BRUTA.

Family *TARDIGRADA*.

Genus BRADYPUS.]

THE TWO-FINGERED SLOTH[2], or L'Unau of Buffon, vol. 13, p. 58 [*Bradypus didactylus*, Linn.].

The thorax is short. The heart is short and round at the apex: the two auricles almost cover the anterior surface of the basis of the heart: the pericardium adheres to the diaphragm by loose cellular membrane. [The thoracic part of the] vena cava inferior is short. The lungs, both right and left, consist of one lobe; and there is no lobe between the heart and diaphragm. The upper ends pass up into long small points, being not so obtuse as in most other animals, and going up a considerable way above the heart: their anterior edges adhere firmly to the sides of the pericardium, those edges not coming so far forward upon the sides of the heart as in other animals. They seem to be composed of small lobes which are united by cellular membrane, like those in the human fœtus. There was a conglomerated body in the situation of the thymus.

The liver has three lobes, viz. two with the Spigelian; the right is the largest, and the ligamentum rotundum enters its convex surface, and passes through its substance: it has also a pretty large fissure in it. The anterior surface of this lobe at its upper part has a falx passing from the ligamentum rotundum to the right side, attaching it to the diaphragm and abdominal muscles of the right side. The liver lies on the right side, occupying nearly the right half of the abdomen at this part, the first cavity of the stomach occupying the other half. The gall-bladder, in Dr. Blane's[3], lay in a fissure, and its fundus appeared

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[1] [Ib. Nos. 2775, 2776. In a preparation of the female organs of an elephant, in the museum at Guy's Hospital, the true vagina is very long and capacious, as in the cavies, and the cornua uteri commence from a very short corpus, as in the same *Rodentia*. For the fœtal membranes and placenta of the Indian elephant, see 'Philosophical Transactions,' part ii. 1857.]

[2] [Hunter quaintly calls this subject of his scalpel "Mr. Two-fingers:" it is characterized by two long-clawed digits on the fore-foot, and three such digits on the hind-foot.]

[3] [Afterwards Sir Gilbert Blane, physician to the forces.]

on the convex surface; it adheres to the under surface of the large lobe of the liver. The ductus cysticus, in Dr. Blane's, passed down through the substance of the liver and emerged at the aorta like the ductus hepaticus; it then joined the ductus communis, and entered the duodenum about an inch from the pylorus.

The pancreas lies in the root of the mesentery; its left end gets loose in the posterior part of the epiploon, or what may be called the attachment of the last cavity of the stomach to the root of the mesentery upon the right: as the pancreas passes along the mesoduodenum it becomes smaller and its duct enters the duodenum about 4 inches from the pylorus.

The stomach consists of different pouches: the first or large one is situated on the left; the last cavity passes to the right, as the last part of the stomach does in common. The first cavity of the stomach adheres by a pretty broad surface to the diaphragm.

The epiploon is narrow, hardly making a doubling, and is attached to the last cavity of the stomach forwards, and to the root of the mesentery backwards. The spleen is almost round, flat, and thin, and is pretty closely attached to the second cavity of the stomach. The mesentery is long from the upper to the lower end, and is narrow from side to side, or from right to left.

The small guts are immediately attached to the right of the mesentery: the intestine passes down the right side and is much convoluted, the turns being short; it gradually twists towards the left behind the mesentery, and then forwards as coming to the right again; when it forms what I shall call a colon without a cæcum. The mesentery is so loose as to be twisted; therefore the true position of the intestines is not to be ascertained.

The colon may be said to begin at the lower end of the mesentery, or at least the gut almost immediately becomes large here; it takes a turn in the contrary direction, back to the left along the opposite edge of the mesentery, and then passes down the loins to the anus[1]. The fæces were a uniform gelatinous mass. There are three valvular parts in the intestinal canal; the first at the beginning of the colon, the next about its middle, and the last near the anus, or in the pelvis; after this the gut becomes very large, like a fowl's.

The kidneys lie low in the loins; each has only one oblong mammilla. The capsulæ renales are long and large bodies, and are more in the usual place of the kidneys[2]; but this was a fœtus. [Added note: (In another, about half-grown, it was the same.)]

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[1] [Home, Comp. Anat. i. p. 434.]

[2] [Hunt. Prep. No. 1279.]

The horns of the uterus are short. The vagina opens close to the verge of the anus, but externally, on a pretty obtuse prominence. By the sides of this prominence, close to the verge of the anus, are two pretty deep fissures, or cavities, which are glandular, and secrete, probably, an essential oil, as in the beaver, &c. The clitoris nearly surrounds the mouth of the vagina, like the hymen in the human subject. The common vagina passes up and seems rather to be continued into the urethra than into the uterus. About half an inch from the clitoris open the two ora tincæ[1], which pass upwards; but they are so small that it is hardly possible to pass anything into them: they seem to pass up to two bodies, which seem to be glandular, and which bodies appear, on viewing them externally, to be the two short horns of the uterus. The ovaria lie almost upon the kidneys. The body of the uterus is a pretty large bag of a pyramidal figure; whether it has horns, or they are only the Fallopian tubes, I could not tell. The vagina opens externally, distinct from, but very near to, the anus[2].

[*Bradypus didactylus.*]

In an old one which came from the southern part of the continent of America, the contents of the thorax, abdomen, and pelvis brought home, in spirits, by Dr. Blane, were given to me, and I took the following description from the female parts[3].

The common vagina [uro-genital canal] appeared to be very short, and the principal opening from it is the urethra; a number of small orifices of glands studded its surface. The proper vagina opens or begins by two orifices which open immediately into one cavity or canal. This cavity is about 2 inches long; and near the fundus or further end it dilates and becomes somewhat of a pyramidal figure, terminating in two corners, like the human uterus. There is no os tincæ; but it appears to be plain [or visible] where the uterus begins; for this pyramidal part has eminences on its inside. There is a large capsula ovaria which is close to the corners of the uterus: at the upper edge of the broad ligament, rather behind and close to the corner of the uterus, is the opening of the capsula ovarii, which is small in comparison with the capsule itself. On the anterior edge of this orifice is the fringe, or opening of the Fallopian tube: the tube runs in a serpentine course upon the capsule and opens at the corners of the uterus at the fimbriæ. The ovarium is a flat oblong body attached to the posterior surface of the capsula. The lateral attachment of the uterus called the broad ligament, in which are the parts above described, has its upper edge

[1] [The two orifices of the vagina mentioned below.]
[2] [Hunt. Prep. No. 2753.] [3] [Ib. No. 2752.]

continued up the loins (almost similar to the horns of the uterus in many quadrupeds) and is attached to the lower end of an oblong body which may be supposed to be the capsula renalis [remnant of the 'corpus Wolffianum']: but there is a body [the true supra-renal one] placed upon the upper end of the kidney, which is not so like the capsule in structure as this I have been describing.

This animal has a very long hand and foot; it has two fingers on the hand with very long claws, and has a longer foot with three toes, also with very long claws. Both the two fingers and the three toes are united, similar to the metacarpus and metatarsus in other animals; therefore the two fingers must move together, as also the three toes.

The hair is not thick; it is about an inch long, pretty strong and waving: it is of the same kind in every part, no one part having two kinds of hair. I found in the stomach of Dr. Blane's specimen, leaves of plants, seeds, and something similar to twigs and the inner bark[1].

The Sloth, or Ai of Buffon [*Bradypus tridactylus*, Linn.].

The lungs adhere to the diaphragm all round the vena cava inferior; and from this adhesion there would seem to go out in a radiate manner muscular fibres, diverging on the lower concave surface of the lungs, adhering to them, and being there lost. If this is muscle, the use must be to contract the lungs and counteract the diaphragm. The lungs also adhere to the pericardium.

The trachea[2] passes down on the right of the aorta, close to the spine, through the whole length of the thorax; and, when got as far as the diaphragm or lower part of the lungs, it bends up upon itself, which fold is before and a little on the left of the other; and, behind the heart, it makes a turn forward and downward, and there divides into two branches, one going to each lung: these have but two lobes on the right, and one on the left side. The cells are very large; much more so than in any other quadruped that I know.

The œsophagus is small; the stomach is large, and of a very singular shape (*vide* Preparation[3]). The last part of the stomach, which I suppose is the digestive part, is somewhat like the last bag in the ruminants: it passes to the left under the liver in a contorted course, and terminates in a stricture or pylorus. The duodenum passes down the right side, loose, as low as the lower part of the abdomen, in a convoluted manner, and is then bent up upon itself in the same manner

[1] ["In the stomach were found leaves, seeds, twigs, and the inner rind of the bark, showing the kind of food the animal lives upon."—Home, Comp. Anat. i. p. 434.]

[2] [Hunt. Prep. No. 1154.]

[3] [No. 310, Dry Prep.]

nearly as high as the stomach; it then makes a turn down again and swells into a large straight gut, the rectum.

The stomach was full of a substance of a fibrous kind like the chewed bark of a tree. The colon was filled with small round fæces, like those of a rat, only somewhat rounder. The epiploon is a very narrow membrane, only attached to the last part of the stomach, as it were, spread upon it, and attached by its edges all around. The spleen is in this membrane, and is an oblong body, an inch long, thicker at one end than at the other.

The liver is broad and thick, very much like the human; only the left edge is not so thin, nor does it extend so far to the left. There was no gall-bladder that I could perceive. The kidneys are conglobate, with one mammilla of course. The bladder is a round body when much contracted. The urethra passes along, like the urethra in she-animals, in a straight direction, and opens into a prepuce, which is in some measure common to the penis and anus, like the opossum's, and then runs along a groove in a small projecting body, which I suppose to be the penis.

Parts of Generation.—Looking upon the rectum, we observe two bodies like the horns of the uterus in brutes, one passing to each loin, twisting obliquely round the rectum. Pretty near their union, which is on the fore-part of the rectum, behind and a little above the bladder, stand two rounded bodies, which I suppose to be the testicles. The whole of these parts at first view appeared to be female, and these two bodies the ovaria; although they were too near to what might be called the body of the uterus. The penis is a short flat body enclosed in a prepuce, which is within the verge of the anus. It is not above two-tenths of an inch in length, and terminates in an obtuse point. It has a groove which runs along its under surface, and which makes the point somewhat forked. The bones of the pubis are small, pass across the rectum, and are united by a cartilage of some length[1].

[THE TWO-TOED ANTEATER,] Fourmilier of Buffon, vol. x. p. 144. [*Myrmecophaga didactyla*, Linn.]

This animal has two fore-claws [on each fore foot]. The stomach is pretty globular, not much projecting at the great end. The duodenum passes to the right, then turns from the right to the left; in this last part it becomes larger and appears to contract at once into jejunum; it is attached in this course by a short mesentery; but the mesentery becomes longer, and the gut is thrown into convolutions forming the

[1] [A fœtal Ai is preserved, Hunt. Prep. No. 3480.]

loose intestines. The ileum passes towards the left, just below the stomach, similar to the colon in many animals, and ends in the colon. There are two cæca, as in birds. The colon and rectum are but short, and are one continued gut passing down the left to the anus.

The liver has three lobes; the middle lobe is attached to the ligament; there is no Spigelian lobe. The gall-bladder is attached to the ligamentum teres.

The pancreas is a long small body crossing the stomach obliquely; its end or tail is attached to the epiploon, and to the transverse arch of the stomach about midway between the two ends of the stomach; from thence it crosses the stomach on its posterior surface towards the small curve, and then to the right to the curve of duodenum.

The spleen lies along the great curve of the stomach, just along the attachment of the epiploon; its right end is very near the pylorus. The kidneys are conglobate. The bladder is pendulous. The testicles are within the abdomen, and are fixed, not moveable as in the mouse, &c.[1]

[The Short-tailed Manis. (*Manis pentadactyla*, Linn.; *Manis brachyura*, Erxl.)]

Pangolin from Sumatra. (The entrails of one brought home by Mr. Griffiths[2].)

This animal has no teeth, nor can it be said to have gums; not even like the mouth of a young animal not near cutting its teeth.

The œsophagus is not small. The stomach appears to be wholly lined with a cuticle; it is small, is thick in its coats, and is very much bent upon the great end. In the small end and just at the pylorus, there is a pyriform protuberance, with its thickest projecting end towards the stomach[3].

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[1] [The head, with the tongue of this animal, is the Hunt. Prep. No. 1502.]

[2] [J. Griffiths, Esq., author of a paper "On a rare species of Worm-shells discovered at an island lying off the north-west coast of the Island of Sumatra," in the 'Philosophical Transactions,' vol. xcvi. p. 296. The following note is appended to the present MS.:—

"Mr. Griffiths presents his compliments to Mr. Hunter, and begs leave to acquaint him that the entrails, &c. of the Pangolin, or Ant-eater, from Sumatra, which he brought home for his inspection, have been entirely spoilt from their long detention at the India House. Mr. Griffiths takes the liberty to send them, that Mr. Hunter may see the state they are in, and will do himself the honour to call in a few days with the aquatic snail that he mentioned when he had the pleasure to accompany Mr. Broff to breakfast in Leicester Square.—Queen Square, No. 6, Thursday morning."]

[3] [Hunt. Prep. Nos. 542, 543. The gastric gland, situated at the middle of the great curvature, is shown in the preparation added by me to the Hunterian Series, No. 590 c.]

The duodenum passes down the right side, and I believe gets on the right edge of the mesentery; but whether the whole makes a twist so as to make the duodenum pass behind the root of the mesentery which would make the jejunum go down on the left of the mesentery, I do not know. The ileum passes up again on the opposite edge of the mesentery nearly as high as the stomach, and is bent quickly down to form the rectum. The intestines are short. At the verge of the anus there are two glands, or rather two bags containing a yellowish mucus. The inside of this bag has a glandular substance projecting inwards like the cotyledons of the uterus of a ruminating animal, and all about the anus, under the skin, there are a number of small glands, whose ducts open on the surface of the skin, containing a white mucus, which, when squeezed, comes out like paint from a bladder. In each duct are growing hairs, which emerge externally from the duct[1]. The liver has four distinct lobes: the gall-bladder is attached to the second from the left side. The kidneys are conglobate; each has but one mammilla.

Parts of Generation.—I suspect the testicles are within the abdomen, for there is no scrotum. The vesiculæ, whose ducts enter the urethra in a separate sulcus from the common canal (such as fig.). [A drawing of this structure would seem to have been made and appended to the MS., with which it was probably destroyed.]

This animal, I should suppose, is a burrower. It is strong for its size. It has a strong neck, strong legs, especially the fore. The talons are strong, and a good deal worn down. The tail is very strong, and I believe the animal uses it by way of holding. The scales are grooved longitudinally; but where they are exposed they are pretty smooth, which I conceive is caused by his going into holes or small passages.

The Armadillo with Nine Bands. [*Dasypus* 9-*cinctus*, Linn.]

The head, back, and tail, are nearly covered with shells or scales, so arranged as to resemble a coat of mail. That on the head is of an oval form, nearly the shape of the [upper sur]face, extending from the ears above, down to within an inch of the point of the nose. On each side there is a notch to allow of the motion of the eyelids. This terminates all round in the common skin of the animal. That on the back makes one general covering; but is made up of three parts, an anterior, middle, and posterior; they all terminate in one regular edge all round: the anterior part covers the whole of the shoulders to which it adheres, and hangs down on each side to the feet, covering the whole of the legs: its fore part is hollowed out, or has a large notch in the middle

[1] [Hunt. Preps. Nos. 2133, 2134. Home. Comp. Anat. i. p. 429.]

of that edge to allow of the motion of the head, but comes forward on each side so as to join that on the head when the head is drawn in. The middle part of the covering is made of nine bands passing from side to side, or from edge to edge, across the body, terminating in a thin edge, and reaching as low down as the anterior portion, or that part which covers the shoulders. The bands are about 2 inches broad, lapping over each other; the posterior edge overlapping the anterior edge of the one behind, for about half their breadth, and connected together by a loose skin, which, being elastic, allows of considerable motion so as to bring edge to edge. The posterior part which covers the rump is anteriorly connected with the last of the moveable bands before described, and at its edges there is a fissure for about 2 inches, admitting of motion similar to that of the bands. Posteriorly, and in the middle, it is hollowed to allow of the motion of the tail, similar to the anterior for the head; and is rounded off on the two sides with a loose edge which joins that of the bands, covering the whole of the thighs. The anterior and posterior [parts of the armour] appear to allow of the motion of the parts which they cover, independently of the covering itself, like the head and feet of the tortoise; but the middle part seems to move with the body, or perhaps may give motion to the body by its own muscles. Some of the muscles of the head and extremities arise from the inside of this covering, as in the turtle. The tail is entirely covered with scales, formed into rings, which are of different breadths, the broadest being near the body, and about an inch in breadth, which are moveable upon one another; the posterior edge of the anterior ring overlaps the anterior edge of the one behind. The skin of the lower rings has much less motion than that of the upper. The upper rings of the tail lap over those immediately under them. This is less and less the case as you descend, for about ten rings, when they only meet each other, and still lower the rings are much blended, or become less distinct. This is less evidently the case on the inferior surface. The anterior edge of all the rings, whether of the body or tail, is thinner than the posterior edge: they are exactly like feather-boarding. The skin of the belly, thighs, and legs, is studded all over with little eminences, each of which is covered with a thin scale, and on each are placed three hairs. These eminences are disposed in pretty regular rows across the fore parts of the legs[1]. The legs are short, and the feet are crusted over with scales like the foot of a bird, which they resemble, in some degree. The fore foot has four claws; the two middle ones are of unequal length and are but little divided; the two

[1] [Hunt. Prep. No. 1899.]

external [outer and inner] ones are smaller and resemble each other in shape, size, and exactly oppose each other. The hind foot has five claws; the middle one is the largest and the longest, the next on each side are a little shorter, but resemble each other; the two outer [outer and inner] ones are much smaller, but are also alike. The ears are nearly 2 inches in length, and are covered with a scaly cuticle. The nose terminates in a flat surface like a hog's, on which open the nostrils, and the anterior part has a projecting edge. The under jaw is shorter than the upper, and has considerable motion and strength. There are no teeth in the anterior parts of the mouth in either jaw. The tongue is exceedingly long; round on the under surface, but more flat on the upper; it is conical, and terminates in a point[1].

On each side of the anus there is a gland, whose duct is large, and opens externally by a large orifice[2]. The penis in its relaxed state is about 2 inches in length, has no sheath or prepuce, terminates in a point, and appears to have no glans, the ends of the corpora cavernosa making two nipple-like processes about half an inch from the point or end of the penis. There are four nipples; two on the lower part of the belly between the thighs, and two upon the breast.

The stomach is pretty globular; the œsophagus enters pretty near the pylorus, so that the hollow curvature is but small or short. The pylorus is loose, not bound down to the back as in the human subject. The duodenum has a pretty broad mesentery, and so has convolutions: it passes to the left, behind the mesentery, being connected to the posterior part of the root of the mesentery, but is exposed through its whole course; it gets on the left edge of the mesentery, and becomes a loose intestine, forming jejunum and ileum. At the lower part of the belly it enters the colon, or rather dilates into colon, which passes up on the right side, attached to the right edge of the mesentery, at the root of which it is more closely connected; it then crosses the spine, having a mesocolon of its own, passes down on the left side, and forms the rectum, which terminates in the anus; on the sides of which are two bags, or rather two large ducts or glands, which open just by the verge of the anus, and which glands secrete a fetid musk or rather castor-like mucus: its internal surface is covered with small glands. In both mesentery and mesocolon there were a number of lymphatic glands. The great epiploon is attached to the stomach on its fore part, and to the pancreas behind, on the left to the spleen, and on the right to the beginning of the duodenum. The small epiploon is connected

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[1] [Hunt. Prep. No. 1501. The salivary glands and bladders, which seem to have escaped Hunter's notice, are shown in Nos. 772B, 772C, Physiol. Catalogue, 1833, vol. i. p. 228.]

[2] [Ib. No. 2132.]

to the small curvature of the stomach, pylorus, and duodenum below, and the liver above. The liver is divided into four lobes besides that of Spigelius: the gall-bladder is connected to the under surface of the second lobe from the left, and to the same lobe is attached the falciform ligament. The liver is not connected to the convex surface of the diaphragm; and on pulling down this viscus, the vena cava inferior may be seen between it and the diaphragm: the liver is pretty large. The spleen is large, oblong, and connected to the stomach by means of the epiploon. The kidneys are conglobate. The capsula renalis is pretty large.

The testicles[1] are placed within the cavity of the abdomen on the brim of the pelvis, connected to the part which answers to the ring, by their proper ligaments; at this attachment the cremaster muscle makes a doubling inwards so as to be ready for inversion. The epididymis, where it terminates in the vas deferens, makes a turn upon itself and then dips into the pelvis. The vesiculæ seminales are each one bag honeycombed on the inside. The caput gallinaginis is before the membranous part of the urethra, between the two crura, so that the ducts of the vesiculæ and the vasa deferentia pass through the substance of the membranous part of the urethra, to open there. They open separately. The vas deferens dilates considerably in its passage along the membranous part before it opens, and loses its firm consistence; becoming membranous.

The transversalis muscle arises from the spine of the ileum, and also from the brim of the pelvis near the sacrum, and lines the iliacus internus muscles. The cavity of the chest was small and flat, a good deal shaped like the human.

The lungs on the right side are divided into three lobes, on the left into two; the edges of which are subdivided. It has no lobe behind the vena cava inferior excepting a small process of the lower right lobe which just goes behind the vena cava. The pericardium was not attached to the diaphragm. The anterior mediastinum is very narrow. The heart is very oblong, and the apex very much to the left side.

The os hyoides is connected to the head. The opening of the eyelids is small: the eye is small and deep-seated: the cornea is large: there is a membrana nictitans, or rather a cartilage on the inner canthus of the eye: there is a large lacrymal gland: the choroid is wholly lined with nigrum pigmentum. The nose is similar to that of a hog, being fit for uprooting. The claws are long. There is a sort of uvula, but it is not loose or pendulous. The flesh is pale, like veal.

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[1] [Hunt. Preps. Nos. 2560, 2561.]

Order INSECTIVORA.

Section CHEIROPTERA.

LARGE BAT, SOUTH SEAS [*Pteropus*[1]].

The anus appears to be upon the lower part of the belly; and just close upon the anus is the mouth of the vagina in the female, and of the prepuce in the male. There is no cæcum. The epiploon is very small, attached to the stomach, pancreas, and spleen, between which parts it is almost stretched. The liver is divided into five lobes with the lobulus Spigelii; the gall-bladder is attached to the second from the left side by a thin membrane. The kidneys are conglobate.

The lung on the right side is divided into three lobes; the middle lobe is fissured, and the lower or third lobe sends in the lobe behind the vena cava; the lung on the left side is divided into two lobes, the lower of which has a fissure in it. The trachea is as in the quadruped.

Upon the fore part of the pericardium are placed two flat glandular bodies which almost cover the anterior part of the heart.

The common vagina goes considerably higher on the under side than the os tincæ. There are two horns which open into one common uterus. This bat has one young at a time, and there is one placenta, which is of the [discoid type]. The fœtus and appendages occupy one horn and the whole of the common uterus[2].

Of the Male.—The penis is large, with a bone at the glans, the testicles are large, and lie in a sulcus, just out of the abdomen; but seem, when looked to from the abdomen, as if this could be easily pulled in. The vesiculæ seminales are large.

THE BAT [*Vespertilio*].

The stomach comes to a point at the large end, which is a little turned up. The duodenum is like [that in] other animals. It has no cæcum. The intestines are very short, like those of the martin, about three times the length of the animal[3].

The liver is divided into three lobes, but I could not find any gall-bladder. The kidneys are pretty large, that is, longer than common for such a sized animal.

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[1] [The skulls of the bats here dissected are Nos. 2418 and 2419, Osteol. Series.]

[2] [Hunt. Preps. Nos. 3578—3581. The pectoral mammæ and teats are shown in Nos. 3754 and 3755.]

[3] [Home, Comp. Anat. i. p. 433, "In the English bat," &c.]

The kidneys are conglomerated, with some vessels on the external surface. The testicles lie on the ossa pubis. There is no protuberance on the external part or beginning of the vagina. The uterus has two horns. The ovaria are inclosed [each] in a capsule.

When kept in a cage, they eat flies and meat. One which I kept ate flies in preference.

In a bat which we knocked down, I found in the stomach the wings and legs of gnats. There appeared on the rectum a small process like a cæcum; the fæces were soft. There was no urine in the bladder: it probably makes water before it begins to fly. Probably [the circumstance of] birds having no urinary bladder is to avoid weight.

On the 13th of November, 1789, a pretty mild evening, I saw a bat flying in the yard of the White Hart Inn, at Colnbrook.

The Mole [*Talpa europæa*].

The chief strength of this animal seems to be in its fore part, viz. the neck and fore legs, which are stronger than in any other animal of its size.

The larynx has something very uncommon, viz. the epiglottis and arytenoid cartilages are continued all round, nearly of an equal height, so that the epiglottis cannot cover them, but is pushed back; and its edge meets the edges of the arytenoid cartilages pretty equally, and there the posterior edge (which is the arytenoid) is bent back on itself, and of course is covered by the anterior edge, [which is] the epiglottis.

The chest is very long, so that the lungs are large, but not so much as one would at first imagine; for the shoulders are a good deal farther forwards than the most anterior part of the chest. If the lungs are larger than in other animals of the same size, it may be owing to the mole's often being in a situation where respiration must be obstructed.

The external ears are very small; this is because it can only hear sounds from near causes.

The œsophagus is long below the diaphragm, and enters about the middle of the stomach. The stomach is very large, filling nearly the half of the abdomen; it was filled with worms and grubs of various sorts. The pylorus is only a little stricture. The duodenum is as in the dog, &c. The other intestines are as in the ferret, &c.; but a great deal longer in proportion to the animal, being about seven times the length of the animal. There are no bags at the anus[1]. The fæces are soft. There are no ossa pubis. The anus passes half an inch beyond the crura. The penis is under the tail and is bent downwards.

[1] [Home, Comp. Anat. i. p. 431.]

Is the want of the ossa pubis for the easier passage of the animal through the earth?

The liver is divided into four lobes besides the lobulus Spigelii; and the gall-bladder lies in a sulcus of the third lobe from the right side.

The spleen is very thin and pretty long; it was a good deal the colour of the pancreas.

The eyes are very little, not so big as a common pin's head.

The testicles are very large in the breeding season, as big as those of a new-born child: they lie almost in the place of the ossa pubis and muscles of the thigh, within the cavity of the abdomen, for it extends so low. There were no vesiculæ seminales that I could find. The lower end of the epididymis passes downwards and out of the belly at what may be called the abdominal ring, and then turns up and joins the side of the bladder. Their passage is a muscular bag [cremaster], and is not an inch in length; it can be inverted by pulling the testis up the belly, as in the fœtus. The penis is pretty long, and the crura are attached to two knobs which may be called ischia. The prepuce is inverted backward, and is pretty prominent, by which means they are retromingent.

There are two glands [Cowper's], one on each side of the anus, that send small ducts round the crura, and seem to enter the bulb of the urethra. If I remember, the hedge-hog has the same.

The bladder would seem to be two bags, viz. the common bladder, and another where the vesiculæ seminales should be; but this seems to be glandular.

On the anterior part of the bladder lies the prostate gland; it consists of a body made up of convoluted tubes, the ducts of which enter the urethra near to the beginning of that canal. These tubes are filled with a white mucus. This gland is very small in the winter, when all copulation is over, but in March they become large, and are full of the above described mucus.

Female parts.—There is no common vagina: the vagina is very long, and runs in a serpentine course forwards and backwards. The two uterine horns go off from the vagina nearly at right angles: they are not long: the Fallopian tubes run on a capsula ovarii. The capsula ovarii is almost a complete capsule. The ovarium is a cluster of rounded bodies.

The urethra opens by a projecting body similar to the prepuce in the male. There is very little fat on a mole; none on the abdomen.

The claws of the fore feet must grow fast.

An African Mole [*Chrysochloris capensis*, Cuv.[1]].

This is not so strong in the fore legs as the British mole: it is of a fine or beautiful changeable [iridescent] colour[2]. It has no ossa pubis: is this that it may pass through smaller holes than it otherwise could? The abdominal viscera are much as in the British mole.

The testicles are very large, lying within the abdomen as high as the lower end of the kidneys. The epididymis begins at the upper and outer side, passes down pretty loose, and terminates in the vas deferens: this proceeds a little convoluted and gets behind the bladder to open into the urethra. There are two bags behind the bladder which may be either called vesiculæ seminales or prostate.

The two vasa deferentia with the testicle appear at first very similar to the two horns of the bifurcated uterus with large ovaria[3].

The Hedge-hog [*Erinaceus europæus*, Linn[4].].

The panniculus carnosus is very strong, especially about the neck, most probably for the erection of the quills. The intervertebral substance is pretty considerable, especially between the vertebræ of the back. The epiglottis is very small, but there is a doubling of the membrane of the fauces that is much broader than the epiglottis itself, and is attached laterally to the thyroid (like the broad ligament of the uterus to the side of the pelvis) which covers the aperture. A process of the cricoid cartilage passes between the arytenoids as high as the last mentioned. The thyroid gland is very small.

The pericardium is very thin and only adheres to the diaphragm by the septum that divides the right from the left side of the chest.

The other thoracic contents are as in other animals, only the trunk of the left jugular and subclavian veins[5] does not pass over the carotids, but round the left side of the heart, as in many other animals [*Marsupialia, Rodentia*, e.g.] and in fowls; this venous trunk is joined by the vena azygos of the left side, which is the largest.

The epiploon is very thin, and there is no little epiploon between the stomach and the liver. The pylorus is pretty thick and yellow. The stomach is as in a dog; the intestines are as in a bear or racoon, and are between six and seven times the length of the animal[6].

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1 [The skull of this mole is No. 2401, Osteol. Series.]

2 [Hunt. Prep. No. 2069.]

3 [Ib. No. 2511.]

4 [The osteology of the hedgehog is shown in the Hunterian specimens, Nos. 2390, 2394—2396, Osteol. Series.]

5 [This trunk is shortly after referred to as one of the two superior venæ cavæ.]

6 [Home, Comp. Anat. i. p. 430.]

It has a thymus when old; two venæ cavæ superiores; two azygos veins.

The liver is as in other animals, and consists of four lobes, or rather five. The gall-bladder is pretty large, and but little attached to the middle lobe, so that it is pretty round. The gall is of a fine transparent green: there are no hepatic ducts entering the ductus communis between the cystic duct and the duodenum. The pancreas is as in other animals, only the lower end of the duodenal pancreas passes below the duodenum, and hangs loose.

The left kidney is lower than the right, and is like a dog's in shape, and is very loose.

The Male Organs of Generation[1].—On cutting through the skin on the os pubis, there is a panniculus carnosus lining it, which arises from the upper part of the tail, passing down on each side of the tail and anus, then passing over the ossa pubis, becoming broader by degrees, and then lost in the skin of the abdomen. The use of this muscle would appear to be to draw the prepuce back during erections of the penis, which would in some degree denude the penis.

On removing this panniculus, there are two round and flat bodies that are situated on the outside of the pubis, ischium, and the flexor muscles of the thigh. These two bodies I took to be the testicles when I first felt them through the skin. Each of these has a duct going from them round the ischium, or rather round the erectores penis towards the anus. These bodies seem to be a heap of tubes coiled together, and these ducts open into the bottom of the foramen cæcum, laterally.

On cutting into the abdomen, we see the urinary bladder, part of which is in the middle way between the pubis and sternum, not at all in the pelvis (but not so large in a second that I examined), and between the bladder and pubis, immediately in contact with the abdominal muscles, is the prostate gland, before and on the sides of the neck of the bladder; it is divided into two by a fissure which has a ligament uniting it to the abdominal muscles like the Fallopian ligament of the liver: the prostate, thus, lies on the bladder in the same manner as the liver lies on the other viscera.

On each side of this prostatic gland are situated the testicles, which are very large, much in the same manner as they are in the fœtus before they pass out of the abdomen, having that ligamentous part attaching them to the [abdominal] rings; which ligament passes through the rings to the os pubis; these attachments are hollow, the

[1] [Hunt. Prep. No. 2512.]

canal being continued through their whole length, the opening of which begins from without.

This ligament appears to be part of the peritonæum as it were pinched up, at this part, and the pinched part is only attached by a very loose and cellular membrane.

This part is also muscular, by fibres continued from the transversales, or the obliquus internus, for they have two pairs of broad abdominal muscles: the manner seems to be thus:—At the part where this ligament is attached to the lower part of the abdomen, which is just on the outer edge of the rectus abdominis, and above the symphysis pubis, the transverse or the oblique muscle is turned in towards the cavity of the abdomen; as it were, inverted, making a sort of funnel, whose mouth is in the groin, especially when the testicle is pulled up. But, if the testicle was pushed out of the belly, this inverted canal would make a coat for the testicles, and the muscular part would then answer to the cremaster muscle, which may be the case in the human fœtus[1].

The vas deferens is very short, arising from the lower end of the testicle, and only adhering to it for a little way, so that it does not make that sharp angle within the epididymis as in those animals whose testicles are down in the scrotum: it passes between the bladder and the two large convoluted bags, then enters the urethra in the membranous part, pretty near the bulb. The two large bags above mentioned are similar to what are called the 'vesiculæ seminales' in many other animals; and contain a white liquor, like the former, and enter near the entrance of the vasa deferentia, which is into the foramen cæcum near the communication of the urethra, by a kind of nipple to the four ducts.

The penis is very large, passing forwards on the belly, like a horse's or dog's, having two muscles passing by the side of it, arising from the erectores, which are lost about the glans. The use of these must be to shorten it, for when it is lax it is thrown into a serpentine course. There is also a muscle arising from the under surface of the tail passing by the side of the anus, then to the bulb, and from thence along the urethra.

The erectores penis are vastly large, partly inserted into the symphysis pubis by two tendons on each side, and partly into the crus, and a great deal of their fibres pass between the penis and pubis, joining with one another. There is a strong muscle passing between the two crura on that side next to the pubis.

In the membranous part of the urethra there is a cavity having a

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[1] [See 'Animal Economy,' 8vo. 1837, p. 7, and note.]

thin partition, which is nothing else but the [terminations of the] ducts of the above described glands, viz. what I found to be the vesiculæ seminales and prostates, and it has an opening into the urethra at its end next to the penis, just where the ducts of the prostates enter. This is something like the foramen cæcum, but is vastly larger; and it does not seem to be a continuation of the urethra from the glans. The ducts of the prostates enter into the urethra at the edge of its communication with the foramen cæcum, which contains a duskish brown liquor.

[*Another description.*]

When the membranous part of the urethra is cut open from above, we see a 'caput gallinaginis,' just as in the human subject. On this caput a great many ducts enter; viz. the remaining part of the urethra that is between this and the bladder, which is just like the foramen cæcum; secondly, the ducts of the large bags by two orifices a little more posterior and anterior; thirdly, the ducts of the prostates just in the edge of the opening of the urethra, or rather within the edge; fourthly, the vasa deferentia just between the ducts of the bags. All these enter on this caput, and the ducts of those [Cowperian] glands on the thigh enter further back where the anterior urethra terminates in a blind pouch, which is about a quarter of an inch beyond the opening of the posterior urethra. These enter laterally, as it were, in the corner where this urethra ends in a blind pouch. It is rugous when we open the urethra on this upper side, this termination looks like a foramen cæcum, and in this cavity, near the bottom, laterally, enter the ducts of the two glands that lie on the thighs, the liquor of which is of a bluish-white colour.

These three pair of bodies, viz. prostatics, those on the pubis, [Cowper's glands,] and the two large bags, are made in one way; that is they are a bundle of tubes convoluted, much in the same manner with the testicle; but much larger, especially those I take to be the vesiculæ seminales. I should not take them to be vesiculæ seminales, because they enter by a distinct duct, for in this case there can be no regurgitation. That these bags are glandular I infer for these reasons, that the further you trace them from their opening, the ducts become smaller by degrees, so that at the most distant part they are vastly small, like the others of the same kind.

In a young hedge-hog they are very small, in proportion to the size of the animal, and so are all these parts, which would make me think that they belong to the parts of generation or are relative to generation[1].

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[1] [The above remarks on the male organs are highly characteristic of Hunter's

The hedgehog has five nipples on each side; the anterior pair come further forward than in most other animals.

Female Organs of Generation[1].—The external vagina is an inch in length, rugous within, and pretty large. The glans clitoridis is midway between the external peak and the meatus urinarius: it has an oblong head which is covered by a semilunar valvular prepuce, and is pretty large. There is very little distinction between the external and internal vagina; [it is marked] only by the opening of the meatus and a gentle stricture there. The internal or proper vagina is very large and rugous, the rugæ being mostly parallel near the os tincæ: here it is contracted, and the rugæ are largest and transverse, and just at the os tincæ there are two large folds of the vagina that cover the mouth of the uterus and appear like the os tincæ itself. The uterus is very small, especially its cavity: the common part is about half an inch long, and becomes wider upwards, where it divides into the horns. The horns are pretty thick but short, and plainly muscular.

The tubes pass upon the capsula ovarii. The capsule is very large and has but a very small opening, which is close to the end of the horn. The ovaria are pretty large, and their surface is very irregular, with deep sulci.

Of the Contents of the Stomach, &c. of the Hedge-hog at different Seasons.

The hedge-hog is one of those animals that lie dormant in the cold weather; therefore the contents of the stomach and intestines must differ in the different seasons very considerably.

In the summer months, as April, May, June, July, August, September, and October, the stomach is found to contain the insects of the season. In April, the stomach contained grubs, something that resembled chopped hay, and sometimes a blade of green grass not chewed. In May, June, July, and August, the stomach contained principally the common caterpillar found on cabbages, with a variety of other insects, as also with the above appearance of chopped hay. In October, the stomach contained the wings of insects, which appeared to be principally those of the black beetle, also a blade of chewed grass.

In the intestine of all [during those months] the contents were simply

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desire for accuracy, and of the pains he devoted to thoroughly comprehending a complex structure. The understanding of the one in question will be facilitated by comparing this account with the preparations Nos. 2152 and 2152 A; and with the plate lv. Physiol. Catal. 4to, vol. iv., and its description.]

[1] [Hunt. Prep. No. 3576.]

the fæces. In the months of November, December, January, February, and March, there is no food found in the stomach; but in the last month there is found in the stomach, and lining it, something like cream, but it is only mucus. In the intestines in all those months there is found a substance exactly similar to the meconium in fœtuses, and this in larger quantities the later in the winter. It does not fill the intestines regularly, but is interrupted. The rectum was filled with or contained a greenish substance. From the above appearance it would seem that animals that do not eat in the winter months become like the animals in the womb[1].

The bladder of urine was full in all of them.

Of the Fat of the Hedge-hog at different Seasons.—As hedge-hogs lie dormant through the cold months without eating, I examined in what condition they were in the beginning of winter, and towards the latter end. In the month of October the hedge-hogs are very fat; there is a very thick layer of fat immediately under the skin, everywhere, excepting the head and legs. The mesentery and epiploon, although fat, were not loaded. The kidneys lay in a bed of fat. In the month of February the fat immediately under the skin was very thin and of a yellow colour, and there was very little fat in the mesentery and epiploon; also little about the kidneys: but this varies.

The Black-Shrew [*Hydrosorex fodiens*[2]].

It is rather smaller than a mouse, of a black-grey, or a very dark iron-grey colour; its belly is whitish, the tips of the hair being white there. The hair is like that of a mole. It has a very projecting nose. The lips do not hide the teeth, especially in the fore-part, and more so in the lower jaw. It has whiskers. The eyes are very small: the opening of the ears is large: the projecting ear is round, and rises about as high as the hair; it is covered with pretty long hair both externally and internally, which is rather lighter in colour [than that on the head].

The tail is short, and the hair is short upon it. Its feet are like those of a mouse. There is no cæcum. The testes pass easily in and out of the abdomen. The orifice of the prepuce is pretty near to the verge of the anus. I should suspect it is a retromingent.

The great difference between the shrew and the mole is in the fore-feet: in the mole they are intended for a greater extent of progressive

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1 [This philosophic comparison is omitted by Home in his transcript of the above remarks, Comp. Anat. i. p. 435, where he quotes them as "made by Mr. Hunter."]

2 [The skull of this animal is No. 2399, Osteol. Series.]

motion under ground in search of food; while I suppose that the shrew only burrows for safety and habitation, and most probably catches its food on the surface or in the water which he [this species] generally lives near.

[The Common Shrew (*Sorex araneus*).]

The Land Mouse, English.

This is very like a mouse, excepting that it has a long sharp nose, almost like that of the coati-mondi, which is used as a digger, as in the mole. The external ears have some white hair upon them: they are very short. The eyes are very small. There is no cæcum. I observed a white body lying at the root of the mesentery.

[The Desman (*Myogalea moschata*, Cuv.)[1].]

The Musk Rat.

This animal is not so large as the common rat: its tail is not so long; it is about as thick at the base, but terminates much sooner in a point, which gives it a conical figure: it is covered with the same kind of hair as on the body, which is short and thin. The head is long, and almost comes to a point at the nose, the cartilaginous and membranous part of which projects considerably beyond the mouth, like a hog's, but does not terminate as in that animal. There is no lip between the mouth and nose; but the two lateral lips of the upper jaw run to the nose, making a kind of groove between them. The eyes are small. The ears project, but are pretty flat and thin: they are rounded and not pointed: the legs are short, especially the fore-legs.

By the pylorus not being closely attached, the mesogaster and mesentery become one continued membrane, from the right of the œsophagus to the pelvis, having the stomach and the whole intestines strung on the edge[2].

This membrane has for its attachment to the body, first the liver above; but, where the lobulus Spigelii unites with the right lobe, it is not attached, which gives an opening into the epiploon; it is then attached down the back to the pelvis. The epiploon is attached forwards to the great curve of the stomach, on the stomach, on the left of the diaphragm, and spleen: it is attached to the back, and on the right the anterior and posterior attachments come to a point at the pylorus or duodenum.

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[1] [The skull of this animal is No. 2400, Osteol. Series.]

[2] [Home, Comp. Anat. i. p. 433: the remarks abstracted are referred to the 'musk-rat.']

The liver consists of four lobes: the right lobe, or fourth, is continued across the spine towards the left, and forms the lobulus Spigelii. The ligament and gall-bladder are attached to the second lobe. The ductus communis is obliged to run a considerable way along the broad mesentery to the duodenum.

The pancreas runs from the spleen to the duodenum along the posterior attachment of the epiploon: the spleen is much as in a dog. The kidneys are conglobate, the right the highest. The testicles are situated as in the mouse, the hedge-hog, and many other animals: they are capable of being either within the cavity of the abdomen or in a pouch which leads backward by the sides of the anus, they having no projecting scrotum. The prepuce or opening for the penis is within the verge of the anus; both make but one external verge or ring, and make a transverse slit: this is similar to that of the beaver. The penis in its flaccid state is turned backward, and appears very much like the tongue of a bird: in shape it is very much like the thumb with the nail upon it. The two crura go back on each side of the rectum, and are attached to the ischia, as there is no pubis[1]. They must be retromingent ordinarily; but, if ever they made water when the penis was erect, it would of course pass forwards.

I found in the stomach hair, a feather, and little pieces of white substance similar to chewed kernels.

[The Sumatran Tree-Shrew (*Tupaia*, Horsfield, *Cladobates*, Cuvier).]

An Animal like an Opossum in the head, and a Squirrel in the tail and feet.

Teeth.—In the upper jaw it is a good deal like the mole, having three grinders on each side; one semi-grinder, and two cuspidati close to the grinders and close to each other near the fore-part; one cuspidatus, and then one tusk, as in the mole, only smaller in proportion to the body: no incisores[2]. In the lower jaw there are three grinders, one cuspidatus close to the grinders, three cuspidati at a small distance forwards, the middle one (the highest) somewhat like a tusk; and then one tusk longer than in the upper jaw.

The liver has four lobes, besides the lobulus Spigelii. The gall-

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[1] [Hunt. Prep. No. 2511.]

[2] [There are no front teeth having the shape of incisors; but there are two cylindro-conical teeth in each premaxillary, the first the longest, and these are opposed to six fore-teeth in the lower jaw; the molar series consists of $p\,\frac{4-4}{4-4}$, $m\,\frac{3-3}{3-3}$.]

bladder is attached to the second from the left, lying in a sulcus, with its fundus in a fissure at the edge of the liver, so as to appear a convex surface, as if in a hole. The stomach is as common. The cæcum is similar to that of the opossum: the colon is short. The clitoris is long and grooved, leading into the vagina. There are two horns to the uterus, but they are short. There is a capsula ovarii. There were found in the stomach a great many wings of butterflies, and skins of other insects.

[Order Rodentia.]

The Chisel-Tooth, *SCALPRIS DENTATA.*

The following class of animals probably ought to be called an order, of which there are several genera, and a still greater number of species.

Genus.	Species.
Hare........	Hare, common. ,, Norway. Rabbit[1].
Guinea Pig ..	
Porcupine....	
Squirrel	

Of the SCALPRIS DENTATA.

I do not know if there be any permanent character of this order, so as at once to distinguish it from all other orders. The head has through the whole order a similarity, which probably is owing to their having a peculiar set of teeth, and which perhaps becomes the only characteristic mark.

The external parts of generation also have a similarity through the whole; but form not so uniform a mark as the head and teeth; but these are marks which require a nicer investigation, and therefore should be put down as only secondary characters. In external form they vary very much, as also in their extremities and appendices. Some have legs of various lengths, the fore-legs much shorter than the hind ones: some have a very long tail, others a very short one, or none: the ears are long in some, short in others: the hair is very fine in some,

[1] [For the number of species now known in this family (*Leporidæ*), see Mr. Waterhouse's 'Natural History of the *Rodentia*,' 8vo, 1846.]

coarse, and even quills, in others. Most have a great variety of powers with their fore-teeth: they are a kind of carpenter's tools, becoming a compound instrument. [See the concluding paragraph of this Section.]

The first, then, or most striking characteristic of this order of animals is the fore-teeth, having two above and two below, which are long, and narrow at their ends, falling off from their external surface, where the edge is, to the internal, like a chisel; from the fore-teeth a vacuity is continued to the grinders.

Their lips are of a peculiar structure. Their tongue is thick between the upper and under surface and narrow laterally; adapted to the shape of the mouth[1]: it has a very little motion in it, never passing beyond the teeth.

The second characteristic is a flat head laterally, nearly of an equal thickness at the nose and ears, curved on the fore-part like a bow from the crown to the nose, and rounded from right to left.

Thirdly, the eye in most is very prominent: very nearly one half of the diameter of the ball projects beyond the eyelids.

In all, I believe that the metatarsus exceeds in length the metacarpus more than it does in most other animals; but this is much more so in some of this order than in others. It is least so, perhaps, in the mouse: the guinea-pig shows a considerable difference: the rabbit much more: the hare still more: the jerboa of Arabia, and the [helamys] of South Africa are remarkable instances of this disproportion, which gives the hind leg a considerable length over the fore.

They are all retromingent, and have a considerable glandular apparatus for the secretion of a thick mucus about the external parts of generation, both of the male and female. The beaver is a striking instance of this.

I believe that the females have all[2] two ora tincæ. Some of them[3] have two venæ cavæ superiores, a right and a left; but this is not peculiar to the present order of animals[4].

The cæcum, colon, and rectum, are very similar in the whole order, and very different from those of any other animal.

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1 [Hunt. Preps. Nos. 1506 (*Cœlogenys*), 1507 (*Lepus*).]

2 [The rat, aguti, la paca, are exceptions; but the common uterus in these is extremely short, and the cornua very long, showing the general tendency to the divided oviparous type.]

3 [*Sciurus cinereus*, *Pteromys*, *Mus*, *Orycterus*, *Bathyergus*, *Dipus*, *Alactaga*, *Helamys*, *Echimys*, *Hystrix*, *Lepus*, *Cœlogenys*. The exceptions observed by the Editor are *Cavia Cobaya* and *Dasyprocta Aguti*.]

4 [It is common to the *Lyencephala*, and is a structure found in most of the *Lissencephala*, and is indicative of the general affinity or tendency of these low-brained groups to the oviparous vertebrata.]

This order of animals consists of many genera, each of which contains several species, and many species have considerable varieties.

I shall give the genera in the order of size [beginning with the largest]:—le cabiai, la paca, beaver, porcupine, hare, rabbit, guinea-pig, jerboa, mouse.

Of the Teeth.—The four front teeth of this order are continually growing; and, if broken at any time, they grow again to their full length[1]; and are formed at their extremities by their action upon one another into their chisel form, as perfect as at the first. They never close or contract at their [base, or] growing extremity, as in those animals in which the teeth have a limited time for growing; but are always open, at the [basal] end, like a socket filled with a jelly, as in all other growing teeth. The way of life of the animal shows that something of this kind is necessary, as these animals use their teeth wholly in cutting or separating their food from its attachments, as in taking off bark, &c.: they likewise use their teeth in other common purposes of life, such as dividing parts that are in their way, or working their way through wood, brick, stones, &c., and making free communication everywhere.

[Family *LEPORIDÆ*.]

The Hare [*Lepus timidus*, Linn.][2].

The œsophagus at the lower part of the thorax, before it goes through the diaphragm, passes into a capsule, which allows it at this part to be unattached all round excepting at the posterior part, where it is attached all along to the posterior mediastinum. This capsule is attached to, or may be said to be made up (upon the left) of, the posterior mediastinum, and of two membranes going from the fourth and fifth lobes of the lungs of the right side, to be fixed to the posterior mediastinum: the membrane from the fifth lobe passes before the œsophagus, that from the fourth behind, and is attached to the posterior mediastinum by a thin membrane or meso-œsophagus.

The œsophagus is about an inch long below the diaphragm, at least at its fore-part. The stomach is roundish, not oblong, making a pretty quick turn or curve: the œsophagus is inserted nearer to the great end than to the pylorus: the great end of the stomach is turned up, and adheres to the left of the œsophagus for nearly one quarter of an inch.

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[1] [In a coypu at the London Zoological Gardens, that had broken an inch off the left lower incisor, I observed (in 1835) that it grew up to its ordinary length in six weeks.]

[2] [The osteology of the hare is shown in the Hunterian specimens Nos. 1916—1928.]

The stomach does not become gradually smaller towards the pylorus, but much more suddenly than in the human.

The duodenum is loose, having a broad mesentery, and is much longer than common; for, at the lower end, before it passes across the spine, it makes a loose fold upon itself for five or six inches, having a pretty broad mesentery attaching this fold together. The last part of this fold, just before it crosses the spine, is attached to the rectum by a thin membrane for nearly three inches; and, where it crosses, it is more attached to the root of the mesentery; it then becomes a loose intestine as common. The ileum, before it passes into the cæcum, passes between the first turn of the colon and cæcum for nearly seven or eight inches[1], being attached to the mesocolon of this part, and along the same attachment it is attached to the cæcum[2].

The great epiploon is attached to the great curve of the stomach at the pylorus; but, near the great end of the stomach, the attachment passes behind the stomach where the spleen is attached: the epiploon adheres, on the right, to the beginning of the duodenum, behind and on the right to the transverse arch of the colon, and on the left to the upper edge of the left end of the pancreas: there is no fat upon the posterior fold. The spleen is very small and long, lying in the folds of the epiploon.

The liver is divided into three lobes, besides the lobulus Spigelii: the middle lobe is the largest, having a pretty deep fissure in it; upon the right of which is situated the gall-bladder, as in the human. The right lobe lies just above the kidney, not more forward than the kidney, and is the smallest: the upper end of the kidney lies in a deep depression in this lobe. The left lobe is pretty regular, having only an oblique sulcus in it, like a cat's. In another hare it had not this, but had three notches on its edge. The lobulus Spigelii is half out from behind the posterior mesogaster, and half behind it, but not attached to it: the anterior mesogaster is entirely before it, and is a very thin membrane just covering that part of the liver which protrudes, which protrusion is adapted to the hollow of the stomach. The gall-bladder is oblong, much of the shape of the human, but not so much contorted at the neck or beginning of the cystic duct. This duct makes a little turn upon the bladder, then goes on straight, and receives all along some ducts from the liver, principally from the middle lobe to which it is attached; it then receives a large duct from the left lobe, and some way further on it receives the duct from the right lobe, so that it is hard to say what is precisely cystic: it enters the duodenum about an inch from the pylorus.

[1] [Home, Comp. Anat. i. p. 453.]

[2] [Hunt. Preps. Nos. 727, 728.]

The pancreas is very thin, lying across the spine as usual, attached to the upper part of the transverse turn of the colon: there is also one in the mesoduodenum, but it is very thin, and separated in many places. Where the duct enters I cannot tell, but should suppose near the gall-duct, as it is attached to that part.

The kidneys are conglobate; the right is the highest and the nearest to the spine, being close to the vena cava and adhering to it; and the vessels pass behind this adhesion; and I believe that in most animals the right is nearer than the left. Their vessels make an obtuse angle upwards, being reflected. There is one mammilla. The capsulæ renales are little oval yellow bodies close to the vena cava. The right lies behind the adhesion of the kidney to that vein, in the angle where the emulgents come off: the left lies in the same angle upon the left side, and not in contact with the kidney, not even near it: they are darker in the centre, and the cortical part is fibrous like the tubular part of the kidney, passing towards a centre. Two large lumbar veins pass into the vena cava just above the entrance of the emulgents.

The tail begins to turn up at the sixth joint. The xiphoid cartilage is attached to the posterior part of the last bone of the sternum near its extremity; for the last bone of the sternum is what answers to that cartilage in us; and where this bone terminates there is a sacculus mucosus. The same in a rabbit. There is a little bit of clavicle which is loosely attached at one end to the tubercle of the head of the os humeri; the other end points towards the sternum, is a little bent, and the concave side is towards the body of the humerus.

The heart is small, and longer than common, and has two apices. There are two venæ cavæ superiores, as in a goat; and two arteries arising from the curvature of the aorta, as in the squirrel. The lung on the right side is divided into three lobes, besides the particular lobe; on the left side the lung divides into two. The valves of the heart are much as common.

The thoracic and abdominal viscera of a rabbit and a hare are the same.

Of the Male Parts[1].—The testicles are pretty prominent. There is a very large and long epididymis, which begins at the upper end broad and flat: as it passes down it becomes very small, and at the lower end it becomes larger and goes on lower than the testicle, forming almost a distinct body, which turns up upon itself to form the vas deferens. The lower end of this part is firmly attached to the lower part of the tunica vaginalis. The tunica vaginalis communicates with the abdomen

[1] [Hunt. Preps. Nos. 2489, 2490.]

by a very large opening, so large that the testicle could be pushed into the abdomen if it did not adhere at the lower end, all along the posterior part of the testicle and spermatic chord. The attachment of them to the tunica vaginalis is by a thin and pretty broad membrane. The vasa deferentia are pretty large, and, where they pass behind the vesiculæ seminales, they become very large, like the swell in a Florence flask; they then enter the vesiculæ seminales very near the opening of them into the urethra, not one-tenth of an inch from it.

There is only one bag, or vesicula seminalis, for both vasa deferentia; it is pretty large, somewhat oblong and flattened, as if it was flattened by the weight of the bladder. It seems to be smooth on its inside, is very thin in its coats at the fundus, but becomes thicker towards its apex, which thickness is an additional gland having its ducts opening into the urethra; but this gland seems to be distinct from the prostate, and is of a much more spongy nature, and goes round the beginning of the urethra. The duct, or rather the opening of the vesicula seminalis, is very large. What I take to be the prostate glands are two on each side of the urethra in the membranous part, just before the other described: they are but small and pretty compact, and the duct enters the urethra about the middle of the membranous part; but these may be Cowper's and the other the prostate upon each side of the urethra. Between these last glands and the bladder there is a plexus of veins which are filled by the vena magna in dorso penis. The urethra is very large through its whole length, but especially at the bulb, where it would admit one's finger. The penis is of a pyramidal figure when not injected; the cavernous part is very strong, being chiefly in parallel tendons. The hare is retromingent: for the penis almost points back to the anus. The penis after being injected with quicksilver is of the figure of an S, and the point is turned or curved backwards much more than before injection.

Upon each side of the penis there is a glandular body much larger than a pea, having an orifice in its middle which leads to its centre, something like a sebaceous gland filled with a pretty firm substance. Immediately between them and the rectum there is a hollow cavity whose opening is nearly as large as the cavity itself: this gland lies just at the mouth of it, or in other words makes a part of its mouth. This hollow is upon each side of the perineum, which is a very thin part, uniting as it were the hollow curve of the penis backwards to the anus like a frænum[1].

The anus goes a considerable way further under the tail than the

[1] [Hunt. Prep. No. 2135.]

beginning of the penis; but the termination of the penis and anus are pretty near one another, on account of the penis being turned backward upon the rectum, where it adheres to the vesicula seminalis. There are two little canals like veins united to it. The skin between the penis and anus is red about the cavities and these glands: it is not covered with hair. The erectores penis are very strong and lie upon the outside of the crura; and on the side next to the pubis some of the external fibres arise from the ischium; the other or anterior part arises from the crura near this attachment to the pubis, and passing a little way upon the crura, are lost in the crura, the conjunction of them forming a middle tendon. Just where these are inserted, they are covered by a thick, strong, and short muscle, which arises from the symphysis pubis, where the ligamentum suspensorium is inserted, and passes along the upper part of the penis, forming a small tendon, which runs along the upper part of the penis, and at last is lost insensibly in the body of the penis. This last muscle might be called a 'suspensorium penis,' if it was in the human, for it is just in the place of that ligament; but it helps to strengthen the penis in erection; for the tendon passes along the convex surface near the anterior end, and by pulling the muscle the curved part is straightened. These muscles exist also in the guinea-pig, squirrel, &c.

The male parts of generation of a hare and rabbit are very much the same.

The Female Parts of a Hare.—The external lips of the vagina are continued close to the anus. There is no hair on the sides of the lips, and but little on the anus; however, there is a great deal on the upper side of the anus between it and the tail, and a great deal on the lower end of the slit of the vagina, as it were on the os pubis, so that the lips and sides of the vagina are bare, but these two tufts of hair in the natural state approach one another, by which means the anus and mouth of the vagina are bent towards, and in some measure oppose one another. The glands on the sides of anus and vagina are made up of different sorts of substance; the most external is of a yellow colour, something like the capsula renalis: the under part is of a brownish colour, very much like the kidney.

The clitoris is pretty long[1], has a very strong coat, and terminates in a broad thin glans, which is pointed, and projects in the vagina towards the mouth of the vagina: it is cavernous. The common vagina is very long, about 4 inches; the proper vagina[2] about 2 inches; there are very

[1] [Les lièvres mâles et femelles ont dix mamelons; sometimes one or two are wanting.]

[2] [This part Daubenton, like Geoffroy St.-Hilaire, regards as the Corpus Uteri,

little rugæ in either, excepting at the beginning of common, where they are longitudinal. Two ora tincæ, as in a rabbit; or [it may be said] that the horns open separately into the vagina: they are thrown into longitudinal rugæ at their terminations, which are pretty strong; and the two horns are united as far as there are rugæ. The horns are very long; the capsula ovarii does not cover the ovarium: the Fallopian tube runs upon it and opens upon the most distant end of the edge. The ovaria are very large; very much of the shape of the testicles, but more oval, the end next the uterus being largest, and the most distant end is bent in towards the termination of the edge of the capsula ovarii, and is studded with little transparent bodies.

The external parts of generation, and the external parts of the anus of a doe-hare, are much the same with those of a doe-rabbit: the differences are, in the hare, the gland at the side of the vagina is larger than in the rabbit; the cavity at the side of the gland is more circumscribed, and at a greater distance from the mouth of the vagina than in the rabbit; and the surface of the skin that surrounds these parts which is not covered with hair is broader than in the rabbit.

Hares and rabbits never use their hind legs alternately, but both together; this arises from the great disproportion between the length of the fore and hind legs, for the fore legs are only used to catch the body when it falls, but the hind are used to give the body the spring forwards.

The White Hare, from Norway, given to me by Dr. Solander, in April, 1780 [*Lepus variabilis*, Pallas].

The external shape and proportions were nearly, if not wholly, those of the common hare of England.

The stomach is pretty full, therefore it gives us much the shape of that of the common hare; it had a kind of stricture in the middle, as it were, attempting to divide it into two cavities. Towards the pylorus

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observing:—"On ne distingue le commencement du corps de la matrice, qu'en ce que ses parois sont beaucoup plus épaisses, dans les hases pleines, que les parois du vagin; on reconnoit, par cette signe, que le vagin finit, et que le corps de la matrice commence un peu au delà de l'orifice de l'urètre;" and in his measurements he makes the Corpus Uteri 2 inches, 6 lines. Buffon.—Hist. Nat. tom. vii. p. 281. And yet he seems unconsciously to admit its non-resemblance to an uterus by observing, when upon the same parts in the rabbit, "Chaque corne avançoit dans le vagin de deux lignes de longueur."—Ib. p. 326.

And again speaking of the ora tincæ he observes that in a doe rabbit ready to bring forth,—"Les orifices des cornes de la matrice commençaient à se dilater pour l'accouchement, comme l'orifice interne de la matrice se dilate en pareil cas dans la plupart des autres animaux."—Ib. p. 327.]

there is a tendon on each side, as there is in the gizzard of fowls[1]. Along the great curvature, for about 3 inches in length, there is a tendinous line where the epiploon is attached, in its course of attachment round the great curvature. There are two venæ cavæ superiores and a double apex to the heart, but the right one is very faint. The kidneys and capsulæ renales are the same as in the common hare.

The fæces are knotted as in the common hare. The food in the stomach was very well masticated, and consisted entirely of short bits of twigs with their bark, and the fæces in the rectum were exactly the same; so that nothing had been digested but the juice.

In another white hare, given me by Sir Joseph Banks, the stomach was short and made a very quick turn: the insertion of the œsophagus was nearer the great curve than the pylorus; towards which, where the middle tendon is, there was a faint stricture. For about an inch and a half of the stomach, close to the pylorus, the coats were much thicker than anywhere else. There were stones in the stomach. The duodenum passes in the same direction with the pylorus for about half an inch, and from the right of this part the gut is continued down the right side, adhering first to the third turn of the colon by a narrow mesentery; it then leaves that and continues its course down the right side to the lower part of the belly, being convoluted; it then passes up again, between which fold there is a pretty broad mesentery, joins the third turn of the colon, and passes across the body behind the mesentery; when it comes out on the left side and forms the jejunum. The ileum is joined by the cæcum, and they pass on together to the colon. Towards the termination of the ileum it lies between the cæcum and colon, joined to both by a mesentery, and just before it enters the colon it dilates into a bag.

The cæcum at its beginning is attached to the ileum as above described, passing along on the outside of that gut, making a considerable curve. The colon makes a quick turn upon itself at the beginning, having hardly any length of mesentery; then passes a little way along with the ileum as before mentioned; becomes small and makes a fold upon itself, having at this fold two bands; it then makes another fold upon itself, which are but faint on the beginning of the colon, where the two bands are lost: it joins the descending part of the duodenum, in whose curve it lies; passes to the right behind the stomach, adhering to it: also to the duodenum as it crosses the body to the left behind the mesentery, and then forms the rectum[2].

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[1] [Hunt. Prep. No. 544.]

[2] [Home, Comp. Anat. i., p. 454, where the notes abstracted are referred to the common hare, and follow those taken from Hunter's anatomy of that species.]

The liver has three lobes besides the lobulus Spigelii. There is a gall-bladder. The right kidney is much higher than the left. There is a pigmentum nigrum. The muscles are as dark coloured as in the common hare.

There was a good deal of fat about the kidneys, the aorta, and down to the pelvis; also about the testicles, &c., which was white and pretty soft. The same is found in the common hare. The male parts of generation are the same as in the common hare.

The Rabbit [*Lepus cuniculus*], compared with the description of the Hare[1].

The œsophagus is the same. The stomach is very similar. In the rabbit the stomach becomes very thick in its coats just before it terminates in the pylorus. The duodenum, as it passes down, is attached to a turn of the colon; it then becomes loose. The ileum passes between the cæcum and the first turn of the colon for nearly a foot, and where it enters it becomes larger, or swells out into a bag.

The cæcum is about 18 inches long, making nearly two spiral turns upon itself, or scrolls, the base being the largest curve or circumference of the spiral. The first part or apex is small, becoming larger and larger in its termination: it is for five or six inches a smooth body, but comes to have a spiral indentation running round and round it to the beginning of the colon.

The colon begins immediately to bend back in the contrary direction to the ileum, passing back between the two turns of the cæcum, following the last part of the ileum; and, when got nearly as far as the beginning of the cæcum, it passes up behind the spiral turns of that gut, adhering to them, making there a band. When the colon has got to the upper part of these turns, it becomes invisible, passing a little to the right, and is next seen on the right of the mesentery behind the ascending part of the cæcum, where it is making a fold or turn; it then joins the duodenum for some way, as it passes up and crosses the body, before the root of the mesentery. When it has got to the left it makes a short fold, and passes down to the pelvis. The colon at the beginning has two bands, viz. one at the mesocolon, the other opposite, but the opposite is lost in the mesocolon band about 7 or 8 inches from the beginning of the colon; and, where the colon is passing up behind the close turns of the cæcum, the band terminates; and it is a smooth intestine afterwards through the whole length.

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[1] [The osteology of the rabbit is shown in the Hunterian specimens Nos. 1950—1961. The ear, injected, is No. 1614, Physiol. Series; the eyes are Nos. 1725, 1787.]

The epiploon is the same as in the hare. The liver is the same; there are a number of small fissures where the right lobe sends in the lobulus Spigelii. The gall-bladder is as in the hare. I found two hepatic ducts, but most probably there were many more, as this specimen had become putrid. The pancreas is the same as in the hare. Kidneys are similar. The capsulæ renales are similar. The lumbar veins are the same. The clavicle is the same, only that the end towards the sternum is cartilaginous. The venæ cavæ superiores are the same. The arteries from the aorta are similar. The lungs are the same. There are two scrotums and but very little hair on them, much less than on the white hare.

The forms of the testicles and of the epididymis, with their attachment, &c., are exactly the same. The whole male parts of generation exactly similar [1].

[Family *CAVIIDÆ*.]

The Guinea-pig [*Cavia Porcellus*, and *C. Aperea*, Erxl.[2]].

They eat almost anything that is given to them, both animal and vegetable food. They have only one vena cava superior. The œsophagus below the diaphragm is as in the rat. The stomach is not a very oblong cavity, but much as in many other animals: it is in the common situation, and has a pretty quick bend at the small end, but not so much so as in the squirrel. The duodenum is pretty large at the beginning, is somewhat sacculated, becomes much smaller (but perhaps this appearance is owing to the contraction of the pylorus on one side, and the contractions of the duodenum itself beyond this swelling), then becomes loose, and does not pass down the right side so low as usual; it only makes a kind of fold upon itself, and passes into the root of the mesentery, where it adheres, passing a little way down something lower than the lower end of the kidney, to which it is likewise attached by a thin membrane. After this it is doubled upon itself a little way, and then passes to the left behind the mesentery, a little convoluted; afterwards it becomes a loose intestine. The ileum seems to pass into the cæcum upon the left side (if I have not inverted them by accident). These intestines are very small. The cæcum is very large, about 1½ inch in diameter: it is thickest where the ileum is inserted, as in the porcupine; then it makes an arch downwards across the brim of the pelvis, becoming smaller towards the right side, when

[1] [The female organs are shown in Preps. Nos. 2743, 2744; the fœtus and membranes in Nos. 3471, 3472.]

[2] [The skulls and teeth form Nos. 2004, 2006, Hunt. Osteol. Series.]

it makes two or three loose turns: in all this course it is loose, only connected to the lower and right edge of the mesentery: it has three ligaments, as in the porcupine, which begin at the apex of the cæcum, and run through its whole length; when two of them unite into one, and then the two, now formed out of the three, run along the colon.

This large gut becomes small almost at once, about 1½ inch from the termination of the ileum: this small part, which is about 1½ inch in diameter, is bent back upon the cæcum, adhering to it by a thin membrane about an inch broad, for nearly two thirds of the length of the cæcum, and becoming smaller and smaller. The colon then leaves the cæcum, comes a little higher, and is attached to the right edge of the mesentery near the root where the duodenum is attached. It then makes a double fold upon itself, whence it crosses the root of the mesentery on the anterior surface to the left side, adhering pretty closely to the mesentery. Then it becomes a loose intestine and passes down, having a pretty broad mesocolon and mesorectum; and, as it is much longer than the distance between the root of the mesentery and anus, it is by that means thrown into convolutions at the upper part, but is straight below. It seems to be in this last part that the fæces become divided.

The length of the small intestines is seven times the length of the body of the animal: the cæcum is more than two-thirds that length: the colon and rectum are four times the length of the body[1].

The liver is divided into four lobes besides the lobulus Spigelii: these four are just like those of the squirrel or rat. The lobulus Spigelii is wholly behind the mesogaster. The gall-bladder is a round cavity, very thin, attached to the second lobe from the left side, and is attached to the right half of that lobe upon the right side of the sulcus for the ligamentum rotundum and falx; this attachment is by a thin doubling of peritoneum, about a quarter of an inch broad, so that if there were any cyst-hepatic ducts here, I think we might see them. The cystic duct passes along to the porta, is pretty long, wide, and straight, not contorted, and is attached to the liver only by a thin membrane. At the porta it is joined by the hepatic ducts, which are two or three in number, and are very short. The ductus communis passes, as common, to the gut upon the left of the vena porta and artery, some way; it is very superficial, as the 'capsule of Glisson' is only peritoneum, and

[1] [Home, in abstracting the above description (Comp. Anat. i. p. 447), accidentally omits to give the name of the animal, and makes it follow the intestinal anatomy of the marmot. Hunter's expressions of doubt are omitted. "Perhaps this appearance is owing to the contraction," is "This appearance is produced by the contraction." "It seems to be in this last part," is "In this last part the fæces are divided."]

that very thin. This duct comes in contact with the duodenum almost close to the pylorus; then makes a turn and passes with the gut for more than one-third of an inch, where it becomes larger, and then it enters the gut at the swell of that gut, as was mentioned. This looks as if this duct must make a turn somewhere, as it did not do it at the gall-bladder. The bile is very thin and almost transparent, and looks a good deal like brandy or rum.

The liver is attached to the diaphragm by two ligaments, the falx and the transverse: the falx is very thin; so is the transverse one; and this is pretty broad through its whole length; so that here it deserves the name of ligament, and perhaps this name was at first taken from the brutes.

The pancreas is much as in other brutes, only the small one passes into the doubling of the duodenum, something similar to that of a fowl, as this gut makes a fold, as in a fowl. The large one is very long, not attached to the spleen, but passes a little way into the epiploon. Its ducts enter the duodenum after the duodenum has made that sort of doubling upon itself something like a fowl's. This entrance is about five inches from the pylorus. The spleen is very small and short, not so long as is common in brutes.

The kidneys are pretty round and thick, and conglobate; the right is higher than the left: the capsula renalis is of two colours, viz. a yellow on the outside, and a darker on the inside [1].

The testes are very large, about the size of the kidneys; the size of which is in the usual proportion to the size of the animal. The testes are placed within the abdomen, in every respect as in the hedge-hog, porcupine, bat, squirrel: the cremaster is the same. At the part where the cremaster seems to turn, the parts are much more loose, and the testicle seems as if it could be half pushed out of the belly. The testicles are not so oval as in the human: their attachment to the psoas is by a broad doubling of peritoneum, so that they are very loose, much like the [testes in the human] fœtus when they are going out of the abdomen. The epididymis begins as usual; it is very small as it passes down on the testicle, but becomes very thick at the lower end. The vasa deferentia pass immediately into the pelvis, are wider than in the human, and were filled with a very white semen like very white cream; they pass behind the bladder, and do not communicate with the ducts of the vesiculæ seminales. The vesiculæ seminales are two long tubes, about 4 inches in length, and a quarter of an inch in diameter at their thick ends, but become much smaller at their points; they lie loose in

[1] [Hunt. Prep. No. 1280.]

the abdomen, and much in the same place as the Fallopian tubes in the female. They are very thin in their coats, and are honeycombed in their inside. They open by very large ducts into the urethra at the common place. On their under surface, just before they enter the urethra, they receive the ducts of the prostate; at the place where they open there is a large opening common to both, which is hard and irregular round its edge. This common opening is as short as you can conceive, and in the angle of union of the two openings are the two orifices of the vasa deferentia, but they do not communicate. The vesiculæ contain a gelatinous substance somewhat granulated, which becomes thicker and thicker towards their openings: the same kind is to be observed in the prostate, which seems to be no more than convolutions of ducts, very like the cæca at the pylorus in some fishes.

This fluid is continued into the urethra, and extends through its whole length, becoming thicker and thicker, so that it is a very hard substance in the urethra, but is here of a whiter colour; perhaps being mixed with some semen.

The penis is bent back, in the flaccid state, close to the anus, so that they are retromingent; it is hid entirely within the skin, so that the prepuce is pretty long. There is a bone in the anterior part of the penis, which is about half an inch long, and a small bone on each side just under the skin, like two splints. Two muscles that arise from the pubis form tendons which pass along the convex side of the penis and can extend it, when it is bent. The membranous part of the urethra is muscular, as usual. There is a gland [Cowperian] on each side of anus as in the squirrel, rat, &c., which sends a duct extending to and entering the urethra, as in the rat. Round the verge of the anus are many sebaceous glands, and that part of the skin can be taken in so as to appear to be the anus itself[1], till it is again inverted.

The lips are a little peculiar. The contents of the thorax are as in a dog.

Supposing I have called the foregoing bags 'vesiculæ seminales,' yet I do not believe that they are so for these reasons:—first, the mucus that they contain is by much too thick: secondly, it is thickest at the entrance of the ducts, where we would expect to find it thinnest if it were semen; for it would be natural to suppose that the last that came in would be the thinnest: thirdly, it is not natural to suppose that it would be in such quantity as to lie in the urethra: fourthly, it is not at all of the colour of the semen that is in the vasa deferentia, excepting that part that is in the urethra which seems to be mixed with it:

[1] [Home, Comp. Anat. i. p. 449.]

fifthly, as that in the urethra is of a different colour (but differs very little in consistence), and that difference is owing to a mixture of semen, that would show that no semen is mixed with the secretion that is within the bags: sixthly, the mucus that is within the bags is the same as that which is within the prostate gland; for they have no prostate, if the gland which I take to be the prostate be not it: seventhly, the vasa deferentia do not open into these bags, nor communicate therewith, excepting by means of the urethra[1].

The female has but two nipples, which are between the thighs; but the udder is not of the hanging kind, but is flat and spread on the abdominal muscles. One that I have had two young ones at one time, which were very perfect animals; more so than most animals; they were capable of running about; saw, and had teeth.

[The Capybara (*Hydrochœrus Capybara*, Erxl.).]

The Water Hare, *Le Cabiai* of Buffon, vol. xii. p. 384.

This animal is about the bigness of a half-grown sheep[2]; its colour is of a greenish yellow: the hair is thin and strong like that of the agouti, or of a hog: the skin of the animal is exposed through the hair. The head is like that of a guinea-pig, la paca, and agouti, viz. large for the size of the body. The ears are like those of the same animals. The belly swells out laterally. There was no appearance of a tail when it was alive, only a kind of knob covered with a horny substance. The legs have very little hair upon them. There are four toes to the fore-feet; the outer one being the smallest and shortest. There are three toes to the hind-feet. The toes are strong and broad, something like the toes of a stork, having flat, short, and strong nails upon them. The toes can be drawn apart from one another; but they are almost united to their ends by a strong thick membrane which makes a very broad foot. The sole of the foot is covered by a hard and thick skin, and in the hind feet this hard skin is continued to the os calcis, so that they walk or sit upon the whole hind-feet. This brings

[1] [In these remarks may be discerned the basis of Hunter's Observations on the Glands called 'vesiculæ seminales,' in the 'Animal Economy,' 8vo. 1837, p. 28.]

[2] [The skull of this animal is No. 1975, Hunt. Osteol. Series, and shows it to have been an immature individual. A male capybara, from Cross's menagerie, which I dissected April 1837, measured from the tip of the snout to the stump of the tail, 3 feet 4 inches; the greatest girth was 2 feet 7¼ inches: the weight of the animal was 68 lbs. A wild capybara has been killed, weighing 98 lbs. This species is now the giant of the rodent order; but there were larger, *e. g. Castoroïdes*, amongst the extinct kinds.]

their hind-feet forwards under their belly, and their fore-feet obliquely forwards.

The œsophagus is continued about two inches below the diaphragm. The stomach is much as in the guinea-pig. The duodenum passes to the right, and down the right side behind, and adhering to the ascending part of the cæcum; then winds round the root of the mesentery and gets upon the left of it, where it becomes loose. From the pylorus to behind the mesentery, it describes nearly part of a circle; and in this course it is so firmly attached to the parts, that it can hardly be said to have a mesoduodenum. The ileum, before it enters the colon, is attached to the cæcum for nearly a foot, by a thin membrane, which appears to be a continuation of the mesentery. This membrane is longest where the ileum[1] begins to be attached, and then becomes narrower, till at last the ileum adheres to the cæcum. The beginning of the cæcum is on the left side; it is vastly large: it passes to the right, crossing the pelvis, then passes up the right to the liver; it adheres to the duodenum, then makes a turn across the abdomen towards the left, close to the stomach, and terminates in the blind end before it has got to the left side: these two last turns are something like the human colon. It is becoming gradually smaller to the end. At the end it has three ligaments, but on the greater length it has five.

The colon is pretty large at the beginning, but soon becomes small: it is reflected to the right in the fore-part of the cæcum, connected to it by a thin membrane, which becomes narrower and narrower, till at last the colon adheres to the cæcum, follows its turns nearly to the tip, is then bent back upon itself for some inches, is again bent upon itself for the same length, after which it passes to the left and becomes loose; as it passes down the left side it has a pretty long mesocolon, and is there thrown into several convolutions, especially as it passes over the left iliacus internus muscle, like the sigmoid flexure of the colon of the human. The fæces are soft, like dough[2].

The liver is divided into four lobes. The two on the left side are the

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1 [In a capybara dissected at the Zoological Gardens, about an inch from the end of the ileum the muscular fibres were very strongly marked, and seemed especially so round one spot, so as to cause a comparison of it to the ball of the thumb, there being a projection. This had probably been where the umbilical vesicle was attached, which therefore is no doubt largely developed as in other *Rodentia*, taking a great share in the uterine development of the animal. The placenta, therefore, has less to perform, and we found indeed scarcely any trace of umbilical vein at the anterior margin of the suspensory ligament, which was situated as usual: a large baboon which was examined at the same time showed well the contrast with the rodent in their manner of development by the size of the suspensory ligament.]

2 [Home, Comp. Anat. i. p. 454 ('Le Cabiai').]

largest: [and of these] the gall-lobe is the largest: the two on the right are the least, and are nearly of equal size; and the right of all is continued across the vena cava, making a kind of lobulus Spigelii. The gall-bladder is attached to the liver by a thin membrane nearly an inch in breadth. The spleen is very nearly of the shape and situation of the human; more so than in any animal that I know excepting the monkey. The pancreas is more like that of the human than in most animals, because the duodenum is short. The kidneys are flatter than usual, and therefore not so prominent as in many other animals; they are nearly of an equal height.

The anus and vagina are close to one another. On the sides of the vagina and perinæum are placed two glands, or rather a congeries of sebaceous glands, which makes there an irregular surface; they are black with an indent in the middle. The skin around here is very loose, so that these glands are sometimes inverted, and at other times turned into the vagina.

The clitoris is a prominent body, not in the vagina, but nearer the belly; however, a kind of sulcus goes from it, which leads into the vagina; there is a loose skin about it which forms a kind of prepuce. The opening of the urethra is just at the mouth of the vagina in that sulcus that leads from the clitoris to the vagina, very much like the human; so that it can hardly be said to have any common vagina. The vagina is very long and small. The ora tincæ are a little prominent in the vagina, are very oblique, or, as it were, cut aslant with the long side next to the urinary bladder. The two orifices are not observable from the vagina; nor is the septum in view. The two horns for nearly three inches are united, and seem, on an external view, to be one cavity or body; they then divide and leave one another. At their beginning they are very rugous, somewhat penniform, but [the canal] becomes smooth before the division: the distinct horns are very long, and smooth on the external surface. The Fallopian tube arises on the capsula ovarii, and terminates in the fimbriæ on the inner surface of the mouth of the capsula, opposite to the ovarium. The ovarium is an oblong dark body fixed to the inner surface of the capsula opposite to the fimbriæ. The capsula is very large, and has but a very small mouth.

[Family *DASYPROCTIDÆ*.]

[The Paca, or Spotted Cavy (*Cœlogenys fulvus*, F. Cuv.)[1].]

The La Paca of Buffon, vol. x. p. 269, from the Musquito shore, called 'Guibenet' by the natives, a very large Guinea-pig.

It is larger than a hare, and so much like the guinea-pig, as, with all the appearance of justice, to be called a large one. Its voice is very different; instead of a squeak it is a rough growl. The eye is large, the cornea prominent, which gives the general shape of the eye that of a flattened acorn. The tunica sclerotica is mottled black and white, especially behind the cornea and at the posterior part. The cornea being very large, more than one third of the eye-ball, there is, of course, a considerable motion in the iris, which is large in proportion. There is a pigmentum album lining that part of the eye behind the processus ciliares, more than half of which is covered by a pigmentum nigrum. Whether this dark part be the upper or lower, I do not know. The optic nerve is small; the retina thin.

The hair is straight and strong, not very long, nor very short, and all of one kind, there being no fur-hair; it is very thin; at every root there is a small rising which appears to be a gland. The skin is the softest and of the most pliable texture I ever met with: it will stretch in all directions. There are two sets of mustachios; one on the lateral part of the nose and upper lip, the other on the side of the head just behind and in a line with the long axis of the eye; the hairs of the first are strong and long.

By the fore-feet the animal treads nearly upon the whole carpus and toes, having several eminences: there are four toes with a very small thumb, which is hardly anything but a nail. By the hind-feet it treads upon the whole tarsus, as far back as the os calcis; but I should suppose not in walking, only in sitting, as in the guinea-pig: there are five toes, three of which are long, and may be called principal; the other two are short, and placed on each side of the foot, farther back: the innermost is by much the smallest.

The colour of the animal is exactly that of a spotted deer, a brown with a mixture of a lighter colour, and two or three rows of white spots along the sides; not so regular on the neck, shoulders, and hips, as on the chest and belly. The hair is strong, of the hog kind, but thin, and not long. The tail is short. It has four nipples; two

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[1] [The skeleton of this animal is No. 2041, Osteol. Series.]

between the fore legs, and two between the hind ones. There is no scrotum in the male, not the least vestige of one.

The tongue is long, pretty thick, does not become thinner and thinner, or narrower to a point. The velum palati is broad; its outer edge rests on the root of the tongue just before the epiglottis, so that the epiglottis, as it were, projects up behind this membrane into the nose, which makes me suspect that they must always breathe by the nose, and even make a noise through this passage. The epiglottis is not so distinct a part as in many animals; for both the glottis and epiglottis make a pretty regular rising, like the opening of a flower, only the anterior part is the highest, and the whole projects up into the posterior nares. That part which may be called epiglottis, or that which makes the anterior half of the glottis, cannot fall so as to cover the other or posterior half; but this must be brought forwards, which at the same time makes it sink under the anterior half, and then the anterior folds over it.

The space between the incisor teeth and grinders is not a continuation of the plane with the roof of the mouth, forming a ridge somewhat similar to a gum, or forming a lateral termination of the roof; but each space forms a cavity which would appear to go up almost into the nose; the roof of the mouth leading from the incisores back, and becoming very narrow, like a ridge. What can be the use of this?

On the inside of the cheeks there is an oblong glandular surface leading backwards in the direction of the mouth covered with a cuticle, having hair upon it[1].

The œsophagus does not pass immediately into the stomach; as soon as it gets through the diaphragm, it enters the stomach about its middle between the great end and pylorus. The stomach is not so oblong as in many other animals, having a large great-end: near the pylorus the stomach grows smaller, and turns upwards, making a pretty quick bend, and terminates in the pylorus. The duodenum seems to be less a continuation of the stomach than common; it is much larger than what the termination of the stomach is, and projects above the pylorus like a cæcum, as in the guinea-pig, and is, at this part, very glandular. From this the duodenum passes to the right as usual, becoming much smaller; and, as it passes down on the right side, it gets behind, and is attached

[1] [This lines the bony cavity formed as follows:—"The malar bone is a slightly curved plate, twice as deep as it is long, and forms the posterior third of the zygomatic expansion, the rest being formed by the maxillary, which is unusually and enormously developed. This zygomatic expansion is deeply excavated on the inner side, forming, in the recent animal, a large bony capsule on each side of the mouth." —Catalogue of the Osteology, Mus. Coll. Chir., 4to. 1853, p. 370.]

to, the ascending and spiral part of the colon. It crosses the spine behind the mesentery, but ascends a little as usual and becomes loose. The small intestines are of considerable length. The ileum enters the cæcum at the lower part of the belly just before the spine; but this situation will vary [1]. The cæcum is very large and long; its top is towards the left; from thence it passes, behind the mesentery, to the right, in a serpentine course, then makes a sweep downwards, and crosses the pelvis to the left again; at this part it receives the ileum. But this situation will vary, as it is a loose gut which may be turned into almost any situation. The above is the course when lying loose in the abdomen; but, when the cæcum is blown up, it makes one complete spiral turn and a half. From the left, the colon again makes another turn to the right, upon the last described turn, adhering to it by a narrow mesocolon. At this last bend it begins to become small, and continues to do so to the right; and here it has got longitudinal rugæ. When got to the right side it passes up, along the right side, adhering to the duodenum, and here it makes two complete spiral turns upon itself, then passes out upon itself again; crosses the spine closely connected to the fore-part of the root of the mesentery, and becomes attached towards the left of the mesentery to a very long mesocolon; it is here very loose and of great length, forming something like the small guts: from this it passes down the left to the pelvis, and is straight [or becomes rectum].

The liver is divided into five lobes; the left is the largest; the next is nearly as large, has a fissure in its edge for the passage of the umbilical vein, and a sulcus on the under surface for the gall-bladder: the two right lobes are small and much of a size; the fifth is the lobulus Spigelii, is very small, and wholly behind the mesogaster. There is nothing particular about the gall-bladder or ducts. In one from Mr. Clarke [2], the gall-bladder was only attached to the liver by a pretty broad thin membrane through its whole length.

The pancreas is a long flat body lying across the abdomen; the left end lies in what is commonly considered to be a doubling of the epiploon, on the posterior part, where that membrane is going to join the spleen. The [other] end of the pancreas is very thin and is divided into several small portions, which spread out in the epiploon like fingers. The epiploon is attached posteriorly to the pancreas instead of the colon.

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[1] [This last remark is omitted by Home in the abstract given in his Comp. Anat. i. p. 449.]

[2] [Probably the Founder of 'Exeter Change,' and who was Hunter's principal creditor for sums borrowed to purchase objects for the museum. The skull of the specimen from Mr. Clarke is No. 2042, Hunt. Osteol. Series.]

The kidneys are conglobate, long, round, not flat, nearly of an equal height; each has one mammilla [1]. The capsula renalis is a long small body, lying close to the inner edge of the kidney above the entrance of the vessels; its internal substance is very dark. There are two venæ cavæ superiores.

There is a lobe of the lungs between the heart and diaphragm; besides which there are three lobes on the right side, and only two on the left: the lungs of both sides are a good deal fissured.

The external parts of the female organs of generation are like those of a rat, or rather of the guinea-pig. The clitoris is an external protuberance like the rat's; having two glandular bodies as in that animal, behind which is the vagina.

The anus is continued under the tail, as in the rat, but turns downwards towards the perineum. About the verge of the anus, just under the skin, there are a vast number of small glands; and on each side of the verge is a flat gland whose duct opens just where the gut and skin join [2]. The vagina is large, dense in its coats and smooth on the inner surface. There is one os tincæ, but the common uterus to both horns is very short: the two long horns pass up the loins. The ovaria are oblong, yellow, and spotted, having a capsule with a wide mouth, and the fimbriæ on the edge of the opening.

Of the Male Parts.—It is retromingent; the penis is full of spikes, with the points turned towards the root of the penis [3]. The testicles are within the abdomen close to the rings. The spermatic artery passes in a broad membrane, and not on the edge of it, but about the middle; so there is a considerable breadth of the membrane, as it were, beyond the vessels; on the left the outer edge of this membrane is attached to the lower end of the left kidney, near to the testicle: it is very loose, more than 4 inches broad.

Although the testicles appear to lie easily in the abdomen, yet they can easily pass into a sheath formed for them, which is in what we would call the 'rings,' being the place of the spermatic cord in other animals; which sheath is invertible into the abdomen like the finger of a glove, and forms the gubernaculum.

The epididymis comes out from the testis by a small neck of some length, then forms the 'head,' then becomes very small, and at the lower part it becomes large again, and is more attached to the lower part of the body of the testis than is the head. The vasa deferentia are small, and of course short, from the situation of the testicle. The vesiculæ seminales are pendulous, being only attached by their outer

[1] [Hunt. Prep. No. 1182.] [2] [Ib. No. 2139.] [3] [Ib. Nos. 2496, 2497.]

edges to the side of pelvis by a thin membrane. They are flat, and serrated on their inner edges. The prostate gland[1] . . . . . The membranous part of the urethra is long.

[The Acouchy (*Dasyprocta Acouchy*, Erxl.).]

L'Agouti, Buffon, vol. viii. p. 380.

An animal that Mr. Rymsdyk has made two paintings of; one to show its manner of eating, the other its walking or standing, or rather the general shape of the animal[2].

This animal is larger than a guinea-pig, but not so large as the smallest rabbit; it has more of the guinea-pig than the rabbit; for instance, its ears are short; its head is larger in proportion to the body; its legs are bare, or rather not covered with that long hair; its toes are almost quite bare: these two last circumstances are more remarkable than in the guinea-pig itself. Its hind-legs are considerably longer than the fore, which is the case with both the rabbit and guinea-pig, but it is not so much so as in the rabbit, although more so than in the guinea-pig. It commonly sits on its posteriors, and seldom straightens its back, but most commonly has it curved. There are three toes on the hind-foot; and they are a good deal in shape like some of the short-toed birds, viz. the stork: there are four toes on the fore-foot, with a little knob on the outside of the foot, which has a nail upon it: these toes bend like the bird's, but do not throw themselves into zigzag lines, when in the most easy position, as they do in the dog, &c. The animal has a rotatory motion in the radius. It has a short tail, with no hair upon it. Its hair is strong, more like the hair of a hog, and like that animal is very thin: each hair is of two colours, viz. in some parts black or dark, and in others of a yellowish brown. It is an awkward walker, sometimes hopping like a rabbit, at other times walking; but in the walk the hind-legs are much bent to proportion themselves to the fore-legs, and the back is very much rounded. Its food is rather bordering upon that of the squirrel.

The liver is divided into four lobes besides the lobulus Spigelii; the

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[1] [This, with the other accessory glands, is preserved in the Hunt. Prep. No. 2497, showing the termination of their ducts.]

[2] [This painting, now in the Royal College of Surgeons, and the skeleton, No. 2046, Osteol. Series, show that the species was the Acouchy, which is figured in the 'Supplement,' No. iii. (1776), p. 211, tab. 36, of Buffon's great work. Hunter's specimen would appear from the MS. of the Old Catalogue, p. 34, now in Mus. Coll. Chir., to have been dissected in the early part of 1789.]

left is the largest, and comes furthest down the cavity of the abdomen. The second is next in size, does not come so low, but is broad and irregular on the under surface, having the gall-bladder attached, and the remains of the umbilical vein: the third is next in size, and the fourth or right is the smallest, lying hid by the others, and is attached to the right of the vena cava inferior. The lobulus Spigelii lies in the curve of the stomach, entirely behind the mesogaster. The gall-bladder is attached to the second lobe [from the left], and would at first sight appear to be in the centre of that lobe, for the two lateral edges of that lobe approach one another, and as it were surround the gall-bladder: it is attached to that right flap of liver by a thin membrane, and to the ligamentum rotundum by another.

The epiploon surrounds the whole intestines: it is attached to the great curvature of the stomach, and to a little bit of the duodenum before; to the diaphragm on the left, and to the root of the mesentery behind, so that both the spleen and large pancreas are, as it were, in a doubling of the posterior and left part of the epiploon. The stomach[1].—The pylorus is not so firmly attached to the back as in the human. The duodenum passes down the right side; it is not attached to the loins, but by a short mesentery to the beginning of the transverse arch of the colon and to the cæcum; it goes behind these guts, attached to the cæcum in the same manner, and then makes a turn upwards on the right side of the mesocolon, being closely attached to it; it then becomes loose. The ileum enters the cæcum at the part which lies nearly in the middle of the body, just above the spine: from this part the cæcum passes to the right side and then up that side.

The length of the small intestines is twelve times the length of the animal, from the nose to the end of the hind-foot, but from the nose to the rump it is sixteen times.

The pancreases are two; but the small one does not lie in the curve of the duodenum, as in most other animals; it comes off from the large one near its middle, and passes down and to the left, getting into the mesoduodenum near its last turns, and then bends round the root of the mesentery with that gut, and some of it, or its termination, is in the mesentery. The large pancreas is pretty long, is not closely connected to the spleen, but lies in the same doubling of the epiploon, and

[1] [See the Dry Preparation, Mus. Coll. Chir. In a specimen dissected at the Zoological Gardens, I found the stomach, 5¼ inches long, and 8 inches in its greatest circumference when moderately distended; it had a remarkable constriction between its cardiac and pyloric portions, which gave it the appearance of consisting of two distinct cavities; the pyloric portion bulged out on each side of the pylorus so as to make the duodenum commence from a central depression.]

its small end runs a little way down in that membrane. The spleen is not very long, has three edges, and lies in the left side of the posterior portion of the epiploon, as in most animals.

In one from Mr. Banks there was a small detached spleen about 3 inches from the large or common one. It lay in the doubling of the epiploon[1].

The heart is short and broad, not peaked at the point as in the sheep. The auricles are very much like one another, rounded on their anterior edges. There is but one vena cava superior. The lungs are as in most other animals, the left divided into two lobes, the right into four. The kidneys are conglobate, very prominent, nearly of an equal height; the right rather the highest.

On examining the external parts of generation, we found two swellings on each side of the anus like testes, but they are glands that throw in a thick mucus into the verge of the anus, as in the guinea-pig, but are larger; which anus in this animal is a pretty large opening, externally, as it were, common to these two glands and the rectum. These parts are hardly covered with hair. The opening of the preputium is very near the anus, just under the bulb of the urethra, from which opening the penis passes forwards towards the belly, for about one half of its length, and then is bent back again to the pubis, and along the symphysis of this bone, so that it lies doubled: this is like the guinea-pig and Virginia squirrel; and, when erected, it becomes straight and is wholly directed forwards.

There is a bone in the centre of this retrograde part, and a small bone on each side of that part that is covered by the preputium, like two splints; exactly the same as in the guinea-pig. The two testes are very large, and lie commonly within the abdomen, but the lower end, which is the epididymis, just points through the rings of the abdominal muscles, and appears a little prominent on the rings or inguen. The tunica vaginalis can easily be inverted, and when so, the epididymis seems to be attached to the lower part of the belly by a ligament, similar to that which is found in the human fœtus, and which has the cremaster muscle lost on it. From this a ligamentous substance goes across the penis on the bend, and would seem to draw these bodies a little out of the abdomen when the penis is erected or made straight.

There are two pretty thick small muscles that arise from the pubis near the symphysis, between the body of the penis and symphysis, that are lost in two tendons which run upon the upper or convex surface of the penis, and by their action will extend that bent part as the extensors

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[1] [Hunt. Prep. No. 839.]

of the fingers do the fingers. The same in the guinea-pig. The vesiculæ seminales are more like the rat's in shape than the guinea-pig's, but open much in the same manner: they do not communicate with the vasa deferentia.

The epididymis and vasa deferentia pass in the guinea-pig, and open as in that animal. What answers to the prostate gland are two glands on the sides of the bladder, having a great many ducts as in the guinea-pig, which enter near the openings of the vasa deferentia[1].

The Female Parts.—The clitoris is in a distinct prepuce from the vagina, as in the rat. The nipples are eight, four on each side; two pectoral, two inguinal, and four abdominal. The os tincæ is one; but the common uterus is short, not above $\frac{3}{8}$ths of an inch. The horns of the uterus are similar to those in the rat[2].

THE PORCUPINE [*Hystrix cristata*, Linn.[3]].

If the two different animals which go by this name are the same species, then we may suppose a reason for the difference in the hair. The last[4] is a native of Hudson's Bay, which is a cold climate, therefore it requires hair of the thickest and softest kind; whereas the quilled one [*Hystrix*] is a native of warmer climates, such as Spain, &c. It walks on the sole of the foot and palms of the hands, like the bear; the claws are much of the same kind. The eyes are small, like those of a beaver, and the eyelids are very narrow. The odour about the anus is similar to that of a ferret.

The œsophagus is 2 inches long below the diaphragm: it is attached to the crura of the diaphragm by a doubling of the peritoneum, and by what might be called the mesoœsophagus: this is similar to the rat and guinea-pig: where it enters the stomach it is very small.

The stomach is very strong, and what is called the great end, or cardia, is rather the smallest, for it ends in a point. The pylorus is very thick, and is situated much as in the human subject. The duodenum is attached to the ascending part of the colon, as it passes down the right side, for nearly a foot in length, by a short mesentery which becomes longer and longer downwards: it is then attached to the root of the mesentery on the same side, and gets behind it to the left; it afterwards gets to the edge of the mesentery, becoming loose. The

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1 [Hunt. Preps. Nos. 2492, 2493, 2494.] 2 [Ib. No. 2751.]

3 [The skull and other parts of the skeleton of the male porcupine here described are Nos. 2076—2086, Hunt. Osteol. Series.]

4 [*Erethizon dorsatum*, F. Cuv., of which the female parts are subsequently described.]

cæcum is a foot long, largest at the entrance of the ileum, and has three longitudinal bands, as in the guinea-pig[1], which are continued on to the colon, but become fainter and fainter onwards, and at the rectum they are hardly perceivable: it lies coiled up in the lower part of the abdomen. The colon is smaller than the cæcum, as in the guinea-pig; and, as it passes up the right side, it is attached to the duodenum, as was mentioned before; it then bends down a little upon itself for near a foot in length; something similar to that in the guinea-pig, but not exactly of that kind, just before it passes across the abdomen; and the piece of the colon that makes the doubling is half an inch distant, with a mesocolon common to both; it then passes a little more to the left, and becomes more attached to the root of the mesentery; from thence to the left and all the way down, it is a loose intestine like the jejunum, and there is a good deal of it having a loose mesocolon; it makes another fold, but not so long as the former, and then goes to form the rectum.

The spleen is attached to the stomach and to the last fold of the colon by the epiploon; it is small, and rather a rounded flat body than an oblong one: it was small, but oblong, in another of the same kind. The pancreas lies in that epiploon which attaches the spleen to the colon on the left side, and to the root of the mesentery on the right side. It is very thin, and its duct enters the gut beyond the attachment of the duodenum to the colon, which is a good way from the pylorus.

The liver is divided into three lobes of nearly equal size; the middle one has a large fissure in it for the umbilical vein: the lobulus Spigelii is very small, and is a kind of continuation of the right lobe: whether this right lobe was only one originally, or two or three united, I am not quite certain, because it was irregular, and had marks of union upon it. In another, which was perfectly sound, it was divided into two, so that there were four lobes, besides the lobulus Spigelii. The gall-bladder was fixed to the third lobe from the right or the second from the left: it has hardly any length of ductus cysticus. The ductus communis is very large, and is a great deal honeycombed on its internal surface. The pori biliarii are likewise very large, and the largest of them enters the ductus communis between the entrance of the ductus cysticus and the duodenum. The ductus communis enters the gut close to the pylorus. In another specimen there was no gall-bladder.

The epiploon is broad and fat, covering all the guts, &c.: the little epiploon is tucked down to the concave surface of the left lobe of the liver.

The kidneys are oblong, conglobate, dark bodies, rather round and

[1] [Home, Comp. Anat. i. p. 449.]

thick, and much of the colour of the human. The right kidney was somewhat the highest. The capsula renalis of the right kidney was rounded, of the left one was oblong. The cortical substance is pretty firm, yellow, and radiated; the medullary is pulpy, and, in colour, like the tubular part of the kidney.

The heart is flat, rounded at the apex, or rather having two apices very like the scrotum of a goat. There is but one vena cava superior[1].

The lung of the right side is larger than that of the left, with three fissures dividing it into a kind of four lobes, besides the median [or azygous lobe].

The tunica vaginalis testis communicates with the abdomen, is pretty thick, and the cellular membrane that connects this coat to the rings and to the external parts is so loose as to allow easily an inversion of the testicle into the abdomen. This is similar to the hedge-hog, guinea-pig, rat, and squirrel. The epididymis is only fixed to the testicle by a thin membrane, excepting at its beginning. The prostate gland is divided into two, one on each side of the urethra, and they are like the branches of a tree; there is a duct in each ramification, uniting into one duct, which enters the urethra just at the caput gallinaginis. The orifices of the vesiculæ seminales are very large. The penis has a bone in it, and is similar to that in the hare, rabbit, guinea-pig, rat, and squirrel.

The whole viscera are very loose: the mesentery is very thin: the stomach can be turned from the right to the left. Some of the internal intercostals arise from the vertebræ of the back. The clavicles are small; one end is connected to the sternum by an elastic ligament, an inch long; the other end by a tendinous expansion.

[The Coendou (*Erethizon dorsatum*, Fr. Cuv.).]

In another porcupine, from Hudson's Bay, the clavicle was almost close to the sternum.

Of the Female Organs.—The broad ligament, or meso-cornu-uteri, at the upper part is attached to the lower end of the kidney. The opening of the urethra is just below the clitoris, as in the human; so that there is no length of common vagina, and no rugæ in the vagina. The vagina and anus make but one external opening when the parts are in their natural position. There is no proper uterus: the two horns arise from the vagina as in the hare and rabbit, and terminate gradually in

[1] [In a *Hystrix cristata* which I dissected at the Zoological Gardens, I found two venæ cavæ superiores. See the Prep. No. 9238, and its description in the Physiol. Catalogue, 4to, vol. ii. p. 52.]

the Fallopian tubes, so that it is hard to say where the tube exactly begins. The ovaria are oval bodies of a yellow colour, studded with dark or seeming-transparent spots: the capsula ovarii is loose and wide-mouthed. (N.B. These additional notes were taken from a Hudson's Bay porcupine[1].)

A small Porcupine [*Loncheres* or *Echimys*, Geoff.].

About the thickness of a rat, but not so long. It has both hair and quills: the quills are flat. There are two venæ cavæ superiores. The liver has five lobes, with the Spigelian lobule. I could find no gall-bladder. The stomach is more globular than the human: the pylorus opens into the side of the duodenum, which makes a kind of cæcum at the beginning of the duodenum.

The duodenum passes down to the left and up. The ileum passes into the colon; beyond which there is a long cæcum, which has a double end, or rather passes into the side of another gut which is blind at both ends, forming two cæca. The colon passes up the right before the duodenum, and at the pylorus it makes a twist or fold which bends upon itself; it then makes a turn down in the root of the mesentery, and up again, going to the left, and down the left side. On the cæcum there are the longitudinal bands, and also on the ascending part of the colon; so that they are pursed in different places.

There are two ora tincæ. In the horns of the uterus were three young: the young had a long tail; but the old one had not. She has eight nipples.

[Family *CASTORIDÆ*.]

The Beaver [*Castor canadensis*[2]].

The beaver is thick and flat in its body like the otter, more so than the human. The legs are short; the thighs of the hind-legs are so short as not to project below the belly at the knee: the fore-feet are a good deal like those of the badger or racoon, only the claws are much longer; but the strength and motion of the fingers would seem to be inverted; for what answers to the little finger is the strongest, and has the greatest motion, acting as a kind of thumb: it has more the figure and motion of a finger than a toe, being flattened forwards, and having a nail, not a claw. The ring-finger is something of the same kind, as is also the middle finger; but what answer to the fore-finger and thumb

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[1] [Hunt. Prep. No. 2750.]

[2] [The specimens illustrating the osteology of this species are Nos. 2163—2165, 2167—2199, from three individuals, in the Hunterian Osteol. Series.]

are flattened sideways; each has a claw, and their motions are more determined. The hind-legs are strong; the feet are broad, and webbed like those of a seal; and the muscles of the abdomen adhere to the inside of the thigh, something like the seal's; and what answers to the little toe is the strongest, as in the fore-foot, but not so remarkably. The insertion of the abdominal muscles into the pubis is at the lower edge, which rises so that the whole anterior part of the surface of the pubis makes part of the cavity of the belly. The hind-legs are capable of being extended backward, for the purpose of swimming, farther than in animals in common. Indeed, this animal is fitted for that action in many respects; as, *e. g.*, the testicles are not loose and pendulous, but flat, and in some measure buried on each side of the rectum; so that there is nothing to retard the motion through the water.

The parotid gland is very large, so much so as to cover almost the whole fore-part of the neck, joining its fellow, before, at the thyroid gland: its duct passes over the masseter muscle. The thyroid is also large, of a dark purple, and comes below the upper part of the sternum, so as to appear like the thymus. The tongue is not flat and edged; but is thick at the fore-end, its two broadest surfaces being reversed, viz. they are lateral; the mouth is so narrow between the grinders and incisors, that the tongue there adheres to the lips or cheek. There are a vast number of glands about the mouth. The eyelids are very small, which is contrary to most of the present order. The fat of this animal is principally on the external surface, immediately under the skin; there is little or none in the interstices of the muscles, and hardly any in the abdomen anywhere.

The œsophagus is long below the diaphragm, as in the rat: at the insertion of the œsophagus [into the stomach] there is a glandular body that appears upon the external surface like a distinct cavity; its ducts open into the stomach upon a flat surface[1]. The stomach is large and wide; it makes a pretty quick turn near the pylorus. The duodenum passes down the right side nearly as low as the pelvis; then turns up by the side of the rectum, adhering to that gut; then gets on the left of the mesentery, where it becomes loose. The ileum enters the colon in the middle of the body just above the pelvis; and the cæcum passes to the right, making a quick turn upwards, and to the left, behind the mesentery; so that the apex of the cæcum lies on the left side. The cæcum is wide at the beginning, and is about 18 inches long.

The colon passes to the left, then makes a quick turn upon itself to the right, crossing the pelvis, the two portions adhering together; it

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[1] [Hunt. Preps. Nos. 587—598; Home, Comp. Anat. i. p. 145. tab. xiii.]

then is connected to the right curve of the cæcum, crosses the lower curve of the duodenum, and gets on the mesoduodenum, to which it adheres and makes two small folds on itself; from thence it crosses the root of the mesentery, and passes down on the left of the duodenum to the pelvis. These two small folds on the hollow of the duodenum may answer the same purpose as the fold in similar animals, as the colon passes the spine. The rectum is carried a considerable way beyond the pelvis, along the lower part of the tail, before it terminates in the anus, which part is bent down from the tail[1].

The epiploon has no fat in it, being an extremely thin transparent membrane.

The liver is divided into four lobes, with the lobulus Spigelii; the second from the left is the largest, and is fissured for the entrance of the ligamentum rotundum and gall-bladder, whose ducts enter the duodenum near the pylorus; the right lobe is also fissured, so that it might be reckoned two. The lobulus Spigelii is pretty large or long, as in most of those animals, and is fitted to the curve of the stomach, covered by the small epiploon; not, however, transversely, but the epiploon makes an angle with itself by being attached along the concave surface of the liver to near its lower edge, making a kind of capsule for the end of the lobulus Spigelii, and adheres to the right edge of the lobulus Spigelii.

The pancreas lies in the curve or sweep of the stomach and duodenum; but its duct does not enter near the pylorus, but at the last or lowest turn of the duodenum; so that there is but one duct to the whole sweep of the pancreas.

The kidneys are conglobate, very much the shape of the human, not so prominent as in most other animals, but somewhat flatter. The capsulæ renales are not flat but prominent, of a greyish-blue colour externally, but of a bright brown within.

The pericardium adheres to the sternum, and the heart is flatter than in most animals, both of which circumstances are owing to the flatness of the chest. Three arteries arise from the curvature of the aorta. There is no foramen ovale, nor ductus arteriosus.

Of the Male Organs[2].—The testicles are pretty large, lying beyond the pubis on the sides of the rectum, which is continued a considerable way beyond the pubis. They have no scrotum; so that the testicles are hardly perceivable when the skin is on. The vaginal tunic is large; so that when we pull by the spermatic chord, from the abdomen, we can easily pull the testicle into that cavity; and they are probably often

[1] [Home, Comp. Anat. i. p. 452.]

[2] [Hunt. Preps. Nos. 2483—2487; the female organs are shown in No. 2742.]

in the cavity of the abdomen, which was the case with the one given me by Sir Joseph Banks. The vasa deferentia pass behind the bladder, as common to most animals; and, when got to this part, they become larger, both in their external size and in the size of their canal, which becomes irregular on its inner surface, having a vast number of circular lamellæ or folds placed close to one another. This part of these ducts in the horse has the same appearance or structure; as also in the shark, skate, &c. The penis is bent back almost wholly from the os pubis along the lower surface of the rectum or anus, and the opening of the prepuce is so close to the anus as to make but one external opening for both[1].

It is hardly possible to conceive how this animal can copulate with the female; because, when the penis is erected, it would appear that it could not be brought forward, from the prepuce being so closely connected with the anus; excepting we suppose that the tail is bent downwards and forwards as in birds, the turtle, &c.; so that the anus by that means is turned forwards (which is certainly the case; for, when the penis is erected by [artificial] injection, it is turned forwards, and the anus is also brought forwards by the rectum's bending that way)[2].

The male beaver has a large pair of oblong bags on each side of the anus and penis; also two other pairs contiguous to the above, but rather smaller, all of which are entirely on the outside of the pelvis, owing to the rectum's being carried some way beyond the pelvis, along the under surface of the tail. The long axis of these glands is transverse to, or at right angles with, the rectum.

One pair of these bags, viz. the large one on each side, must be for a different purpose to that for which the others are intended. One pair seems entirely for the penis or parts of generation, the others probably belong to the anus. They lie alongside each other, those for the penis being nearest the pelvis; they are all oblong bags, extending nearly the same length in all. The bags for the penis are the largest, and of nearly the same width through the whole length; and they open by very large openings into what may be called the under surface of the prepuce, in conjunction with each other; and the external opening from them is the opening through which the penis passes. The coats of this bag are of a greyish colour, and pretty firm in texture: it is lined with a cuticle, contains a light brownish mucus which mixes with water as chalk or clay would, and has the castor smell.

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1 [Hunt. Prep. No. 2118.]
2 [Supplementary note, in which the experiment had been tried on another beaver.]

The other bags, viz. those belonging to the anus, are a pair on each side; are more of a pyramidal figure, being thicker at the fundus, and becoming small towards the anus: they open on each side in the sulcus, between the anus and prepuce, by very small openings. They contain a thick oil of a light brown colour, about the consistence of common butter, but rather more tenacious. This has something of the castor smell, but not so much as the other[1].

The Water-rat [or Water Vole[2] (*Arvicola amphibia*), Lacép.].

The specimen about to be described measured seven inches from the tip of the snout to the anus, and weighed six ounces and seven drachms.

On opening the abdomen no epiploon was visible, because it was very short and hidden by the stomach, which extended as far as the umbilical region; the duodenum was seen on the side of the stomach, and nothing else, with the exception of the cæcum, was discernible between the stomach and the bladder. The liver was situated more towards the right side than the left, and the stomach a little more to the left than towards the right.

The duodenum was placed on the right side, where it made some windings; it turned upon itself in the right flank, and was prolonged forwards to join the jejunum, the convolutions of which were above the cæcum in the anterior part of the umbilical region, and on the right side. The convolutions of the ileum were likewise above the cæcum in the right flank, and in the umbilical region. The cæcum extended from left to right in the flanks and hypogastrium: in other subjects I have seen it in the umbilical region, where it formed some sinuosities. The colon had many nearly spiral convolutions in the posterior part of the abdomen; it then passed from left to right in the umbilical region above the small intestines; it afterwards curved forward in the right side, and turning inwards above the stomach, ran backwards in the middle of the abdomen to the rectum.

The membranes of the stomach and intestines were all so thin, that their contents shining through them gave them a greyish colour. The figure of the stomach was very irregular, the great cul-de-sac being deep, and the right portion of the viscus separated from the left by a constriction, which reduced its circumference to an inch and a half at the point of junction; between this constriction and the pylorus, the anterior surface of the pylorus presented a large convexity, which appeared to be a third stomach; but, on opening the organ, I found that

[1] [Hunt. Preps. Nos. 2118—2122.]

[2] [It is more nearly allied to the beaver than to the rat.]

this appearance was produced by the unequal thickness of its coats. All the left portion, and that part of the right side placed between the constriction above mentioned and the œsophagus, had their coats thin and transparent like the tendinous centre of the diaphragm. These thin membranes were terminated at the constriction of the right side, and on both sides of the convexity on the anterior aspect, by a fringed margin; all the rest of the right portion had its membranes much thicker, and had a very apparent villous coat.

The small intestines were of the same diameter from one extremity to the other; the cæcum was very long, and transversely furrowed; it was nearly of the same dimensions throughout, except at its very end, which was smaller than the rest. The colon at its origin equalled the cæcum in size, but its circumference diminished gradually for the space of 2 inches, after which it remained the same for 9 inches further; and along this portion of the colon oblique fibres were perceptible, placed at a distance of half a line from each other, none of which were visible upon the other portion of the colon, which was nearly of the same size as the rectum.

The liver[1] was composed of six lobes; that which was placed in the middle of the diaphragm was divided into two nearly equal portions by a deep fissure, into which the suspensory ligament was inserted; the gall-bladder was attached to the bottom of this fissure. The largest lobe was on the left side, and this covered the left portion of the middle lobe; the third was on the right side, behind the upper part of the right portion of the middle lobe, to which it was much inferior in point of size, but was a little larger than the fourth lobe, which was placed behind it, and embraced the anterior part of the right kidney. The fifth and sixth lobes were the least of all; they were attached to the left side of the root of the liver, one extending below and another above the middle of the stomach; these two lobes were much smaller than in the rat. The liver was of a reddish-brown colour, which was deeper externally than within. The gall-bladder was ovoid.

The spleen presented three surfaces; it was oblong and broader at the inferior than at the superior extremity; its colour was reddish, but rather lighter than that of the liver.

The pancreas formed three long and slender branches; one ran along the duodenum, the other along the left side of the stomach, and a third towards the left side under the spleen; between the second and third branches was a fourth, placed upon the upper part of the stomach, and there branching.

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[1] [Hunt. Prep. No. 808.]

The kidney is conglobate, with only one mammilla.

The heart was elongated and placed in the middle of the chest, the point was slightly turned towards the left side. The right lung had four lobes, the left only two.

The tongue appeared narrower in the middle, and more elevated at its posterior part than that of the rat; the edges of the glottis were serrated; there were upon the palate eight furrows disposed nearly as those of the rat, but those which were placed between the molar teeth were less convex anteriorly.

The water-rat has no well-defined scrotum; sometimes the testicles may be perceived on each side of the space which is between the anus and the orifice of the prepuce; at other times one only is perceptible externally; but in most of these animals the testicles remain in the abdomen, at least to a certain age. The glans penis is large and cylindrical. The urethra is placed in the centre of a cavity which is at the extremity of the glans; and on each side of the latter, in the prepuce, is a long and thin glandular body, the orifice of whose duct is seen on the edge of the prepuce. The urinary bladder was of a pyriform shape, and the testicles like an olive; the tubercle of the epididymis was small, and its convoluted vessels very apparent. The vasa deferentia were short but capacious. The vesiculæ seminales formed an elongated pouch, notched nearly as the comb of a cock is, and bent in a cruciform manner at the extremity. When opened, there issued a whitish matter of some consistence. The prostates were large, and placed at the root of the vesiculæ seminales: they were of an irregular shape, each composed of three lobes.

The extremity of the rectum was surrounded by a gland, which poured a milky matter into the gut near the anus.

The urinary bladder was large, and almost round. The teats are almost imperceptible in the male, and even in the unimpregnated female; but in a gravid specimen I counted eight, four on each side, two on the chest, and two on the belly.

The female resembles that of the rat and mouse in the situation and shape of the urethra, and of the glands by the side of it. The clitoris, which is perforated by the urethra, projected externally like a tube, about two lines in length, resembling the prepuce of the male; the orifice of the urethra of the female was three lines distant from the vulva.

The coats of the vagina are thin, and have longitudinal folds on the internal surface.

The cornua uteri were long; the ovaria were flat, long and tuberculated. The tubes of Fallopius were convoluted in the interval between the extremity of the cornua and the ovaria. There were four fœtuses in the right cornu of this womb, and two in the left[1].

[Family *MURIDÆ*.]

Of a Rat [*Mus decumanus*[2]].

The arteries arise from the curve of the aorta just as in the human. There are two venæ cavæ superiores. The contents of the thorax are as in the squirrel. The trachea is bony; the lungs are divided into three lobes on the right side, besides the middle lobe, or that between the heart and diaphragm: the left lung is one entire lobe, but would seem as if it were two united by adhesion[3].

The œsophagus below the diaphragm is about 1½ inch long, and has a mesoœsophagus; and is inserted about the middle of the concave curve of the stomach. The great arch or end of stomach is very long, and as it were bent upon the œsophagus, or turned in upon itself, making a common arch between it and the œsophagus[4]. All that part upon the left of the œsophagus is of a whiter colour than the other externally, and is thin; having hardly any muscular fibres on it excepting the concave side, and is lined with a kind of cuticle which is white towards the small curve[5]: there is a tendon on each side, as in a bird, and all that part that is between the œsophagus and pylorus is strong and muscular; it is soft and spongy upon the internal surface. The small arch is attached by the mesogaster to the liver, but not on the same plane; for, about the middle of it, it makes an angle, by being inserted there lower, or nearer the lower edge of the liver. Before the spine the stomach ends in the pylorus; thence, to the right, goes the duodenum, which has a pretty long mesentery as it passes down the right side; it then makes a turn to the left, and passes up by the side of the rectum to the root of the mesentery: it is attached to the rectum by a narrow membrane, and also to the root of the mesentery, as it passes forwards round its left edge; it then becomes loose and convoluted, and enters the [part of the] colon which lies before the spine, and a little to the right. The cæcum is turned towards the right, is about 1½ inch long, a little bent, and near an inch in diameter. The colon at the insertion of ileum is a little convoluted, as it comes out on the left of that inser-

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1 [Hunt. Preps. Nos. 3462—3465; showing the extensive vitellary sac, and the small discoid placenta.]

2 [The skull is preserved in the Hunterian Osteol. Series, No. 2234; the teeth are displayed in No. 2235.]

3 [Hunt. Prep. No. 1130.] 4 [Ib. No. 447.] 5 [Ib. No. 1908.]

tion: it passes behind that gut to the right, and, up that side, attached to the right edge of the mesentery [through] its whole length; then passes before the root of the mesentery to the left, being pretty closely connected to it; from thence it passes down to the pelvis nearly on the middle [line] of the spine.

The fæces begin to be divided at the beginning of the colon, where there is a thickening and a kind of stricture: Qu., whether or not is this the part that divides the fæces? There was the same structure in another that I examined. The great intestine is just once the length of the body of the animal; the small intestine is six times. All along the attachment of the colon to the mesentery there is a series of lymphatic glands.

The liver[1] is divided into four principal lobes besides the lobulus Spigelii, which is divided into two; the smallest lies in the posterior side of the curve and behind the other, which is pretty long, and lies before the stomach, enclosed in the mesogaster, but would seem to perforate that membrane. The two left lobes are the largest, and the falx and umbilical ligament are inserted into a deep fissure in the second lobe from the left, as in the squirrel. There is no gall-bladder. The hepatic ducts enter the gut about 1½ inch beyond the pylorus. The epiploon is attached to the stomach. The spleen and pancreas are as in other brutes: the spleen is an oblong triangular body, pretty red.

The kidneys are conglobate, and their coat is very thin: the right is much in the usual place, but the left is very low, near the pelvis. The capsula renalis is of a whitish yellow and almost round, situated at the upper end of the kidneys.

Male Organs[2].—As the sacrum is in a line with the back, the pelvis is very small, therefore the contents of the pelvis appear above the pubis. The penis is turned back as in the squirrel, guinea-pig, porcupine, hare, rabbit. The penis has a bone in it: there are two glands on the side of the retrograde part of the penis, whose ducts open on the edge of the preputium, and are filled with a white mucus. The urinary bladder is thin and pendulous, attached to the linea alba by a thin ligament. On each side of the neck of the bladder lie two glandular bodies, soft and pulpy, which may be called prostate glands, as they send in a thin juice into the urethra just at the beginning. The testicles are large, and lie within the abdomen, having their lower ends pointing out. There is no scrotum. The epididymis begins at the upper end of the testicle, and as it descends becomes smaller; it

[1] [Hunt. Preps. No. 809.]

[2] [Ib. Nos. 2500, 2501.]

then passes out of the abdomen into the sac, and becomes pretty large; thence the vas deferens begins, which passes up and winds round the bladder and the [vesicular] glands; and where it passes in between the bladder and vesicula seminalis, there is a granulated body containing a mucus similar to that in the vasa deferentia; and the duct or ducts [of these prostatic glands] open into the vas deferens, near its opening into the urethra, which is near the beginning of the urethra.

The testicle is very loose, being attached to the side of the neck of the bladder by a broad thin ligament, and the lower end of the epididymis is attached to the sac by a continuation of the same. On this ligament pass the vas deferens and the blood-vessels; and from the upper edge of this ligament, near the testicle, passes up a part like a collapsed epiploon which lies loose in the loins. The sac that the lower end of the epididymis lies in and the lower end of testicle can be pushed into, is occasionally muscular; so that the testicles and epididymis can be squeezed or kneaded between the action of the abdominal muscles and this muscle.

There are two bags, resembling in figure a cock's comb, that are large and flat, spreading outwards, and as it were covering most of the pelvis: they contain a thick cheesy mucus, and are commonly called 'vesiculæ seminales:' their ducts enter the urethra just where the vasa deferentia enter, but they do not communicate; therefore they cannot be 'vesiculæ seminales' [as to function]. The contents are hard, and some of it fills up almost the whole cavity of the urethra, moulding itself to it.

There are two [Cowperian] glands, one on each side of the rectum, as in the squirrel, whose ducts pass up to the bulb of the urethra, and there enter into the urethra: there is a large foramen cæcum where these ducts enter.

Of the Female Parts.—The opening of the anus is not just above the vagina, but is carried nearly half an inch further under the tail. The vagina is pretty large. The clitoris is not within the vagina, but is placed upon the ossa pubis externally. It is pretty long, covered by a prepuce, and the urethra passes along it and opens at the glans, just as in the penis. There are two glands, one on each side of the clitoris, which throw out a thick mucus on each side of the glans. The vagina is very large: there is no common vagina. The os tincæ is prominent and rugous. The uterus is but small; the horns are long; the Fallopian tubes do not pass along the capsula ovarii, as in many other animals, but form something like a ruffle around the basis of the capsule. The capsule of the ovary is not large, but wholly encloses the ovary, and seems to have no opening into it; for, by making a small hole into the side of it, and blowing into it, no air escapes by the side of the opening of the Fallopian tube into the capsule. The ovary is like a cluster of yolks in the hen.

They produce ten or twelve young ones at each gestation. They have a placenta to each, which is attached to that side of the uterus where the meso-uterus [peritoneal fold attached to the cornu] is, or where the vessels enter that tube. There appears to be no spongy chorion going out from the edge of the placenta to cover the fœtus. The membranes come out from the root of the umbilical chord[1].

There are twelve nipples, six on each side, three of which are on the abdomen, and the other three on the thorax.

Of the Common Mouse [*Mus musculus*, Linn.[2]].

This animal comes nearest to the rat in external form of all that I know of this order; yet it is a very different kind of animal: its food may be said to be different, as mice eat little but what is of the vegetable kind. Cheese may be said to be its principal animal food: however, mice will eat dried animal food.

It differs from the rat in having but five nipples[3].

Mice, like cats, bitches, &c., carry off their young when disturbed. In a meadow when the grass was mowed, a mouse-nest was found with young ones in it: next morning, when the mowers were going to take the nest with the young, the young were gone. They were too young to have gone of themselves, and indeed it was not to be supposed; for they had not been disturbed themselves; the nest having been left entire[4].

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1 [Hunt. Preps. Nos. 3466—3468.]

2 [The skeleton is No. 2238, Osteol. Series.]

3 [The usual number of nipples in the *Mus musculus* is eight; and they sometimes produce as many young. Daubenton states that, of eight gravid mice which he dissected during the months of February, April, May, June, and November, one had four young, four had each five young, two had each six young, and one had eight young. He notices several varieties in the number of the nipples in the black rat, the ordinary number being ten, six ventral and four pectoral; but "some individuals have supernumerary nipples, whilst in others the ordinary number is not complete." Hunter may have observed a variety, by defect, in this respect, in the common mouse. See Buffon, Hist. Nat. 4to. tom. vii. p. 279.]

4 ["I have seen the same thing in the domestic mouse."—W. Clift, 1821.]

[THE CAPE MOLE-RAT (*Bathyergus*, Brants).]

From Mr. Banks[1].

It walks on the whole [hind] foot, which is short, as in the rat: the great and little toes are like one another, only the great is the longest; the middle toe is the longest of all: the nails are pretty flat. The toes are straight on the fore-feet: the thumb is the shortest, the fore-finger the longest; the rest gradually become shorter to the little finger. They are flat sideways, with one edge forward and a little inward; the hollow concave edge turned backward and a little outward. The balls of the thumb and little finger are very prominent and pointed downwards; they are tipped with a horny substance, on which the animal walks. It has a thick short neck like a rat's. The axis of the head is almost in the direction of the body. The external ear is not projecting, [there being] only a canal, which is cartilaginous on the upper side of the opening between the skin and the bone, covered with short hair. The eyes are extremely small, so small that they are hardly to be seen. The lower jaw is very short, which obliges the two fore-teeth of that jaw to be very long. The two lips go on the inside of the mouth, across the mouth, so that the fore-teeth are in view through their whole length; this makes the mouth small, and, of course, the tongue.

There are three nipples on each side, one on the inside of the arm, one on the lower margin of the thorax, and the third on the middle of the thigh; the first and last are the largest. The thorax is short for the whole length of the animal. There are thirteen [pairs of] ribs[2]; it has complete clavicles: the symphysis of the os pubis is but short.

The œsophagus is about an inch long below the diaphragm: it enters the stomach about midway between the two ends. The left end of the stomach becomes small from the œsophagus, and terminates in an obtuse point; the right end is bent upon itself, so that the pylorus is near the insertion of the œsophagus. The duodenum passes to the right, and at first a little upwards, then passes down the right side, having a narrow mesentery; it then crosses the spine to the left, being attached in this course only to the root of the mesentery, and is in view through its whole course; so that the mesentery does not attach

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[1] [The dissection was therefore made before the year 1781; see note i. p. 49.]

[2] [This is the number in the skeleton of the male *Bathyergus maritimus*, No. 2246, Osteol. Series, Mus. Coll. Chir.; but in the skeleton of the female there are fourteen pairs of ribs, with only six instead of seven lumbar vertebræ.]

itself to the back or loins below the duodenum. The jejunum and ileum are loose guts, as common, but are very short. The ileum passes into the colon, which is pretty long. The cæcum makes a close spiral turn upon itself, has many transverse foldings in its inner coats, which make a kind of valves within, with sulci between each fold, as in the human colon. The colon passes a little way up the right attached to the mesentery, being much of the same size and structure with the cæcum; it then makes a long fold upon itself, which lies loose in the cavity of the abdomen: this fold, as it passes back to where it set out, becomes smaller, and more even on its surface: it crosses the spine before the root of the mesentery, close to it, and adhering to it by a pretty broad surface; it then passes down the back to the pelvis in a straight line. The anus is close above the vagina, and does not run so far under the tail as in the rat.

The liver is divided into four lobes, the two left being the largest; the second from the left has a large fissure in it, in which lies the gall-bladder, and the ligamentum rotundum; the Spigelian lobe is very small, and is a continuation of the right lobe.

The spleen is a long small body, lying along the great curve of the stomach in a doubling of epiploon: it is thickest at its left and upper end, becoming smaller to the other. The kidneys are conglobate, [having] one mammilla. The heart is flat; the right ventricle comes as low as the left, and is not so oblique or twisted round the left as in many other animals. There are two superior venæ cavæ. The lungs on the left side are divided into three lobes, the lower of which has a small lobe at its root. On the right side there are three lobes, besides the lobe between the heart and diaphragm.

The External Parts of Generation.—The clitoris stands or hangs on the outside of the vagina, like a nipple, and is covered by a prepuce; the whole being like a rat's. Just above the clitoris is the vagina: it is an opening beginning at once, without any external rising, similar to the rat's. The vagina is pretty long, and is very rugous near the beginning, which is penniform, the plumes diverging upwards: it becomes smooth near the os tincæ. There are two ora tincæ, which are placed on one common prominence, as in the hare, rabbit, &c., which are the openings of the two uteri or cornua. These pass up the loins to near the kidneys. The ovaria are oblong bodies; the capsula is only a thin membrane, a little hollowed on that side next to the ovarium, with a Fallopian tube running against it[1].

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[1] [Hunt. Prep. No. 2745.]

MOLES from the Cape [of Good Hope (*Bathyergus*)].

The mouth is very small; the tongue is narrow and thick; the lateral lips unite across the mouth in both the upper and the lower jaws; the skin of the roof of the mouth is lost, or terminates forwards in the union of the two upper lips, which is there loose as in the lower jaw. There is no outer or anterior lip to the upper jaw; or, in other words, the two lateral lips do not unite forwards, a structure which is now become a technical term, "Hare lip;" but there is a union of the lower lips which makes the fore-teeth in the lower jaw to be enclosed, as in a sheath, at their roots, by a lip going all round.

Both [specimens] have three grinders on each side of both jaws. In the upper they have three fangs, one large, and two small. In the lower they have two fangs, one larger than the other.

[ORYCTERUS CAPENSIS?]

Mr. Banks's 'Nick,' brought from Africa by Mr. Mason.

The hair is thin on the body and strong, of the bristly kind, like that of the agouti; but the tail has long hair. This animal has no external ears: it has four nipples, two between the hind-legs, and two on the belly pretty near the hind-legs. It has four grinding teeth on each side of each jaw; they are fanged: those of the upper jaw have three fangs, those of the lower only two. The scalpriform or fore-teeth are not strong, so that this animal seldom bites. In a second specimen the scalpriform teeth were much stronger[1].

The stomach is rather round, or very obtuse at the great end. The duodenum, jejunum, and ileum have nothing particular. The cæcum is a short thick gut projecting but a little way beyond the ileum; it is rounded at the end. The colon passes up the right side, and before it crosses the abdomen it makes a pretty long fold upon itself; as it crosses, it makes another nearly as long; when it has got to the left it makes another very short one (this was hardly perceptible), and then passes down to the anus.

The liver is divided into four lobes: the left is the largest; the second from the left has the ligamentum rotundum, falx, and gall-bladder fixed to it. The lobulus Spigelii is a fifth lobe attached all along its anterior part to the little epiploon, so that the cavity behind the membrane is divided into two. The gall-bladder lies in a notch on

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1 [This may probably have been the *Orycterus maritimus*, F. Cuv.; the *Orycterus capensis* has smaller incisors.]

the edge of the liver; the ductus cysticus is long, on account of the situation of the gall-bladder, and runs along a groove in the liver to the ductus hepaticus. The posterior edge of the epiploon is attached to the transverse branch of the pancreas.

The spleen has a dent in which the upper end of the kidney lies. There are two venæ cavæ superiores.

The lungs are larger on the right side than on the left. On the right side they are divided into three lobes, besides the middle one; the left lung has only one lobe. The uvula is like a nipple projecting equally on all sides.

The clitoris is on the inside of the vulva. The uterus is not rugous. There are two ora tincæ. The capsula ovarii is large, with a small opening[1].

[Family *HELAMIDÆ*.]

Forster's Jerboa [*Helamys Capensis*, Cuv.[2]].

The œsophagus is about an inch long below the diaphragm. The duodenum passes to the right side, being attached to the upper surface of the transverse turn of the colon, passes down the right side as low as the ileum, then makes a turn upwards and towards the left, behind the mesentery, where it gets upon the edge of the mesentery and becomes the jejunum. The ileum gets behind the lower end of the cæcum and adheres to it, and is attached to it as far as its entrance into that gut. The cæcum lies in the direction of the abdomen, its beginning being as low as the pelvis; thence it passes upwards upon the right of the mesentery and terminates in an obtuse curved end. The colon begins at the lower end, winds round the beginning of the cæcum, and follows it upwards nearly its whole length, being attached to it through its course by a narrow mesocolon. However, at the lower and the upper ends, it is in contact [with the cæcum] and attached to it by its surface. The colon, where it leaves the cæcum, makes a little convolution, then a fold upon itself about five inches long: from that part it crosses the spine, attached as before mentioned: it then makes a short turn, about an inch long, upon itself, passing down the left side to the pelvis: in this last course it becomes a loose intestine, having a broad mesocolon[3]. The small intestines are about five lengths of the animal from nose to anus.

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[1] [The preparation of the female organs, ascribed in the Hunterian MS. Catalogue to "Mr. Banks's Nick," shows the above characters: No. 2749, Phys. Catal., 4to, vol. iv. p. 161.]

[2] [The skeleton of this animal is No. 2252, Osteol. Series.]

[3] [Home, Comp. Anat. vol. i. p. 456 (Jerboa).]

The spleen lies in the epiploon on the left side, which epiploon is attached to the left loin and kidney. The liver is small, and is divided into three lobes and a lobulus Spigelii. The ligamentum rotundum enters the middle lobe: the right lobe is the smallest. There is no gall-bladder. The kidneys are conglobate, with one mammilla projecting pretty much into the pelvis[1]. The capsulæ renales are circumscribed oblong bodies, of a bluish-grey colour.

The heart lies pretty much in the middle of the chest: it is flat, broad, with the right ventricle rather lower than the left: it has two venæ cavæ superiores. The lungs, on each side, are divided into three lobes, which become larger downwards, with a middle lobe from the right lung, and also one between the heart and diaphragm. The trachea divides into two about the second or third ring from the cricoid cartilage.

The rectum, as it comes out of the pelvis, is bent down between the two ossa pubis, and opens just upon the bulbous part of the urethra about 2 inches from the tail. About half an inch farther between the legs is another opening, similar to the anus, passing in the same direction between the two crura of the ossa pubis, and leading to, or terminating in, two blind ends, between the rectum and the bulbous part of the urethra. These two ends are glandular, or secrete a whitish mucus: they are lined with a cuticle, are white and silky, having a good deal of short white hair[2].

Just before this opening is seen the glans penis, directed backwards, lying in a very large prepuce. The prepuce appears to be no more than the loose skin on the pubis drawn in with the penis in its flaccid state.

The testicles commonly lie in the cavity of the abdomen just at the rings; however, there is a passage for them to the scrotum, which is a bag placed between the anus and the tail. The testicles are large for the size of the animal, oblong, the upper end thicker than the lower; from which end there passes down into the tunica vaginalis communis a gubernaculum, which is pretty thick. The tunica vaginalis communis passes down by the side of the penis, then crosses the rectum, where it is reflected downwards, and terminates in the scrotum.

The gubernaculum is attached to the tunica vaginalis by a thin membrane along its edge. The vesiculæ seminales are very large, larger than the human, and much the same in appearance; they are almost wholly pendulous in the abdomen.

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[1] [Hunt. Prep. No. 1225.]

[2] [Home, Comp. Anat. vol. i. p. 456 (Jerboa).]

The penis arises from, or is fixed in the common way to, the os pubis; but, after it has come forwards some way, it is immediately bent back upon itself. The glans swells out to a considerable size, which terminates all at once in a hollowed end, like the flower of a convolvulus, in the centre of which is the opening of the urethra[1]. There is a short bone in the glans.

It has clavicles. The carpus and metacarpus are extremely short. The ball of the thumb is very large and prominent: the ball of the little finger is very prominent, though not so thick: the fingers are five; with the last joints long, with long nails. The tarsus and metatarsus are long, as in the hare; there are four toes, which are very strong, the ends being covered by pretty broad strong nails. Below the outer angle of the eye arise three whiskers: the face is like a hare's, but is rather broader between the eyes. The two lips in the upper jaw unite across the mouth, making a theca for the roots of the two fore-teeth in the upper jaw.

[Family *JERBOIDÆ.*]

[The Jerboa (*Dipus sagitta,* Zimm.).]

The Jumping Mouse.

The stomach is globular, with the thick end very obtuse, small and short. The duodenum passes to the right, and then down as low as the pelvis, connected to the ascending part of the colon; it then makes a turn up to the left, behind the mesentery, and becomes loose. The ileum passes into the cæcum about the middle of the spine. The cæcum is about 4 inches long; is large at the entrance of the ileum, becoming smaller and smaller, ending in a point: it makes a turn, as it were surrounding the entrance of the ileum in a spiral manner, with its small end lying loose in the pelvis.

The colon is largest at the beginning, makes a turn upwards, and is attached to the first turn of the cæcum by a mesocolon; it passes a little up on the right side, makes a fold upon itself about an inch and a half; and, when it crosses the spine, it makes another short fold; from thence it passes to the anus[2].

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[1] [There is a drawing of an animal in Sir Joseph Banks's library, called the jerboa of Dr. Reinhold Forster, much like a jerboa, but much larger, and I think evidently too small an animal to possess such a large penis. Vide No. 2497, gallery, marked on the top of the bottle by Mr. Bell "Jerboa of Forster." (Now No. 2563.) When Cuvier was in London (1818), he was much struck with the singular appearance of this preparation, but did not know to what animal it belonged.—W. C.]

[2] [Home, Comp. Anat. vol. i. p. 455 (jumping mouse).]

There are two venæ cavæ superiores.

The little epiploon is attached to the liver, as in the guinea-pig. The liver is divided into four lobes and the lobulus Spigelii. The gall-bladder is attached to the second lobe from the left side, which is the largest, and has also the fissure in it for the vein. The capsulæ renales are oblong bodies, distinct from the kidneys.

The lower part of the abdomen lies upon the anterior part of the pubis, and the testicles lie on each side of the symphysis, so that the bend of the penis is seen within the cavity of the belly, making a little projection, as it were, between the origin of the two musculi recti. The epididymis is very much detached from the testis. The rings of the abdominal muscles are very large, so that the testicles can occasionally lie in them, but never can go far beyond them, as there is no scrotum. The vesiculæ seminales are two long bags bent upon themselves. The penis, when not erect, is bent back; it has two bones on each side as in the guinea-pig. The prepuce is very glandular, secreting a thick mucus. The anus would seem to bend down upon the penis. The eyes are very large like a bird's, with a very large or broad cornea: the crystalline humour is very large in proportion to the eye. The external ears are thin, of a middle size. The meatus auditorius externus is large like that of a bird. The tympanum is very large[1]. The lacrymal glands are large and white, as it were granulated[2].

[Family *ARCTOMYIDÆ*.]

The Marmot [*Arctomys Marmotta*[3], Schreb.].

The stomach is pretty round; the pylorus, of course, is near the

[1] [Hunt. Prep. No. 1599. See also the Appendix to Russell's 'History of Aleppo,' where the above notes are given, with the following remark:—"Having met with nothing more on the internal structure of the jerboa than what is given by Gmelin from M. Buffon (Hist. Nat. tom. xiii.), I applied to my worthy friend Mr. John Hunter, who very obligingly favoured me with the following circumstances from his 'Adversaria' by way of supplement:"—then follows an extract from the notes in the text. When alluding to this testimony by Dr. Patrick Russell to the 'Adversaria' of Hunter in the ed. of the 'Animal Economy,' 8vo, 1837, p. 393, I believed them to be lost.]

[2] [In the menagerie of the late Sir R. Heron, M.P., the female of a pair of jerboas, kept in confinement since June 1843, brought forth, May 14th, 1844, two young ones, which were blind, naked, and so continued to the 12th of June. Five weeks elapsed ere they appeared to have the use of their eyes or limbs; they had then "little fur, but were a good deal grown." At 46 days' old they were three-quarters grown, well clothed, active, and ate corn. The jerboas were never seen to drink.—Proceedings of the Zoological Society, August 13th, 1846.]

[3] [The skull of this marmot is No. 2256, Osteol. Series.]

œsophagus. The duodenum is long and loose; as it passes down the right side it is attached to the first bend or fold of the colon, round or behind which it passes, and then comes forward on the left side, forming the jejunum. In all this last-mentioned sweep, the duodenum is attached by a mesentery to the ascending colon upon its concave side on its lower bend; and on the left, it is attached to the descending colon by a mesocolon on its convex or left edge. The cæcum is a large and pretty long gut, lying upon the fore-part of the loins just above the pelvis, and is a little bent upon itself, having a narrow mesocæcum: its external appearance is that of a quilted petticoat. From the entrance of the ileum the colon passes up on the right side before the descending part of the duodenum; it is just a continuation of the cæcum, but soon becomes narrow or small; it then makes a long and loose bend upon itself, adhering to the descending duodenum, and then to itself by a narrow mesocolon. This fold is about 8 inches long. From this bend it inclines to pass to the left, but it soon makes another fold, somewhat more than half the length of the former. From thence it passes down the left side to the pelvis, becoming much stronger in its coats, having a pretty broad mesocolon. Where it begins to make its first bend or fold upon itself, the fæces are soft, but are beginning to be divided, becoming harder and harder as they pass to the rectum[1].

The great epiploon is attached forwards to the stomach, pylorus, and a little piece of the upper part of the duodenum, and on the right, behind, and on the left, by the transverse pancreas, the spleen, and the diaphragm. The little epiploon is attached to the upper part of the duodenum, pylorus, small curve of the stomach, œsophagus, diaphragm and liver, covering the mouth of that passage or hole; that part which is attached to the body of the liver makes an angle downwards on that viscus, as it were making room for the Spigelian lobe behind. The spleen is a long small body lying in the left of the epiploon. The body of the liver is divided into four lobes, the left being the largest; each becoming smaller towards the right: the lobulus Spigelii is a continuation of the third or fourth, and is attached to the hollow curve of the stomach by a thin membrane: the umbilical vein is attached to the second lobe from the left. The gall-bladder is attached to the same lobe, projecting a little below the lower edge of the liver; its duct enters the duodenum about an inch from the pylorus. The attachment of the liver to the diaphragm is by a thin membrane and vessels, not by any contact of surface.

[1] [Home, Comp. Anat. vol. i. p. 446, who prefaces the abstract with the following: —"The first of the chisel-teethed animals, whose intestines I shall describe, is the marmotte."]

The kidneys are conglobate, the right being rather the highest.

The anus is a considerable way from the tail, is very little projecting, but the rectum cannot be said to terminate at the verge of the anus; but about three-quarters of an inch higher up, that lower part seems common to the anus and to a glandular apparatus whose ducts open into it. It is something like the common vagina to the bladder and uterus, or the common passage to the rectum and oviduct, in fowls. These ducts in many of this class open externally, as in the rabbit, hare, &c.: also in the pikito [*Bathyergus*, p. 235] from the Cape of Good Hope, brought home by Mr. Banks, which is a very different kind of animal.

The external vulva is below the anus; it projects but little: the common skin on both terminates all at once at the verge of both. The common and the proper vagina are almost one undistinguishable canal, with flat longitudinal rugæ: the urethra opens on the largest, which terminates quickly in the common vagina. At the os tincæ the uterus is hard and closed a little: there are two ora tincæ, which are very irregular: the two horns are as in a rabbit[1].

Male Parts.—The opening of the prepuce is more than an inch from the anus. The penis is retromingent. The testes are very small, and rather longer for their thickness than in most other animals: they lie in the rings of the abdominal muscles, and can be pushed with ease either into the abdomen or entirely out, as occasion serves: the tunica vaginalis will admit of a total inversion into the cavity of the abdomen, as in the rat, mouse, and mole. The spermatic artery passes down the loins in a broad membrane or mesospermatica, which is a doubling of the peritoneum. This is very fat in some.

[Family *SCIURIDÆ.*]

The Virginia Grey Squirrel [*Sciurus cinereus*, Linn.[2]].

The stomach is short and thick; the thick end is not far from the œsophagus, and is very obtuse: the small end is bent upon the small curve of the stomach, so that this small curve is very short, and the two orifices are very near one another: it is not made, like the rat's, thinner in its coats at one end than at the other.

The beginning of the duodenum is nearer the left, on account of the fold of the small end of the stomach: it passes pretty near the liver in

[1] [Hunt. Prep. No. 2748. The uteri are connected together for about an inch before they diverge towards the ovaria.]

[2] [Parts of the skeleton of this squirrel are numbered 2287—2289, Hunt. Osteol. Series. The fore- and hind-foot form the wet-preparation, No. 1415.]

its way to the right side: when it has passed the vessels of the liver it becomes loose, forming the jejunum, which has a pretty long mesentery, and passes low down on the right side, just where the colon ascends in man; then passes upwards and behind the mesentery to the left, and is there without any mesentery; being connected to the root of the mesentery pretty closely. In an English squirrel this part was connected to the vertebræ of the loins or the large vessels and psoas muscle by a very thin membrane, which membrane attached itself to the mesocolon or mesorectum; the same in another fox-squirrel: it then becomes loose intestine as usual, and upon the right it passes into the cæcum. The cæcum is pretty long and very large; but becomes smaller at the insertion of the ileum. The colon passes up the right side, attached to the right edge of the mesentery by a thin mesocolon, and also to the mesoduodenum: where the colon is going to the left or upper part of the right side, it makes a pretty long fold upon itself for about 5 inches; when it has just crossed the mesentery, to which it is closely connected, it makes another fold of the above length: these two folds are similar to those in the porcupine; from thence it passes down to the pelvis, having a pretty long mesocolon.

The length of the small guts are seven times the length of the body of the animal: the cæcum is 5 inches, or half the length of the body. The colon is about twice the length of the animal[1].

The epiploon is attached to the great curve of the stomach, to the spleen, and to the large pancreas: it was pretty broad, but not fat. The small epiploon is, as it were, perforated by the lobulus Spigelii; but the edge of this perforation is attached to it all round: besides this attachment of the stomach to the liver by the little epiploon, there is another passing from the liver to the stomach across the little epiploon in a contrary direction, upon the right of the lobulus Spigelii, but it is very narrow.

The liver is pretty large, is divided into four lobes besides the lobulus Spigelii, but these divisions are not like those of a dog; for in a dog they are cut directly through in the direction of the body, but here they are slanting, from the left to the right downwards; the two right lobes are very small, and the left is the largest and covers almost the whole of the other, for there is only a little bit of its right edge seen, before the left is turned down. The lobulus Spigelii is half behind the mesogaster, and half before it, so that the mesogaster is fixed to its middle. There is a gall-bladder which lies deep in a sulcus of the lobe next to the left, and the cystic duct passes along and joins the hepatics, which

[1] [Home, Comp. Anat. pp. 451, 452.]

are two in number. The duct enters the duodenum pretty near the pylorus, almost as in the porcupine. The gall is pretty yellow and thick. The lobe of the liver, to which the gall-bladder is fixed, is as large as the left, and is divided into three, two of which are covered by the left lobe, and the bladder is between the two right of these divisions. In another specimen the second lobe from the left, or that to which the bladder was attached, had two pretty deep notches in it.

The pancreas is made up of two lobes as usual. The spleen is as in a dog. The kidneys also are as in a dog; but the right is much higher than the left.

All the foregoing account answers very well with the English squirrel; but this [one compared] being a female, we can go no further[1]. I believe that this Virginian squirrel had but one punctum lacrymale. The testicles are half out of the abdomen and half in; so that they can be pushed entirely out or entirely in. The passage is upon the outer edge of the rectus muscle, is very large, and is half an inch above the os pubis: this is as in the porcupine and guinea-pig. The vasa deferentia pass behind the bladder; and, when passing through the prostate gland, they unite with the ducts of the vesiculæ seminales, and each common duct passes a little way further in the membranous part of the urethra. The vesiculæ seminales are very small, having a very long duct, and seem rather to be glandular than vesicular.

The penis is pretty long, passing from the divisions of the pubis along the belly, between the testes; and about half an inch further it is bent back again, which last part is about another half-inch in length, so that it returns to near the testes. All this last part has a bone in it. The bulb is covered by a pretty strong tendinous coat, and is only attached to the crura by a loose cellular membrane: as it passes into the penis and becomes urethra, it seems to dip into the centre of the penis pretty near the union of the crura.

There are two bodies placed on the sides of the anus about the bigness of a little pea: each body [Cowperian gland] seems to be coiled upon itself like a nautilus; from thence goes a pretty thick duct which is turned round the other, and passes to the bulb of the urethra, emerging from under the accelerator urinæ; and at the bulb it opens into a duct common to it and the one of the other side. From this common duct passes back a large foramen cæcum, which is, as it were, between the two ducts where they are passing on the side of the bulb under the acceleratores: the common duct passes along the urethra, in

[1] [The female organs of *Sciurus vulgaris* form the Hunt. Preps. No. 2746, unimpregnated; No. 3470, impregnated.]

its body, to near the glans or last turn, and then enters the urethra itself. When these bodies are cut into, they look something like the testes in structure. The prostate is a pretty large body, much of the figure of a heart as it is painted upon cards, not so sharp pointed at the apex, but sharper pointed at the two bases; it is placed at the under surface of the urethra, a little way beyond where the bladder has become small; it is loose at both ends, only being attached to the urethra by loose cellular membrane. This is something like the human; but it does not surround the urethra; the urethra at the bulb is rugous, and penniform[1]. There is something very particular about the penis and urethra that I could not examine. (It is just the same in the English squirrel[2].)

The contents of the thorax are as in a dog; there is a cavity for the œsophagus as in the other [squirrel], and there are two venæ cavæ, as in the goat, rat, &c. The right subclavian and two carotids arise by one common trunk from the aorta, and the left subclavian by itself, so that only two arteries arise from the curve of the aorta.

The Flying Squirrel [*Pteromys* (*Sciuropterus*) *volucella*].

The thorax is much flatter than is commonly found in quadrupeds, and increases in breadth very far downwards, something like the mouth of a French horn. The pectoral muscles seem to be thicker than in other animals of the same size. The fore-legs do not fall down parallel with one another by the side of the trunk, so that the scapula may stand almost perpendicular, but pass out almost transversely from the body, so that the scapula lies flat upon the flattened chest almost as in the human subject. The belly is likewise flattened, and the thigh-bones are turned out; so that the adhesion between the muscles of the thigh and belly that we find in quadrupeds is not to be found here, for they are as much detached as in the human.

This circumstance of the whole length of the fore-legs passing out almost transversely, and likewise the thigh-bones of the hind-legs, gives attachment to the skin that is extended between the two limbs. But from the skin being attached to the whole length of the fore-leg as far as the wrist, and only to the thigh-bone of the hind-leg, the anterior part is much broader than the posterior; and along the edge of this membrane, for about 1 inch at the anterior end, there is a cartilage as if it

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[1] [Hunt. Prep. No. 2498.]

[2] [It would seem that Hunter had procured a male specimen when he entered this remark. The bones of the *Sciurus vulgaris* are numbered 2268—2286, Hunt. Osteol. Series.]

were folded in it. This cartilage is fixed at one end to the carpus at the inner edge, thence passing into the doubling of the membrane where it is becoming smaller, ending in a point, and is a little curved, with the hollow side turned down. This cartilage is moveable upon the carpus, and has muscles inserted into it for its motion, viz. the flexor carpi ulnaris; and is what answers to the os pisiforme in us.

The skin of this animal is in general very loose; and, when the legs are stretched out transversely, they seem to draw a great deal of skin from the body to be stretched between the fore- and hind-legs; but this membrane is not entirely a doubling of the skin of the body so as to be wholly at times doubled, and at other times not; for the outer edge is always doubled like a duck's foot, even when the animal is walking, which is the most relaxed state of this membrane; and, at times, we may observe a ridge passing along the side of the animal, which terminates the two colours of the hair; for on the belly it is white.

As the whole body of this animal is very flat, the anus appears to be almost at the termination of the abdomen. The testicles lie upon the abdomen [when the body is supine], and the penis reaches almost half-way up the belly.

The heart is as in the common squirrel, having the two venæ cavæ superiores.

The stomach is short and thick; there is a long projection of the great end beyond the œsophagus, and it becomes pretty suddenly small at the pylorus: its coats are but thin, and equally so all over. The pylorus is a little upon the right of the spine: the duodenum is loose from the pylorus to its passing across the spine, where it inclines upwards, and is attached by a thin membrane to the root of the mesentery and to the spine; it then again becomes a loose intestine. The ileum enters the colon on the middle line of the abdomen, and the cæcum lies chiefly on the left side, projecting about 2 inches beyond the insertion of the ileum; it is a little bent by a narrow mesocæcum. The colon on the right side, before it crosses the spine, makes a fold upon itself, about 2 inches long; and, when it passes across the spine, it makes a very faint one; it then passes down upon the left and to the anus[1].

The epiploon is attached to the stomach, spleen, and pancreas: it is pretty broad and flat. The pancreas has two lobes, the small one close to the duodenum, and the union of the two is close to the pylorus. The liver is divided into four lobes besides the lobulus Spigelii; the two

[1] [Home, Comp. Anat. p. 451.]

right lobes are small, the third from the right side is by much the largest, and is rather more in the right hypochondrium than in the left: it is divided into three by two fissures; in one lies the gall-bladder, in the other is the round ligament. The lobulus Spigelii is partly before the mesogaster and partly behind, as in other squirrels.

The spleen is a thin long body, and its attachment is very loose. The kidneys are conglobate; the right lies close to the liver, but the left lies very low, as in the rat. The capsula renalis is as in the rat. The tunica vaginalis testis does not pass out close to the pelvis, but half-way between the pubis and the navel, so that the testicles lie upon the abdomen. This situation obliges that part of the penis which is behind to be so much the longer; as it would seem necessary that the penis should be before the testicle[1]. The testes are half out of the abdomen, and half in; they can be just pushed entirely out and brought wholly in. When brought within the abdomen, the cremaster muscle is spread upon the tunica vaginalis as in the rat. The penis has a bone in its end which is beyond the anterior bend.

The parts of generation are the same as in other squirrels, having the glandular bodies on the sides of the anus. Also the contents of the thorax (see description of the English and Virginia squirrels).

The eye is very large and prominent in proportion to the size of the animal: the cornea is very broad, the crystalline humour almost round, and the nigrum pigmentum of a dark brown colour[2].

[Subclass Lyencephala.

Order Marsupialia.]

Of Animals from New Holland.

General Observations.

It is much to be wished that those gentlemen who are desirous of obliging their friends, and promoting the study of Natural History, by sending home specimens, would endeavour to procure all the information they can relating to such things as they may collect, more especially animals. The things themselves may be valuable, and may in some degree partly explain their connexion with those related to them, so as in some measure to establish their place in Nature; but they cannot do it entirely; they only give us the form and construction, but leave

[1] [This is not the case in the Marsupialia.] [2] [Hunt. Preps. Nos. 1707, 1708.]

us in other respects to conjecture, many of them requiring further observations relative to their economy. A neglect in procuring this information has left us almost to this day very ignorant of that part of the natural history of animals which is the most interesting. The opossum is a remarkable instance of this. There is something in the mode of propagation in this animal that deviates from all others; and although known in some degree to be extraordinary, yet it has never been attempted, where opportunity offered, to complete the investigation. I have often endeavoured to breed them in England: I have bought a great many, and my friends have assisted me by bringing them or sending them alive, yet I never could get them to breed; and although I have a great many facts respecting them, yet I am not certain that I am possessed of sufficient information to complete [our knowledge of] the system of propagation in this class.

In collecting animals, even the name given by the natives should be known if possible; for a name to a naturalist should mean nothing but that to which it is annexed, having no allusion to anything else, for when it has it divides the idea. This observation applies particularly to the animals which have come from New Holland: they are, upon the whole, like no others that we know of; yet, as they have parts in some respects similar to others, names will naturally be given to them expressive of those similarities, which have really taken place; for instance, one is called kangaroo-rat, but which should not be called either kangaroo or rat.

Animals admit of being divided into great classes, but will not so distinctly admit of subdivision without interfering with each other. Thus the class called 'Quadruped' is so well marked, that even the whole is justly placed in the same class; birds the same; amphibia (as they are called) the same; and so of fishes, &c. But when we are subdividing these great classes into their different orders, genera and species, then we find a mixture of properties, some one species of one tribe partaking of some properties of a species of another tribe[1].

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[1] [The above 'General Observations' were published in Hunter's life-time, in the 'Zoological Appendix' to the "Journal of a Voyage to New South Wales," 4to, 1790, by John White, Esq., Surveyor-General to the Settlement. Dr. Shaw, who superintended the publication of White's 'Zoological Appendix,' thus introduces the observations contributed by Hunter:—

"The nondescript animals of New South Wales occupied a great deal of Mr. White's attention, and he preserved several specimens of them in spirits, which arrived in England in a very perfect state. There was no person to whom these could be given with so much propriety as Mr. Hunter, he perhaps being most capable of examining accurately their structure, and making out their place in the scale of animals; and it is to him that we are indebted for the following observations

Of the Kangaroo [*Macropus major*, Shaw].

This animal, probably from its size, was the principal one taken notice of in this island; and the only parts at first brought home, were some skins and skulls; and I was favoured with one of the skulls from Sir Joseph Banks[1].

As the teeth of such animals as are already known, in some degree point out their digestive organs, and so lead into the knowledge of other parts, I was in hopes that I might in some degree have been able to form an opinion of the particular tribe of the animals already known, to which the kangaroo should belong: but the teeth did not accord with those of any one class of animals I was acquainted with, therefore I was obliged to wait with patience until I could get the whole animal; and in many of its other organs the deviation from other animals is not less than in its teeth. In its mode of propagation it very probably comes nearer to the opossum than any other animal, although it is not at all similar to it in other respects.

Its hair [is of a greyish-brown colour, similar to that of the wild rabbit of Great Britain[2],] is thick and long when the animal is old, but it is late in growing, and, when only begun to grow, is like a strong down: however, in some parts it begins earlier than in others, as about the mouth, anus, &c. In all the young kangaroos yet brought home (although some are as large as a full-grown rat), there are all the marks of a fœtus: e. g., no hair; ears clap'd close over the head; no marks on the feet of having been used in progressive motion: the large nail on the great toe[3] is sharp at the point; and the sides of the mouth are united something like the eyelids of a puppy just whelped, having only a passage at the anterior part. This union of the two lips on the sides is of a particular structure, and wears off as the animal grows, and by the time it is of the size of a small rabbit, disappears.

The proportions of some of its parts bear no analogy to what is common in most other animals, although it is in this respect more like some than others. The disproportion in length between the fore-legs and the hind-legs is very considerable, as also in their strength; yet

upon them, in which the anatomical structure is carefully avoided, as being little calculated for the generality of readers of a work of this kind."

The anatomical notes appear for the first time in the present work. The above published notice, like that by Dr. Patrick Russell (note, p. 241), of Hunter's MSS. on Comparative Anatomy, forms important evidence of their authenticity.]

[1] [No. 1732, Hunt. Osteol. Series.]

[2] [This has been added to the printed description in White's 'Voyage' before cited.]

[3] [Answering to the fourth in the five-toed hind-foot.]

not more perhaps than in the jerboa. This disproportion between the fore- and hind-legs is principally in the adult; for, in the very young, about the size of a half-grown rat, they are pretty well proportioned, which shows that at the early period of life they do not use progressive motion. The proportion of the different parts of which the hind-legs are composed is very different. The thigh of the kangaroo is extremely short, and the leg is very long. The hind-foot is uncommonly long, on which, to appearance, are placed three toes; the middle toe being by much the largest and the strongest, and looking something like the long toe of the ostrich. The outer toe is next in size, and what appears to be the inner toe, consists of two enclosed in one skin or covering. The great toe-nail is a good deal like that of an ostrich, as also the nail of the outer toe; and the inner, which appears to be but one toe, has two small nails which are bent and sharp. From the heel or os calcis, along the under side of the foot and toe, the skin is adapted for walking or resting upon. They have a fibula the whole length of the leg. The tarsal bones are four; the metatarsal are three: one large in the middle, but the inner one is divided or consists of two[1].

The fore-legs in the full-grown animal are small in comparison either with the hind, or with the size of the animal: the hands are also small; the skin of the palm is different from the back of the hand and fingers: there are five toes or fingers, the middle rather the longest, becoming from that very gradually shorter, and are all nearly of the same shape: the nails are sharp, fit for holding.

The tail is long in the old one, but not so long in proportion to the size of the animal in the young. It would seem to keep pace with the growth of the hind-legs, which are the instruments of progressive motion in the animal, and would show that the tail is a kind of second instrument in this action.

The upper lip is divided in the middle, each side rounded off at the division. There are two clavicles; but they are short, so that the shoulders are not thrown out.

Of the Teeth.—The teeth of this animal are so singular, that it is impossible from them to say what tribe it is of. There is a faint mixture in the dentition corresponding to [that of] different tribes of animals.

Take the mouth at large respecting the situation of the teeth, it would class in some degree with the Scalpris-dentata, in a fainter degree with the horse and ruminants; and with regard to the line of direction of all the teeth, it is very like the Scalpris-dentata. The fore-teeth in the

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[1] [Hunt. Osteol. Series, No. 1773.]

upper jaw agree with the hog; those in the lower jaw, in number, with the Scalpris-dentata; but, with regard to position, and probably use, with the hog. The grinders would seem to be a mixture of the hog and ruminants; the enamel [is only] on their external surface, and the grinding surface is rather formed into several cutting edges than points. There are six incisors in the upper jaw, and only two in the lower; but these two are placed almost horizontally, so as to oppose the six in the upper jaw. There are five grinders on each side of each jaw, the most anterior of which is small, and probably is cast when the mouth is full[1].

Of the Viscera.—The œsophagus passes into the stomach towards the left. The stomach, at first view, is more like the transverse arch of the colon in the human subject, than like a stomach: it reaches across the abdomen, making two slight convolutions like the letter ∞, first down, then up, and slightly bending down the right side, to its termination in the duodenum: it has longitudinal bands like the colon in man and some other animals. The duodenum passes down a little way on the right side, attached to the back by a thin membrane, as also in front to the ascending colon; then makes a quick or short turn upwards, the bent parts being connected by an intermediate mesentery; it then crosses the body behind the mesentery towards the left, and commences the jejunum: the small intestine is strung upon the mesentery as far as the cæcum, and, when got to the right, rather passes up along the cæcum to which it is attached, and enters the cæcum. The whole of the small intestines are thin in their coats, and small in their diameter. The cæcum lies in the right loin; it is pretty long, something like the appendix cæci in the human. The colon passes up the right side before the duodenum, attached to it by a thin membrane, as also to the right edge of the mesentery; it then crosses the body to the left. In this passage it is attached to the back by a mesocolon, as also to the stomach by the epiploon, which is short on the right side, and which attaches the colon pretty closely to the stomach. It then passes down the left side very loosely, having many convolutions with a broad mesocolon and mesorectum. The colon is not much larger than the other intestines, therefore it cannot be said to be a reservoir for the fæces.

The small intestines were 5 feet long: the cæcum was . . . . inches: the colon and rectum were about 1 foot. This was a young animal[2];

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[1] [The lower jaw of No. 1732 shows this number. For the homologies of the teeth and phases of dentition in the genus *Macropus*, see the article 'Odontology,' in Encyclopædia Britannica, vol. xvi. (1858), p. 483.]

[2] [Probably the specimen from which the skull, showing the two deciduous and

therefore the proportion that the intestines bear to the body is greater than in an old one.

The liver is divided into four lobes besides the lobulus Spigelii, all nearly of equal size, excepting the second from the right, which is the smallest of the four. The whole under surface of the five lobes makes one concave surface. The gall-bladder is in a sulcus of the second lobe from the left, and the falciform ligament is attached to the convex surface of the same lobe, but does not come to the lower or anterior edge of the liver, only a little way on its surface, having no round ligament.

The pancreas passes to the left towards the spleen, along the root of the mesentery; and its left end is in the posterior part of the epiploon; and at this part it is thin and branches out in this membrane like the Dendrites in stone (the mocha stone or pebble).

The epiploon is not a large and loose membrane covering the intestine, but is only loosely continued from the stomach to the transverse arch of the colon. It is attached forwards to the stomach, on the right to the pylorus, and beginning of the transverse arch; below to the transverse arch of the colon; on the left to the diaphragm, to the loins, &c.

The spleen is in the epiploon. It is one large spleen similar to that in the dog, &c., but it has a process, or small spleen, coming out from its side, near the lower or small end, lying in a sulcus of the stomach[1].

The kidneys[2] are conglobate, and the cortical substance is but thin: there is one principal mammilla, making a ridge, with several lateral processes running from it, or joining it as in many other animals.

The Heart.—There is a 'vena cava sinistra.' The lungs on each side are divided at their anterior edges by a fissure; that in the left side is the deepest, the superior portion of which lung comes forward before the vessels above the heart, the mediastinum at this part being more on the right side than common to other animals: the lobus medius is triangular [three-sided]; one side is convex towards the left, one is concave in contact with the pericardium, and the third side is concave towards the diaphragm.

When the kangaroo is about the size of a plucked thrush, before any

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first permanent molar teeth, was derived: No. 1729, Osteol. Series. In an adult female, *Macropus major*, dissected by me at the Zoological Gardens, London,—

	ft.	in.
The length of body from snout to vent was	3	3
The small intestines	22	0
The cæcum	0	9
The large intestines	2	0.]

[1] [Hunt. Prep. No. 838.] [2] [Ib. No. 1228.]

hair is grown, its testicles are in the scrotum. The penis is formed on the verge of the anus, and is itself external at this age[1].

The Potoroo [*Macropus minor*, Shaw; *Hypsiprymnus murinus*, Ill.].

This animal might be called 'kangaroo minus:' the head is flat sideways, but not so much so as in the true Scalpris-dentata: the ears are neither long nor short, but much as a mouse's in proportion to the size of the animal. The fore-legs are short in comparison with the hind: there are four toes on the fore-foot; the two middle ones are long and nearly of equal length, with long narrow nails slightly bent: the two side toes are short, nearly of equal size, but the outer one is rather the longest. From the nails on the two middle toes one would suppose that they burrowed. The hind-legs are long, and they are able to stand on either the whole foot or on the toes only: on the hind-leg there are three toes; the middle one is large, and the two side ones are short[2]. The tail is long. The hair on the body is rather thin: it is of two kinds, the fur and the long hair, which latter becomes exterior from its length. The fur is the finest and is serpentine. The long hair is stronger, and is also serpentine for more than two-thirds of its length, near to the skin, and the extremity terminates in a pretty strong pointed end, like the quill of the hedgehog. It is of a brownish grey, something like the hair of the brown and grey rabbit, with a tinge of a greenish yellow. The female has a pouch on the lower part of the belly, which opens forwards and passes back to the pubis, where it terminates: on the abdominal surface of this pouch are four nipples, or two pairs; each pair being very near to one another.

Of the Tongue.—The tongue is not thick, as in the Scalpris-dentata. The velum palatum molle is broad, and terminates in a thin edge. The epiglottis is complete.

Of the Stomach.—The œsophagus is continued a little way within the abdomen, before it dilates into the stomach. The stomach is of a very singular shape[3]. The duodenum takes the usual sweep, from the right to the left, and is attached through its whole length; it is also exposed through its whole length, and commences jejunum. This gut is strung

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[1] [The male organs of the kangaroo are shown in Hunt. Preps. Nos. 2474, 2482, the female organs in Nos. 2739, 2740: the peculiarities of the mammary fœtus in Nos. 3768—3776. The preparations described in the Editor's memoirs on the generation of the kangaroo, are Nos. 2740 A—C, 3460 C—F, 3765 A.]

[2] [The inner toe consists of the homologues of the second and third toes enclosed in a common sheath of integument as far as the claws.]

[3] [See the description of the stomach of the potoroo (*Hypsiprymnus*) in my article *Marsupialia*, Cyclopædia of Anatomy, vol. iii. p. 301.]

on a very thin mesentery. The ileum passes to the right side and enters the colon, which is large. The cæcum is a pretty large and wide bag, lying on the lower and right side of the pelvis. The colon passes up the right side, then crosses the body to the left, and then down the left to the pelvis. In all this track it is very loose, or thrown into long convolutions, not folds, especially when it crosses the body. It has a long or broad and thin mesocolon, which is continued down the back, attaching the descending colon to the back, to which the last turn of the duodenum is also attached.

The liver is divided into four lobes; the second from the left is the largest, in a sulcus of which the gall-bladder lies: the two right lobes are small: the second lobe from the left is continued in behind the mesogaster, making what might be called the Spigelian lobe, but it is not a distinct lobe. The pancreas comes from the spleen on the left side, and follows the curve of the duodenum. The kidneys are conglobate.

The lungs on the left side have one lobe with a fissure on the anterior and upper edge; on the right side there are two or three deep fissures, and a lobulus medius.

The left subclavian and jugular veins pass, after joining, round the base of the heart on the left side, to enter into the right auricle, as in the kangaroo [and the rest of the Marsupialia].

The parotid gland is extremely large, passing down from the ear as far as the clavicle[1].

The Hepoona Roo [*Petaurus taguanoides*, Desm.].

This animal is of the size of a small rabbit, having a broad flat body: the head is like that of a squirrel: the eyes are prominent and large, the ears broad and thin: the legs are short, and the tail is very long.

Between the fore- and hind-legs is placed on each side a doubling of the skin of the side, which, when the legs are extended laterally, is, as it were, pulled out, forming a broad lateral wing or web: when the legs are situated as for walking, this skin by its elasticity is drawn close to the side of the animal, yet forms there a kind of ridge on which the hair is different: this is very similar to the grey squirrel of America. It has five toes on each fore-foot with sharp nails. The hind-foot has also five toes, but here is a considerable difference between them and the toes of the fore-foot: the inner hind-toe may be called a thumb

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[1] [The male organs of the *Hypsiprymnus murinus* are No. 2478, the female organs No. 2741, Hunt. Physiol. Series. The skull is No. 1780, Osteol. Series.]

with a broad nail, somewhat like that of the monkey or opossum: what answer to the fore- and middle-toes are united in one common covering, appearing like one toe with two nails: this is somewhat similar to the kangaroo: the two other toes are as usual. These four nails are sharp, like those on the fore-foot. This form of the hind-foot is well calculated for holding while the animal is moving its body or fore-feet to other parts; a property belonging, probably, to all animals which move from the hind parts, such as the monkey, mocock, mongoose, opossum, parrot, leech, &c.

Its hair is very thick and long, making a very fine fur, especially on the back: it is of a dark brown grey on the upper part; a light white grey on the lower sides of the wing, and white on the under surface from the neck to near the anus.

The œsophagus at the lower part of the thorax passes in the duplicature of the posterior mediastinum, and is at some distance from the back, or aorta. The stomach is pretty globular, but its great end is bent up upon the œsophagus and adheres to it, somewhat, I think, like the rat. The duodenum passes down the right side for a considerable way, attached to the ascending colon for some length by a thin membrane, then makes a quick turn up behind, and on itself, which is attached to the back by a thin membrane: it then crosses the spine behind the root of the mesentery, and commences jejunum. The small intestines gradually convolute towards the right, and down; and the ileum passes into the colon on the right side. The cæcum is a large gut about 4 inches long, having a mesocæcum acting like a frænum and making it a little convoluted. The colon passes up the right side as high as the liver and stomach; then crosses the body before the mesentery, attached to it by a pretty broad mesocolon; then passes down in a pretty straight line to the anus: the rectum is small near the verge, having a pretty broad mesorectum. There are two small bags at the sides of the anus, containing a white mucus, the ducts of which enter within the verge of the anus. The fæces are a little globulated like the rat's, but are not so distinct.

These contents of the abdomen are somewhat similar to those in the rat. The liver is divided into four lobes besides the lobulus Spigelii; three of which are very much of the same size, the right being very small. The second from the left has two deep fissures in it, one for the umbilical vein, and the other for the gall-bladder: the third from the left has also a pretty deep fissure in it. The lobulus Spigelii is small.

The epiploon is attached forwards to the stomach as usual, to the pylorus, and the beginning of duodenum on the right, to the transverse turn of the colon behind, and on the left to the crus of the diaphragm, The spleen is large, and in the duplicature of the epiploon. The kidneys are conglobate; the right is about the length of itself higher than the left. The trachea is pretty large; the lung on the right side is divided into three lobes besides the middle lobe: on the left it is divided into two lobes: there is a small vena cava sinistra, not the continuation of the whole of the left jugular and subclavian. The tongue is one continued body to the tip. The epiglottis is broad, and its edges enclose laterally the arytenoid cartilages. There are two very small [marsupial] bones to the pubis. There are two clavicles.

The opening of the anus and vagina is the same: the lower part of this opening has a small peak, in which there is a passage leading to the vagina. There are two clitorides. The vagina is very long and small, and appears to be the common vagina through its whole length. The uterus has, or is, two horns, which are not long but pretty wide, excepting at their beginning; but whether they arise separately from the vagina or from a common uterus I cannot say, as they were too small to be traced into the vagina; but I suspect they make some turns. I saw two small orifices entering the vagina whereabout I should have called it the neck of the bladder, which is near about where the ureters enter; and they seemed to be retrograde respecting the vagina, but directed towards the bladder. The ovaria are pretty large and flat bodies: the capsula ovarii hardly encloses them. The bladder is pendulous its whole length, and unattached, excepting being united at the pubis by a thin membrane; therefore the ureters must enter about its neck.

Of the Teeth.—[1].

Wha-tapoa Roo [*Phalangista vulpina*, Geof.[2]].

This animal is about the size of a racoon, of a dark grey on the back, becoming rather lighter on the sides, which terminates in a rich brown on the belly. Its head is short; eyes rather prominent; ears pretty broad, not peaked; legs rather short; tail long and fitted for laying hold. Its hair is of two kinds, the 'long' and the 'fur'; and the long is of the fur kind at the bottom. On the fore-foot there are five toes; the inner and shortest resembles in a slight degree a thumb; the fourth toe is the longest. The hind-foot resembles more a hand, or the hind-foot of the monkey, opossum, &c., the great toe, on which there

[1] [The structure of the female organs of *Petaurus* may be understood by reference to the preparations Nos. 2734 D and E, and their descriptions, Cat. of the Physiol. Series, vol. iv. p. 151. See also my art. "Marsupialia," *tom. cit.* p. 316; and, for the dentition of *Petaurus*, ib. p. 264, fig. 88.]

[2] [The skull of this specimen is No. 1854, Hunt. Osteol. Series.]

is no nail, being formed into a thumb, opposing the whole foot. The sole or palm is bare: the nails of all the other toes, both of the fore- and hind-feet, resemble in a small degree those of the cat; being broad [*i. e.* deep, compressed] and curved, and the last bone of the toe having a projection on the under side at the articulation: each nail has, in some degree, a small sheath covering its base when it is drawn up[1]. The tail is long, covered with pretty long hair, except along the under surface for about half-way to the termination or end. This uncovered part forms a line about a quarter of an inch in breadth, but broadest nearest the point where it most commonly holds. This surface is only covered by a pretty firm skin.

The teeth have a resemblance to all those of [the quadrupeds of] this island I have yet seen: the incisors are not continued into the grinders by intermediate teeth, although there are two in the interspace in the upper jaw, and one in that in the lower. There are six incisors in the upper jaw very similar to those in the kangaroo, opposed by two in the lower jaw; but it is by an oblique surface extending some way from the termination, which lengthens the opposing surface. There are two cuspidati on each side in the upper jaw, and only one in the lower. On each side are five grinders, the first rather pointed, the other four much of a size, and quadrangular, with a hollow running across from the outside to the inner, which is pretty deep, and another crossing this, but not so deep, dividing the grinding surface into four points[2].

The œsophagus, as soon as it gets through the diaphragm, opens into the stomach, not a great distance from the left, or what is called the great end. The stomach lies almost directly across the abdomen; and appears to be nearly as large at the right end as at the left, from the pylorus not being directly at that end, but on the upper part of the end.

The duodenum passes pretty far down the right side, on the right of the root of the mesentery, to which it adheres for some way; then makes a bend up upon itself behind the mesentery, and gets on the left of the root of the mesentery, as it were, enclosing it: then gets on the left edge of that membrane, and becomes a loose intestine, forming jejunum. The jejunum and ileum pass down the left, and across the abdomen, obliquely towards the right loin, where the latter enters the colon. The cæcum is long and loose[3], having a broad mesocæcum, which is con-

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[1] [In the hind-foot the two toes next the thumb are enclosed in a common sheath of integument, from which the two claws project, as in the petaurus, p. 256.]

[2] [See 'White's Journal,' &c. 1790, p. 278: and, for the dental formula and homologies of *Phalangista*, my 'Odontography,' p. 382, pl. 100, figs. 1, 2, 3.]

[3] [See remarks on the cæcum and its relations to food, in the art. "Marsupialia," *tom. cit.* p. 302.]

tinued into the mesocolon on the right, and which is crossed by the mesentery where the ileum is going to pass into the colon: this attachment of the ileum to the mesocolon is double. The colon passes up the right side loose, having a broad mesocolon; and, when at the upper part of the mesentery, it is attached to it, as also to the descending duodenum; it gets nearer and nearer to the root of the mesentery and then crosses it, being closely attached to it and to the head of the pancreas; when got to the left it becomes loose again, having a very broad mesocolon, and being considerable in length, it is thrown into a number of convolutions. The mesocolon on the left is attached all along to the loins as far as the pelvis, where this gut may be called rectum. The colon is not a very large intestine. The length of the small intestine is about six times the length of the animal from nose to anus: the length of the cæcum is 1 foot 3 inches: the length of the colon on the right side is 10 inches; its length on the left is near 4 feet.

The liver is divided into five lobes, besides the lobulus Spigelii: the left lobe, which is commonly the largest, is in this animal divided into two; or the right portion may be considered as a portion from the middle lobe: the right lobe, which is the smallest, is continued on behind the mesogaster, to form the lobulus Spigelii. The gall-bladder lies in a deep fissure in the third lobe from the left, not in the second lobe, as commonly: there are three falciform ligaments, but none of them broad, or coming far towards the edge of the liver; one is attached to the supernumerary lobe, one between it and the common middle lobe, and one between the common middle and the third lobe. There seems to have been no ligamentum rotundum[1].

The pancreas begins on the left side, by several beginnings in the left and posterior attachment of the epiploon at the spleen, and even on the left kidney; it passes across the body, and its head, or right end, is attached to the descending duodenum; but it does not make a curve with the duodenum. The spleen is pretty large, of a triangular form, adapted to the sulcus in which it is placed. The epiploon is large and loose, although not covering the intestines: it is attached to the stomach forwards and towards the left, to the root of the mesentery backwards, as also to the kidney and crus of the diaphragm on the left. The little epiploon fills up the space between the hollow of the stomach and liver; besides which it sends down a process or doubling which attaches it to the hollow side of the first lobe on the left.

The kidneys are conglobate: there is not a great difference between

[1] [The absence or inconspicuousness of this relic of the umbilical vein of the fœtus, relates to the brief period of utero-gestation. See art. "Marsupialia," *tom. cit.* p. 321.]

the cortical and tubular parts; the single mammilla has one sharp ridge, with hardly any lateral abutments. The capsula renalis is small.

The heart is a regular rounded body, without much distinction externally between the right and left sides: the auricles are smooth and rounded at the edges, which correspond with the shoulders of the ventricles. There is a vena cava superior sinistra. The pericardium is attached to the large vessels near to the heart. The mediastinum is pretty broad.

The lungs on the right side have three lobes, the middle one small, and the most detached being something like the lobulus medius: the lungs on the left side have two lobes, or one lobe with a deep fissure. The lobulus medius is of a triangular form; the lower and posterior edges are attached by a thin membrane to the œsophagus[1].

The Opossum [*Didelphis virginiana*, *Did. Opossum*, and *Did. dorsigera*, Linn.].

This animal is distinct from all others, so far as I know. There is no animal that it can be immediately classed with; excepting it be a second degree from the monkey, mocock, mongoose, and sanguine; considering them as the first steps from the monkey, and this as the second.

It would appear that opossums paired, for an old male paid great attention to two young ones that were put to him. They ate fruits of all kinds.

Mr. Smeaton, from Virginia, who brought me an opossum, told me that he had two brought to him by a negro, one of which was a female with young in the pouch, which were smaller than any young mouse he ever saw, with no hair on them[2]. This was in the month of February; therefore they must breed in the winter.

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[1] [The tongue and larynx of the *Phalangista vulpina* form No. 1504; the male organs are Nos. 2475, 2480, Physiol. Series.]

[2] ["I have been so fortunate as to ascertain the size and weight of several embryons immediately after their exclusion from the uterus. One of them weighed only one grain! The weight of each of the six other young ones was but little more than this.

"The young opossums, unformed and perfectly sightless as they are at this period, find their way to the teats by the power of an invariable, a determinate instinct; . . .

"In this new *domicilium* they continue for about fifty days; that is until they attain the size of a common mouse (*Mus musculus*), when they begin to leave the teats occasionally, but return to them again, until they are nearly the size of rats.

". . . . At the end of about fifty or fifty-two days from its first reception in the pouch the eyes of the young begin to open.

"I have found that the same embryon has increased in weight 531 grains in sixty days; that is, at a rate of almost nine grains daily. . . . The animal attains to nearly its full growth in about five months; but never, I believe (in our latitudes I mean), procreates the first year of its existence.

"On the 21st of May, upon looking into the box which contained the female

One would suspect that this animal sleeps most part of the winter, as it has such large quantities of fat both immediately under the skin, and in the cavity of the belly, especially about the urinary bladder.

Whether this description was taken from a large American opossum or a small one, I do not remember; but, by comparing it with one of the small ones, I found them the same [*vide* Preparation No. 3759, *Didelphis opossum*, Linn.].

The ears are thin, broad, and round, without any hair. The eyelids are long, and much in the direction of the head: the pupil is round: the cornea is much larger than in the human eye, in proportion to the size of the eye: the tunica sclerotica is very thin. The teeth are most [like those] of the dog, of any; although they differ considerably, especially the last grinders. The tusks are thinner than the dog's.

The os hyoides is not attached to the head by bony continuity, nor by ligament.

The hind-feet are a mixture of the human hand and the foot of the toed animals. The cuticle on the upper side of the toes is scaly, like the tail. This form of foot is well adapted for climbing, as it can grasp like the chameleon. The nails are similar to the dog's. The great toe of the hind-foot is more of a thumb than a toe, as it is in many monkeys; but it has no nail upon it. The opossum walks upon the sole as far as the os calcis, like the monkey, bear, &c.

The male opossum has a small tendency to a pouch on the belly.

The tail seems not to serve as a rudder for progressive motion, but to serve for a fifth foot; for the animal can coil it up in a very small compass, and the skin is what may be called 'scaliform,' or like that of a rat's tail: it has but little hair, excepting at the root: the scales are similar to those of the beaver, only not so large. This is what is called a '*cauda prehensilis*.'

The hair of the body is of different kinds, according to its situation; on the trunk, neck, shoulder, and thighs, the hair is long, not thick, of two kinds. On the legs it is shorter, stronger, and smoother, as also darker; there is but little on the feet, and none on the soles. The colour of the skin varies: generally it is of a lightish grey, but is darker in some parts, viz. on the legs and toes, and is white on the soles and tips of the toes: it is of a dark grey colour at the attachment of the scrotum.

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opossum, I found that she had just excluded from her uterus seven embryons, the smallest of which scarcely weighed one grain, another barely two grains, and the remaining five (taken together) exactly seven grains."—Barton in 'Annals of Philosophy,' vi. (1823) p. 349. "Facts, Observations and Conjectures relative to the generation of the Opossum." See also my art. "Marsupialia," *tom. cit.* p. 320.]

As the she one has a false belly, for the conveyance of her young, it may be reasonably supposed that she does not make any sort of nest for the young, but that she carries them from place to place.

In its genitals the opossum partakes both of the quadruped and bird; for its testes are in the usual place, but the penis is within a small orifice just at the termination of the anus; and, when it is pulled out, it inverts a little part of the anus: the rectum is turned down, as it were, from the tail to join the penis. What the position of the penis is when erected I cannot say; but it seems to be backwards, or at least at right angles with the body. If so, they must copulate tail to tail, and the situation of the penis with respect to the testicles or scrotum would make this very probable; for, let us suppose that the penis is turned forwards in the time of erection, it must come directly against the testicles, for the scrotum will be directly against the mouth of the vagina[1]; or it may be supposed that they copulate similar to a bird, or probably like the rat or rabbit, which are somewhat different from the common quadruped; although in these two animals the testicles are not so pendulous, and are by the sides of the penis.

The penis is forked at the end, and the urethra opens at the union of the two forks, and a groove is continued from the urethra along each fork, like the groove in birds. The testicles are very pendulous, the scrotum hanging by a small neck: it is white, while the skin of the attachment, or neck, is grey: but this varies in different opossums. The tunica vaginalis testis does not communicate with the abdomen, being in that respect as in man. The tunica vaginalis is of a dark grey colour (in one at least). The epididymis is attached to the testicle by a broad and very thin transparent membrane; as also is the vas deferens to the epididymis. If it was injected with quicksilver, the ducts coming from the testicle would be very plain to be seen. There are no vesiculæ seminales. The ureters open very near the opening of the urethra, and are therefore very near to each other: the urinary bladder opens into the urethra, which is of a singular construction. That part which is between the bladder and scrotum, which is called 'membranous' part, is about 4 inches long: it seems to be twisted; it is thick in its cavity, but particularly so near the bladder. It would seem to be made up of two kinds of substances; for, on looking on it, one is dark, the other is light brown; yet both are glandular. The dark substance is divided by the light brown into portions; one at the opening into the bladder,

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1 [In the coitus of the kangaroo, which was '*more canino*,' I noticed that the scrotum was obliterated by the retraction of the testes, which appeared to be forcibly compressed against the marsupial bones of the male.—Philosophical Transactions, 1834, p. 334.]

which is about half an inch long; the other portion, which is about 2 inches long, unites the brown part to the penis, but becomes thinner in its coats towards the penis: the light brown part is thicker in its coats than the other, which makes a kind of swell at this part.

The crura penis are not attached to the pubis, as in many other animals, but are detached, and have their bodies and ends surrounded with a muscle almost like a gizzard. There are two bulbs, like glands, which are covered each with a muscle. There are two 'glandes penis,' and two large Cowper's glands[1].

Quære, As the bones from the pubis exist in the male as well as the female, what is their use[2]?

The left jugular and subclavian veins pass down on the left of the heart, and in this course it [left superior cava] receives the vena azygos of the left side.

The liver is divided into four lobes, all of which are united at their bases. The gall-bladder lobe is the largest, the left is the next in size, the first to the right of the gall-bladder lobe is the next, and the right of all is the least; there is no lobulus Spigelii, excepting what the right lobe forms by being continued a little way to the left of the vena cava inferior: the reason of that would seem to be owing to there being no curve between the entrance of the œsophagus and pylorus to be filled up by this lobe.

The ducts of the liver are the cystic, which is straight, the hepatic and the common duct, which is pretty long, and which enters the duodenum about an inch and a half from the pylorus; which would be, in the human subject, 5 or 6 inches, as the animal is not so large as one's hand from which this description was taken[3]. There were vessels, besides the common duct, filled with bile, between the liver and a gland lying behind the duodenum: they had valves that hindered a return of the bile to the liver.

The œsophagus is about 2 inches in length below the diaphragm. The stomach is globular, not oblong, as in the human subject; and the œsophagus enters about the middle between the two ends, more like that of a hare, or animals of the vegetable-feeding kind[4].

The duodenum passes to the right, and then down; but soon crosses the spine to the left, where it becomes loose as common; it is therefore not so long as in most quadrupeds, yet has a mesoduodenum. The ileum terminates in a colon on the right side as in the human subject. The

[1] [Hunt. Preps. Physiol. Series, Nos. 2471, 2472, 2473, 2479, 2481.]
[2] [See Phil. Trans. 1834, p. 334.]
[3] [Probably the *Didelphis dorsigera*, Phys. Series, No. 3777.]
[4] [Hunt. Prep. Physiol. Series, No. 541.]

cæcum is moderately long and straight. In another subject it was bent, having, in one part, a little bridle or mesocæcum. The small intestines are pretty large, but short.

The colon passes up the right side, then across and down the left to the pelvis: but, as the cæcum and colon have no attachment but by mesentery, the colon is therefore moveable, by which its situation and course become various.

The anus in the female appears like the termination of the vagina in most quadrupeds, such as the sheep, sow, &c. But, from comparing this description with others, I suppose this is rather accidental, owing to the mode of contraction of the parts, than a natural formation. There are two bags, one on each side of the anus, having long small ducts, which open by two small points close to the verge of the anus.

The epiploon is attached to the stomach, spleen, pancreas and duodenum, as in the dog. There was little or no fat in it, although the animal itself was very fat, which fat is of the flaky kind.

The spleen and pancreas are much as in a dog, only that the large pancreas is somewhat larger, because the little pancreas is obliged to be less on account of the shortness of the duodenum, or the quick turn of that gut.

The kidneys are conglobate[1]. The capsula renalis is attached to the vena cava on the right side; on the left it is prominent, not flat as in the human. The urinary bladder is large and loose.

Female Organs of Generation.—The opening of the vagina is close to the anus, and indeed would seem to be within its verge; only it is capable of being pushed out, in the form of a round protuberance, with a dimple in it, like the oviduct of a laying hen; but this will vary according as the anus is drawn in more or less.

A very little way within the vagina is the clitoris, which is forked, or rather consists of two small pyramidal bodies standing across the vagina, pointing outwards. From them a rugous hollow goes to the mouth of the true vagina: within, or rather further in than the clitoris, is a sulcus.

From thence goes up the vagina, which is longitudinally ridged. About 2 inches up it divides into two, each passing a little outwards from the other, and when they have passed for about an inch in length, each opens laterally into a bag which lies on its inside.

This bag is full of rugæ; from the inner edge of this bag, about its middle, is the os tincæ of one side, or horn, of the uterus. The Fallopian tube passes along a membrane which makes a kind of bag for the

[1] [Hunt. Prep. Physiol. Series, No. 1227.]

ovarium, and upon the inner edge of this is the fimbria. The ovarium is a flat, dark-coloured body[1].

Quære, As there are two vaginæ, in the female, at the upper part of the common vagina which go in a particular manner to the uterus, does the forked penis in the male suit these, and does the stream of semen divide, and then go along the groove of each fork, as in a fowl?

Within the pouch or false belly are the nipples, six in number, three on each side[2]. There is a bag at each side of the anus, placed beyond the bones of the pelvis, the rectum extending farther on under the tail. It contains two kinds of matter; one a fluid, the other a kind of sediment which seems not soluble in the other. These bags open by small ducts just at the verge of the anus, where the rectum terminates in the skin.

An Opossum [*Didelphis Hunteri*, Waterhouse[3]].

This animal is of the size of a small rat, but is brown, like a mouse. Its head terminates on all sides equally to the tip of the nose: its fore-feet are those of a rat, mouse, &c., but the great toe of the hind-foot is a thumb, as in the monkey, or large opossum. Its tail is not so long as the rat's, but is stronger, and does not taper to the end so gradually, terminating in a pretty thick end: its motion is a flexion of the under-side, so as to throw itself into spirals for clasping. The hair is much longer on the upper surface of the tail than the under surface. It has seven nipples situated on the lower part of the belly; not so much between the thighs as in the cow, mare, &c.; six of these nipples are as it were set in a circle, and the seventh is in the centre of the whole. From the size of the nipples it is probable she had had young very lately, but there was no appearance of a pouch.

The œsophagus is about half an inch long below the diaphragm. The stomach is a roundish pouch, having a very short small end, so that the pylorus is very near the œsophagus. The duodenum passes to the right and then down, having a mesentery: it becomes more fixed to the back, and then loose, forming jejunum and ileum, both of which are but short. The mesentery is pretty loose and narrow. The ileum passes into the cæcum upon the right, and pretty high up; the cæcum is similar to the large opossum's. The colon passes almost immediately

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[1] [Hunt. Preps. Nos. 2735—2738, and No. 2738 A, the description of which supplies the answer to the question that follows in the text.—Physiol. Catal. vol. iv. p. 154.]

[2] [The Hunterian Preparation, Physiol. Series, No. 3795 (*Didelphis opossum*, Linn.), shows seven nipples, one in the centre and three on each side.—Physiol. Catal. vol. v. p. 210.]

[3] [The specimen is preserved in spirits in the Natural History Series of the Hunterian Collection. See 'Naturalists' Library,' vol. xi. p. 110.]

down to the rectum, both of which have a ligament, and probably one at the attachment of the mesocolon and rectum.

The stomach was pretty full, in the contents of which I found feathers, hair, wings, and legs of insects, and either the skins of insects or scales of lizards or snakes; but most probably of insects only. The pancreas has the common structure, viz. a long one across the root of the mesentery, and a short one in the mesoduodenum. The epiploon is attached to the stomach forwards, to the duodenum on the right, to the pancreas or root of the mesentery behind, and to the diaphragm on the left.

The liver is divided into three lobes, the right of which is subdivided into two, besides smaller fissures, and has the vena cava entering it: the middle lobe has the ligamentum rotundum entering the substance[1]. The gall-bladder is imbedded in a fissure on the under surface: the lobulus Spigelii has one end behind the little epiploon, the other on the right of the entrance into this cavity. The spleen is a long body on the epiploon. The kidney is conglobate, with one long mammilla that passes into the ureter[2].

The heart is oblique, as in the human subject; with a long vena cava inferior, and two venæ cavæ superiores.

The lungs have two lobes on the right side, one lobe on the left side, and a pretty large lobe between the heart and diaphragm, belonging to the right. The vagina may be said to begin within the verge of the anus in the contracted or natural state of the parts, and passes on in a straight line, but terminates in a large bag; which bag terminates at its most distant end in two obtuse ends, each of which has a little lateral chamber: the inside of this bag is granulated. There are two ora tincæ; or the horns of the uterus open separately into this bag by projecting orifices, one on each side of the angle of the division of the two obtuse ends of the bag. The horns are pretty large and convoluted, becoming larger towards their most distant ends, terminating in the Fallopian tubes, which pass on the meso-Fallopian or capsula ovarii, and open by two fringed edges near the ovarium on the edge of the capsule; this is large or wide at the mouth. The ovaria are flat bodies.

The Tapoa Tafa [*Dasyurus Tafa*, Geoff.: *Phascogale penicillata*, Temm.].

This is a small animal of the size of a rat, with very much the

[1] [This would indicate a more prolonged uterine gestation in the pouchless opossums than in other marsupials.]

[2] [Hunt. Prep. Physiol. Series, No. 1227.]

appearance of the martin cat, but hardly so long in the body in proportion to its size. The head is flat forwards, and broad from side to side, especially between the eyes and ears: the nose is peaked, and projects beyond the teeth, which makes the upper jaw appear to be considerably longer than the lower: the eyes are pretty large; the ears are broad, especially at their base, not becoming regularly narrower to a point nor with a very smooth edge; having a small process on the concave or inner surface near to their base.

It has long whiskers from the sides of the cheeks, which begin forwards, near the nose, by small and short hairs, and become longer and stronger as they arise nearer to the eyes. It has very much the hair of a rat; to which it is similar in colour; but near to the setting on of the tail the hair is of a lighter brown, forming a broad ring round it.

The fore limbs are shorter than the hind, much in the same proportion as in the rat; but the hind limbs are more flexible. There are five toes to the fore-feet; the middle one is the longest; the others falling off on each side nearly equally, but the innermost toe is rather the shortest. They are thin from side to side: the nails are pretty broad laterally, thin at the base, not very long, but sharp. The animal walks on its whole palm, on which there is no hair. The hind-feet are pretty long, and have five toes: what answers to our great toe is very short and has no nail; the next is the longest of all, the rest falling off gradually to the outer toe. The shape of the hind-toes is the same as in the fore-feet, as also the nails: it walks nearly on the whole foot or sole. The tail is long and covered with long hair, but not all of the same colour.

The teeth of this animal are somewhat peculiar; different from any yet known: the mouth is full of teeth. The lower jaw is narrow in comparison to the upper, more especially backwards, which allows of much broader grinders in the upper jaw, where they project considerably over those in the lower: the cuspidati [premolars] oppose one another: the upper piercers, or holders, go behind those of the lower: the second class of incisors in the lower jaw overlap those of the upper, while the two first in the lower go within or behind those of the upper. In this jaw, before the holders, there are four teeth on each side [incisors], three of which are pointed; the point standing on the inner surface, and the two front ones are longer than the two behind, stand more obliquely forwards, and appear to be appropriated to a particular use. The holders [canines] are a little way behind the last fore-teeth: to allow those of the lower jaw to come between; they are pretty long; the cuspidati on each side become longer and larger towards the grinders: they are points or cones placed on a pretty broad base. There are four grinders on each side; the two middle are the largest, the last the least: their base is a triangle, having one angle obtuse and two acute. Their base is composed of two surfaces, an inner and an outer, divided by processes or points; it is the inner that the grinders of the lower jaw oppose when the mouth is regularly shut. The lower jaw has three fore-teeth or incisors on each side, the first considerably the largest, projecting obliquely forwards; the other two of the same kind, but smaller; the last the smallest. The holder in this jaw is not so large as in the upper jaw, and is close to the incisor: there are three cuspidati, the middle one the largest, the last the least. They are cones standing on the base, but not on its middle, rather on its anterior side. There are four grinders; the two middle are the largest, rather quadrangular; each has a high point or cone and a smaller one on the outer edge, and three smaller points on the inner edge.

It is impossible to say critically what the various forms of these teeth are adapted for, till we have the general principles of teeth. In the front we have what may divide and tear off; behind those we have holders or destroyers; behind these, such as will assist in mashing, as the grinders or carnivorous teeth of the lion (sectorial or carnassial teeth); last of all, there are grinders to divide parts into smaller portions, as in the graminivorous; and the articulation of the jaw in some degree admits of all these actions[1].

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[1] [A comparison of the foregoing description with the jaws and teeth of a *Phascogale* (see No. 1884, Osteological Series, Mus. Coll. Chir.), cannot fail to impress the comparer with Hunter's faculties of accurate and minute description. It was probably without parallel at the time when it appeared in print (White's Journal, &c., 1790, p. 281). The nature of the teeth, as now understood and admitted, is shown by the formula:—

$$i\,\frac{4-4}{3-3},\ c\,\frac{1-1}{1-1},\ p\,\frac{3-3}{3-3},\ m\,\frac{4-4}{4-4}=46.$$

Hunter's 'second class of incisors' have been called the 'lateral incisors' by Mr. Waterhouse (Nat. Hist. of Mammalia, 8vo, 1845, p. 404): Hunter notices that "the two front incisors of the upper jaw are longer," and Mr. Waterhouse remarks that *Phascogale penicillata* differs from some other species "in having the foremost of the three lateral incisors of the upper jaw the largest" (ib.); the number of the paremolars, termed 'cuspidati' by Hunter, from their shape, shows that the 'Tapao Tafa' was a *Phascogale*, not a *Dasyurus*, in which genus the premolars are $\frac{2-2}{2-2}$ instead of $\frac{3-3}{3-3}$. It was, however, referred by Geoffroy St. Hilaire to his genus *Dasyurus*; but Temminck regarded the *Dasyurus Tafa*, Geoff., as a doubtful species, remarking "elle n'a point été vu depuis par aucun naturaliste:" and Lesson suspects it to be founded on the immature state of the spotted dasyure (*Dasyurus viverrimus*, Geoff.). The hinder half of the body of the tapao tafa, described by Hunter, is preserved in Phys. Series, No. 3758, to show the marsupium and teats, which are eight in number, arranged in a circle; the tail is that of the *Phascogale penicillata* of Temminck. The dentition is adapted, like that of *Didelphis*, for such food as Hunter found in the stomach of the small opossum described at p. 266.]

The œsophagus as it passes down the thorax, especially near the diaphragm, has a broad thin mesoœsophagus. The stomach is pretty globular: the œsophagus enters about its middle. The duodenum passes out on the right, being attached to the common mesentery at the very beginning; it passes down loosely on the right, and is continued into the jejunum without any interruption of attachment, and this is continued into ileum, colon, and so on to the rectum, without any distinction, being one continued gut, and on one continued mesentery: however, we may suppose where the jejunum begins by there being a slight doubling of this membrane. The whole gut is very short, not quite three times the length of the body and head of the animal: they appear to be more like the viscera of a lizard. There are eight nipples placed between the thighs nearly in a circle; they have rather a loose skin, making a ridge round them, but I think hardly sufficient to make a pouch; however, it is probable this may increase at the time of uterine gestation, because they have the two [marsupial] bones.

The liver has four lobes with the lobulus Spigelii, which is very small. The left lobe, as also the next, or middle one, are the largest; the third is the next in size, and the fourth, or right, is the smallest, having two long processes. The gall-bladder is in the fissure of the middle lobe, where I imagine the umbilical vein entered, although I could not find it. The two large lobes are attached by a number of long adhesions to the diaphragm; but whether natural or diseased I cannot say. The pancreas is very thin, has several branches in the beginning of the mesentery on the right, and one process goes to the left in the attachment of the stomach to the mesentery on the left, forming a kind of epiploon. The epiploon is a thin membrane, attached forwards and to the right, to the stomach, pylorus, and duodenum; backwards to the root of the mesentery; and towards the left to the stomach again, being continued into itself, in which is the spleen. The spleen is so small that at first I was not certain it was one. The kidneys are conglobate.

The anus and vagina have but one opening; the vagina is long, which is, I believe, common to the bladder and uterus its whole length; for I believe the opening of the urethra is as high as the os tincæ. There are two horns to the uterus, but whether they arise from one common uterus, or whether there be two ora tincæ, I am not certain. The urinary bladder is pretty high up, and is pendulous.

The tongue is not globose at its base: the epiglottis is continued round to the tips of the arytenoid cartilages; the whole being like the mouth of a tube cut slantingly. The lungs have two lobes on the right side, besides the centre lobe; and on the left side only one lobe. The jugular and subclavian vein on the left side form a left vena cava superior.

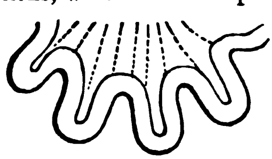
[Class Aves.

Order Raptores[1].]

The birds of this order live principally upon animals which they catch and kill, and are generally obliged to eat or swallow the hair or feathers, especially of those which are very small, such as mice or the smaller birds; but more especially the first; they are also obliged to swallow the bones of such food. These parts of animals are indigestible; and therefore must either pass along with the other excrementitious matter, or be thrown up by the mouth: this last way is that which is used. Those of the eagle-kind, I believe, first kill their food by their claws, and then begin to pluck the feathers, if it is a bird, before they begin to eat; but it is impossible for them to be nice, therefore they are obliged to swallow many of the feathers. If it is a hare or rabbit, they soon begin to open a way into the side or chest, and therefore have less chance of eating the hair.

The Golden Eagle [*Aquila Chrysaëtos*, Cuv.].

He has a swelling in his œsophagus, something like a crop, and has a cavity behind the œsophagus before it becomes glandular. After the third turn of the duodenum it passes down on the right side, becoming immediately loose; then makes its convolutions, which are scolloped, or rather the mesentery, something in this form,



and becomes a good deal smaller; at last it passes upon the left side, and is attached to the posterior part of the stomach; from thence it passes down, and makes a loose turn on itself, thrown a little into convolutions, and then forms the rectum.

The length of the whole intestines is twice the length of the whole animal, and four times the length of the trunk.

The eye is very large, and upon its lower and anterior surface it does not adhere to the orbit; and there is a cavity [orbital air-cell, extending] half-round the eye, like the cavity round a stile. This cavity communicates with that which is above the lower jaw, just before and

[1] [The following notes occupied vol. vi. of Hunter's MSS., entitled "Of the Anatomy of Birds."]

a little below the eye; however, this cavity is divided into two bags, by a thin membranous partition at the inner canthus of the eye, which extends inwards to the bottom of the orbit. The lacrymal [Harderian] gland is placed at the upper and interior part of the eye near the bottom of the orbit, upon the muscles of the eye; and on the exterior and upper part of the orbit there is a small body [answering to the true lacrymal gland in mammals] which is glandular, but the duct I could not find[1]. The processus ciliares are much longer than in a quadruped's eye of equal size. The vitreous humour of an eagle's eye has plainly a coat, for it is capable of being separated from the humour[2]. The anterior part of the first ventricles in the brain of an eagle passes to [the canal answering to the holes in] the cribriform bone along with the olfactory nerves, which are in this class of animals very short.

Of the Abdominal Air-Cells.—The lowest, or that which is nearest to the back, is the largest, and is immediately on the outside of the membrane which covers the intestines; it is bounded by a thin membrane going across, the anterior edge of which is attached to the abdominal muscles. The inner edge is attached anteriorly to the gall-bladder, and posteriorly to the right of the mesentery, somewhat higher than the above-mentioned, also to the head of the kidney, where it seems to be split into two, one of which is attached to the lower and anterior edge of the lungs. The anterior attachment is to the three lower ribs, and then down to the loins. Into this cell, so formed by these two partitions with the other parts of the abdomen, opens the lower air-hole of the lungs. The second cell is bounded above by the third partition, which is fixed anteriorly to the abdominal muscles, inwardly to the upper part of the foregoing partition, near its anterior part, but posteriorly this inner adhesion is to the root of the mesentery, and to the attachment which the liver has to the back: then the tip or edge runs across the lower surface of the lungs, about their middle, to the ribs, then to the four last ribs between this partition and the foregoing. The middle cell communicates with the middle opening of the lungs; which opening is close to the ribs near the fixtures of the membranes to the ribs. The third or anterior cell is bounded downwards by the last described membrane or partition anteriorly, and superiorly by the fourth membrane. This fourth membrane is attached anteriorly to the inside of the sternum, inferiorly to the last described, and to the basis of the liver; superiorly to the pericardium, and across from that to

[1] [But see p. 274, 'Bald Eagle.']
[2] [Hunt. Preps. Phys. Series, Nos. 1796, 1797.]

the anterior edge of the sternum. This cell receives the three openings of the lungs. The above-described partition is common to this cell, and the capsule which encloses the liver and œsophagus, as it passes between the lungs and the neck. There are a great many smaller cells which communicate with the others.

The air-bags in the abdomen differ from one another in different birds. In some, as in the eagle, they are principally attached to the diaphragm, kidneys, ribs, &c.; but in many others these membranes are attached to the intestines in many places, as in the bittern.

The Black Eagle, or rather a dark brown with rough legs [*Aquila Chrysaëtos* in immature plumage].

The duodenum has a pretty broad mesentery, like a loose fold of some of the other intestines: the jejunum is a loose intestine, strung for some way, on a deeply scolloped mesentery: it then passes up behind the stomach, adhering to it and to the root of the mesentery; next passes down the back, and makes another loose fold upon itself; then it forms the rectum. The anus is very large, and behind the cloaca, the mesorectum divides, and makes a cavity like a pelvis. The liver has two equal lobes; the two ducts enter at the termination of the duodenum, the hepatic first, the cystic last. The vein from the abdominal muscles does not enter the liver at the edge, but passes down below the heart, and enters the vena cava inferior just at the heart. The pancreas is in two parts, one on each side of the mesentery, and are short, only lying between the beginning and termination of the duodenum; they have but one duct, which enters the duodenum about an inch before the entrance of the hepatic duct.

The Dark-brown Eagle [The Sea-Eagle, *Haliaëtus albicilla*, Sav.].

With yellow legs, not wholly covered with feathers[1]. This bird died extremely fat, with all its parts very sound. The cavity of the abdomen was much larger than the viscera which it contained, by which means the different partitions and cells were very clear and observable.

The intestines were enclosed laterally in a thin membrane, one on each side, the edges of which are fixed as follows: the anterior edge was fixed to the abdominal muscles almost their whole length; the superior edge on the left side was attached to the middle of the lower part of the stomach, and was continued up on the posterior surface of

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[1] [The upper part of the tarsus is plumed in the sea-eagle, and the entire tarsus in the golden eagle.]

that viscus as high as the spleen; it was then attached to the left of the root of the mesentery; the posterior adhesion is to the head of the kidney, thence down the back and loins, along the veins that lie on the kidneys, to the swelling of the rectum, along the side of which it passes to the anterior adhesion. On the right side the superior adhesion was, anteriorly, attached to the gall-bladder; and then along the right of the mesentery to the back, but did not go so high as on the left. Between these two membranes are contained the intestines and the spleen. The anterior adhesions on each side make something like the mediastinum; in which there was a great deal of fat.

The duodenum is long, and it is doubled upon itself besides the [ordinary] fold. The small intestines are strung on the edge of the mesentery in a pretty long scolloped manner, which made something of the appearance of short folds, some longer and closer than others. The ileum passes immediately to the rectum, or rather the common mesentery is continued directly into the mesorectum. The cæca are very short. The rectum is short; the vesicula recti [bursa Fabricii] is pretty large.

The liver is composed of two lobes of equal size, each of which is enclosed in a loose distinct capsule; the falciform ligament divides the lobes. The ductus hepaticus anastomoses with the ductus cystico-hepaticus; for, by blowing into the hepatic towards the liver, the gall-bladder is inflated. The ducts of the liver enter at the last turn of the duodenum.

The pancreases are two, very short, confined to between the first and last turns of the duodenum; there is but one duct which enters the last part of the duodenum[1].

The Bald Eagle [The American Sea-eagle, *Haliaëtus leucocephalus*, Sav.], or what is called "The Eagle of the Sun."

It is about the size of a turkey, measuring about 2 feet 8 inches from the tip of the bill to the end of the tail, and about 6 feet from the tip of one wing to that of the other. It is in general of a fuliginous colour, and round the exposed part of each feather it is rather of a lighter brown, which is shaded into the other: the flight-feathers are darker, and have hardly any of the brown border. From the exposed parts of the feathers to their roots, they become lighter and lighter, first of a duskish grey, then of a dirty light blue, and afterwards almost white at their roots. The feathers of the head and upper

[1] [The biliary and pancreatic orifices, in one I dissected, were 18 inches from the pylorus, in consequence of the extent of the duodenal folds.]

part of the neck are white; then become a little spotted; and then brown. Those of the tail, or arising from the rump, and a little above it, are white.

The bill is exactly of a lemon-colour; and is of the same colour with the nose [cere] of other eagles or hawks. The nostrils are $\frac{3}{8}$ths of an inch long and oblique; one end turning upwards and inwards. The eyelids are in the direction of the bill. The iris of a yellow colour, pretty much like that in the lion or leopard. In its anatomy the eagle is just like the kite. The mesentery is scolloped. The gland that I observed in the orbit of the eagle has its duct passing forwards on the inside of the os lacrymale into the nose. There are two pretty large puncta lacrymalia, situated on the inside of the angle of the eyelid, not on the edge.

The Golden Vulture [*Vultur fulvus*, Gm.].

The feathers of this bird are of two colours, of a white dun and a black: the two rows of the largest feathers of the wings are black, excepting at the roots, where they are white: those that arise from the thumb of the wing are black. From each shoulder of this bird arise two long feathers, which pass backwards towards the tail, covering the whole feathers of the back that are between them and the tail; but they are covered at the roots by the feathers of the neck, &c.: they are black like those of the wings; and when the wings are either stretched out or folded, these two black feathers join as it were the black feathers of the wings, or make one continued blackness across the body. The longest feathers of the tail are black, and some of the smaller ones upon the upper surface of the tail. All those of the shoulders, upper part of the back, lower part of the neck, breast and thighs, are of a dun colour, those of the neck becoming darker upwards to their termination, where they are pretty dark at the tips but white at the roots. There they are somewhat smaller, and are turned both ways; that is, the most superior are turned towards the head. All along the fore part of the neck no feathers arise.

From the edge all round the merry-thought arises a thin muscle upon the skin of the neck as in a pigeon; under this is a cavity, as it were between the two cavities [air-cells] of the merry-thought, which communicates with the cavity of the trunk. In this cavity is situated the crop. Upon each shoulder is another cavity [air-cell] under the skin.

It has a crop. The stomach is pretty strong, but not of the gizzard kind; it is almost round, and has a small round tendon in its middle about the bigness of a farthing. The trachea is long, somewhat flattened, and is rather hollowed on the anterior and posterior surface. There are no small cartilages at the division, as in most birds, in which they are somewhat like the cartilages of the trachea in other animals, but the trachea divides into narrow rings as in other animals; but, before each division gets to the lungs, it becomes quite membranous, and the membrane is very thin.

The folds of the duodenum are not closely connected to one another, and I believe it makes a turn upon itself like the duodenum of the bald eagle or kite; after it has made its third or last turn, it passes backwards, on the right of the viscera, to the back, then passes towards the left behind the root of the mesentery as in other animals, having there but a short mesentery: it then becomes a loose intestine, the mesentery becoming longer to the middle of the gut, then becoming shorter towards the termination of the ileum, where it becomes a little longer again, and then becoming shorter, where the gut adheres to the posterior part of the stomach, just before it passes down to the rectum, before which it makes a little fold upon itself. There are no cæca. The rectum becomes very large [at the cloaca]. The ducts of the liver and gall-bladder enter the duodenum at the last turn, very near one another. The pancreatic ducts are two in number; one is thick and short, coming off from the head of the pancreas, running across the mesoduodenum and entering that gut just by the gall-ducts: the small and long duct comes out from the pancreas at its middle; and, passing as the former, enters just by it.

The Sparrow-Hawk [*Astur Nisus*, Bechst.].

The stomach is a good deal of the common shape, but is white and thin. The liver and ducts are as usual in birds; that is, the hepatic and cystic do not enter together, but separately: however, there is a small groove continued between their terminations, made of the doubling of the inner membrane: the hepato-cystic is continued into the cystic by a groove on the inside of the gall-bladder. I thought that the hepatic duct, when near to the gut, made a turn upwards towards the entrance of the cystic. The cæca are very short. There is no cavity at the end of the rectum; only the rectum is enlarged at that part: this was a hen. The length of the intestines is much the same in both [sexes?]. There were a vast number of small white bodies adhering to the inside of the gut at the entrance of the (ducts?, cæca?) for about 3 inches in length of the gut. They were just like maggots attached to the gut by one end.

[The Hen-harrier (*Circus cyaneus*, Bechst.).]

In a hawk between the gos- and sparrow-hawks, having long, small, yellow legs, and a head approaching that of an owl, with a yellow spot [cere] at the root of the bill, there is a kind of crop, or a wideness in the œsophagus, as in the goshawk. The viscera in general are as in that bird.

The Goshawk [*Astur palumbarius*, Bechstein[1]].

The œsophagus is very large on the neck, becoming larger and larger downwards; this serves as a crop; for there was a great deal of meat in it, which the bird had eaten some hours before; it then contracts at once at the usual place. Where the œsophagus begins again to swell, then it is glandular, but the orifices of the glands are smaller than in the [proventriculus of the] hen. The stomach is a good deal like that of an owl; it is oblong or pyramidal, beginning to swell as soon as it is got below the diaphragm, and is largest at the lower end with a little bend, and from the hollow of the bend passes out the duodenum. The stomach is not very strong in its coats; it has a middle tendon, but not of a shining colour; and the muscular fibres are white, not red like those of a gizzard. The inside is rugous like the human stomach, and is continued so into the duodenum for about half an inch, and there the rugæ end at once. The food was the same in the stomach as in the œsophagus. The duodenum makes the first turn, as in the common fowl, and was filled with a white chyme. Then the intestines grow loose, and, before they end in the rectum, they make a little turn on themselves. The cæca are not above $\frac{3}{8}$ths of an inch long. The rectum is about 3 inches long, and opens into a large bag which is more than an inch long, and about as wide. Its opening is like that of the os tincæ into the vagina. Above the rectum there is a pretty large cavity. The ureter passes into the rectum a little above the edge of this cavity.

The gall-bladder is round; the ductus cysticus and ductus hepaticus enter more than a $\frac{1}{4}$ of an inch distant from each other; the ductus cysticus terminates further on in the gut; and on the inside of the gall-bladder there is a kind of groove passing between the cyst-hepatic and cystic ducts. The pancreases are two, one before the common or intermediate mesentery of the duodenum, the other behind it; and their ducts do not enter together or with the gall-ducts.

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[1] [The anatomy agrees better with that of the buzzard (*Buteo vulgaris*, Bechst.).]

OF THE KITE [*Milvus regalis*, Briss.].

The œsophagus becomes very large before it enters the thorax. The stomach is as in birds of this kind, and is pretty large. The duodenum makes a turn and a half upon itself and follows the same course throughout, then the intestine goes on attached to the edge of the mesentery; but, near the termination of the ileum, it makes a short fold on itself, and is closely connected to the posterior part of the stomach. The length of the intestines was three times the length of the whole bird, and six times the length of the trunk; the length of the rectum was 3 inches; it was very large at the anus, where the small part terminates all at once in a somewhat valvular way: I could not find any cavity [bursa Fabricii] above the anus. The liver is as usual. The ducts enter the duodenum where it comes out of the turnings. The flesh was pretty red, but very tough and strong. The muscles of the neck were very strong.

In a blue hawk, or kite (which birds are to be found chiefly in Scotland), the toes were of an orange colour, so were the legs; the bill and claws were black. There is a crop as in other carnivorous birds. The stomach and the cæca were similar [to those in the hawk tribe]. There is a gall-bladder, with a hepato-cystic duct which is of some length between the liver and the bladder; this duct enters obliquely, and a groove is continued from it into the cystic duct, which enters the gut at the last turn of the duodenum. There were no hepatic duct or ducts; so that all the bile must pass through the bladder. The pancreatic duct entered the duodenum about an inch before the last turn. The testes were pretty large, of a whitish colour: there were two penises as in a cock [erectile papillary terminations of the vasa deferentia].

THE HORN-OWL [*Otus aurita*, Ray].

The œsophagus is long below the lungs: it is very large, and much longer than that of an eagle. The stomach adheres by its whole anterior surface to the abdominal muscles; it is white, and in shape something like a gizzard. The duodenum passes out on the right side, then down and bends up again: at this bend the whole makes a little turn: it passes up as high as the liver, is then bent down again nearer to the back: from this bend the intestines become more loose, but even this loose intestine makes three folds upon itself, having a pretty broad scolloped middle mesentery. The first fold is the shortest, the second the longest: the last part of the last fold has the two cæca running on each side of it. From the termination of this last, which is close to the back, the gut passes down the back and forms the rectum. The cæca are pretty long. The rectum becomes very large at the anus [the cloaca]: there is a cavity above the anus [bursa Fabricii] which communicates with it.

The liver has two equal lobes. The gall-bladder lies between the two, rather to the right. The ductus hepaticus enters the last turn of the duodenum: the cystic enters near the same place, but farther on. The pancreases are two, one on each side of the [duodenal] mesentery: there are two ducts; the first enters the last fold of the duodenum, half-way between the first and second turn; the second enters near the last turn, about an inch before the hepatic duct.

The small intestines are connected together by loose thin membranes, which are obliged to be divided before they can be unravelled. There were yellow stones in the rectum at the anus. The testes were pretty large. No vein enters the liver at the edge, as in the swan. There were muscles on the tarsal bone.

The membrana nictitans in a horn-owl comes from above downward over the eye. The eye of this bird is almost directed forwards. The vitreous humour has a capsula[1].

THE GREAT HORNED OWL [*Bubo maximus*, Sibbald].

The duodenum is as usual [in birds of prey]: the jejunum passes back, and then becomes loose; but not at equal distances from the root of the mesoduodenum, for it is scolloped, making folds, the last of which is nearly as long as that of the duodenum: it then ends in the rectum. The rectum is very large, and was filled with a fluid. The cæca are nearly as long as the last turn of the ileum, and are about as thick, excepting at their opening into the rectum. The length of all the intestines was 2 feet 7 inches.

The kidneys are shorter than in other birds; their upper ends are thick and globular, projecting forwards, appearing like the kidneys of [mammalian] animals.

The testes were about so large ———, but the right rather less. They are of a pale yellow colour. There are two penises, as in the common cock, but they are somewhat larger; and seem to be bifid, with one point short. That part of the anus between the two penises, with the edge of the valvular part of the anus, is something different from the rest, enclosed by two small ridges, one from each penis to the edge of the valvular part, converging as they pass, and terminating in

[1] [Hunt. Prep. No. 1799. The organ of hearing is No. 1581.]

two points. Query, whether or not this is the proper penis, making a kind of groove for the passage of the semen?

The liver is but small; the ducts enter at the last turn of the duodenum, about a ¼ of an inch from one another. The hepatic is the first that enters, and is the smallest; the cystic, at the beginning, is pretty large, but becomes smaller. The pancreases are two, at the end next to the liver; but they unite at the other end, which does not pass so low as the second turn of the duodenum; from that lower end of the pancreas, passes the duct which enters the duodenum at that part, about an inch beyond the second turn. The abdomen is wider and shorter than in other birds, which makes the viscera more compact.

The motion of the eye must be very little, for the eyeball filled up the whole socket; so much so, indeed, that it was with difficulty that I could extract the eye. The crystalline humour of the eye of an owl is almost round; this renders this animal near-sighted, which property is calculated for seeing in the dark. One who is long-sighted cannot see objects in the dark, because they are then not to be seen at a distance; and, when near, the eye is not adapted to them. The retina does not come so far forwards in this bird as in many others:—not near so far forwards as in the quadruped. This is probably owing to the shape of the anterior part of the eye being almost a cylinder, and the retina comes no farther forwards than where the eye is becoming globular. There is a distance between the anterior edge of the retina to which the nigrum pigmentum is attached, and the processus ciliares, making a circle that has no pigmentum [1].

Of an Owl [*Strix flammea*, Linn. ?].

In an owl the stomach is a good deal of the common shape [in birds], but is white and thin. The liver is as usual, as well as the ducts; that is, the hepatic and cystic do not enter together, but separately. The cæca were as long as in a hen [common fowl], in proportion to the size of the body: there was a little cavity either before or behind the rectum, as in a swan or hen. This owl was a cock, and this cavity [bursa Fabricii] was thrown into rugæ [2].

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[1] [Hunt. Preps. Phys. Series, Nos. 1749, 1755, 1798.]

[2] [See Hunt. Preps. of the bones of an owl, Phys. Series, Nos. 210, 211, 212; of the tongue, No. 1481; of the eye, Nos. 1750, 1751.]

[Order Insessores.]

[Family *FISSIROSTRES.*]

Of Swallows.

Swallows of each sort are the same in every part of the world, which shows that they are birds of passage. This is not the case with other birds that are not birds of passage; for we may observe that all countries have their [particular species of] animals [which] differ from those of another country in some circumstances. Swallows live wholly on flying insects, and those insects are only to be found in hot weather; therefore, in a climate that changes from hot to cold, we can only have those insects in the hot season; and the swallow too can only be there in those seasons. In warm climates, where there is a sufficient degree of heat all the year round for those insects to live in, we find the swallows all the year round.

Swallows are not easily tamed so as to live in a cage; for they do not peck their food, when both they and their food are at rest, but catch it when both are in motion. This motion cannot be had to either food or bird in a small place: however, they have been tamed. Mr. Pearson tamed several and gave me one of them.

Swallows are of two kinds in England: one, a small white-bellied one [1]; the other, a large black one [2]. The white-bellied one catches its food in the heat of the day; the black one catches its food nearly in the evening, towards dusk. In the year 1764, I saw a swallow at the beginning of October. In the forward spring of 1791, I saw swallows about the 20th day of April.

If swallows sleep in the winter, as it is said, it must be very different from the manner in which the bear, dormouse, lizards, snakes, &c. do. Some of these really sleep most of the time; the others are in a state of stupor or insensibility: but the swallow must be in a state of total suspense of animal action, such as they say people are when in a trance. There can be no circulation, as there can be no respiration.

Perfect sleep is a suspension of sensibility; and a trance is a suspension of simple life.

The Night-raven, or Goatsucker [*Caprimulgus europæus*].

A night-raven has no crop. The stomach is not so strong as a hen's,

[1] [This may be either the chimney-swallow, *Hirundo rustica*; or the bank-swallow, *Hir. riparia*; or the window-swallow, *Hir. urbica.*]

[2] [This is the swift (*Cypselus murarius*).]

but is stronger than a jackdaw's; it was filled with stones and flies. The cæca are about half the length of the animal. It is of the swallow kind[1].

[Family *DENTIROSTRES.*]

The Butcher-Bird [*Lanius excubitor*, Linn.].

The butcher-bird is something of the shape and appearance of a jay, and is about the size of a blackbird. Its toes and claws appear to be somewhat more adapted for laying hold of objects than a magpie's, but not so much as a hawk's, when we allow for difference in size. The bill seems to be a mixture of both; for it is shorter and somewhat more bent than a magpie's, but is not so short, nor yet so much bent as a hawk's; and it has two small processes, one on each side of the upper mandible, pretty near the point, as we see in some hawks. The head is broad and flat, and the eyes large, as in all birds of prey.

The crop and the stomach are of the hawk-kind: the duodenum is as usual: the other small intestines are loose: the rectum is very short; and the two cæca are very short likewise. The termination of the rectum in the cloaca is very large. The gall-bladder contained a very fine pellucid bile.

The viscera are just like a hawk's. The butcher-bird is carnivorous: it killed two birds before it died.

[Family *CONIROSTRES.*]

The Raven [*Corvus corax*, Linn.[2]].

The glandular part of the œsophagus [proventriculus] becomes longer and larger, and is continued into the stomach, which seems to be only a continuation of the former. The stomach is like those of carnivorous birds: it is not strong in its muscular coat, and is of a very pale red. The tendinous part is very small, and hardly of a shining colour: the horny substance on the inside is pretty hard, but is thin.

The duodenum after it has made its third turn passes back, and then towards the left behind the stomach; and, when got to the left of it, throws itself into concentric folds on the mesentery, which is very narrow from right to left, but is very long from the root to the most

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[1] ["Caprimulgus *genere differt ab* Hirundine, *uti* Strix *a* Falcone, Phalæna *a* Papilione."—Linnæus, Systema Naturæ, ed. xii. tom. i. p. 346.]

[2] [The skull of the Raven is No. 1546, Osteol. Series. The lower larynx is preserved in Hunt. Prep. Physiol. Series, No. 1161, the upper larynx and tongue in No. 1485.]

distant part; when the intestine has got to the root of the mesentery, on the right side, it makes a turn with the duodenum, adheres to the pancreas and mesoduodenum; and when it has got to the beginning of the duodenum, it passes towards the left, before the root of the mesentery, adhering to it by a mesentery an inch broad; it then passes down the left side to commence the rectum. The cæca are very short, much like those of the sea-gull. The length of the whole intestine is only twice the length of the whole bird, but five times the length of the trunk. The rectum is about 2 inches long; it becomes pretty large at the cloaca, but gradually expands from the cæca to the anus, as in the crow. The gall-bladder is pretty large. The ducts of the liver pass in at the third turn of the duodenum, separately, but very close together, and the cysto-hepatic duct seems as if it were continued into the cystic. The pancreatic duct passes across on the posterior surface of mesentery, and enters with the hepatic. The pancreas, on the posterior side, passes 3 inches further into the third turn of the duodenum than the entrance of the duct. The testes were very small: I could not find the vasa deferentia, nor the penis. The duct of the gland above the tail is very large, or rather it is a pretty large bag filled with a creamy juice.

The Crow [*Corvus corone* and *C. frugilegus*, Linn.].

The stomach is a little stronger than a raven's: the tendinous part is broader in proportion to the bulk of the stomach, and of a more glistening colour. All the other intestines presented the same in shape and position, only that the mesentery attached to the small intestine was twisted from left to right three or four times, so that I was obliged to untwist them to spread out the mesentery. I do not know but the raven may show the same. The ducts of the liver and pancreas were the same as in the raven. The testes were smaller than they were even in the raven. The stomach may be called a gizzard; it has stones in it as usual. This description was taken from a shot one [probably a rook].

The difference between a Crow and a Rook.

One [*Corvus corone*, Linn.] was larger than the other, of a much finer black, and had more feathers on the neck. The bill was short and black, the legs black and not strong, nor the toes long: the claws were sharp. The downy roots of the feathers were of a clear pale or ash colour. The stomach was not strong, yet was of the gizzard kind: it was filled with stones and skins of insects. The two cæca were very short. This was a female, and in three males of the same kind the parts were similar to the above.

The other was a black crow [*Corvus frugilegus*]. The flight-feathers of the wing were the lightest. The downy part of the roots of the feathers were not of so clear an ash colour as the other. It had a longer bill; the legs were stronger; the toes longer; the claws not so sharp; and all these parts were not of so fine a black. The stomach was much the same, but was empty. The cæca were nearly twice the length of those of the other[1]. This was a male. Both species had muscles at the division of the trachea[2].

A crow is so well known in this country, that no one can mistake another bird for it; therefore, when a Briton says he saw and killed crows in any other country, we must suppose they were really crows: and if this mode of reasoning is just, the crows are a very universal bird. White[3] writes familiarly of crows in New Holland. They are also talked of in America[4].

THE CORNISH JACKDAW, OR CHOUGH [*Pyrrhocorax graculus*, Temm.].

The ducts of the liver are the same as in the guinea-fowl, only that the cyst-hepatic duct opens into the bladder; but the space between the entrances of the two ducts was a kind of groove; so that the bile passing by the cyst-hepatic duct might get into the cystic duct without getting into the bladder; it is much the same as in the guinea-cock. The length of the ducts was about $1\frac{3}{4}$ inch. The stomach is like that of the peewit, but there were no stones in it. The length of the rectum was $1\frac{1}{2}$ inch: the length of the cæca was $\frac{3}{8}$ths of an inch. The testes were black, and about so big ——. The spleen was oblong and lying

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[1] [The most obvious mark of distinction in mature birds, is that the rook is bare of feathers about the base of the bill, which is whitish and scurfy; but this is acquired by the habit of thrusting its bill into the ground after worms and insects, and does not characterize the young bird. The male has a pouch at the root of the tongue, which may be observed distended with food at the breeding season.]

[2] [All the *Corvi* have five pairs of muscles to the lower larynx.]

[3] [John White, Esq., Surgeon-General to the settlement of New South Wales; author of a 'Journal of a Voyage to New South Wales,' 4to, 1790, in the appendix of which are Hunter's descriptions of some Australian quadrupeds. The Australian crows are referred to the genus *Cracticus*.]

[4] [Gould remarks, "It is exceedingly interesting to trace the range of the members of this genus or the true crows; not so much on account of their wide distribution, as from the circumstance of the form being non-existent in some countries which appear admirably adapted for their well-being; thus, while the species are widely distributed over the whole of Europe, Asia, Africa, North America, the Indian Islands and Australia, none are to be found in South America."—Birds of Australia, p. liv.]

transversely in the common place. At the division of the trachea there were many small muscles.

The Magpie [*Pica caudata*, Ray].

It has no crop. The stomach, in respect of strength of coats, is between that of the hen and the heron. The testicles were as large as a horse-bean, pretty round, of a yellow colour, and very soft. The thyroid gland is on the side of the trachea at its lower part.

The Jay [*Garrulus glandarius*, Briss.].

The viscera of a jay are just like those of a jackdaw; so are the small muscles of the trachea. They have a cavity above the anus as in an owl. This specimen was a cock.

The Nightingale [*Sylvia luscinia*, Linn.].

The stomach is a kind of gizzard; the intestine is short, but pretty wide. It has no cæcum. There are muscles at the division of the trachea, but not strong. [It has five pairs, as in all *Sylviadæ*.]

The Sparrow [*Pyrgita domestica*, Cuv.].

"Mr. Cheston's compliments to Mr. J. Hunter, and begs his acceptance of three views of a sparrow, which was killed by a random shot among a flight of birds of the same species in a lady's garden at Dursley. The extraordinary length of the bill seems to have arisen from disease."

The Large Wattle Bird, Banks [*Philedon caruncululatus*, Cuv.; *Merops carunculatus*, Shaw].

This bird has no crop. The stomach, in strength, is between a stomach and a gizzard: the internal horny coat is very strong. The duodenum is very short; from the last turn of the duodenum it becomes a loose intestine, which then goes behind the root of the liver, and behind the stomach, to the back of which it is attached; it then passes down the back to the anus. There are no cæca. There is no enlargement at the anus. The whole intestine is short and pretty large.

The stomach contained a red fruit with a stone in it: many of these stones were in the intestines deprived of their pulp. It has a gall-bladder. There are muscles on the division of the trachea. The legs, toes, and claws are similar to those of the crow and raven. The bill would appear to come nearest to that of the Guinea-fowl. The wings would appear to be of the common fowl kind, viz. hollow or concave on the inside, and convex on the outside, and rounded on that edge made by the termination of the feathers.

[Order SCANSORES.]

THE CUCKOO [*Cuculus canorus*, Linn.].

The cuckoo has no crop. The œsophagus is pretty large. The stomach is white, much the shape of a kidney-bean, and the tendinous part is nearest the concave edge: it is not very strong, hardly as strong as a peewit's. Its situation is as common. In some cuckoos I have found the inner surface [of the stomach] hairy, and the direction of the hair is round the centre tendon on each side, and in the middle of this centre there is a small fleshy knob, like a small nipple[1]. In some this hairy coat peeled off with a thin membrane; in others it came off without any coat; and in a hen-cuckoo there were no hairs at all.

The gall-bladder is very small. The duodenum is as common. The jejunum makes a fold upon itself, which is pretty large at the bend; it then makes a close fold on itself, at the termination of which commences the rectum, or where the cæca are inserted. The cæca are short and small. The length of the whole intestines is three times and a half the length of the body of the animal: the rectum is nearly half that length, and is pretty large at the anus.

It has no cartilage to the under eyelid, and but one punctum lacrymale.

The cuckoo has yellow legs; the bill is dark-coloured on the upper part, yellow underneath, excepting at the point: the mouth and tongue are orange-coloured: I have seen cuckoos pick beetles and caterpillars, and have immediately shot them and found the same in their stomach.

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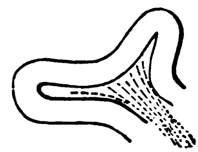
[1] [In a cuckoo in which I found the stomach in this state, they were the distichous hairs of the larva of the tiger-moth (*Arctia Caja*).

Hunter, in adducing evidence of the regular or rotatory action of the gastric muscles, writes:—"The same motion seems also to take place in the bird-kind; and of this the cuckoo is an example; which, in certain seasons, living on caterpillars, some of whom have hairs of a considerable length on their bodies, the ends of these are found sticking in the inner horny coat of the stomach or gizzard, while the hairs themselves are laid flat on its surface; not in every direction, which would be the case if there was no regular motion, but all one way, arising from a central point placed in the middle of the horny part; and the appearance on the surface of both sides of the gizzard evidently corresponding. These two facts prove, in my opinion, a regular circular motion taking place in the gizzard and membranous stomach; and, therefore, most probably, something similar is carried on in stomachs of all the various kinds."—John Hunter, On the Animal Economy, 8vo, ed. 1837, p. 93.]

Bird, of the Toucan-kind, from New Holland[1] [*Scythrops Australasiæ*, Shaw].

It has no crop; the stomach is rather of the gizzard kind, but not strong; it is not above $\frac{1}{8}$th of an inch thick; the cuticle is pretty strong or hard. The duodenum is short, and makes but one fold upon itself. The jejunum is also short, having a pretty broad mesentery on the right side, not making a regular sweep where the intestine is attached; but a scollop or an attempt to two little folds on itself, as—



The ileum also is short, makes only one fold, which is about the centre of the abdomen, and in the direction to the last fold of which, are attached the cæca. The cæca are pretty long, being the length of the fold of the jejunum, and are pretty thick or wide. The colon, or what should be called the rectum, passes directly to the anus. The liver is rather small; the left lobe is rather smaller than common. Between the two lobes are the cells for the air. The pancreas is also but small: it is short, on account of the duodenum being short. The contents of the stomach were beetles, and a seed which was bruised and broke. There were no stones in the stomach.

In the female were several yolks of a pretty large size; it is therefore a bird that hatches several young ones at a brood. The testicles of the male were pretty large, therefore both must have been caught in the breeding season. They are a pretty plump bird, broad and short, with a short sternum. In length of wing and tail they come nearest to the hawk.

The Woodpecker [*Picus viridis*, Linn.].

The woodpecker has a very long tongue, about $2\frac{1}{2}$ inches, and often it is capable of being thrown forwards to that length. When brought back into the bill it is enclosed in a kind of prepuce. There are muscles for these purposes; and to answer the motion that must be in proportion to the length of the tongue, the horns of the os hyoides are made long, so that they pass round behind the head, and come over the upper part of the head as far as the beginning of the beak. At the end of the tongue, which is very small, there is a little bit of horn, with which it is, as it were, tipped[2].

The Wry-neck [*Yunx torquilla*, Linn.].

This bird is like the woodpecker, by having no cæca; and the feet of

[1] [Temminck called the *Scythrops* an 'anomalous hornbill.']

[2] [Hunt. Preps. Phys. Series, Nos. 1477—1479: the beak of the woodpecker is No. 311.]

both are alike. The pancreas does not fill up the whole length of the fold of the duodenum; and its ducts enter near the same place with the biliary ducts.

This bird always turns the head down when it alights on the trunk of a tree.

The Parrot [*Psittacus*, Linn.].

The tongue of a parrot is much thicker, broader and shorter, than in other birds, and the posterior edge terminates in two broad wings which are larger than in other birds. The os hyoides is shorter. They have a crop which lies on both sides of the trachea. The glandular part of the œsophagus is where it passes between the lungs, so that it is about an inch from the stomach, between which the œsophagus is very large and pretty thin, and is continued into the stomach.

The stomach is very small, about the strength of a jackdaw's; it was filled with stones, and the horny coat thrown into wrinkles, but it is not very hard. The intestines are all folded on one another like the duodenal fold, which is the largest, and the ends of some folds lie within others. They have no cæca. The rectum is enlarged at the anus: there is a small cavity above the anus. The length of the intestines is 4 feet 6 inches. The length of the bird was one foot. It has no gall-bladder, but two hepatic ducts which communicate in the liver, and enter the duodenum as the cystic and hepatic do in common. The testes were very small.

The Macaw [*Macrocercus*, Vieill.].

The stomach or gizzard is about as strong as a crow's, with stones in it. The duodenum is as usual. The jejunum and ileum are folded upon themselves, making three different bundles. The jejunum passes from the last turn of the duodenum backwards, then downwards for some way, and is folded up upon itself to the root of the mesentery [first bundle]. From thence it goes to make another turn, but not upon the last described, but a distinct one, which makes the second bundle. After making the new fold it passes to the first, and makes a second fold upon that, but not such a long one. From thence it goes to the second bundle, and makes a second fold upon that like the former. Then it comes to the first bundle and makes a third fold upon it, in length between the first and second; so that it goes alternately from one to the other. After making the third fold upon the first bundle, it makes a pretty long fold upon itself distinct from the others, which makes the third bundle. The last of this fold adheres closely to the right side of the gizzard, then passes backwards to the back, and then along the back to the anus, which is very large. There is no cæcum, and no gall-bladder. There are two hepatic ducts, which enter the duodenum near its last turn, about $\frac{3}{8}$ths of an inch from one another; they communicate with one another in the liver; for by blowing into one it filled the other. The muscles at the lower end of the trachea are as in the parrot, &c.[1]

[Order Rasores.]

The Pigeon [*Columba livia*, Briss. ?].

It has no gall-bladder. It has two hepatic ducts, one large, the other small: the large one, which is the shortest, enters the duodenum just at its bend at the stomach; the small one, which is considerably longer, passes down between the two folds of the duodenum, and enters that gut in the middle between the bend and the termination. The pancreas is situated as usual, having its anterior end passing backwards to be attached to the spleen: it likewise has two ducts, one of which enters the duodenum very near the long hepatic duct, the other passes upwards and enters the duodenum near the termination of that gut, where the biliary and the pancreatic ducts commonly terminate. There are two small cæca as in a dove.

The Dove [*Columba palumbus*, Linn.].

The dove has a very large œsophagus, and has a crop; the stomach is very strong[2]. The cæca are small and short. The intestines made three folds on one another: the first, the duodenum; the second, a little further on and larger; the third, near the rectum and smaller. The length of the rectum in the Dove, Partridge, and Butcher-Bird, is nearly the same in proportion. The testicles were very small, and of a whitish colour. In two others the testes were of this size ———.

Comparison between a Dove [*Columba palumbus*, Linn.] and a Pigeon [*Columba livia*, Briss.].

The liver is the same in each, the right much the largest, and comes much lower than the left; but not higher. The pancreas is just the same: the anterior one is divided into two and lies lower than the posterior one, as low as the bend of the duodenum; the posterior passes up higher than the anterior one, and its upper end is hollowed by the lower end of the spleen, which is yellow in the dove and red in the

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1 [The Psittacidæ have three pairs of inferior laryngeal muscles.]

2 [Hunt. Prep. Phys. Series, No. 527.]

pigeon. The duodenum is nearly the same, only that the pigeon's does not run so parallel as the dove's; for the last fold is a little loose or serpentine.

The duodenum of the pigeon, after its third or last turn, passes to the back, then the intestine makes a turn down to the pelvis, but is folded up again upon itself to the root of the mesentery, connected by a very thin membrane that has no vessels upon it: from thence it makes another fold which takes up nearly its whole length, but is somewhat particular, for the guts are closely connected together, yet the mesentery is a broad membrane behind them, common to both, and having an edge that has no gut attached to it, along which pass the branches of the mesenteric artery: this fold is very much convoluted. When the intestine has got to the root of the mesentery again, it makes another turn for about 5 or 6 inches long; at the beginning of which there is a small one. [The dove has not this.] Now that it has got to the root of the mesentery for the third and last time, it passes back on the left of the mesentery to the back, then passes down to the colon or rectum; and indeed the whole from the root of the mesentery to the anus may be called the rectum. The cavity behind the anus [bursa Fabricii] is very thick, and seems to be wholly glandular, of the conglomerated kind. The ducts of the liver are two, as usual; the large and short one enters the duodenum near the stomach; the small and long one is about the middle of the last fold, midway between the second and third turns.

The pancreatic ducts are three. One from the inferior lobe of the anterior pancreas, passes upon the gut, and enters in its fore part a little way above its second turn. The second duct, from the lower end of the superior lobe of the anterior pancreas, passes along the mesentery and enters the duodenum near the former, but at the place where the mesentery is fixed. The third passes from the lower end of the posterior pancreas, and enters pretty near the third bend of the duodenum, some way above the insertion of the small duct of the liver. All these three ducts pass into the gut just between the second and third fold. The internal membrane of the crop in both is very thin and smooth[1].

A Brazil Dove.

It has a crop. The stomach is like that of the common fowl: the duodenum is as common: the jejunum makes a long fold upon itself, the two parts being very closely connected to one another, and it is

[1] [Hunt. Prep. No. 526. The change that takes place in the character of the internal membrane of the crop during the breeding season is shown in Preps. Nos. 3737—3741; and described in the 'Animal Economy,' 8vo, p. 124.]

rolled up upon itself in a circular form: then the intestine makes another shorter turn upon itself, and afterwards goes to form the rectum. There is no cæcum. The liver is divided into two lobes.

[So far, I examined the parts of a small East Indian dove, and found them agree: this was a hen-dove: the following I could not observe.] There is no gall-bladder. One of the biliary ducts enters the duodenum within a $\frac{1}{4}$ of an inch of the stomach. A pancreatic duct enters the duodenum near the third turn. The situation and shape of the spleen were as usual. The testicles were very large and close to one another. The two penises were just as in the common fowl.

A White Dove.

It had no gall-bladder, but two biliary ducts; one very large, the other very small: the large one enters the duodenum just in the first turn, close by the gizzard, as in the Brazilian dove; the small one enters the duodenum about an inch before the last turn. The pancreatic ducts enter at the last turn of the duodenum. By blowing into the large one it fills up the small one, which dilates the duodenum. It has the two small cæca, as in other doves.

The Large Blue Crowned Pigeon, from the East Indies [*Lophyrus coronatus*, Vieillot].

The œsophagus is large between the mouth and the crop: the crop is large, bulging out laterally as in the common pigeon[1]: the œsophagus between crop and stomach is smaller and stronger in its coats than the other. These divisions of the canal may be called 'œsophagus superior' and 'inferior.' There are two rows of glands[2] arising from the beginning of the lower œsophagus, and gradually losing themselves in the œsophagus as they pass down. The gizzard is extremely strong, and its horny lining is very strong at its two muscular ends; it is furrowed on its inner surface, and cross-furrowed with less deep grooves. The duodenum passes out as usual towards the right, makes a bend downwards for 5 inches in length, and is then bent up upon itself as high as the former: the intestine then leaves the duodenum at this first turn downwards towards the back on the right, and passes behind the former or duodenum, and may now be called jejunum, as it becomes a loose intestine: this is about 8 or 9 inches in length, having a pretty broad mesentery; the termination of which loose part is at the root of the mesentery, and thence it sets out, forming a long fold upon itself near a foot in length, not above $\frac{3}{8}$ths of an inch distant from one another: this fold is united by cellular membrane loaded with fat; besides which

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[1] [Hunt. Prep. Phys. Series, No. 525.] [2] [Ib. No. 583.]

it has a mesentery common to both, which being shorter than that connected to the intestines, throws the intestines into an irregular sweep. Along the loose or unconnected edge of the common mesentery pass the blood-vessels, throwing out their branches laterally along the mesentery to the intestines. This fold of the intestine is again folded upon itself so as to shorten it; but these folds are not attached. The intestine, after having made this fold upon itself, sets out from the root of the mesentery a second time, and makes another which is about 6 or 7 inches in length, and a good deal similar to the duodenal fold, and about half an inch distant: in the centre, between the two, pass the blood-vessels, ramifying laterally into the two portions of intestines. After finishing this last turn the intestine passes down the back, and may be called rectum. The setting off of the two last turns, as also of the rectum, is from the root of the mesentery. At the anus there is a considerable reservoir. This account of the intestine corresponds very much with the pigeon (*vide* Comparison between the dove and pigeon, page 288).

There is no cæcum. The pancreas is a single body, bent or folded upon itself at the upper part, or it is made up of two bodies united at the upper part, lying in the folds of the duodenum; one portion upon one side of the uniting mesentery of the duodenum, the other on the other side. The anterior portion becomes larger downwards; and sends from near its lower end two ducts which pass to the duodenum after that gut has finished its two turns, and enter it close to one another, near an inch from the entrance of the duct of the liver. This posterior pancreas sends a duct up to the duodenum, about an inch before that gut terminates in the jejunum which enters the duodenum there.

The liver is divided into two nearly equal lobes. There is no gall-bladder. There are two hepatic ducts which come out of the porta of the liver; one a little towards the left, the other a little towards the right: that from the left is the larger. They pass in between the two folds or turns of the duodenum, closely connected to one another, and are continued down between these folds to the lower curve: that nearest to the left enters the duodenum hardly half an inch beyond that bend, close by the lower duct from the anterior pancreas.

The contents of the crop were tinged of a yellowish green, but had no bitter taste; the mucus adhering to them had the same colour. The contents of the gizzard were of a pretty dark green, and very bitter. The gizzard was full of stones. The contents of the beginning of the duodenum was of a yellowish green, but not bitter to the taste. The contents of the jejunum were ash-coloured, both before the entrance of the biliary ducts and after. The trachea is flattened; [its transverse section] is an oval near to the head, becoming flatter and broader downwards, the division having no muscles at its division[1].

The ovarium is a little round granulated body, placed at the root of the mesentery, or the beginning of the mesorectum, upon a yellow body which may be supposed to be the capsula renalis. Some of the ova were whitish, while the others were black, which gave the whole a grey colour[2].

This bird agrees very much with the pigeon.

The Guan-Bird [*Penelope cristata,* Merrem].

This bird is about the bigness of a common pheasant, and in figure and shape it is a good deal like that bird. It is black, but has some white feathers upon its breast.

Its head and bill are a good deal of the pheasant-kind; it has some long feathers upon the top of the head, like the silver cock. Its throat has something like hair growing from it, but very thinly. This naked part is red, and the skin is a little doubled, resembling the same part of a turkey-hen. The legs are of a dark red, and the claws are somewhat longer and more bent than those belonging commonly to graminivorous birds. They rather resemble those of a crow.

The trachea, before it enters the breast, is doubled upon itself, lying upon the lower end of the clavicle, almost as low as the anterior end of the keel, rather upon the right side of the breastbone; having a muscle which arises from the lower point of that bone, and runs forwards along the crista of the sternum on its right side, and is inserted into the bend of the trachea. It is probable that the trachea is often brought more into a straight direction by the turns or position of the head; when so altered this muscle will draw the trachea into its right position again.

The œsophagus is very long, becoming larger and larger downwards, but does not seem to terminate in a regular bag like a crop; it becomes contracted where it passes through the thorax, and then terminates in the stomach, which is a continuation of the œsophagus, becoming, as it were, larger and thicker in its coats. The strength of the stomach is much like that of the peewit's: its tendinous part is but very small.

The duodenum is pretty thick or wide, and its fold upon itself is but short; about 2 inches in length. In another which I examined it was

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[1] [The *sterno-thyroidei,* after gaining the trachea to pass to the sternum, send off a narrow slip on each side the trachea, to be inserted in the membrane between the lowest tracheal ring and the first ring of the bronchia. There are a few fibres in the same situation in other *o lumbidæ,* showing an affinity to the *Insessores.*]

[2] [Hunt. Prep. Phys. Series, No. 2727.]

longer, about 3 inches in its fold or doubling. It now makes a sweep backwards on the right, where it receives the ducts of the liver. After it has made this last turn it becomes a loose intestine, which is only attached to the mesentery behind the duodenum and stomach, to which it is attached near the beginning and end of the duodenum, likewise to the upper end of the pancreas that is between them. From thence the gut passes upwards behind the gizzard, as also behind the root of the mesentery, to which it is attached pretty firmly, and then begins to make a turn downwards, where it is joined by the two cæca, which are slender and hardly 3 inches in length[1]. These three guts pass a little way down, and, where all three join, the rectum commences, and passes straight on to the anus.

The distribution of all these parts is exactly similar to that in the common fowl. The cæca were filled with a mucus as dark as ink, about the consistence of thick cream: there was none of it in the rectum nor in the other intestine: this must have been secreted in the cæca, but for what purpose I cannot say.

All these intestines, excepting the cæca, are larger than is commonly to be found in such a sized bird. The mesentery is more loaded with fat than is commonly to be found in birds. In the second guan bird there was no fat; the mesenteric vessels, contrary to those of the human or quadruped, pass down upon the left mesentery. The intestine is rather shorter than is commonly to be found in birds: the whole intestines were not much more than four times the length of the body; and twice the length from head to foot. The testicles are very small and black. There is but one penis, which is pretty long, of a pyramidal figure, somewhat flattened, a good deal the shape of the tongue, but more pointed; it is bent inwards towards the gut, and upon the external or convex side there are little protuberances whose apices are turned towards the base, something like those upon the tongue of a lion. The situation of this penis is just upon the inside of the verge of the anus, adhering as it were to the valvular part. This bird has nothing of the granivorous kind belonging to it, except the bill; for its œsophagus is large and has no crop; its stomach is not of the granivorous kind; its cæca are not so long as those of the granivorous: its talons are considerably longer: its flesh is solid and red: it has very black eyes, &c.

The ducts of the liver I could not examine perfectly, as I had previously cut off the liver. I found a hepatic duct and a cystic duct, but could not find a hepato-cystic duct, and the hepatic and cystic ducts

[1] [Hunt. Preps. Phys. Series, Nos. 687, 688.]

pass into the duodenum before the duodenum makes its last turn just opposite its beginning. The gall-bladder was divided into pretty nearly equal portions; or, in other words, there were two of them, having a duct passing between them about $\frac{5}{8}$ths of an inch in length; both lie upon the duodenum, as common[1].

THE TURKEY [*Meleagris Gallopavo*, Linn.].

The nigrum pigmentum is both on the outside and inside of the choroid coat: the outer pigment is intermixed with the uniting cellular membrane: the inner is a distinct coat[2].

THE GUINEA FOWL [*Numida Meleagris*, Linn.].

The guinea-fowl has a crop, the other parts of the alimentary canal are as in the swan; the ducts of the liver are as in the heron, only that they unite before they enter, and join the duct of the pancreas. [But see the more careful dissection which follows.] The colon was filled with the white urine its whole length. One of the cæca was inverted into the colon by a kind of volvulus.

On opening the body I found all the viscera covered with a white substance like chalk that had been a little wetted; the heart and pericardium were the same; so were all the joints, and, in short, every cavity in the body. I found the kidneys of a most beautiful colour, spotted with white, and the natural colour of the kidneys. This white was the urine which had filled all the cryptæ, and from them some of the tubuli; but there was very little of it in the ureters, and none of it in the rectum. This urine was of the same consistence with the white stuff in the cavities of the body, and I do imagine it was a deposit of urine in all the cavities in the body from a wrong turn given to the secretion. I conclude that this animal did not evacuate urine, from none being found in the rectum and but little in the ureters. What is the state of the urine in gouty people, or do they make less than common? Can we call this a kind of gout? The urine from this account is first deposited into the cryptæ, and then the tubes take it

[1] [Hunt. Prep. Phys. Series, No. 817. The description of this preparation states that "The gall-bladder is of a remarkably elongated and tortuous form. The hepatic duct, being greatly dilated, resembles a second gall-bladder."—Physiol. Catalogue, 4to, vol. i. p. 241.]

[2] [Phys. Series, No. 1748. Hunter has also left the following preparations of the anatomy of the turkey:—the gizzard, No. 528; the kidney, No. 1196; the coloured rete mucosum, Nos. 1880, 1881.]

from them. This I could see plainly was the case in this kidney; therefore should be ready to think it was so in all.

In a guinea-cock, after carefully dissecting the ducts of the liver, they appeared as follows:—the ductus hepaticus passes on by the right side of the gall-bladder, adhering to it, to the intestine; the ductus cysticus arises from a little pouch on that part of the bladder that adheres to the liver: this pouch communicates with the bladder by a small hole, and into this pouch enters the cyst-hepatic duct. From this structure we see that there must be regurgitation even into the cyst-hepatic, for the bile must come into this pouch, and then it can either go on to the gut, as in the human, when it has got into the ductus communis, or it may be thrown into the bladder; so that here is the same mechanism as in the human subject, or what answers the same end; and besides this mechanism, there is what is called the hepatic duct in the bird.

I could see but one pancreatic duct, and that and the two biliary ducts entered by one orifice only through the inner membrane, though by distinct ones through the outer. The length of the bile-ducts was about two inches. The cæca were very long, and rather wider than a cock's. This animal died of a seeming disease in the head, for it began to swell about the eyes.

The Argus Pheasant [*Phasianus Argus*, Linn.].

The viscera of this pheasant are similar to those in the common fowl, excepting that the duodenum is considerably longer. There is a crop; the gizzard is strong: the duodenum is long, passing down on the right and then making a sweep towards the left: the jejunum and ileum are loose intestines strung on the right and lower edge of the mesentery; and the ileum before its termination passes up behind the others, towards the posterior surface of the root of the mesentery; being in this passage attended by the two cæca one on each side, united to the ileum by a narrow mesocæcum. At this part the intestine is attached to the root of the mesentery, and to the back; and, where the two cæca open into the gut, commences the rectum, at which part there is a band; the rectum passes down the back. The liver, spleen, and pancreas are as usual.

The Golden Pheasant [*Phasianus pictus*, Linn.].

In the golden pheasant the ducts of the liver enter the duodenum at the last turn; the pancreatic duct enters at the same place. The intestines are as in the hen. The testes were black, and there are two penises, as in a cock.

The Partridge [*Perdix cinerea*, Ray].

A partridge has a crop: the viscera are just like a fowl's. The rectum is about 5 inches long; and the cæca each 4 inches. The length of the whole intestine was one length and a half of the bird. The ovaria were white. Its flesh was very red, and it has bones for tendons in the legs. The testicles are black. The redness of the cheeks is owing to the colour of the rete mucosum; for, by steeping the chin in water until the cuticle comes off, it is found like a red paint between it and the cutis.

Norway partridges feed in the winter upon the buds of trees or shrubs, and the small stalks on which these buds stand.

[Order Cursores.]

The Ostrich [*Struthio camelus*, Linn.].

The ostrich is very weak everywhere, excepting in his legs. As the anterior parts of the body are of no use, excepting what immediately concerns the economy of the animal, it is there extremely weak; but as the legs are its support, also its offensive and defensive weapons, and as its whole progressive motion is by walking or running, everything relating to them is strong.

The gait of this bird resembles that of the camel very much: the motions of the head are very like also; but that may be owing to the ength of the neck in each: their lying down is also much alike; for both lie down on their breast, so that there is a hard part on the breast of each, whose fat is like that upon the sole of the foot in men. The ostrich has another pad on the pubis (which bones are united together in the ostrich[1]), so that he rests upon two points, viz. the breast and pubis, with his two legs laterally folded parallel to the body, so as to rest upon the whole tarsus.

The feathers are not so firm as in most other birds, nor so close-set upon one another. The lateral plumes are very soft, long, and not at all close; something like those of a peacock's tail[2]. The skin on the sole of the foot is studded with horny processes, about a $\frac{1}{4}$ of an inch long, thicker than four or five bristles, parallel to one another, and very thickly set; so that the ends of them seem to make a rough sur-

[1] [See the skeleton, Hunterian Osteological Series, No. 1362.]

[2] [Hunt. Preps. Phys. Series, Nos. 1998, 1999.]

face for walking on [1]. It has a nail on the outer or little toe. A ligamentous elastic substance lies between the skin of the toe and tendon, serving as a kind of cushion [2].

Both eyelids move equally, and both have muscles. The ligamentous substance that connects the eyelid to the brim of the orbit all round is very strong and distinct; strong at its attachment to the orbit, becoming thinner, and is at last lost insensibly in the lid. There is but one tarsal cartilage, which belongs to the under eyelid, and is not near the breadth of the eyelid; it is a round piece of cartilage about the bigness of a halfpenny, situated in the middle of the lid, not coming close to the edge of the eyelid, so that the remainder of this lid and the the upper lid is membranous [3]. I could not find any Meibomian glands, nor their openings. The muscles of the eyelids are three: two to the upper, and one to the lower lid. The first of the upper is an uncommon one: it is a thin muscle situated above the outer part of the upper eyelid, under the ligamentous substance that connects it to the orbit: it arises from the brim of the orbit a little on its inside; thence passes downwards and outwards, and is lost in the upper eyelid near the external or posterior angle, and into the angle itself. The use of this must be to raise the upper eyelid and at the same time to raise the angle, which will affect the under eyelid, so that it might be called 'levator communis.' What may be called 'levator proprius' is nearly as in the human subject, but is much broader; and part of its origin is from the globe of the eye; so that its action cannot be so much as the others. The depressor is just such another as the levator; it arises from the bottom of the orbit. The glands of the eyelids are two. One [the Harderian] is placed just at the external angle of the orbit, half within the bone, half without: it is about the size of the human lacrymal gland, and much of the same shape and consistence; it has a large duct passing towards the external angle of the eyelids, where it opens by a large orifice through the tunica conjunctiva, about half-way between the angle or edge of the lid and the reflection of the tunic upon the eyeball: the juice of this gland is of a brown colour, and pretty thick. Qu. Whether or not this supplies the place of the juice secreted from the Meibomian glands?

The other gland is placed on the under side of the eye lying immediately between the depressor and the adductor muscles of the eye, between them and the inferior oblique; it is larger than the other gland, and its juice is like water. From the anterior or outer end passes a

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[1] [Hunt. Preps. Nos. 1902—1906.]
[2] [Ib. Nos. 274—276.]
[3] [Ib. Nos. 1794, 1795.]

pretty large duct, whose coats are much thinner than in the other gland, forwards and upwards, getting between the inferior oblique and the adductor, and so to the inner angle of the eye, where it perforates the tunica conjunctiva, or rather the membrana nictitans near its root. This I take to be the true lacrymal gland.

There is a glandular body [nasal gland] contiguous to the external gland, lying on the temporal muscle and ball of the eye just under the skin. It is very vascular, and when cut into it is like a fine sponge, but whether it has a duct or not, I don't know.

The stomach will be described from the preparations[1]. At the termination of the stomach there is an enlargement, which is rugous on the inside, very much like the fourth stomach of ruminating animals. The intestines differ from those of all other birds that I know. The duodenum passes out of the stomach on the right side as usual: it passes down for about a foot or more, then makes a turn upon itself as far as the stomach; but before it reaches so high as this part, it makes a little fold upon itself; when it has got as high as the stomach it is folded or bent backwards, and passes down again, but this last turn is behind the others. This part is attached to the mesentery on its right edge, and as it passes down, becomes more and more loose, and at last becomes a loose intestine. After continuing loose for some way, it passes more and more forwards towards the left, and upwards, and attaches itself to the posterior surface of the mesoduodenum, and then gets wholly behind the root of the mesentery, where it is joined by the two cæca. In all this last turn upwards, towards the left, behind the mesentery, the ileum is attended by the two cæca, one on each side, which are attached to it by a membrane, and at the upper part all these are united together, viz. duodenum, mesentery, cæca, and ileum. From thence it passes down, answering to the rectum in other birds, but of much greater length, and becoming a loose intestine again. The rectum opens obliquely into a reservoir, so as to prevent in some degree a regurgitation; and as this is somewhat similar to the valve of the colon in other animals, the part below it might alone be reckoned the colon: but I shall keep to the general principle, viz. that all the intestine below the cæca is colon and rectum. At the beginning of this part of the intestinal canal, the valvulæ conniventes commence, and are continued along it for about 6 feet. This gut is largest at the beginning, and becomes smaller and smaller; the valves decrease in size, and become fewer and fewer, till at last there are none at all[2]. There are

[1] [Hunt. Preps. Phys. Series, Nos. 533, 584—586.]

[2] [Ib. Nos. 677—684, 689—692.]

some glandular parts at the back of the anus [cloaca], as also on one side. The rectum has muscles which can pull it down. The anus has muscles which pull it up[1]. The duodenum is 4 feet in length; the first loose intestine 22 feet; the valvular and whole last part 44 feet; which make 70 feet in the whole.

The length of this bird from head to feet in a straight posture is 9 feet, so that the guts are nearly eight times the length of the animal. The length of the body is three feet and a quarter, which makes the intestine twenty-one times the length of the body [or trunk].

Where the valvulæ conniventes become very few and imperfect, the fæces seem to take on the appearance of being knotted. The situation of the cæca is not, at their beginnings, as in other birds; I could not find any adhesions of them at their beginnings to the stomach. The contents of the small guts were of a yellowish dusky colour, and of a pulpy consistence, as in other animals. What was in the beginning or vascular part of the colon was of a dark green, and pretty thick; when I was cleaning this part, the valves seemed to retain these contents. What was in the remaining part of the colon was lighter in colour, and was divided into small portions through its whole length. This animal does not digest the whole of its food, for there was a good deal of whole corn in the fæces, as in those of a horse.

In the stomach there were a great many halfpence; some very much worn down; as also buttons, stones and nails; all partly ground down. The contents of the thick or last part of the stomach was very green, owing to the regurgitation of the bile.

The lungs[2] lie along the sides of the spine, but do not come forwards towards the anterior ends of the ribs, by half the length of the ribs, so that the fore part of the chest, or that part enclosed by the ribs, is filled up in the middle by the heart above and the liver below, and laterally by cells which communicate with the lungs.

The liver has two equal lobes, as in most other birds. There are two hepatic ducts; one, the largest, enters the duodenum close to the stomach, in a retrograde direction so as to favour the passage of the bile into the stomach: the other enters beyond the last turn, with the duct of the pancreas[3]. There is no gall-bladder. The pancreas is small for the size of the bird: it is situated as usual in this class: the end next to the stomach has a duct which passes on the outside.

It may be said to have three mesenteries, viz. that for the duo-

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[1] [Hunt. Preps. Phys. Series, No. 750.] [2] [Ib. No. 1127.]
[3] [Ib. No 818.]

denum, that for the first loose part, and that for the last loose part of the intestines. The lacteals pass along with the vessels of the three mesenteries towards the back: those of the last or lower mesentery communicate above with the others: at the root of the mesentery and near to the termination of the abdomen they pass to the back between the two kidneys, and join [the thoracic duct] at the side of the aorta.

The oviduct was very large, and so were the ova. They were attached to the great vessels of the back by a ligament nearly half a foot long, and 2 inches broad, through which the vessels passed to the ova. The eggs were attached to the edges of this ligament, which attachment was by long strings, so that they were twisted one with another [1].

The air-cells communicate with the joint of the thigh and knee, by the ham along the great vessels beside the ramifications of the vessels in the thigh; there the air-cells pass along with them. There are two duræ matres to the medulla spinalis; one is pretty loose, the other lies close to the medulla; underneath which is the pia mater. The medulla is almost two [chords] lying close to one another, but united at one edge [2].

The ischiadic nerve in the thigh is still pulpy; for at the cut ends, when steeped in water, it was found to be squeezed out by the swelling of the nerve within its coat. This coat is strong, and makes one sheath for it, so that it can be dissected off.

The jugular vein of the ostrich has in some places three valves; in other places only two: and there is but one principal [vein], which is on the right side.

The vessels of the thigh-bone pass in at the passage for the air.

The joint of the ankle of the ostrich does not move upon the centre; the middle part of the joint from side to side being the most projecting, so that it is easiest when either in flexion or extension.

[Order Grallatores.]

The Bustard [*Otis tarda*, Linn.].

The cock-bustard has a very thick neck and long hairy feathers under his throat. On the fore part of his neck, reaching lower down than the middle, is a large bag as large as the thick part of one's arm: it terminates in a blind pouch below, but has an opening into it at the upper end from the mouth. This aperture will admit three or four fingers; it is under the tongue, and the frænum linguæ seems to enter

[1] [Hunt. Prep. Phys. Series, No. 2734.]

[2] [Ib. Nos. 1352—1357.]

it; and it seems to have a sphincter. What the use of this is I don't know. In a young cock-bustard about a year and a half old this pouch did not exist; therefore it becomes a question whether or not this is a mark of age. The œsophagus is very large, for he swallows every thing whole, and of considerable size, as, *e. g.*, a mouse. It is easily observed going down, making a moving tumour on the fore part, till it comes to the bend of the neck; then it moves backwards, and although not now to be seen, yet its effects upon the feathers is such, that it makes them separate between the shoulders, and, as it passes on, the feathers close again; and where the œsophagus enters the stomach, it is a little contracted.

The stomach is not perfectly a gizzard; but being of the gizzard kind at one part, just below the entrance of the œsophagus, the duodenum arises from the right and upper part of the stomach. The duodenum makes the usual turn. The pancreas has three ducts: one at one end, the other two at the common end; one of these two is pretty large, the other small, and enters the duodenum four inches before it makes its third turn, pretty near one another. There are two ducts to the liver: the hepatic is the larger, and enters the duodenum about a ¼ of an inch from the pancreatic, nearer the second turn, and the cystic about as far on the other turn; this was seen by passing in bristles, and opening the gut. After the third angle of the duodenum the intestine makes a similar turn to it; then makes another about twice as long, or rather more than a foot, and is rather larger than the others. This last turn adheres to the duodenum, and it is to this last turn that the cæca adhere. The rectum goes on to the anus, is pretty large and loose, and is about a foot in length; whence it dilates into the anus, but this dilatation or opening of the rectum into the anus is on its lower surface; not at the upper and anterior part as in other fowls.

The guts are something like those of the ostrich in this, that the rectum is much longer than in other birds; and there is a cavity above the anus about three inches in length. The rectum, before it dilates, is villous, but the swell is smooth.

The testicles are larger and looser than those of a cock; they lie on the capsulæ renales, which are oblong bodies on the upper ends of the kidneys. The vasa deferentia enter the cloaca by two nipples, as in a cock, but are more rounded[1]. The kidneys are much less than in other birds of the same size; not coming so far back as common, and the ureters enter between the two penises. There are bones in the legs

[1] [Hunt. Prep. Phys. Series, No. 2454.]

instead of tendons; as also in the muscles of the leg, or those muscles on the tibia.

This description is from another Bustard, a female.

It has no crop; the stomach is pretty long with the œsophagus entering at the upper end, and the gut coming out from its most convex side, near the upper end on the right side. It is not much thicker in its muscular coats than [is] the human [stomach], but the horny coat is pretty strong; about as thick as the muscular one. There were pretty large stones in it. The intestines are as in a hen, only that the cæca are larger and wider in proportion, and the rectum is enlarged. Its anus [cloaca] is about as big as one's fist.

The ducts of the liver are as usual, only that they all enter the gut upon one nipple, but by distinct orifices as far as I can judge. The pancreatic ducts terminate upon the same nipple and by distinct orifices likewise. Besides the second duct of the pancreas, as usual in birds, there is a small one that enters the gut at the other end of the pancreas.

The ovarium is as in a hen, and also the oviduct; the ureters are the same; but, on the right side of the rectum, just opposite to the opening of the vagina, there is an opening just like that of the vagina; it leads up, like the vagina, and ends in a blunt point like the cæcum: it is largest at the blind end, and is about 4 or 5 inches long [right oviduct].

Above the rectum there is a cavity that will admit one finger.

Some observations on the living Bustard.

He appears rather a tender bird, for he dislikes the cold much, and falls off his appetite if left out all night in the cold evenings of May or September. He likes a dry soil, for he will hardly go upon grass, if there is gravel. He lies squat all night, and if possible on something soft. When very tame he flies at strangers, raises his tail somewhat similar to a hen's, or fan-tailed pigeon, and raises a little his wings; and I suppose he lays hold with his bill, and strikes with his wings. His bill is pretty hard, somewhat like a raven's, but is not so hard. He kills animals with it, such as mice and young birds. He eats meat, is fond of boiled liver, swallows mice whole after having pinched their heads with his bill, as also young sparrows: he is fond of cucumbers, but eats only the inside; he eats plums, and the buds of flowers, as roses; he is also fond of worms, and will look sharp when a person is digging. In things that cannot be called food, they, like the ostrich, are not nice, but will pick up nails, bits of cloth, &c.

The excrement is thin, and is thrown from him.

I suspect that the bustard is a bird of passage, and only comes into this country in the summer to breed; and my reason for supposing so is, that in the early and late summer months he cannot bear being out all night; as also he seems not to be able to bear the cold of a common greenhouse in the winter. My cock bustard died in November, although put into the greenhouse every night; but this house had no fire. On opening him there appeared no part to be diseased: he was lean.

The Numidian Crane [*Grus Virgo*, Cuv.].

This bird is larger in the body than our common heron, being considerably thicker. Its flesh is red and excessively fat; and, contrary to most other birds, the fat is in the interstices of the muscles, as in most animals, and is more solid than in other birds. It has the same smell with the generality of birds that feed upon fish. Its legs are very long, like those of the common heron, and the thighs are bare of feathers for about three inches. Its toes are not nearly so long as in the common heron; the nails of the toes are short and thick. The back claw is very short, scarcely having any nail upon it; from which I should suppose that it is not a bird that perched like the heron. The colour of the legs is black, and instead of tendons they have bones, and those divide into smaller ones in the body of a muscle: these bony tendons are also in many other parts of the body.

The bill of the animal is not so long as that of a bittern, nor is it so sharp, yet the whole animal, when alive, appears to be of the heron kind. It has no crop, nor does the œsophagus appear to be vastly large. The gizzard is like that of the common fowls, but hardly so red, strong, or firm. The duodenum makes the usual turn; then the other intestines make four turns upon themselves, something like the duodenum; the last of which makes another short turn upon itself; afterwards they are attached to the root of the mesentery and gizzard as common; and then pass down and terminate in the rectum, which goes straight to the anus. The cæca are about 5 inches long; the rectum becomes considerably larger about the anus. The female parts of generation are as usual in fowls. There is a gall-bladder[1]; the bile-ducts pass into the duodenum near to the termination or last turn, pretty near to one another. The pancreas I could not make anything of. All the mesentery was so thick with fat that it was almost impossible to see the intestines themselves. The trachea as it passes down the neck

[1] [In two of the Numidian demoiselles dissected by Duverney (Perrault's 'Mémoires pour servir à l'Histoire Naturelle des Animaux,' 4to, 1699), the gall-bladder was not found.]

is a little flattened, and when got near the thorax, leaves the neck and passes on to the union of the two legs of the bone called 'merry-thought,' under which it creeps; likewise gets under the most prominent part of the sternum, and follows the sweep of the end of that bone; making a very quick turn, and is bent again round another prominent part of the end of that bone, and then enters the thorax: here it makes two complete turns like the Roman letter S.

There is a cavity [air-cell] between the eye and the anterior part of the orbit that communicates with the nose. This crane has a bursa nigra [marsupium or pecten] as in other birds [1].

The Crane [*Grus cinerea*, Bechstein].

The crane is blue, something like the common heron or demoiselle. It has a strong gizzard, in which were stones, buttons, halfpence, &c.; the inner cuticle is firm. The duodenum makes its usual fold close upon itself, then becomes a loose intestine, strung on the mesentery, but not regularly so, for they make five loose folds in their way to the rectum. The two cæca are attached to the last fold; they are about 4 inches long, and round at their blind ends; then commences the rectum. The liver is as usual: the hepatic and cystic ducts enter the duodenum near together, and at the last turn of that gut, where it may be said to terminate in the jejunum. The pancreas consists of a pair of glands, one on each side of the mesoduodenum: the duct of the anterior gland arises from the upper end of it and enters the gut with the cystic duct of the liver: the duct of the posterior one passes out from its middle, and enters the last fold of the duodenum about two inches before its termination.

The trachea is long, pretty small, and makes a turn in the keel of the sternum for about two inches [2].

Of the Cyrus [or Serass] Crane [*Grus Antigone*, Cuv.].

This crane has a pretty strong gizzard: I should imagine nearly as strong as that of a goose, turkey, &c.; it had stones in it, like the above birds, and the contents were strongly tinged with bile, yet there was nothing like bile in the duodenum. The gut makes the usual fold, in which lies the pancreas: the other small intestines first make three

[1] [This statement may have been made because of the observation in Perrault's 'Mémoires pour servir à l'Histoire Naturelle des Animaux,' 4to, p. 334, that they could not find the black sacciform membrane proceeding from the optic nerve, in the Numidian demoiselle, as in other birds.]

[2] [Osteol. Series, Nos. 1341 (skull), 1342 (sternum).]

irregular folds which are attached to one another; then they make two other folds separate from the other three, gradually passing from the right to the left while forming these folds: in the last of these folds are the two cæca, which are long. The last part of these folds passes upwards behind the stomach, and terminates in the rectum, which is bent down, and passes on to the anus. There is one oviduct, as usual in birds[1]: no crop, but a pretty large œsophagus. The trachea is flattened, having a rather oval section, so as to make as little prominence on the neck as possible: it makes some very curious turns within the substance of the sternum[2].

The Crown-Bird [*Grus pavonina*, Cuv.].

It has a pretty strong gizzard. The duodenum makes the usual fold, in which lies the pancreas; the intestine then makes three folds upon itself, which lie in the right side; it then makes two other folds, which are not so closely connected with one another; these are more in the left; from thence it continues to the rectum. The two cæca are about an inch long, and are attached to these last folds, beginning at the rectum, and are about an inch from the anus.

Of the Herons [*Ardeidæ*].

I do not yet know whether the heron is one species of a tribe or a genus: the heron and the bittern come near to be two species of one genus; but the serrated toe-nail may remove them so far as only to be two species of one tribe, and whether they are two species of one or of two genera, yet they form part of a tribe: but I am at present not sufficiently acquainted with their connexions to make out the tribe to which they belong[3]. Their legs are long, as also their toes, and nearly one half of what is called the thigh is not covered with feathers; and they can bring their legs in a straight line when standing. The herons, like the bitterns, have five places, or fine tufts of feathers, upon the skin, viz. one on each side of the thigh and pelvis; one in each groin, where the thigh and abdomen unite; and one on the breast.

The Heron [*Ardea cinerea*, Linn.].

The œsophagus is very large, passes straight down, does not take the

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[1] [Hunt. Prep. No. 2726.] [2] [Osteol. Series, Nos. 1322, 1334.]

[3] [Cuvier divided them into two genera, 'les hérons vrais' (*Ardea*) and 'les Butors' (*Botaurus*): and from these also he separated the night-herons, 'les bihoreaux' (*Nycticorax*). Hunter's 'Tribe' would seem to signify the modern 'Family' *Ardeidæ*.]

turns of the cervical vertebræ, is on their fore-part above, then on the right side; then behind at the first bend, and again gets on the fore-part at the lower part of the neck; it becomes thicker and thicker downwards, passes into the thorax without any crop, and about two inches below the diaphragm dilates into the stomach, which is a kind of dilatation of the œsophagus. The stomach passes down in the same direction with the œsophagus for three inches; then makes a sharp turn up and terminates in the pylorus: it is somewhat of the shape of the human, only that the œsophagus does not pass in at one side so as to form a projecting end; its coats are similar to those of the human, but rather stronger: it is covered with fat, and adheres to the neighbouring parts as in other birds. The glandular part of the œsophagus [proventriculus] occupies the upper part of the stomach. The duodenum doubles on itself for four or five inches, and between it lies the pancreas.

All the folds of the intestines are parallel to one another. There is only one cæcum as in the bittern, and that is but short. The intestines are twice the length of the whole animal, and eight times the length of the trunk. The colon is more than half the length of the animal, and becomes large at the rectum. There is a cavity just above the anus about an inch in length; it contained whitish mucus, and seems to be glandular on the inside, and of a black colour. The liver is divided into two lobes, the right rather the larger. The ducts pass distinctly and enter by two orifices, so that there is no probability of regurgitation: there are, however, two or three cyst-hepatic ducts, but they communicate with the ductus hepaticus in the liver. The pancreas is but small; it has two ducts, which enter the duodenum before it makes the last turn, one with the hepatic duct, the other with the cystic: they pass out of the pancreas near the small end, and, as the duodenum is not so near the gland as in other birds, the ducts are seen for an inch in length passing upon the mesentery between the two duodenal folds.

The kidneys are shorter than common, as the lungs come lower, and the bones of the pelvis are shorter and less deep than usual; so that the kidneys are both short and more superficial. The ureters open [into the cloaca] by a nipple, larger than those of the vasa deferentia, and nearer the upper part of the anus, but not more externally. The capsulæ renales are yellow throughout; and, on cutting through them with a knife, it was covered with the yellow substance, just as in a putrid spleen. The testicles are about the size and very much of the shape of the common magpie's; they lie upon the capsulæ renales. They are black in colour, only the lower end of the left was white. The vasa deferentia are very small, and open on the sides of the anus, each by a little nipple.

The heart is very large. A diaphragm[1]. The vena cava between the liver and heart is longer than in any other bird; it is about an inch long. The trachea follows the œsophagus; it is made up of circular cartilages with notches in them laterally. The lungs go rather lower down than in other birds, as far as to the last rib.

Its flesh was very red. There was flexion forwards between the head and first vertebra; between the first and second, second and third, third and fourth, fourth and fifth; and between the fifth and sixth, which was the greatest of any. All these five joints come only to a straight line in extension; the flexion backwards began at the sixth joint, which was the greatest, and continued on to the thirteenth joint; at the fourteenth vertebra began the flexion forwards. The greatest extension of all these thirteen vertebræ brought them to a straight line.

In the place of the crop there was a cavity filled with air, and between the œsophagus and vertebræ of the neck, just between the two clavicles, there was another [air-]cavity.

Of the Genus of Birds called Bittern [*Botaurus*, Brisson].

The birds of this genus have several peculiarities, so much so as from external appearance alone we should be induced to suppose them to be only varieties of the same species. They may be ranked among the waders and strikers, for which purposes they have long legs, as also a long straight sharp-pointed bill, like a dagger. They have cuticular glandular parts on the body, which have a short soft particular feather covering them: they contain, or rather secrete, a mucus. There are five parts of the bird on which they are placed, viz. on the upper and outer part of each thigh, on the upper and inner side of the thigh; and the fifth is on the anterior part of the breast or on the clavicles, which part is sometimes divided into two. The toes are long, and have considerable motion in them. The inner edge of the nail of the middle toe becomes thin and hollow on the under surface, and its edge is serrated with the teeth pointing a little forwards. The use of this is not easily ascertained; if it was in the contrary direction, it might be supposed to be for the purpose of holding their prey. Bitterns are extremely thin in the body: they have long loose feathers, and can in some degree raise those on the back of the head and upper part of the neck. The neck is long, but in the common posture it appears short, for they curve it very much, which curves are covered by the long feathers. The tail is short, and when they fly they throw their legs

[1] [In a heron dissected by me I observed only the usual rudiments of a diaphragm, less developed than in the apteryx. See art. Aves, Cyclopædia of Anatomy, vol. i. p. 293.]

back in a line with the body, which serves for a rudder. They perch on trees. They are of different colours; whether these are only varieties in colour I do not know. They have but one cæcum.

THE BRITISH BITTERN [*Botaurus stellaris*, Cuv.].

This bittern is of a mottled brown, some parts of the feathers being of a lighter and others of a darker colour, which become more and more distinct towards the back, where also the darker tints become more predominant: the feathers of the belly are of a pretty regular light brown. The feathers in general are long, few, and loose.

A male had but one testicle, and that adhering to the fore-part of the vena cava where the ovaria adhere in the female. The female parts of generation are as usual. The legs are of a yellow-green, and the skin is continued about an inch above the knee, without any feathers, and of the same colour. The skin of the legs, toes, and soles of the feet is much softer than in the common fowl. The claw of the middle toe is serrated on the inner edge, and those serræ are pretty nearly at right angles with, but a little pointed towards, the end of the claw, very much like the teeth of a sickle. The flesh is pretty red and tender, and has a good deal the smell of a roasted fowl. This bird grows extremely fat, so much so, indeed, as to have fat between the muscles; but it is principally subcutaneous, and on the abdominal region; the fat is very oily.

There are four particular parts on the skin of this bird, one on the outside of each thigh at the upper part, the other two on the breast; these are called 'gall-bags;' they are of an oval figure, and seem to be no more than a particular kind of feathers, which are about half an inch long, and are little quills ending like hair-pencils; so that they are pretty soft and of a yellow colour at the roots or quills; the other part is white. When the skin is taken off at this part it seems to be here much thicker, glandular, and fat, but it is not bitter to the taste[1].

The eye is like that of a heron, with a bright yellow iris. The œsophagus is very large, but there is no crop. The stomach is rather stronger than that of a heron, and somewhat redder; in it I found the wings of beetles. The turns of the duodenum are as usual. The other intestines are folded upon themselves for three or four times, and then become loose. There is but one cæcum, which is pretty thick. Just before the small gut passes into the rectum it makes a turn upon itself like the duodenum, which turn is pretty closely connected to the posterior part of the stomach. The convolutions of the intestines are

[1] [Hunt. Preps. Phys. Series, Nos. 2007, 2008.]

attached to one another by the air-membranes. The length of the whole intestines is not twice the whole length of the bird from head to foot, but is more than seven times the length from shoulder to tail: the length of the rectum is about 5 inches. There is a cavity above the anus whose opening is very large, and the anus also becomes very large.

The pancreas was so tender that I could not dissect the duct. The gall-bladder is very small and long. The kidneys were short and pretty thick at the upper end. The lungs are small, and situated very much towards the back.

The East-Indian Bittern [*Nycticorax purpureus*, Cuv.].

It is very much the size of the British bittern, and very similar in manner; but its colour, on the whole, is that of our heron, viz. a grey-blue. It has, however, three different shades of feathers; on the upper and back part of the head, the feathers are long and appear almost black, but it is a very dark shining green; these it raises when attacked. On and between the shoulders the feathers are of the same colour, and some large ones pass towards the tail, which makes the whole back dark; and when he throws his head back to his shoulders, the head and back make one continued colour. On the back part of the neck the feathers are of a light blue-grey. The outsides of the wing, upper part of the neck and tail, are of the blue-grey; as is also the under side of the wing, but of a shade lighter. From the throat down the underside of the neck, breast, belly, and tail, the feathers are white, more especially the last[1]. The feathers are long, therefore not thick-set. There is a long small white feather that comes out of the back part of the head, which is very beautiful when the bird raises it: I found this in both male and female. There are six clumps of feathers of a particular kind in this bird, which makes me class it with the bittern: two are on the fore-part of the breast, two on the upper part of the thigh extending on the pelvis, and one on each side of the belly close to the joining of the thigh; these are long narrow clumps: the feathers of which these clumps are formed are of a particular kind.

The legs are long, small, and with long toes; they are of a yellowish-green colour. This bird perches on trees, and it not only flies from branch to branch, but it climbs from branch to branch by its toes like a parrot; only it does not make use of its bill. From this circumstance it is hardly possible to keep them in a garden, although pinioned;

[1] [The above colours vary with age.]

for they will climb up wall-trees to the top of the wall: I had one that climbed to the top of a hop-pole. The eye is large, with a broad orange-coloured iris.

The tongue is long and peaked. The œsophagus is large. The stomach is an enlarged continuation of the œsophagus, somewhat of the shape of a pear: the smallest end is where the œsophagus enters: it is attached all round by loose cellular membrane, so that it cannot be said to have any peritoneal coat. It is membranous, yet has a centre of union of its muscular fibres which is tendinous, so as to give it a regular motion. The gastric glands occupy the upper half[1]: as it has no grinding function, its inner surface is villous. On the left side the duodenum begins, about an inch above the bottom; but between the beginning of the duodenum and stomach there is a bag; or we may say that the duodenum begins in form of a small bag[2]. It passes down on the right, as it were, enclosing the other intestines, and bends round their lower part towards the left, then is folded back upon itself, going up the right side towards the basis of the liver, and makes a slight serpentine course, or two or three convolutions; it then goes down again. Into this upper bend enter the ducts of the liver, gall-bladder, and pancreas; the pancreatic duct crossing the hepatic duct, and entering by the side of the cystic. The intestine now makes a turn down, about half-way of the duodenal fold; then up again upon itself, somewhat higher than the former; then down again and turning up between the two last, as high as the hollow curve of the last, making a fold between them; when got down again it makes two or three loose short turns, where there is a little point like a cæcum: it then goes up again, then down and up again, within itself; then down upon the last; then winding round behind the lower part of the last to the left of the whole; then up upon the left, and immediately bends down upon itself, and becomes a loose intestine for a convolution or two. Just behind the lower ends of these turns of the former folds; the gut passes up behind the whole, towards the left, making a kind of sweep down, and terminates in the rectum. There is one cæcum. The rectum passes down straight, and forms a large cavity, which may be called vesica recti.

The Portuguese Bittern, which I shot when crossing the Tagus [*Nycticorax europæus*, Latham; *Ardea caboga*, Pennant].

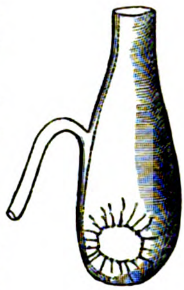
It is white, has long wings and a short tail, a long small neck, small head, yellow iris, long small black bill; long legs of a dark colour, mixed with a slight green: the lower part of the thigh is naked for

[1] [Hunt. Prep. Phys. Series, No. 521.] [2] [Ib. No. 520.]

2 inches. The toes are long, and of a green colour; and the claw of the middle toe is serrated. The skin in general is of a dark colour. There are six glandular parts on the skin; two of which are behind the upper part of each thigh-bone, between it and the rump; two on the inside of each thigh, just where the skin of the belly joins the thigh; two, one on each side of the breast lying along the merry-thought bone. These six glandular parts are not of the same colour; their ducts open upon the skin, and contained a thick matter.

Upon the skin of the abdomen and thigh, there were small knobs filled with a reddish-yellow fluid; but as these were not regular on each side, I imagined them to proceed from disease.

The liver is as common, only the vena cava is long between the liver and diaphragm. The gall-bladder is oblong, lying upon its ducts and duodenum. The ducts enter a little below the last turn of the duodenum along with the pancreatic duct.



The stomach is an oblong body, somewhat like the figure annexed; with a small middle tendon[1]. The duodenum makes the usual turns. The small intestines become loose, making only deep scollops which appear like folds. There is but one cæcum, and the rectum is as usual. There is a bag [bursa Fabricii] above the anus, opening into it [the cloaca]. I found beetles in the stomach, but no fish.

The Spoon-bill [*Platalea leucorodia*, Linn.].

This bird is about the size of a heron, and is all white excepting the bill and legs, which are of a dirty or dark grey. The œsophagus terminates in a round bag, somewhat flattened, like a Cheshire cheese. The duodenum is as usual; the jejunum makes a fold similar to that of the duodenum; then becomes a loose intestine; and, before it passes down the back, it makes another fold similar to the first. The trachea, after it has passed into the thorax, makes a turn up, then goes down again.

The Flamingo [*Phœnicopterus ruber*, Linn.].

This bird was shot in the East Indies, and sent home in spirits.

The tongue is of a peculiar shape, answering to the shape of the cavity of the beak[2]. It is oily, and the oil is of an orange colour, and smells like train-oil: this probably is owing to the bird's eating fish.

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[1] [Hunt. Prep. Phys. Series, No. 522.] [2] [Ib. Nos. 1470, 1471.]

The œsophagus is pretty large[1]: the gizzard is strong with a pretty hard cuticular lining, but not very thick; it contained small stones dwindling to coarse sand, and the shells of shell-fish, some plainly of the bivalve kind, broken into pieces: there was also found a fibrous part, like the woody part of vegetables, but very small and short, as if broken in pieces: whether it was sea-weed, a species of coral, or a land vegetable, I could not make out.

The duodenum passes out as usual, and makes a turn towards the left for 4 inches and is then bent back upon itself, and, at the termination of the fold, or beginning of the jejunum, it receives the hepatic and cystic ducts. From this part the gut sets out, making oblique circular turns, pretty close upon one another, ten in number, each turn rather becoming smaller in circumference; and at last the intestine is turned in within these turns, making similar turns within them, following them back again, which of course is in a contrary direction. When it has got to the upper part again, it emerges and forms the rectum.

The two cæca are each about 4 inches long, blunt at their blind end; they are involved in the fold of the duodenum. The small intestines are pretty long: the rectum passes down to the increased part at the anus: it may be said to equal the whole length of the cavity of the abdomen. The liver has two lobes: the gall-bladder is large: the ducts as in other birds. The trachea is small, its area oval; and each ring is bone.

This bird, from the length of its legs, is a wader, and the length of its neck corresponds with its legs: but the curious thing is its mode of feeding. When a duck or goose feeds, or takes anything small, as grain, off a surface, they lower their head and lay the lower bill almost flat on the surface or ground; so that, by the quick motion of the lower bill alternately forwards, and the motion of the tongue, the food is, as it were, shovelled into the mouth. But the flamingo converts his upper bill into the lower in such actions: he bends his head backwards, as it were, under him, instead of before him; and probably much in the same manner he uses the upper jaw, as the duck, &c. use their lower one; by which means he picks up shells, sand, &c. He has also teeth similar to those in the bill of a goose, &c., by which he eats his grass or vegetables of various kinds, as also sea-weed, &c.; but such he probably picks up in the common way.

[1] [In the flamingo dissected at the London Zoological Gardens, I found a small crop: see Phys. Series, Prep. No. 524 E. Phys. Catalogue, vol. i. p. 151.]

The Scarlet Ibis [*Ibis rubra*, Cuv.].

This bird is about the size of our curlew, and in most respects might be called, or supposed to be, a curlew of a very fine scarlet-red. It is a wading bird, having pretty long legs, and naked above what is called 'the knee.' Its toes are pretty long, as is also the back toe. The bill is long and slightly bent, very much like our curlew, but thicker at the root. Its feathers are red, excepting at the tips of the flight-feathers of the wings: the tail is short. This bird had been kept tame; and when I got it first, its feathers were of a pale red; but when it cast its feathers, the new set came out a fine red; first appearing mottled with a pale red and a deep red, which became redder and redder till the whole was red. This circumstance shows that the first mode of life was an artificial one or a life of civilization, and that the animal was probably not so hardy; but when allowed to go at large in a large garden, it became of its natural red[1].

Although very like the curlew, yet it was of a very different species, even genus[2]. It came into the house at night, and roosted with the fowls; but this might be supposed to have arisen from domestication, yet could not entirely; for although previously kept in a cage, as also in a pen, which might give the inclination to going into a cover or house, it would not give the inclination to roost.

Its mode of feeding was very much that of the curlews, viz. running the bill into holes, such as worm-holes, and picking out the worms, &c. I had reason to think it fed upon corn. The tongue was short, even for a bird. It had no crop: the stomach is a gizzard in shape, somewhat stronger than the pewit's (*Vanellus*). The duodenum makes the usual fold: the jejunum takes a sweep to the right, then down the right, and in towards the left; then up, almost making a circle, and becomes a loose intestine, which is placed in this sweep. It then makes another fold on itself, the termination of which passes down to form the rectum. The two cæca are only two points; therefore, in this respect, this ibis is not like our curlew.

The Long Bent-billed Curlew [*Ibis falcinellus*, Temm.].

It has no crop: the œsophagus is very large. The stomach is stronger than that of the pewit, but not nearly so strong or so red as a hen's: however, it has a pretty strong tendon on each side. The duodenum

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1 [The difference more probably related to the age of the bird than the circumstances under which it lived.]

2 [Cuvier has since separated the curlews proper (*Numenius*) from the ibises.]

is as usual: the other intestines just make three turns or folds like the duodenum, then become more loose; but still there is an inclination for a fold, as the edge of the mesentery is irregular or scolloped; they then pass to the rectum. The cæca are about 4 inches long, and very small, attached to the ileum their whole length, which ileum is attached to the posterior part of the stomach. There is, in the middle of the intestines, a cæcum which is about an inch long, which I take to be the remains of the duct of the yolk. The rectum becomes larger at the anus.

The liver is as usual, only the right lobe is much the longer. The ducts are as in the curlew. The length of the whole intestine is five times the length of the body of the animal.

Fish scales and bones were found in the stomach. The testicles were very small and yellow. The legs are of a bluish colour, and are naked for near 2 inches above the knee: the skin of the legs is not hard. The flesh is red. There is a sort of downy feathers under the other, but not nearly so thick as in the goose, &c.

The Curlew [*Numenius arquata*, Latham].

A curlew has no crop, but has the muscles arising from the breast as in a hen, which in them pass over the crop; so that this muscle must be owing to [subservient to the motions of] the skin of the neck. The stomach or gizzard is not so strong as a hen's, but is rather stronger than a pewit's (*Vanellus*). It was filled with the skins of beetles and the juice extracted from their bodies. There were no stones in it, so that the hard shells of the beetles seemed to supply their place.

The intestines are not very long; the cæca are about 3 inches in length, and much smaller and thinner than the rectum or ileum. There was a small canal above the rectum, about as big as to admit a probe, and an inch in length.

The liver is as usual; only the ducts entered the duodenum about half-way between the two bends, separately, so that they were longer than common. The two gall-ducts enter the gall-bladder on one side, and there is a kind of groove going between them. The pancreatic duct entered with the hepatic.

The Pewit, or a bird that resembled the Pewit in all respects except the colour [*Vanellus*, Briss.].

It is very much like the curlew (*Numenius*) also, but its belly is higher, and is almost black in the fore-part of the neck and breast.

having a little white on some of the feathers there. The legs, feet, head, bill, shape of the body, and manner are just like those of a pewit. There is no crop. The stomach is like that of a pewit. The duodenum is as usual. The first part of the intestines is coiled up within themselves, in an oblong mass, something like that in the water-hen, but not so regularly. The cæca are about 2 inches in length. There is the swell at the anus [cloaca], and a small canal above the anus about half an inch long. This was a cock, and I imagine I have the hen.

Ruffs and Reeves [*Machetes pugnax*, Cuv.].

These seem to be a good deal of the pewit-kind. The bill is something of that kind, and the legs and feet nearly the same. The feathers of the ruff are inserted close to the head. The tongue is like that of all birds that have long small bills. There is no crop: the stomach is about the thickness of the pewit's, not very red, nor quite pale. The duodenum is as usual: the other intestines make three singular folds, the last of which is the longest by much; and is again a little folded upon itself, having the two cæca upon the last part of the fold, viz. the third. As this part goes to the root of the mesentery, it must there bend down to the rectum; so that the rectum is no more than a continuation of this part, which is about an inch and a half long, along the sides of which pass the cæca. These are each about 3 inches long, pretty small, and where the ileum is bent to become rectum, there they are bent likewise. The rectum is as usual, becoming large at the anus. There is scarcely any cavity about the anus. There are two penises. The testicles are the size of ——, and of a yellow colour. The ducts of the liver enter the duodenum about an inch from the stomach. The length of the guts is not much more than that of the animal from head to feet, or about four times the length of the trunk.

The Whistling Plover, or Sea-Pie [*Hæmatopus ostralegus*, Linn.].

This is a good deal of the shape of the pewit, but is larger. Its legs are red, and part of the thigh is not covered with feathers: like an ostrich or bustard, it has no back-claw. Its bill is about 3 inches long, strong, and but little bent; it is a little flattened upon the sides, and is red like the legs: the iris is likewise red. There is no crop: the stomach is between a stomach and a gizzard, much about the strength of a pewit's; it seems to be a continuation of the œsophagus, become considerably thicker, and is I think rather thicker than the gull's. The duodenum is just as in the water-hen, or water-rail.

The other intestines are nearly the same as in that bird, only there are more turns. The cæca are the same; so is the anus. I found no cæcum [bursa Fabricii] to the anus.

The liver is as usual: the two ducts enter close by one another, but do not communicate at the last turn of the duodenum. The pancreatic ducts are two in number, entering close by the others, one on each side, as it were, enclosing them.

The testes are round bodies, of a yellow colour, lying upon the capsulæ renales, which are of a red colour.

This bird seems to be much of the water-rail, but its stomach is not strong.

The Water-Rail [*Gallinula chloropus*, Latham].

This bird is about the size of a pewit, but is not so round in the body, being very thin or narrow: its legs are, however, stronger and flatter. It seems to be of the rail-kind; the bill is of that form; so are the legs, being broad and thin, with very long toes for a bird of that kind, tipped with pretty strong nails, and the skin of the toe near the sole on each side forms a border, which is harder than any other part of the skin of the toe.

They eat fish, like all wading water-fowl; but eat corn in common. There is no crop. The stomach is nearly of the strength of that of a common fowl; and had stones and grass in it. The fold of the duodenum is pretty long, passing to the lower part of the abdomen: it passes to the left, and then up a little upon the left. The other intestines are a good deal like those of a swan; and I think entirely so. They are almost wholly bent upon one another, so that they run parallel to each other. At the last turn of the duodenum, the gut passes down, and then is bent up, alongside of the duodenum; after which it passes down upon the inside of this turn, and is bent upon itself; then passes down upon this bend, and when got to the lower part, turns round with it in a contrary direction, joining the duodenum and passing down with it towards its second bend, but not so far; the gut then becomes irregular, or a little loose, behind these turns at their lower end. It then passes up again to the upper part of these turns and is suddenly bent back, and about $\frac{3}{8}$ths of an inch from this, it forms the rectum, which passes in a straight line to the anus. The cæca are not long, passing parallel to the very last turns of the ileum as low as the loose part of the intestine; and indeed their tips are a little serpentine according to these irregular turns. The rectum becomes larger at the anus; and there is a cæcum to the anus, about an inch long, and small.

This was a cock, the testes lying upon the capsulæ renales being small and of a white-yellow colour. I could not find anything like a penis.

This bird is a good deal of the swan internally. The feathers are very soft and downy, besides which there is a very soft down, like that of a swan, under the feathers.

One that I opened, which had a red head, not yellow as some are, was a hen, and had large yolks ready for laying; so that one would imagine that they might breed in a garden.

The White Fulica [*Porphyrio albus*, Cuv.[1]].

It has no crop, but a gizzard, which is not strong, although a complete gizzard: its horny lining is not thick, but is firm or hard: there were stones in the gizzard.

The duodenum passes down as usual, and then up, somewhat higher than its beginning, making a sweep backwards to the loins and commencing jejunum. This passes down on the right side, then up, making a fold upon itself; then a second fold, as also a third, which last is attached to the first fold: all these are parallel to each other. The intestine then passes down more in the middle of the abdomen, further than the former three folds, along with the duodenum; and is then folded, or bends up, behind all the other folds, the gizzard, &c., towards the root of the mesentery. In this last course it lies between the two cæca, whose blind ends begin at this last turning up. At this part the rectum commences and the two cæca enter. The rectum is bent down, passing along the back to the anus. The whole intestines are not long. It has a gall-bladder.

[Order Natatores.]

The Swan [*Cygnus olor*, Briss.].

The size of the thorax and abdomen of this bird is, perhaps, four times larger than their contents; there is therefore great room for air. The coat of feathers of a swan is near 2 inches thick; viz. from the anterior surface to the skin[2]. This bird is well formed for lightness.

The œsophagus before it enters the stomach is dilated, and very much thickened by a glandular substance that surrounds it, and is full of orifices on the inside, and is here lined with a mucus of a dark colour: and, as you trace this mucus into the stomach, it becomes stronger and stronger, and on the strongest sides of the stomach it is like horn, and is fibrous. The fibres are not perpendicular to the surface, but oblique; and this obliquity is not in the same direction on both sides, but in

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[1] [White's Journal of a Voyage to N. S. Wales, p. 238.]

[2] [Hunt. Prep. Phys. Series, Nos. 1987, 1988.]

contrary directions; so that by their rubbing against one another it is against the grain in one direction, and with it in another[1].

They have two very long cæca, which become very small before they enter the colon; this is but short, has a large valve, and forms at the bottom a pretty large cavity [cloaca[2]]. The ductus hepaticus passes into the body of the gall-bladder, and the ductus cysticus passes, without any duct entering it, to the duodenum just after it has its first turn[3]. The bile is of a dark transparent green, not very thick. The testicles are very small[4]. The spleen has its veins running on the outside, like the kidney of a lion. The two small glands on each side of the trachea, when blown into, fill the veins with air: they are of a dark brown mixed with blue. On their lower ends is placed a small body of an orange colour, which seems to have no communication with the other, [judging] by the air which was thrown into the other; nor do they fill anything but veins when blown into. There are two oblong lymphatic glands on each side of the former; when blown into, there is a lymphatic to be observed passing from this lower end, and entering the subclavian vein.

The Eustachian tube in a swan passes from the lower part of the tympanum near the membrana tympani by an oval hole in the bone. Besides that, there is another canal leading forward and inward like the tube in the human; but this is blind, and seems to communicate on its inner edge with the cells of the lower part of the occiput. The bony part of this canal opens on the basis of the skull a little way behind the articulation of the bones of both jaws to the basis of the skull; the two [Eustachian] openings have a little thin plate of bone projecting over them, so that they are not seen. From this they pass forwards for about half an inch, in one common pipe, which becomes larger and larger, and opens into the mouth or beginning of the fauces, just behind the posterior nares: the membranous part of the tube is rugous. The septum narium is irregular and very vascular; and there is an opening at the anterior part between the two nostrils, just where the two nostrils open externally. The internal cavity of the nose is very irregular, the turbinated cartilages forming many cavities; and, besides these, there are cavities answering to our sinuses. There is one on the outside of the nose, behind the root of the beak, laterally above the angle of the mouth, and below and before the eye: it is only covered by the common integuments outwardly; on the internal surface it is very irregular, and has a duct passing into the nose: at its posterior part it is lined by a very vascular membrane, and the inner surface is no more than the outer surface of the turbinated cartilages. There is another deeper

[1] [Hunt. Preps. Phys. Series, Nos. 530—532.]
[2] [Ib. Nos. 674, 748.]
[3] [Ib. No. 816.]
[4] [Ib. No. 2467.]

seated [cavity or sinus] just below the bottom of the orbit, which is pretty large, and is very irregular on its outer surface: the inner surface is the septum between the two eyes. This has a duct passing forwards which opens into the cavity of the nose just behind the largest turbinated cartilage. There is a third just above this opening, which is less, situated before the bottom of the orbit, and opening under the great turbinated cartilage [1].

The lacrymal gland, which is as large as in the human subject, is placed at the bottom of the orbit, just above the second cavity and behind the third. It sends a large duct forward and outward, with the abductor muscle, which opens behind the membrana nictitans.

The puncta lacrymalia are very large: they open into the sac, which is an inch long; and its duct, which is pretty large, opens into the nose below and a little before the great turbinated cartilage. These cartilages are very vascular.

THE WILD SWAN [*Cygnus ferus*, Briss.].

The only difference I could observe between this swan and the common [*Cygnus olor*], was a yellow part at the setting on of the beak. It has a gizzard like a common swan, which contained some pulpy vegetables and a tolerably fine sand, not bigger than pins' heads: the thickest part of the horny lining was not above $\frac{1}{10}$th of an inch. This bird may be said to have three mesenteries: one for the duodenum, the second for the jejunum, and the third for what may be called the ileum.

The duodenum makes a fold as usual in birds, on the first mesentery. The jejunum makes three folds upon the second mesentery; it passes down upon this flat mesentery, folds up upon itself, turning over the upper edge of that mesentery and passing down on the opposite side; it then turns up upon itself again, making a similar fold to the first; then turns round, encircling the whole; and, when got to the upper part, it leaves this mesentery, beginning to make folds upon the third mesentery, on which, as ileum, the gut makes three folds. After passing about 10 inches it folds up upon itself again, then makes another turn down and up upon itself; from thence passes down between these two folds, winds round the lower part of this common mesentery, going up upon the posterior surface of it, and is attached to the two cæca. It then makes a turn down towards the back and forms the rectum, at the upper part of which arise the two cæca. The rectum terminates in the anus, which has a very different surface from the gut, appearing to be covered with a cuticle.

The ductus cysticus and hepaticus enter the duodenum at the upper

[1] [Hunt. Prep. Phys. Series, Nos. 1536, 1537.]

turn, where it terminates in the jejunum: the pancreatic duct enters close by the ductus hepaticus.

This was a female. The oviducts, &c. were like those in other fowls. The male is larger than the female, and the testicles, at the time it was shot, in January, were of this size:—  The males differ much in size, some being much larger than others. Their breast-bone is different from the female's; the cavity in the bone in which the trachea takes the turn being only such as admits of the turn, while that in the female is considerably larger.

The Difference between the Wild and Tame Swan.

The head of the wild swan is more like the head of the goose; it comes more to a point at the top, or rises higher; this is probably due to the feathers. The neck is commonly much more straight; and has not that curve we often find in the tame swan. It never throws the head backwards on the back between the wings. They never raise [the wings] so as to make them hollow underneath, as the tame swan does. They stand more straight on their legs: I believe their legs are rather longer, and they walk better.

A wild swan, that was shot in the year 1783–84, and had his flight feathers cut short, and was kept through the summer, did not cast those feathers; nor did it in the winter 1784–85; but, about the month of August 1785, it cast them. It threw off a great many feathers in the summer of 1784, but whether he may be said to have moulted I do not know.

Extract of a Letter from Mr. Davy to Mr. Banks, with the breast-bones of two Swans[1], *to show the specific difference between those that breed in England, and those that only visit us in severe weather.*

"That with the trachea joined to it is the breast of a wild swan shot in this parish last February. As almost all defenceless birds have a sentinel upon the watch to give warning of danger to the flock, he conceives the use of the hollow box in the septum of the breast-bone may be to add loudness to the voice, which on being alarmed, somewhat resembles the snorting of a horse in high mettle; and that as this bird soars very high where the cold of the air is piercingly severe, the length of the trachea, by its curvature, enables it likewise to take in a larger portion of air, and to give it a degree of warmth in this cavity of the breast-bone before it suffers it to pass into the lungs. If he is not mistaken, there is a peculiarity in the form of the lower end of the

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[1] [viz. the Hooper [*Cygnus ferus*, Yarrell], which has the entosternal tracheal fold vertical and confined to the keel, and the Bewick's Swan [*Cygnus Bewickii*, Yarrell], which has the tracheal fold horizontal. See Linn. Trans. vol. xvi. p. 449.]

trachea which is separated into two pipes, crossing each other, that on the left hand passing into the right side of the lungs, and that of the right into the left portion of them; but this may be common to other fowls."

The Goose [*Anser palustris*, Cuv.].

A goose has no crop; but the œsophagus is pretty large, the size being increased at the entrance into the thorax, and continuing so to the stomach: in all this passage lies the food, which seems as if it passed into the stomach gradually. The stomach is like that of all graminivorous birds. The duodenum is the same. The jejunum first makes a fold on itself for about 8 inches in length, which fold is turned in upon itself one whole circle and a half, like a snail-shell. The ileum makes four folds on itself with one central mesentery to the whole; and to the last of these the cæca are attached, and at the termination of the last fold the rectum begins, which is about 6 inches long.

The liver is as in other birds. The gall-bladder is the same. The ducts enter the last turn of the duodenum separately, but pretty close. There are two pancreases, one on each side of the mesoduodenum: the anterior sends a duct to the posterior one, near the lower end; and each sends a duct from the anterior end to the duodenum which enters near the ducts of the gall-bladder, but separately from them and from each other.

The ovarium is a long body, with the upper end placed on the capsula renalis. The oviduct enters [the cloaca] as usual; and on the other side there is a smaller opening which leads up in the same manner for about 4 inches: it is rugous on the inside, and as if there were some hydatids upon it. The opening above the rectum is very short.

The bird expanded its membrana nictitans when I put its head into water.

The Wild Goose [*Anser ferus*, Lister] ?

"Oundle, Dec. 30th, 1790.

"Sir,—By the assistance of the servant to whom the care of our poultry is consigned, I am now enabled to give you a more particular account of the parentage of the geese I some time since sent to you, and which I have had the satisfaction to hear were acceptable. To the best of my recollection, it was in the summer of 1773 that I took the original goose (now in my possession), with three others (then very little goslings), in the fens between Cambridge and Ely. An old wild goose * taking flight from some sedge and rushes, led me to the discovery of them. In the spring of 1774 two only remained, one having taken wing and flown off, and another having fallen by the hand of the cook; the remaining two being females, we were disappointed of a breed that year.

"In 1775 we introduced a common gander to them, and they being no way backward to receive his caresses, a numerous progeny was the consequence. The tame or common gander was killed by a dog during the incubation of the geese; and all the numerous broods we have since had have been produced from males of that family, as no common or tame goose or gander has since been mixed with them.

"The servant tells me that the gander (the largest of the three birds) I sent to you is of an early brood, and, as he believes, is at least ten if not twelve years old. The birds produced from the original goose and that gander (her offspring) have constantly resembled herself, both in delicacy of shape and colour, which is that of the wild goose, with some white under the tail. Unfortunately they have all fallen victims to the spit. The old lady, though blind of an eye and somewhat rheumatic, is in fine feather; and, if proposals were made to her, perhaps might not be averse to try her strength for another brood; so that if you have the least inclination to have her to experiment upon she is at your service. I shall always be happy to exert my feeble efforts for the furtherance of your pursuits and amusements which tend so largely to benefit mankind.

"And I am, much yours,

"Wm. Walcot, Jun."

These geese with me did not lay eggs till the month of April, and Mr. Walcot informed me they were not so early in breeding as the common or tame goose, and his finding them in the summer when he was shooting, shows they are naturally late. My gander was the most original; and one of the geese was more of an original than the other. The latter end of the month of July 1792, when they were full in feather, they had a field of six acres of grass-ground to range in; they seemed very tame; were with the ducks and other birds; yet they took flight one by one and made off. They first tried their wings as soon as they could rise; then they rose, took several spiral turns, rising higher and higher, widening the turns, and then flew straight away.

* This goose is of the sort called the gray-legs, or rush-goose, the only one of the tribe that breeds in this country; and is the only one fit for the table.

The Canada Goose [*Anser canadensis*, Briss.].

This has a strong gizzard; the duodenum is as usual. The jejunum makes a fold like the duodenum, which is turned in upon itself; then the remaining part of the jejunum and the whole of the ileum make three folds upon themselves, when the latter passes into the rectum. The two cæca are somewhat longer than the last fold made by the ileum, and are a little serpentine. The rectum is as usual: there is no cavity above the anus. The liver is but small. There are a ductus hepaticus and a ductus cysticus, which enter the duodenum at its third turn close by one another. The bile is very thick. The pancreas is divided into two, as usual: the duct enters just by the duct of the liver. The clitoris is a small point, just in the place of the penis.

The Brent Goose [*Anser Bernicla*, Cuv.].

It has no crop; but has a gizzard like that of a swan. The duodenum is as usual. The ducts of the liver enter at the last turn, and the pancreatic duct just by them. The pancreas is not so long as the fold of the duodenum. The small intestines are folded upon one another in parallel folds, about 5 inches long; and in the direction of the body of the bird, there are two cæca which are attached to that part of the ileum which makes the last fold, so that they seem to make up part of the fold: they are somewhat longer than the folds, and are a little serpentine at their ends.

There is a difference between the viscera of this bird and those of a swan; but the male parts of generation are just the same as those of the swan.

The Barnacle Goose [*Anser leucopsis*, Cuv.].

In a water-fowl, about as large as a Moscovy duck, that had a black short bill, thick at the root like a goose, which was white headed, with a large black spot upon the top of the head, and a black neck, I found the glandular part of the œsophagus filled with grass. The stomach was like that of a swan, very strong, and filled with small stones; there was a muscular bulge on its convexity opposite to the insertion of the œsophagus. The duodenum was as usual: the other intestines were as in the swan; that is, they were folded upon one another in two parcels, in folds like that of the duodenum. They were larger than common for a bird of that size, and were filled with a kind of mashed hay, mixed with other kind of stuff, like horse's dung; and that which was in the duodenum was like small pieces of hay, mixed with whitish juice.

The cæca were very long, as in the swan, and the coats thinner than in the other intestines. The length of the whole intestines was four times the length of the whole animal, and more than six times the length of the trunk. The length of the rectum was about six inches, which is two-thirds of the length of the animal. The liver is divided as usual. The ducts enter at the third duodenal turn, pretty close to one another; and there are two pancreatic ducts that enter with them. There was very little bile in the gall-bladder. The ovarium is as common. The oviduct is a small cavity above the anus.

The Moscovy Duck [*Anas moschata*, Linn.].

This bird has a crop, but not of that sudden swell as in the common fowl. The gizzard is as in a swan. The duodenum is as usual. From the last turn of this gut the jejunum passes back on the right side, and then makes a short fold upon itself, having an intermediate mesentery; it then becomes a loose intestine: however, this loose part forms a kind of scollop or short folds. After this the gut is folded upon itself three times, which makes six portions of intestine lying parallel to one another; they are all connected to one another at the root of the mesentery, but are single folds at the other end; and indeed one fold is almost single for its whole length; these are parallel in direction with the body. After this the intestine passes back and becomes rectum, which becomes larger and larger towards the anus, where is the usual swell. The cæca are pretty long, about the length of the last folds, and are connected to them.

The gall-bladder does not lie upon the last turn of the duodenum, but between its curve and the porta of the liver; there are two ducts as usual, but are shorter, because they both enter at the duodenal curve. The pancreas consists of an anterior and posterior portion, have two large ducts which enter by the biliary ducts; besides which there is a small one that enters the duodenum midway between the second and third turn: it comes from the lower end of the posterior pancreas, which is the largest one. The pancreases are loose at the lower end, and do not go so low as the second turn of the duodenum.

Parts of Generation.—In the dissection of these, the gut is not to be slit, but the parts are to be dissected all round the anus. If injected, the better. There are two glands above the tail as in all the duck kind, each having a duct; but I believe that if the duct was injected, we might fill the tubes of the gland, for it appears to be in structure like the kidney of a horse.

THE GOLDEN-EYE DUCK [*Anas clangula*, Linn.].

In a pied sea-fowl, about the size of a duck, with yellow legs, and a bill very thick at the root, of the shape of that of a common goose, but with the head of a duck, there is something very uncommon in the trachea, which somewhat resembles a crop; and there is a bony swelling at the division of the trachea as in a duck, but larger. The contents of the abdomen were like a swan's.

THE SMEW [*Mergus albellus*, Cuv.].

It is a pied bird about the size of a widgeon, with black legs and narrow bill: this has a bent point which is white, viz. that part which might be called the nail of the bill; it is turned very sharply over the under part of the bill.

Its stomach is not much stronger than a bittern's, so that it is not a gizzard: it had some stones in it.

The duodenum is as usual: the jejunum is loose: the ileum is folded upon itself by two folds, which are united to one another. There is only one cæcum, as in a bittern.

THE WEST INDIAN PELICAN [*Pelecanus fuscus*, Ed.].

The nostril is a slit in a groove between the upper and side parts of the horn of the bill, just before the true skin of the head. This slit is hardly visible; it is only known by blowing into the posterior nares, the air escaping that way. The stomach is rather a stomach than gizzard; it is oblong, much in the direction of the œsophagus, with a little curve, smallest at the lower end: it makes a quick turn and swells again into a round bag; or, it may be supposed that from the side near the lower or smaller end is attached a bag whence the duodenum arises [1]. The duodenum is a fold of the intestine similar to that in other birds; it then makes another fold similar to the above, but shorter. The remainder of the small intestines are strung on the edge of the mesentery in pretty deep scollops or folds, some of which are longer than others; but the last is the largest or longest, and, becoming more attached to the root of the mesentery, it then goes down to commence the rectum.

The cæca are about $1\frac{1}{4}$ inch long. The liver has two lobes, the left very small. The bile in the gall-bladder was not green as in birds, but yellowish. The pancreas is as usual in birds. The spleen was large. The lungs appear to be small for the size of the bird; they do not come

[1] [Hunt. Preps. Phys. Series, Nos. 519, 582.]

so far forwards as the ends of the ribs at the upper part, and, as in other birds, they do not extend so far forwards at the lower part, but lie in the hollow made by the spine and ribs on each side. The lungs, when coarsely deprived of the surrounding parts, weighed 9 drachms and 2 scruples; and the bird appeared as large as a small goose. From the lungs can be blown up the whole cellular membrane of the body. By blowing into the trachea, the cellular membrane of the skin to the body is everywhere filled, as the base part of the leg surrounding the lower end of the tibia, and the wings as far as the pinion, and on the pinion itself; up the neck as far as the head, but not so much on the back and upper part of the head. From thence the air passes among the muscles of the eye, going along the upper and lower bills. Under the pectoral muscle there is a hollow [or air-cell], the pectoral muscle being attached only at its origin and insertion, and by the vessels and nerves coming into it, appearing as if they were dissected. All the other muscles inserted into the os humeri had also this appearance of being dissected, as also the blood-vessels and nerves coming to these places. The thigh was hardly attached to the body or ribs, but by membranes forming two or three large cells filled with air. The air passed into the canal of the medulla spinalis surrounding the dura mater: and on the roof of the mouth, behind the posterior nares, is a slit, which is the opening of an air-duct [eustachian tube] which passes back to the posterior edge of the ridge on which the bone of the lower jaw slides, and then enters the bones of the skull[1].

The Large Pelican from Arabia [*Pelecanus onocrotalus,* Linn.].

The stomach is similar to that in the pelican from the West Indies, above described. The curve of the duodenum, which terminates in the jejunum, goes much higher on the right of the stomach than the beginning of the duodenum. The jejunum makes a sweep down to the right, then towards the left and up, making an oblong spiral turn within itself, then back, but not within the other, but upon it, having a central mesentery; and where it is strung on the edge of the mesentery we shall call it 'ileum'[2]. The ileum passes along the edge of the mesentery in pretty deep scollops towards the left; then makes a long fold on itself, the last part of which passes higher up behind the stomach and mesentery to the root of that membrane, and then bends down the back to form the rectum. The cæca are about 2 inches long

[1] [The kidney of a pelican is preserved in Phys. Series, No. 1197, and the tongue and upper larynx in No. 1472.]

[2] [The structure of the small intestine is shown in Phys. Series, Prep. No. 675.]

each, and are pretty near the anus, which makes the rectum short. The rectum opens somewhat obliquely into the reservoir. The whole length of the intestines is rather short. I could find but one duct to the liver, or rather gall-bladder (but of this I am not certain), which was large and honeycombed; it opened into the duodenum before its termination in the jejunum.

The pancreas is a round body placed above the beginning of the duodenum, whose duct opens near to the entrance of the duct of the gall-bladder. This bird has the air diffused through its body similar to the West Indian pelican[1].

This pelican had a bezoar in its intestine, which appeared to be too large to pass; and probably was the cause of its death.

THE CORMORANT [*Phalacrocorax* CARBO, Briss.].

The iris is green: it has little or no tongue, like a fish.

The two nostrils join into one backwards, before they open into the mouth.

The œsophagus is pretty large, and is much of the same size all the way to the stomach. The stomach is oblong, turned up at the lower end, and lies much in the direction of the body of the animal. At the curve there is a small round tendon having all the muscular fibres running towards it. The coats of the stomach are thin; but there were stones in the stomach, so that digestion is assisted here by abrasion. The duodenum is as in other birds, but is pretty long. The jejunum makes a fold like the duodenum, is then coiled upon itself, and the gut makes another turn or fold before it passes down the back to form the rectum: it is hardly possible to tell where the rectum begins, only that it is a little thicker in its coats. The cæca are two small swellings, one on each side of the rectum. The liver is divided into two lobes, the right one being much the larger. The gall-bladder lies in the curve of the stomach. The hepatic duct enters about an inch on this side, where the duodenum forms its third curve, and the cystic duct enters at the third curve. The pancreas is small and irregular, having its ducts entering the gut between the two ducts of the liver; it has a small process running upwards behind, and attached to the stomach. The spleen is situated behind the stomach, is broad and thin; the flat sides are turned backwards and forwards; the right edge being the thickest, and is attached to the stomach by vessels.

The legs are short, like a duck's, and are thin; one edge, which is the thickest, is turned forwards, the other backwards; and there are muscles

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[1] [See the preparations of the air-bones, Osteol. Series, Nos. 1173—1179.]

in the posterior edge for the motion of the toes. The foot is webbed. The back-toe is joined to the inner one by a web: the outer toe is the longest, becoming shorter to the back-toe. There is a down on the skin under the feathers, as in a goose.

A small bone, about an inch long, passes back from the os occipitis and gives origin to the temporal muscle, which is very strong [1].

Cormorants build their nest in the rocks, on any smooth corner of a stone jutting out and overhung by another rock so as to shade them. The young are black, and covered with down like a plumed goose. They continue on their nest till they are feathered, which is not until they are nearly as large as the old ones. This last peculiarity is contrary to that which takes place in a great many swimming birds.

The Sea-Gull, a large Species [*Larus marinus*, Linn.[2]].

The œsophagus is very large, but has no crop; the viscera are like those of the jay or jackdaw. The flesh is pretty red. The stomach is pretty strong, like the pewit's, and very rugous on the inside; there was nothing in it but a little air or froth, which was very green; the middle tendon is shining, and the muscle of a pale red. The stomach contained stones.

The duodenum makes the usual turns or folds, and then becomes a loose intestine to near the termination of the ileum, where it is attached to the posterior part of the stomach, whence it descends to form the rectum. The cæca are very short and small [3]; the rectum is not above 2 inches long, and is large at the anus; it was filled with a white stuff. There is a little cavity above the rectum, as in the owl. The length of the whole intestines is hardly twice the whole length of the animal; they are four times the length of the body of the animal from the shoulders to the tail.

The liver divides into two lobes as usual. The gall-bladder is very large. The ductus hepaticus passes a good way between the two pancreases, and enters the gut halfway between its second and third bend, about three inches from the entrance of the cystic. The hepato-cystic duct is very small, only admitting a common bristle, and the cystic duct is pretty large, entering the gut at the third bend as usual.

The spleen is about 1½ inch long, of the shape of a worm, lying behind the stomach, or rather along the right side of the glandular part of the œsophagus, reaching as low as the pylorus: the upper end is the thickest.

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[1] [Osteol. Series, No. 1181.]
[2] [The skull of this bird is No. 1228, Hunt. Osteol. Series.]
[3] [Hunt. Prep. Physiol. Series, No. 686.]

This bird I kept in the garden upon flesh for about a month; and, about four or five days before I killed it, it was taken ill so that it did not eat, but grew worse and worse till I killed it.

On opening the abdomen I saw a number of white spots; some on the kidneys, some on the membranous partitions, and others upon the stomach. These I found to be chiefly mould: some parts of them were green, and had a down [*Mucedo*] upon them. This mould must have formed before death; and, although one can hardly believe it, yet so it must have been; for it was seen in less than twelve hours after death; and, if a little could have been produced in that time, yet the whole could not, for some of it was more than a quarter of an inch thick. The membranous partitions were thick and inflamed, and I account for this mould in this way. We know that there is air within the cavity of the abdomen, which is taken in by the wind-pipe, and goes through the lungs; from thence through the diaphragm into the abdomen. Now if this air was at all confined, and did not get out, for a supply of fresh to get in, it would certainly putrify the juices that were thrown out by inflammation, and then these juices might become mouldy before death [1]. This is a hint that the air in an emphysema should be let out and not allowed to become putrid.

THE SMALL SEA-GULL [*Larus tridactylus*, Linn. [2]].

This is the common sea-gull, which is of a light blue colour, with some black feathers upon its neck, wings, and tail, with black legs and bill. It has no crop. The œsophagus is large, continuing so to the stomach, and rather becoming larger. It is almost impossible to say where the œsophagus ends, or the stomach begins; for the stomach is not a bit larger than the œsophagus, and its greatest axis is in the same direction; but there is one mark, which is that the œsophagus becomes much stronger, harder, and thicker just at one part, which distinction becomes more and more towards the bottom of the stomach. The muscles of the stomach are not very strong nor very red, as in granivorous birds [3]. There is a white tendon on each side of the stomach; the inner coat is horny, but not very hard.

The duodenum passes out on one side, just below the beginning of

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[1] [Owen, 'Anat. of Flamingo,' Proceedings of the Zool. Society, vol. ii. p. 141 (1834); Robin, 'Des Végétaux qui croissent sur les animaux vivants,' 1847; and 'Lancet,' Aug. 2nd, 1851, p. 101, for a summary of subsequent observations with demonstrations of *Entophyta* in living animals.]

[2] [Parts of the skeleton of this bird form No. 1236, Hunt. Osteol. Series.]

[3] [Hunt. Prep. Phys. Series, No. 523, showing the thickening of the muscular coat in a gull which had been fed for a year chiefly upon grain.]

the stomach, and makes the usual turn, but not very long. The œsophagus, stomach, and passing out of the duodenum are just like colon, cæcum, and passing in of ileum; but they are folded upon one another through their whole length; for the beginning of the duodenum joins near the termination of the ileum which is behind it; and the ileum passes along with the duodenum then with the jejunum to the bend that the two make. The part of the fold that is beyond the duodenum is twisted upon itself into a spiral form; the other intestines are loose. The cæca are very short. The rectum is not above an inch long; and has a swell at the anus. There is a bag [bursa Fabricii] above the anus.

The spleen is about an inch long, is small, and adheres to the upper end of one of the pancreases, next to the first turn of the duodenum. The hepatic and cystic ducts enter that gut about an inch from one another, the hepatic first, the cystic at the last bend of the duodenum, or its termination. The pancreatic duct enters between both, but nearer the cystic.

The testes are very small, oblong, mostly black, but whitish at the lower end: there are some orifices above where the penis should be situated.

This description is taken from two gulls, viz. the above-mentioned [*Larus tridactylus*], and another something larger, and of an ash-grey, with a yellowish bill and legs [*Larus canus*, Linn.[1]].

The Great Speckled Diver, or Loon of Pennant [*Colymbus glacialis*, Linn.].

It has a stomachic gizzard [*i. e.* having side-tendons, but with thin coats like an ordinary stomach]. The duodenum is as usual. The jejunum passes pretty high up, to the lungs, then down to the loins, then up the middle of the abdomen, to the liver again, making one complete oval sweep; within which it passes, making three slight folds on itself, or what may be called angular attachments to the mesentery; from thence it passes to the left at the upper part, making there a few convolutions, then goes down the left side in the loins, forming the rectum. The cæca arise about 2 inches from the anus, and are about 3 inches long. There is a large cavity at the termination of the rectum. The anus is continued above an inch under the tail beyond the pelvis. In the stomach were stones and bones of fish.

The testicles were not larger than pins' heads; but this was killed in winter. The circumstance most remarkable in this bird is its tibia,

[1] [The skull of this bird is No. 1232, Hunt. Osteol. Series.]

or what might be called its patella, or what answers to the patella in other birds. This bone projects up in the line of the tibia, 2 inches beyond the joint of the knee: there are three strong muscles inserted into it, one of which is inserted through its whole length; the other two nearer to the joint of the knee: these muscles arise all along the sides-man or ileum: they must give great power to the forward motion of the leg, although they must lose in velocity. This projecting process gives a greater surface of origin to the extensors of the tarsal bone, or what is commonly understood by the leg, than they otherwise could have had; for some of those muscles arise from its fore-part through its whole length, and wind round the tibia to get behind the tarsal joint. The tarsal bone, or what is called leg, is very thin, having its sides outwards, and its edges turned forwards and backwards. This form may be against the effect of the back-stroke, but it assists in the fore, or the bringing the leg forwards[1]. The back-toe is small, but it is webbed with the outer toe of the foot. The first bone of the three front toes is articulated almost in a straight line with the bone of the tarsus, and the second bone only extends a little forwards, so that the bird cannot possibly walk; and when it floats on the water its legs and toes are in a straight line along the belly.

THE DIVER, or Sea-Parrot [*Fratercula arctica,* Brisson].

This bird has an orange bill and legs, back black, breast white. What is called thigh, but more properly leg, is close to the body, and passes backward in the direction of the body, as far as the extremity of the rump. This part of the leg is not so much detached from the body as in other birds.

The stomach is a kind of gizzard with a strong transparent horny coat. The duodenum is as usual: the other intestines make several turns, and pass down or back, to form the rectum: there are two small cæca. [In the cloaca are] two small nipples, which I suppose to be the terminations of the vasa deferentia, like those in the cock. The œsophagus enlarges before it enters the thorax.

THE SEA-PARROT [*Uria Troile,* Latham].

This bird is web-footed, but has no back-toe: it is black. The bill is something like the vultures, being covered with feathers as far as the nostril: where the feathers terminate, there is a round bend or ridge with a pretty deep groove: a little further on there is a hollow that

[1] [Osteol. Series, No. 1166.]

runs obliquely across the bill, which is white: half-way between that and the point of the bill there is another depression, but shallow. There is a white stroke on each side of the head that runs from each eye forwards towards the upper part of the bill, and terminates at the bend. It has a long thin body, with a very long sternum. The ribs come as far as the pubis, so that the passage into the abdomen [in the skeleton] is very small[1]. The membrane that divides the abdomen into two cavities is very thin, so that you can see all the intestines through it.

The stomach, taking in the glandular part of the œsophagus, is much the shape of the human cæcum, and is about 4 inches long in the whole. The lower end, which is the true stomach, is by much the strongest, and has a centre tendon on it.

The duodenum makes the usual turns; then passes back and much higher than its origin, and passes down again and soon makes a turn upon itself, which fold is coiled upon itself in a conical spiral form. After this it makes some loose convolutions, and passes up behind the stomach; then is bent down and forms the rectum. The cæca are very near the anus, and about $\frac{5}{8}$ths of an inch long. The rectum terminates in a pretty large bag, by an opening like the os tincæ. This bag was filled with a yellow matter, which was gritty like sand. There was no trace of a penis, yet it was a cock bird.

The hepatic duct was at the place where the gall-bladder lies upon the duodenum; and the cystic about half an inch further on. A process of pancreas runs up and is joined to the spleen.

[Class Reptilia, Cuv.; Tricoilia, Hunter.]

General observations on the Tricoilia.

The following divisions are those that have three cavities to their heart, and which, therefore, I call *Tricoilia*[2].

This constitutes a large class of animals composed of different tribes, each tribe of different genera, and each genus of different species. Whether there are any varieties in any of the species, I do not know. If there be, it must be owing to country, climate, &c., not to cultivation, as in many quadrupeds and birds.

As the Tricoilia are capable of retaining the same air in their lungs for a considerable time, and are likewise capable of going a considerable time without air in their lungs, much more so than those that have four cavities to the heart, it gives them a power of living some time without breathing; and therefore they can live under water without drawing

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1 [Osteol. Series, No. 1164.] 2 [Vol. i., p. 25.]

in their breath, and can live in a vacuum a considerable time, in a half state of death. Accordingly nature has made some of this division both terrestrial and aquatic; from which last quality, naturalists have commonly, but improperly, called the whole *Amphibia*.

As this class of animals are, as to the construction of the heart, in a kind of middle state between the fish, or dicoilia, and the tetracoilia, it was natural to suppose them to be truly amphibious; and, while many of them seemed to live both in and out of water, the idea of their being so became still more natural. But although this last circumstance [viz. the heart of three cavities] does not in the smallest degree constitute this property, yet, by those who knew not what it was that did constitute an amphibious animal, that alone was deemed sufficient. Some, even, of the Tetracoilia have been termed 'Amphibia,' such as the otter and beaver: but the construction of the heart is not the immediate cause of their being either fish, flesh, or both; it is whether they have gills, lungs, or both.

All of this division [or class *Tricoilia*] sleep in cold weather; and in their sleep, are as if almost dead. They are, I believe, the only animals that can be called sleepers for seasons; for we do not find this structure of heart in any other animals, and it is natural to suppose that this property arises from the structure of heart[1]; and from this structure of heart, and that of the lungs, it would appear that it is not so necessary for the life of these animals to have their blood exposed to the air, as it is in those that are more perfect, and in those that would seem to be less perfect.

This division of animals may be subdivided into three orders, viz. swimmers, lizards, and snakes. Each order consists of different genera, and those genera into their different species.

The first order consists of turtles, frogs, toads, efts, and crocodiles.

The second, of lizards and chameleons.

The third of snakes.

[*Loose Notes.*]

Amphibia grow slowly, eat little, and breathe slowly.

As it appears, in general, that Nature can hardly make one part perform two actions with advantage, may we not suppose that the Amphibia see but indifferently, or that they do not see equally well in and out of the water?

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[1] [Bats and insects show that seasonal torpidity may be a property common to animals with very diverse structures of heart.]

Parts of animals whose direct uses are not known, and also consisting of several parts whose peculiar offices are not in the least known from any kind of construction that they have: when these parts are differently arranged or disposed from the common [type], or that which we are mostly acquainted with, it becomes very difficult to say what are the parts in every variation. For instance, the brain of a turtle may have all the parts that the human brain has; but as these parts are differently disposed, and of different shapes and sizes in proportion to the size of the brain, it becomes very difficult to say what each part is that corresponds with those of the human.

Of the Disposition of the Digestive Organs in the Tricoilia.

This class of animals, like every other that has a uniformity in the disposition of the parts of which they are constructed, has their digestive and the other organs relative to them, disposed on pretty much the same principle. The beginning of the stomach is more on the left side than in the middle, as it is in fish; but, whether it passes down straight, as in the snake, whose body is long, or goes across to the right, as in the turtle, whose body is broad, the intestine arises from the right, the stomach bending that way, so that the intestines may be said to arise on the right. They are immediately attached to the right of the mesentery, and pass along that membrane on its right edge, till they form cæcum, colon, or rectum, whichever they may have.

[Order Crocodilia[1].]

Of the Crocodile.—There are two kinds, with regard to the trachea; in one it is nearly straight[2], in the other it makes a bend upon itself towards the left side of the thorax[3]; and when it returns to the middle between the right and the left, just above the heart, it then passes down and divides into two. Some birds have a fold in the trachea before it enters the thorax.

All those [crocodiles] that I have examined that had not this fold were young ones. The one [*Croc. acutus*] which had this fold was a large one, above 6 feet long, and is the one from which this description was taken*. One with a broad mouth [*Alligator lucius*] had it not.

* In the beginning of the winter 1764–5, I got a crocodile which had been in a

[1] [The Hunterian osteological specimens of *Crocodilia* include parts of *Gavialis gangeticus*, Nos. 682, 703, 708; *Crocodilus acutus*, Nos. 713—715; *Croc. vulgaris*, Nos. 717, 718; *Croc. biporcatus*, Nos. 720, 723, 725, 731, 745, 754; *Alligator lucius*, Nos. 761, 763.]

[2] [*Alligator lucius.*]

[3] [*Crocodilus acutus.*]

In one from Jamaica, sent me by Mr. Home[1], which measured 1 foot 6 inches from the back part of the head to the giving off of the hind-legs, and measured from the nose to the tip of the tail 4 feet 6 inches, the trachea was bent as above described. It had a narrow nose, but rising and round where the nostrils opened, and his two fore-teeth of the lower jaw came through.

In another of nearly the same size, which I had from Mr. Bailey the bird-man, the trachea divided pretty high, a good way above the heart, but had not this bend, excepting that, after it had divided, the two took a gentle turn to the right instead of the left[2].

The crocodile comes nearest to the fowl in the structure of its internal parts, of any animal that I know: it is the nearest of any of this class. The trachea is similar, and has some of the variations. Both birds and crocodiles have two glands on the upper part of the thorax, and some flat scattered ones near the same place, which are thyroidal glands. The communication of the veins of the stomach, &c., with those of the liver, and the vein of the rectum, joining or entering into the vena portarum, is similar to the bird, although it is much more considerable [in the crocodile].

The adhesion of the stomach to the peritoneum is somewhat similar: the stomach itself is of the gizzard kind, and the folds of the duodenum are also something similar.

'show' for several years in London before it died. It was at the time of its death, perhaps, the largest ever seen in this country, having grown to my knowledge above 3 feet in length, and was above 5 feet long when it died. I sent to Mr. Hewson, and before I opened it, I read over to him my former descriptions of the dissections of this animal, relative to the 'absorbing system,' both of some of the larger lymphatics and of the lacteals, with a view to see how far these descriptions would agree with the appearances in the animal now before us, and on comparing them they exactly corresponded. This was the crocodile from which Mr. Hewson took his observation of the colour of the chyle (Phil. Trans. 1769, p. 199) [four years after, when Mr. Hewson writes, "I lately saw by favour of Mr. John Hunter," &c.]. The intention of my showing this crocodile, and also reading my former dissections to Mr. Hewson was, that he might see that I had a tolerable description of this system in the Amphibia; because I found him busy in the pursuit of this system in various animals, and hinting himself to be the discoverer of it even in birds, and to convince him that this description must have been written some considerable time before, in all probability before my going abroad. As crocodiles are seldom to be had in this country, I could hardly have dissected two crocodiles, besides this, between May 1763 (the time I returned from Portugal), or the autumn 1763, when the turtle was dissected, and the beginning of the winter 1764–5. Mr. Hewson at the time appeared satisfied, or at least made no remarks.

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[1] [The brother-in-law of John Hunter, afterwards Sir Everard Home, Bart.]

[2] [In a small *Croc. acutus* the trachea made a sudden turn just above the pericardium, from the left to the right of the œsophagus, passing sternad, and then divided.]

When the skin is taken off the abdomen and abdominal muscles, we find what may be called false cartilages; that is, a middle cartilage continued from the lower end of the sternum to the ossa pubis, which might be called an 'abdominal sternum' or false sternum: from this, there are, going out laterally, a great many cartilages like those from the true sternum, but not so large; these have muscles between them like intercostals. There is in the body of the muscle a white substance like extravasated blood, but the blood of this animal is red. The peritoneum is very thin, and is loosely connected to the abdominal muscles; and what is very remarkable is, that it only covers those viscera that are below the great arch of the stomach and lower edge of the right lobe of the liver; so that there is only the posterior surface of the stomach covered by it, as in the bird, and the lower concave surface of the right lobe of the liver, and lower surface of the gall-bladder. From, or to, these three parts, it is reflected to or from the abdominal muscles, so that the whole convex surface of the liver is not covered by the peritoneum. This surface of the liver adheres to the parts before and above it, which in the human is the diaphragm; and on the inside of the abdominal muscles in a young one, there was a capsula on the anterior surface of both lobes, which neither communicated with the peritoneum nor pleura; this is a continuation of the pleura; therefore the liver might be said to be in the thorax.

All the anterior surface of the stomach adheres to the liver by loose sacculous adhesions to the left side of the gall-bladder and abdominal muscles. This adhesion is by a very thick layer of fat. When the lower edge of the liver comes in contact with the abdominal muscles there, the most internal lamella of those muscles becomes tendinous, and a thin lamella of this tendon passes on each side of the liver. The inferior lamella is fixed at the root of the liver, but the superior is lost insensibly in the convex surface of the liver; these two lamellæ are not a uniform tendinous fascia, but are fasciculated, and some parts are only membranous.

The lamella which passes under the concave surface of the left lobe of the liver adheres in some places to the anterior surface of the stomach; but I believe it does not in every part (this is the adhesion we spoke of when on the adhesion of the stomach). The other surface of this lamella that is next to the liver, does not adhere to the whole of the left lobe of the liver, but only round the circumference of that lobe. The liver, thus enclosed by the tendon of an abdominal muscle, must be influenced by the action of the muscle, viz. pulled down when the muscle acts. By this adhesion of the liver all round its edge to the whole cavity of the abdomen, it makes a kind of diaphragm, which is indeed the only one the animal has; for the upper surface of the liver, with the superior tendon, adheres to the pleura, which is very thin; so that the liver is properly the diaphragm, and is at the posterior part in contact with the lungs. As, however, the inferior lamella is the strongest and goes to the œsophagus and to the vessels that pass upon the back, this, therefore, is most properly the diaphragm; but if we consider this as the diaphragm, we must consider the liver as in the thorax. In respiration the liver must be moved downwards, which will increase the cavity of the thorax.

The situation of the liver is much as in the human, and, as in the human, it does not go quite to the posterior part of the loins, where the spleen lies.

Of the Œsophagus.—The œsophagus passes through the thorax, and, when got below the left lobe of the liver, it immediately dilates into the stomach; but it passes principally through the membranous part that connects the liver to the posterior parts, or that membrane we spoke of above.

Stomach.—The stomach is pretty large, roundish, and lies much in the place of that in the human subject; it is about as strong as an eagle's, and has a middle tendon, on each side, about the breadth of a shilling, and all the fleshy fibres passing to it. Very near the opening of the œsophagus is the pylorus; but the stomach has, there, a little swell or another small stomach or cavity, and from thence the duodenum begins [1]. In the stomach of one I had sent me from Jamaica, I found the whole of the feathers of a bird, with a few of the bones, but I could not make out what bird it was. The most curious circumstance was the bones having lost all their earth, exactly similar to a bone that has been long steeped in an acid, just the contrary to what might have been expected.

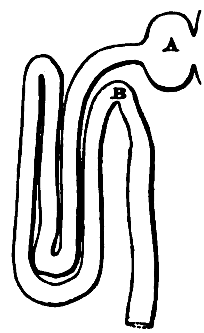
They do not regurgitate the insoluble and indigestible part of the food, as do the owls, eagles, &c. There were stones in the stomach of considerable size, larger, *e. g.*, than the end of a man's thumb; there were also the seeds of some vegetable. The question is, how did he catch the bird? Was the bird swimming on the water? and did he dive under the bird, and come up under him and catch him? Or was the bird asleep in the night? Mr. Home says it was probably a pigeon; for, whenever a pigeon is shot and falls near them, they immediately catch and swallow it. One would be induced to suppose that birds were their favourite food; for one that I had sent me from the West Indies, when I gave him fish he did not touch them, but when I gave

[1] [Hunt. Preps. Phys. Series, Nos. 517, 518.]

him sparrows he swallowed them feathers and all; but I found he did not throw up the feathers, as the owls do; but they passed through him in part digested. What was singular, he only ate by fits; that is, he fasted several days after a good meal, although sparrows were lying by him, and then would eat heartily again.

This crocodile (*Croc. acutus*) had five fingers; the ring and little finger had no claw, but terminated in a point, like a snake's tail. [On the hind-foot it had] four toes; the little toe has also no nail.

The duodenum passes towards the right side for about 4 inches, and is folded upon itself for more than 2 inches, which fold is continued round its outside, or is again folded upon itself as in the figure. A is the pyloric sac of the stomach: B, the last end of the turn, which is something similar to that in the bird. Thence the intestine passes behind the others, and then downwards, adhering to the posterior parts, as in the human; it then crosses the spine a little below the root of the mesentery and becomes loose, and is smaller and thinner in its coats until within 3 inches of the anus, where it passes down straight and becomes a little larger. There is no cæcum, nor does the large gut take the turns of the colon, as in some others. The rectum, about 2 inches from the anus, terminates in a valvular manner like that of a carnivorous bird; and, before this termination, it passes upon the kidneys and between them. The mesentery is loose and thin; I could not observe any lymphatic glands, and the intestines are more than four times the length of the animal from nose to anus.



The spleen is nearly as large as the human, and much of the same shape; it is of a pale brown, not of the bluish cast that the human spleen has; it is situated on the right side, below the right lobe of the liver; its situation there is much the same with that of the human spleen on the left side. Its convex surface is turned towards the abdominal muscles, and is as loose as in a fœtus. There are no vasa brevia, and there is no connexion with the stomach; so that the old notion of vasa brevia carrying fluid to the stomach and spleen to keep the stomach warm and to be a balance for the liver, is groundless; its vessels enter its posterior edge, not at the middle, so that there is no fissure on the inner angle.

The pancreas is but small and irregular; it is situated in the folding of the duodenum; one end of it begins near the pylorus, the duct enters the duodenum at its last turn, as in fowls, and seems to enter with the hepatic duct. These parts agree in every respect with the same in some fowls, *e. g.*, those that eat fish, especially with the fish-hawk and eagle.

The liver is large in proportion to the size of the animal; it is pretty uniformly concave below; it is divided into two lobes, the right being the larger; this division is by the spine behind, and by the heart at the fore and upper parts, so that almost the whole heart is sunk in the upper convex surface of the liver; but these two lobes are united by the pericardium, above which adheres all round the surface of contact, so that there is a capsula between the pericardium and liver, and the tendinous membrane that covers the lower surface of the liver, but there is a little continuation of the liver from the one lobe into the other, just as in a fowl.

The gall-bladder is fixed to the concave side of the right lobe, much as in the human subject, but not so closely; it is much of the shape of that in the human, and is furrowed on the inside like a fowl's. The hepatic duct, as it passes to the duodenum, sends a branch to the gall-bladder; it then goes to open, separately from the cystic, into the duodenum, but seems to be in conjunction with the pancreatic duct at its insertion. The cystic duct arises from the lower end of the bladder, is longer than the hepatic, is straight through its whole length, and opens into the duodenum, by the entrance of the hepatic and pancreatic ducts.

There is an oblong dark body placed in the root of the mesentery; it is thicker at one end than at the other, is about two inches long, and half an inch thick; it has arteries running along one side of it, and the veins seem to run principally on the outside. I imagine this is analogous to the 'pancreas asselli,' viz. a lymphatic gland: it is a good deal like the spleen of a bird, and as I could not find any ovaria, I do not know but this may be them, but rather suspect it is not. The crocodile, like the fowl, has no epiploon.

The kidneys are very large, very nearly as large as in the human body: they are situated on the pelvis something like those of birds; the upper end is largest and lies before the psoas muscles, and the lower end passes into the sides of the pelvis. They are convoluted like the brain, of a dark brown, in some places lighter; are in contact with one another, and have small bodies placed on the outer surface, as in the kidneys of fowls [1]. Their ureters enter the sides of the anus, or the rectum, after it has become valvular [2]. The ureters are as large as in the human subject; I should imagine that the urine was like that of birds,

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1 [Hunt. Preps. Phys. Series, Nos. 1182, 1189.]

2 [Ib. No. 747.]

as the kidneys are similar: the yellow bodies and the entrance of the ureters are similar.

Upon the outer surface at the upper end and inner edge of the kidneys are placed two oblong bodies that I take to be the 'capsulæ renales;' they are darker on their exterior surface than internally, and in some places little yellow bodies are to be seen upon them as in the kidney; and on the outer edge there is a very small yellow thread [the oviduct] passing down, which is continued along the broad ligament its whole length towards the anus. This seems to be a duct filled with yellow matter, which we see studded on the surface of the gland. In one given me by Mr. Bailey, which had no oviduct, these bodies were larger at the upper end, terminating below almost in a point. Behind the upper end there is another body, which goes a little higher and seems to be rather lighter in colour; whether this be a process of the other (whatever the other may be), or epididymis, or capsula renalis, or whether the whole is capsula, nothing but finding them in the copulating season can determine. The duct leading down had nothing in it[1].

Of the Female Parts.—There are two oviducts which lie on the anterior surface of the kidneys, extending the whole length of the kidney. They are attached to the kidney by a thin doubling of the peritoneum, which is about an inch broad; the course of these is serpentine; the upper end terminates in the fimbriæ; the other end passes down, and gets upon the fore-part of the rectum, then passes through the coats of that gut obliquely, excepting the internal; and, when blown into, it terminates in a blind point, forming a protuberance upon the inner surface of the rectum; but the air does not escape by any orifice therein: so in what manner they enter I do not know; but it must be in this common anus, as it is in birds, and must be, I think, by two orifices. The oviduct was about the bigness of a goose-quill, but was much smaller at the morsus diaboli[2]. There arises from the inner surface of this common anus, the clitoris, which is nearly an inch long, thickest at the root. At its point it is a little hollow, but very protuberant and rough; at its root it seems to begin from two flat white bodies about a

[1] [I found, in a male crocodile dissected at the Zoological Gardens, the testes narrow and long, situated a little atlantad and sternad of the kidneys. The semen was carried to two pretty large vesiculæ, lodged close behind the cloaca, formed in part by a cartilaginous sac; the openings were at the sides of the cloacal commencement of the groove of the penis.]

[2] [There are no fimbriæ; the margins of the slit-like abdominal aperture are entire: the cloacal orifices of the oviducts are demonstrated in the preparation No. 2724, Hunt. Phys. Series: see the description in Phys. Catalogue, vol. iv. p. 147.]

quarter of an inch broad, and near half an inch long; the formation of the anus is a slit about an inch long, and has a little of the external skin carried a little way into the rectum, but there it is very fine. The sphincter ani is very strong; the whole of the clitoris is hid within the anus[1].

The centre of motion of the lower jaw is nearly in the same line with the centre of motion in the head on the neck; but it is a little further back, nearly as far back as the union of the first and second vertebræ of the neck; so that there is one centre of motion to the jaws, and to the first vertebra upon the second. Now, as all the openers of the mouth are behind this centre of motion, and their origin from the head is at a greater distance from the centre of motion than the insertion is, it may be owing to this that the head moves upon the lower jaw. The raisers of the jaw or depressors of the head arise from the head; their origins are very extensive; they arise as far forward as half-way between the anterior and posterior nares, making part of the roof of the mouth posteriorly and laterally, but not in the middle, where there is an interval between the two muscles; they make part of the bottom of the orbit. This origin is continued backward along the base of the skull under the ear as far back as the [posterior margin of the entopterygoid bone]. From this extensive origin the muscles pass backward and downward in different directions, and the anterior fibres almost directly back, the others almost directly down, and are inserted into the upper edge and inner surface of the lower jaw principally before the centre of motion, but some are inserted behind it. The use of these is to raise the lower jaw or depress the upper one, and those that arise so far forwards will rather depress the upper jaw. As they are so far before the centre of motion at the origin, and so near it at the insertion, one would imagine that those fibres that are inserted behind the centre of motion, would depress instead of raising it; but the lower jaw is carried further back, and these fibres in some measure pass over a ridge of bone, as over a pulley, when the mouth is open, so that by these means these fibres are upon the stretch at that time.

There are two bony processes, one on each side[2], passing down on the middle of the lower jaw, just before the insertion of these muscles. These processes are covered on their exterior surface by a smooth articu-

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[1] [Hunt. Prep. Phys. Series, No. 2725. The peritoneal canals terminate on two papillæ, placed on either side the root of the clitoris or penis, and communicate, at about a line distant, with the cavernous structure of those parts; they oppose the ingress of fluids from without.]

[2] [The 'entopterygoids.' See 'On the Homologies of the Vertebrate Skeleton,' 8vo. 1848, figure 22, 24.]

lating cartilage; they move on the inside of the lower jaw like a joint; but that part of the jaw which opposes them is not covered by a cartilage, but with a soft ligamentous substance. There is a very loose capsular ligament[1], which has an opening at the angle of the mouth as in the drawing[2] of the head. These processes keep the jaw from moving from side to side, so that, as there is no rotatory motion, there is no moveable cartilage.

As the crocodile has no lips, the teeth are exposed[3]: they are very sharp, something of the shape of a lancet; the upper teeth stand on the outside of the under; they are not made for smashing or grinding, but are well fitted for holding; so that this animal must swallow everything whole that it gets into its mouth; which indeed they do. The posterior nares is one opening with a ridge, which becomes broader and broader, forwards in the nose and at last divides into two. The external nose is a round soft substance on the fore-part of the upper jaw near the lip; it does not project, and the two nostrils open near the lower end in a semicircular form[4]. The velum palati is opposite to the valve on the tongue, and is half an inch further forwards than the bony palate, so that it arises from the roof of the mouth, is very elastic, and completes the stoppage into the fauces[5].

The eyelids move equally, so that there is a depressor and elevator; but the last seems to be inserted pretty near the external angle (but this muscle I am not very clear about), and some of its fibres are lost in the tunica conjunctiva at its external part. The depressor is a very broad muscle, and seems to be inserted both into the membrana nictitans and the under eyelid. The course of it is oblique, arising from the internal, or rather what we would call the anterior part of the orbit in this animal; from thence it passes upwards and a little backwards. The use must be to depress the under eyelid; and, as it is inserted into the membrana nictitans and then comes back, it must

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[1] [A continuation of the membrane of the mouth.]

[2] [This drawing is in the Museum of the Royal College of Surgeons, and is engraved in the 'Physiological Catalogue,' vol. ii. pl. 26. fig. 1, *i*.]

[3] [Hunt. Preps. Phys. Series, Nos. 380, 388.]

[4] [By a single aperture. In the living crocodile the nose can be slightly raised, and much more so in the gavial.]

[5] [Hunt. Preps. Phys. Series, Nos. 1464—1467, and Phys. Catal. vol. ii. pl. 28. The margins of the tongue being tied down to the rami of the jaw, that part of the membrane over the basihyal cartilage is pushed up when this is raised, the tongue itself being immoveable; when the basihyal is depressed the valve disappears. This structure does not relate so much to the act of swallowing the food, as to that of seizing and retaining it under water; as a defence against the entry of water into the glottis during immersion, and against the intrusion of insects, when on land.]

bring that membrane forwards towards the anterior or inner canthus. Along the inner surface of the under eyelid there seems to be a ridge of glands. There are four straight and two oblique muscles, but there is not a trochlea for the superior oblique: the inferior oblique is the smallest, and arises from the inner or outer angle of the orbit. The four straight muscles are not inserted at equal distances from one another, and not at equal distance from the optic nerve; for the abductor is much the broadest at its insertion, is nearest the optic nerve, and is bound as it were to the nerve by the muscle of the membrana nictitans. The muscle of the membrana nictitans arises, broad and thin, from the sclerotic coat, between the depressor and adductor muscles, from thence it passes backwards and outwards, winding up the optic nerve and the abductor muscle; thence, forwards and outwards, and is lost in the lower part of the edge of the membrana nictitans: the last course makes it draw the membrane over the eye, which I saw it do, when the head of the animal was put into water.

The lacrymal [Harderian] gland is twice as large as in the human; it is very soft, and is white like a bit of fat; it lies at the inner or outer part of the orbit contiguous to the adductor muscle, and between the two origins of the oblique muscles. It is oblong, one end towards the bottom of the orbit; the other towards the inner angle of the eye, and is contiguous to the tunica conjunctiva. There its duct opens immediately into the cavity of the eyelid behind the membrana nictitans, so that the duct from the gland is of no length: its mucus was as thick and white as cream. The puncta lacrymalia are two, both of which are in the under eyelids, and these two unite into one common duct which passes to the nose. In another crocodile I could find but one punctum lacrymale[1].

The tunica sclerotica is very dense, but is transparent, so that the pigmentum nigrum appears through it. The pigment is on the outside of the choroid; is of a dark brown, and is pretty full of floating membranes mixed with the nigrum. The inner surface has no pigmentum nigrum, but is marked with a dark colour and a light one. The pupil of the crocodile is vertical, and when in a pretty strong light it is almost a mere line: when put into the dark the pupil dilates, but not into an oval form, but a rhomboidal. The retina is very thick and opake. The pigmentum covers the posterior part of the iris. The optic nerve runs serpentine, and enters with an obtuse angle towards the nose, which is contrary to [its direction in] the human subject.

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[1] [Physiological Catalogue, vol. iii. pl. 17. fig. 3. Hunt. Preps. Phys. Series, Nos. 1769—1771.]

The external ear is a flap, like the upper eyelid, covering the membrana tympani; which is bony at the upper part, like the orbit of the eye. The membrane is very superficial, being immediately under this flap, looking upwards and a very little downwards, and is rather convex externally, especially in the middle. The Eustachian tube opens behind the posterior nares, by one common orifice, to both of which there is a doubling of the membrane of the fauces like a clitoris within the prepuce. The Eustachian tube soon divides into two; at this division a cavity soon runs forwards a little way, and terminates in a cæcum; each Eustachian tube passes outwards in a bony canal all the way to the tympanum, becoming smaller as it passes in: thence it passes backwards, diverging. There is an irregular fasciculated surface, I suppose the tonsils, or a glandular substance[1].

The thyroid cartilage is broad and flat, a good deal the shape of the mouth of a shovel; it stands prominent in the mouth at the root of the tongue, where it appears as the epiglottis[2]. There are two glandular bodies on the neck, close to the upper part of the thorax on each side of the trachea, a good deal like the thymus and some small ones scattered near them, having lymphatics passing into them.

There are pretty broad cartilages fixed to the lower edge of most of the true ribs, like the bony processes in birds; their lower edges overlap the ribs below. They have two false ribs on each side at the upper part of the thorax.

The lungs are two lobes, one on each side; they lie pretty far back, and do not come forwards as in the human: they are, therefore, oblong; they are loose, except at the lower end, where they come in contact with the liver, to which they adhere all round that surface of contact, which forms a capsule between them and the liver; the left lobe adheres by a broader surface; it also adheres to the anterior part of the stomach on the left of the œsophagus[3].

The apex of the heart[4] adheres to the pericardium, in which adhesion passes a vein from the heart to the liver; this is one of the coronary veins. Besides the two carotids, as in the more perfect animals, they have two running up the fore-part of the neck covered by the muscles, as in birds.

The fat is not oily, nor solid like that of an ox, nor is it quite so soft as the human: it is of a brownish ash-colour, and has very much the appearance of being glandular, being similar to some conglomerated glands, such as the pancreas.

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[1] [Hunt. Prep. Phys. Series, No. 1577.]

[2] [The above description applies to the basihyal cartilage. See Note 3, p. 342.]

[3] [Hunt. Preps. Phys. Series, Nos. 1118—1123.]

[4] [Ib. Nos. 921, 922.]

The skin in some places, especially the tail, gives origin to muscles: this is like the turtle, lobster, &c. The ribs have a great deal of motion. The depressores costarum are very large muscles, and cover the whole of the inside of the ribs, and what answer to the triangularis sterni are also very strong. These circumstances may account for the want of a diaphragm.

The stomach was full of the leaves of vegetables: the intestines were also full of them, but they were become indistinct, excepting that some of them had the appearance of being dissected; viz. the pulpy part was destroyed, and the fibrous parts left.

Although the crocodile is classed with the AMPHIBIA and really comes nearer [to that class] than to any other that I know of, it has not all the same character, as has been observed. It comes nearer the bird than any of the others, and therefore is a degree higher [than the other AMPHIBIA]. The brain, although it has the same parts [as in the Amphibia], yet has them closer connected, and the skull is more in contact with it[1].

Of the Construction of the Heart in the Fœtus of the Crocodile.

From the construction of the heart in the AMPHIBIA, where the two bloods meet in the ventricle, one would be inclinable to suppose there would be no occasion for a foramen ovale or ductus arteriosus; but in the crocodile we have both. The foramen ovale is to be considered as the first communication between the two bloods or circulations; in the crocodile it is large and free. The pulmonary artery, which arises from the anterior part of the right ventricle, after going out, divides into two, one going immediately to the lungs of the left side, while the other passes behind the different aortas, and passes to the lungs of the right side, from which passes down a branch which joins the left aorta, which forms the ductus arteriosus. What this is to answer one can hardly conceive, as it would appear that the same purpose could have been answered by the adult construction; but it becomes a kind of proof that the two bloods are kept much more distinct in the adult than what we should have imagined, from the communications between the two ventricles[2].

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[1] [Hunt. Preps. Phys. Series, Nos. 1315—1318, 1348. The spinal chord is shown in No. 1349.]

[2] [The following are my notes made on dissecting the heart of the *Alligator lucius* and *Crocodilus acutus*, at the Gardens of the Zoological Society in 1831 and 1834:—

"Laid open the left ventricle of the *Alligator lucius*; traced the small depressions near the base of the ventricle which lead to sinuses extending towards the right, but which divide and are lost in the septum, without penetrating the cavity of the right ventricle. The same with respect to the sinuses at the apex, where some small com-

Of the Yolk.—In the yolk of the alligator, while in the state of incubation, there is a quantity of oil collected in different parts of its substance; whether this oil is in the yolk before incubation, or is formed from the yolk in the time of incubation, is not in my power at present to determine: this oil can be squeezed into the gut through the duct[1].

[Order CHELONIA.]

This may be called one order, of which I shall at present reckon two genera, and of which there are many species. The two genera are, the turtle and the tortoise. Which should be reckoned first and which second, I cannot at present determine. From the tortoise[2] probably being wholly a land-animal, and the turtle being an animal of the water as well as, if not more so than of the land, it might be thought that the tortoise was nearer to the orders or tribes above them; but from some circumstances it is rather less so, the turtle having lungs more like those of the bird than the tortoise has.

Of the first [aquatic Chelonia] there is also a great variety. One tribe, which is probably the largest in number and also in size, includes those which inhabit the sea[3]; and the other [those which frequent] fresh water[4], probably rivers, and often ponds. A species of this kind

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munication may, however, take place. Injected mercury by the left aorta, hoping the valves might be not so complete, but that the metal would pass into the right ventricle: however, it did not, but it passed freely from the left into the right aorta and its branches. Then injected mercury into the right auricle and ventricle, but none got into the left ventricle.

"In the heart of the *Crocodilus acutus*, injected mercury by the left auricle into the left ventricle, and kneaded the cavity in order to press it through any of the sinuses which might establish a communication between the two ventricles; then opened the right ventricle, and found some mercury in it; but on pressing the left ventricle, found that the mercury passed into the right ventricle from the orifice of the visceral aorta, which had received it by the aperture of intercommunication with the aorta from the left ventricle. Upon repeating the pressure on the left ventricle, filled with mercury, none passed into the right; and on tracing the different sinuses leading from the right ventricle, they all terminated in the parietes of the heart, without communicating with the left ventricle.

"The orifice of intercommunication between the two aortæ is larger in the alligator than the crocodile. But this is the sole medium of the intercommunication between the venous and arterial bloods, which exists in the central organ of circulation. See Preparation No. 921 A, *Crocodilus acutus*. To convert a crocodile's heart into that of a bird's, stop up the orifice leading from the right ventricle into the visceral aorta, and obliterate that vessel."]

1 [Hunt. Preps. Phys. Series, Nos. 3364—3374.]

2 [Genus *Testudo*, Cuv.]

3 [Genus *Chelone*, Cuv.]

4 [Genus *Emys*, Cuv.]

is found in the ponds in the Bay of Honduras: it is not much larger than a crown piece, and is called by the Indians *Shanqua*[1].

[Family *MARINA*, Turtles.

Genus Chelone, Cuv.]

The Turtle[2] [*Chelone mydas*, Cuv.].

Most of the muscles that move the first bones of the extremities [humerus and femur], instead of arising from the external surface of the trunk-bones, as in a man, arise from the inside of those bones, or what answer to them; for, in this animal, we have the properties [of its class] in some particulars inverted; for the muscles that arise from the external surface of the trunk in common [*i. e.* in *Reptilia* and *Vertebrata*] arise from the internal.

Upon removing these muscles, and likewise the pelvis and the scapulæ, we have a view of the whole contents of the body. The abdomen, thorax, and pelvis form one cavity without any marks of distinction either by whole or partial separation. There seems but one muscle, which arises almost all round the cavity and becomes tendinous on the anterior part. The heart, indeed, is enclosed in a bag for itself, which lies in the upper part of the common cavity, midway between the two sides, and with its axis parallel with the axis of the body[3]. There was a good deal of fluid in the abdomen, of a mucilaginous consistence, which coagulated when exposed; although the day was hot.

The bladder, which is situated in the same place with the urinary bladder in the more perfect animals, is certainly not the bladder of urine in this animal; because the ureters open into the common passage just by the openings of the oviducts[4]. The bladder is similar to that in the toad and frog, with respect to situation, and most probably use; and so far this animal is near these in order.

The brain of the turtle does not fill the cavity of the skull. There is a strong tunica arachnoides, which is attached to the dura mater at

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[1] [See p. 359: probably the *Emys ornata*, Cuv.]

[2] [In the autumn of 1763 Mr. Hunter was requested to assist in dissecting a turtle sent to Dr. Wm. Hunter by Robt. Adair, Esq., because "it was known that he had dissected many." Hunter writes:—"The late Sir John Pringle, P.R.S., knowing of this dissection, often desired me to collect all my dissections of this animal, and send them to the Royal Society, which, if I had done, would have deprived Mr. Hewson of the supposed honour of the discovery, but the publishing a description of a single animal, more especially a common one, has never been my wish."]

[3] [Hunt. Prep. Phys. Series, No. 888.]

[4] [Ib. No. 1272.]

the parts where the nerves go out[1]. At the basis of the skull it is attached to a cartilaginous knob[2]. Along the top of the skull it has different attachments, which would appear to answer the purpose of a falx; and between the cerebrum and cerebellum, there is either the going out or the coming in of the longitudinal sinus. There are eleven pairs of nerves arising from the brain: the ninth pair receives the accessorius[3].

Of the Breathing of the Turtle.—It appears to be a considerable effort in a turtle to draw in its breath, as they have no distinct thorax or apparatus for breathing. It becomes a distension of the whole body, which includes the abdomen. If a turtle is thrown upon its back, and makes an inspiration, we may observe that his four fins are, as it were, erected: the breast-bone is pushed forwards, and they swell out wherever the parts are soft; all this is done, I conceive, by the muscles of the extremities moving their respective bones in an inverted order; for, instead of their moving the extremity, the extremity becomes the fixed point; and the bones answering to the clavicles are moved forwards; and the bones of the pelvis at the lower part are pushed against the inside of the breast-bone, so that the whole bone [plastron] is pushed out[4]. They appear to draw in their breath but once in twenty minutes or half an hour, and often at a much longer interval. They are constantly working their throat, moving it outwards and inwards, which made me suppose that this motion was short breathing; but their doing the same when under water, when no air could pass or enter, made me relinquish that idea. When its throat was cut, and bleeding freely, I could hardly observe that the blood flowed by jerks.

Of the Arteries.—The heart has three arteries arising from it, viz. a right, middle, and left. The right supplies every part of the body excepting the lungs, liver and intestinal canal; the middle supplies the liver, stomach, and guts; and the left supplies the lungs only.

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[1] [Hunt. Preps. Phys. Series, Nos. 1312—1314.]

[2] [The ligamentum denticulatum arises from this knob, from which it diverges on each side to gain its usual situation between the anterior and posterior roots of the spinal nerves. The fourth ventricle is closed posteriorly by a diaphanous layer of pia mater. The cellular flocculent external surface of the arachnoid sac is turned towards the brain; it does not penetrate the ventricles.]

[3] [The homologue of the ninth, or hypoglossal, nerve in man, arises two lines mesiad of the nerve which the accessorius joins; the nerve which, on account of the separate origin of the glossopharyngeal, is the ninth in number in the turtle, is the nervus vagus. The nervus accessorius comes from the posterior myelonal tract, as low down as the third cervical nerve.]

[4] [Such a movement is only possible in the turtles and trionyces; in the rest of the chelonian order the plastron is fixed by bone to the carapace.]

It would appear that the arteries of a tortoise (turtle) did not contract longitudinally so much as the veins and mesentery. I observed that when an artery was cut through, and looking upon the end of it, that it consisted of an external white ring, and an internal ash-coloured one, somewhat transparent. This internal coat is much softer or more spongy than the other; its fibres are principally circular, and are very elastic, but not quite so much so as the external ones[1]. I do suppose that these internal fibres are muscular; but their being elastic made me suspect [the accuracy of] this: however, I found that most of the muscles had a greater degree of elasticity than the muscles of other animals. I found that the lower end of the mesenteric artery opened into the aorta.

Of the Lymphatics.—In a young turtle I observed the lymphatics, and they had but very few valves. I could not see any lymphatic glands. The absorbents pass on the inner membrane of the gut, which is thin and easily separated from the outer, or muscular. They pass longitudinally or in the direction of the gut, and are so numerous as to be in contact with one another, forming a plexus. From this plexus they send out small regular vessels which penetrate the outer coat, and afterwards join and pass along with the blood-vessels[2].

Of the Trachea and Lungs.—The opening of the trachea is on the upper surface of the tongue, something like that of a bird, which is an oblong body attached by its whole under surface[3]. The os hyoides is similar to that in birds. The cartilages of the trachea are circular, but a little flattened: the tube divides into the two bronchi behind the upper part of the heart, which thence pass into the lungs.

The lungs are oblong bodies, almost the shape of a cow's melt. They are placed in the general cavity of the abdomen close to the spine, and pass backward in that direction, adhering by the inner edge, and likewise adhering to the back-shell [carapace] by more than one half of their breadth, from end to end. The part that does not adhere is towards the external edge, so that you can raise that edge. The upper [anterior] end is thicker and somewhat broader than the lower; and adheres to the vessels, &c. at the upper part. The lower end is much more than half-way down the body[4].

Of the Digestive Organs.—The œsophagus is large, and beset with pointed bodies on its internal surface through its whole length, which are of an acute pyramidal figure covered by a strong coat, which

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[1] [Hunt. Preps. Phys. Series. Nos. 940, 956—962.]
[2] [Ib. Nos. 850—854, 864.]
[3] [Ib. Nos. 1462, 1463.]
[4] [Ib. No. 1110, *Chelone caretta*, No. 1117, *Chelone imbricata*.]

becomes horny at the points; they stand very oblique with their points down towards the stomach, and the œsophagus enters the stomach at one end, not in the middle, as in the human[1]. The use of these bodies would seem to be to prevent the regurgitation of solid bodies, as they must make a most formidable barrier. Perhaps as the animal has not teeth to chew live animals, Nature has taken this precaution; yet I should suspect some other use[2].

The stomach is a long cavity, and seems to be continued directly from the œsophagus, lying for more than one half of the upper end in the direction of the body, on the left side of the abdomen, a little bent, having its curve to the left side: it makes a pretty quick turn upon itself like a fold, and then terminates in the duodenum[3]. It is attached to the liver by a mesogaster, or little epiploon, but not by a loose membrane, as in the human body. The pylorus is not very valvular.

The intestines[4] pass first to the right side, and then become in general very loose, excepting at the upper end of the rectum on the left side. There they are, as it were, bound down, and are one continued canal to the common passage of fæces, eggs, and urine [cloaca], which is some inches in length[5]; but there is a contraction which divides what may be called the small intestine from the colon. There are no valvulæ conniventes. There is no large epiploon.

When I cut out the mesentery after the animal had been dead twenty-four hours, and put it into cold water, I observed that it contracted much, and that the arteries that ran straight before, ran now very serpentine, but that the veins still were straight. The contraction of the mesentery I imputed to muscular contraction by the stimulus of cold water.

The liver is a pretty long body, and lies at the upper or fore-part of the abdomen across the body, adhering to the pericardium, &c. The right end is the largest, the liver becoming smaller towards the left end, which lies upon the stomach. The vena cava passes through its substance. The gall-bladder is a round body, much the shape of a short pear, adhering to the liver about one-third of its length nearest to the right side. Its apex comes close to the gut, and its duct may be said to be entirely within the coats of the gut. The passage of the duct through the gut is very oblique, therefore it does not terminate in a projecting point, as in the human. The gall is green as in a bird's,

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1 [Hunt. Preps. Phys. Series, Nos. 460, 461.]

2 [The structure is peculiar to the turtles which feed upon slimy sea-weeds, often of great length.]

3 [Hunt. Preps. Phys. Series, Nos. 514—516.]

4 [Ib. Nos. 665—668.]

5 [Ib. No. 713.]

with a sediment in which it could not pass the duct. The cystic duct is larger, straight, and not very long, opening into the duodenum, about two inches beyond the pylorus. There is a long hepatic duct from the left side or end of the liver, which runs externally to the liver, between it and the transverse pancreas, making in its passage several turns: it joins the right hepatic duct, and the common trunk joins the cystic not far from its entrance into the duodenum. There are no hepato-cystic ducts[1].

The pancreas is similar to that of a fowl's, viz. it is divided into two; one running in the curve of the duodenum and stomach, and the other in the contrary direction: the duct enters near the ducts of the liver.

The spleen is a rounded body situated in the middle of the body behind the upper part of the intestine at the root of the mesentery, adhering to the pancreas; very much like the kidney of a lion in shape, having its veins passing on the outside[2]. The arteries are very small.

The kidneys are situated at the lower part of the abdomen, covered by other bodies, and smoothed over by the peritoneum, so as not to be seen at first. They are flat on the anterior surface and a little rounded behind; are convoluted like a fowl's; and have their vessels enter at its anterior surface[3]. The ureter comes out at the anterior surface and lower end of the kidney, and enters the bladder near its opening into the rectum by a flattened protuberance. The bladder is an oblong body and pretty loose[4]: the urethra, or opening, is large, and, as it were, of no length. The urine is not very thick; but the bladder was lined with a thick mucus, which made us suppose it to be urine, as there was no other urine in the bladder.

The Male Parts.—The testes are oblong bodies lying upon the kidneys, much in the same place with the ovaria. They are thick at their anterior ends, and become smaller and smaller to their posterior parts, and ending almost in a point. They adhere by a very narrow line, so that they can be turned from one side to the other. In texture they are extremely spongy or cellular, so as to be easily inflated by blowing by a pipe into their substance. They are of a cream colour through their whole substance[5]. Where they adhere to the kidney, pass out the ducts, which form the vasa deferentia. These proceed in a contorted or convoluted manner along the surface of the kidney, adhering to it, and pass into the union of the bladder and rectum, and open into the upper part of what may be called the urethra, each by a prominent nipple flattened from side to side[6].

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[1] [Hunt. Preps. Phys. Series, Nos. 813, 814.]
[2] [Ib. No. 831.]
[3] [Ib. No. 1183.]
[4] [Ib. No. 1272.]
[5] [Ib. Nos. 2441, 2442.]
[6] [Ib. Nos. 2444, 2445.]

The urethra and last gut may be considered as opening into one common canal or cavity [uro-genital canal] at one part, or together, which canal leads to the anus and is of a livid colour. Along the lowest or anterior side of this canal passes a groove; this groove begins at the opening of the urethra, and would seem, at the beginning, to be almost wholly in the side of the canal; but, as it advances towards the anus, its sides rise higher and higher, till at last it emerges wholly out and projects like a bird's tongue, underneath which projection is a fold of the internal membrane, which is a kind of preputium. This groove is made up of a firm ligamentous substance, so that it is always straight; it is the conductor of the semen to the female, and the projecting part may be called the penis. This projecting part does not seem to be capable of elongating so as to project beyond the anus at the time of coition; but all the parts are brought further back, and a kind of prolapsus is produced which exposes the penis. This can be done in the dead subject by introducing the finger and laying hold of the penis and pulling it out[1].

The Female Parts.—The ovaria are situated before the kidneys; they appear like a membrane sewed down on its middle, and puckered or gathered so that its edges run in a convoluted manner, broadest in the middle, becoming narrower and narrower, and ending in an obtuse point. This membrane is studded as thick as possible with small bodies, some of which are darker than others, which make the whole a kind of grey colour. They have their vessels mostly from the lower part of the aorta[2].

The oviduct [traced from the cloaca] runs along in the doubling of a very thin broad membrane from the rectum, upward and outward, over the kidney, on the outside of the ovarium, and then along the shell [carapace] on the outside of the lungs as far as the upper and fore-part of the abdomen, and opens upon the edge of this membrane in an oblique direction [the anterior or abdominal aperture], which makes the edge appear double for some way. They had no opening into the rectum; but where they emerged into the adhesion of the rectum and bladder, they became wider, and seemed to terminate in a blind end. But this blind end is within the nipple of the ureter; therefore it is most probable that they enter there, as they do not come near the rectum[3].

On the outside of this cavity is an oblong protuberance projecting inwards. The inner surface of this cavity is rugous. All round these

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[1] [Hunt. Preps. Phys. Series, No. 2446.]

[2] [Ib. No. 2718.]

[3] [Ib. No. 2722, in which the cloacal aperture of the oviduct is shown.]

parts there are vast plexuses of veins. The vessels of the oviduct are from those that come to the ovaria, but the upper part is supplied from the brachial; before they pass out of the shell these anastomose with the ovarial artery on the membrane of the shell.

The clitoris is a good way from the common opening of the rectum and bladder: it is something like a bird's tongue lying in the lower jaw; for there are two projections or points from the clitoris, passing as two bodies, like cords, on to the bladder, and seem to be lost there. These two cords make a groove, which becomes wider from the tip of the clitoris as it passes to the bladder. From this groove, two ridges arise, about an inch from the mouth of the bladder, and, as they pass to the mouth of the bladder, encompass it, or are continued into the mouth of the bladder[1]. These grooves are a kind of conductors of urine and eggs. Two muscles are inserted into the root of the clitoris which arise from the pubis: their use seemed to be to fix it and make it less moveable. There is a cavity on the upper part of the termination of the rectum, into the common cavity, as in fowls[2].

Of the Eye.—The under eyelid seems to move most, and therefore has less of the scales upon it, and those that are there, become softer the further they are from the edge of the lid; so that it admits of being folded near the brim of the orbit, and on its inside. In every respect the contrary obtains in the upper lid; for the scales become harder and broader the further from the edge of the lid; so that the folding of the lid is near the edge, and in the raising of the lid it is pushed out, or swells out. The muscle of the inferior lid is very broad, arising from the bottom of the orbit, the same as in the human subject. The internal surface of the lid is lined with a cuticle[3]. There is a membrana nictitans, which is very strong and thick; it is moved by two muscles, which arise together from the globe of the eye on the inner side of the optic nerve; the common muscle is pretty broad and passes above the nerve, outwards, becoming narrower, and then divides into two distinct muscles, each ending in a round tendon: the lowest is lost in the superior horn of the nictitating membrane, at the external canthus; while the other continues its course round the optic nerve to the lower part of the eye, and is inserted into the lower horn[4].

There are two glands, one at the external canthus, the other at the internal, as in fowls. The external [true lacrymal gland] is very large, about the size of the eye itself, and is of the conglomerated kind, having a wide short duct opening into the external canthus of the eyelid: the

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[1] [Hunt. Prep. Phys. Series, No. 2719.]
[2] [Ib. No. 2130.]
[3] [Ib. No. 1768.]
[4] [Ib. No. 1767.]

mucus is thick, like pus. The other gland [Harderian] is small, about the bigness of a common bean, having a small duct opening on the inside of the membrana nictitans. Its mucus is thinner than that from the large gland, but is more slimy[1]. There are no puncta, nor sacculus lacrymalis.

The globe of the eye has four long straight muscles, as in the human, but not corresponding to the angles of the lids as in the human. Likewise one continued muscle round the optic nerve. There are also two oblique muscles; the superior is double at its origin, like a biceps, enclosing the insertion of the abductor or levator, and is the strongest, but it is not a trochlearis. The inferior has the common structure.

The globe of the eye is not a true sphere, the narrow axis being between the outer and posterior parts. It has but a small cornea. The anterior part of the sclerotic is bony as in fowls, [the bones being], as it were, enclosed in a doubling of the sclerotic. The sclerotic becomes very thick posteriorly; or, rather it is lined with a thick spongy part which is black, covered by the horny substance of the true sclerotic. The optic nerve is very oblique; it passes through the coats of the eye without any contraction, and seems to terminate by a smooth end in the eye; but is continued into the retina. The retina is thick and strong, and does not pass so far forward as in the human, and terminates in a distinct edge. There is a strong nigrum pigmentum between the retina and tunica choroides, and another between the choroides and sclerotic. The sclerotic is vascular. The crystalline humour is small, and is nearly spherical, only a little flattened on its anterior surface[2]. The turtle can see [the same object] with but one eye at once.

Of the Ear.—Behind the orbit there are four scales [placed vertically], the edges of which make part of the posterior edge of the orbit; behind these there is a second row, four in number; behind this row is a third, which is more irregular, and the scales are smaller; and behind these is a pretty broad scale. Under the second scale of the third row, counting upwards from the articulation of the lower jaw, lies the external part of the ear. Under these scales is a thick ligamentous substance, and immediately under that is a soft pulpy substance, very vascular, of a cellular texture, which chiefly runs from a centre. When this is removed, we find a small oblong oval convex body with its broad end forwards, of a transparent cast, and of a horny nature. This body is attached all round its edge to the bones of the head, and to a strong ligament that is placed upon its upper and posterior edge. This strong

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[1] [Hunt. Prep. Phys Series, No. 1766.]

[2] [Ib. Nos. 1674—1676.]

ligamentous substance is also convex externally, and is a covering to the larger part of the external cavity of the ear, which cavity is continued backward, like the cells of the mastoid process in other animals. The oblong body [representing the membrana tympani] is convex externally and concave internally, in shape something like the mouth of a spoon: it is loosely lined with a fine transparent membrane, which seems to be a covering for that part of the ear, and is attached to it by pretty long fibres.

The Eustachian tube begins at the posterior part of the mouth, a little behind the articulation of the lower jaw. It is membranous at the beginning, but soon becomes ligamentous on the posterior part, and bony on the anterior, excepting just at the middle, where there is a little piece of cartilage, which makes this part a little more bent. The membranous part is a little contorted, and becomes a little narrower at the beginning of the cartilage. The bony and cartilaginous part forms one curve, whose convex part is turned backward. The cartilage takes the same sweep with the bone, and seems to fit it; so that the cartilage seems, in its natural situation, to lay close to the bone, which flattens the canal. This cartilage is moveable, and projects a little into the cavity of the ear; it has a very strong muscle attached to the posterior convex surface about the middle, which pulls it back, and at the same time a little outward, from the cavity of the ear. This enlarges the cavity of the canal, and by bringing out the cartilage it seems to have some effect upon the bone of the ear by being attached to it[1].

The other part of the ear is enclosed chiefly in bone, which is much harder where it makes the inner surface of the [acoustic] cavities than elsewhere. That part which is next to the brain, or that which makes part of the cavity of the skull, is cartilaginous.

Under the horny ligamentous substance before mentioned [the ear-drum, or homologue of the membrana tympani], is a large oblong cavity, which answers to the tympanum in the human. Its direction is forwards and backwards; it is one circumscribed cavity lined with a dark-coloured membrane, having the Eustachian tube opening on the external end. From the concave side of the horny [ear-drum] passes a long small bone to the vestibulum: in its passage through the tympanum it is attached by its whole length to the inner end of the cartilage of the Eustachian tube. Then it enters a bony canal, surrounded by a strong ligamentous substance, but is only loosely attached to this substance, so as to have free motion in it. At its inner end it becomes

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[1] [Both the tensor and laxator tympani arise from the cartilaginous part of the Eustachian tube in mammals, and are inserted into the malleus.]

thicker, and terminates by a thick broad flat end in a hole that leads into the vestibulum, and makes part of the sides of that cavity. The length of this bone was about an inch and a half; but it must be shorter in smaller turtles. This difference in size [according to age] is contrary to [the state of the tympanic ossicles in] the human subject.

The vestibular cavity in the bone is somewhat irregular, but not very much so: it is a little flattened on its outer and inner surfaces. The bony semicircular canals hardly deserve the name; they are large holes passing round a small piece of bone. Within this general cavity of bone there is a lining of a spongy membranous consistence, which seems to be divided into two; one the outer, which is immediately compressed or influenced by the tympanic bone; the other, or innermost, next to the skull, seems to be the communication of the semicircular canals, and to go through a cellular network before entering the cavity. This cavity, with the semicircular canals, is filled with a fine cellular substance which is loaded with water. Through each of these bony canals passes a small tube about the size of a hog's bristle: these [membranous semicircular canals] are attached to, or lost in, the partition between the two cavities, and become much larger at this attachment, being there somewhat bulbous [the ampullæ]. They are of such a nature as to keep circular, and I should suppose answer the purpose of the bony semicircular canals in other animals; and the cellular membrane and water surrounding them is to keep them suspended in their proper places. I found a good deal of mucus in the second cavity like the urine of birds[1]; the inner surface is cartilaginous in the middle, and membranous round the edges, so that it is moveable, and would seem only a partition between this cavity and the [bony] semicircular canals, but I found a small passage between it and the cavity of these canals.

I could not find any openings into the cavity of the vestibulum; but one had an opening into the common cavity of the canals.

There are two nerves; the anterior is the largest: this nerve, as it is going to pass out of the skull, divides into two, both of which pass into the ear, and seem to be lost on the partition where the small canals are lost. The posterior nerve divides also, and sends a small plexus to the anterior part of the same partition. There is no fenestra rotunda, only the opening [fenestra ovalis] where the long bone, answering to the stapes, malleus and incus, terminates[2].

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[1] [The substance of a chalky nature, answering to the 'otolite' in fishes.]

[2] [Hunt. Preps. Phys. Series, Nos. 1578—1580.]

[Family *PALUDINOSA*, Box-tortoises, Terrapenes.

Genus CISTUDO.]

THE [FRESHWATER BOX-]TORTOISE, from Germany [*Cistudo europæa*, Flem.; *Emys lutraria*, Lac.[1]].

This tortoise is about 6 inches long, and wide in the usual proportion, with a rather convex shell, although not so much so as in the South American tortoise [*Testudo tabulata*]. The tail of the male is much longer than that of the female; it is about three inches long. The female turns her tail to the right side. The anus is continued obliquely along the base of the tail in both, but further in the male, as his tail is longer; and, at last, forms there a kind of groove. When they draw in their heads into the shell they throw out some air, from the lungs, which feels very cold to the hand.

It has a membrana nictitans.

The abdomen is a complete cavity, there being no attachments between the peritoneum on the fore-part and any of the viscera, excepting where the two anterior venæ cavæ send off branches to the liver. From this circumstance, does the yolk enter the abdomen in the fœtus as in the chick and crocodile?

The stomach passes across the body along with the lower surface of the liver, having a part of that viscus projecting into the hollow curve, which answers to the lobulus Spigelii: on the right it terminates in the pylorus. The hollow curve of the stomach is closely attached to the liver before the lobulus Spigelii, by a membrane and vessels. The great curve is attached likewise to the liver behind this process by a membrane which is analogous to the great epiploon; but this membrane is no broader than the distance [between the parts it connects].

The stomach has a glandular part on one side, a little way from the pylorus, with many orifices. The duodenum becomes immediately a loose intestine, continued, as such, into the jejunum and ileum. The small intestine is very short, and gradually passes to the left along the mesentery, and terminates in the cæcum which lies nearly in the middle of the abdomen. From the cæcum is immediately formed the rectum; for we cannot say there is any colon. The rectum terminates in the [cloaca]?. The anus [cloacal outlet] is cut off obliquely, so as to form a groove under the tail.

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[1] [The shell of this box-tortoise is No. 996, Hunt. Osteol. Series. It is the species described in the beautiful anatomical monograph by Bojanus, 'Anatome Testudinis Europeæ,' 1819—1821, fol.]

The pancreas is very small, lying in the first curve of the first intestine. This gland bears a much smaller proportion to the liver [than in mammals]. The liver has two lobes, right and left, united in the middle, by a continuation of substance. The spleen is a round body lying behind the stomach.

The coronary artery arose, in one specimen, from the subclavian on the right, in another from the fore-part of the right aorta. The bladder is an oblong bag laterally, the long axis being from right to left, answering to the breadth of the abdomen: it appears to come out from the side [of the cloaca] and opens into the rectum [uro-genital canal].

The lungs of this genus are [proportionally] much larger than [those of] the turtle: they fill the whole back, as low as the extremity of the pelvis, having almost every viscus adhering to their anterior surface, but they are thrown into a large irregular cavity, more especially at the lower end. There is not a branching trachea dividing into cells as in the turtle[1].

Of the Male Parts.—The male parts consist of two testicles, vasa deferentia and penis. The two testicles lie on each side of the rectum, before the lower end of the lungs: they are pretty large bodies. The vas deferens goes out from the [upper and inner] end; and as it passes down it is very much convoluted, forming a body, like the epididymis. This body is of a dark colour, having a dark covering, and the [convolutions of the] duct are united by dark cellular membrane. The last part passes along with the ureter, as it is passing from the kidney to the bladder, and they both open together into the urethra [uro-genital canal] before it opens into the rectum[2]. The penis is long, and begins as the clitoris; but the projecting part is of considerable length. It can be pulled out of the anus more than two inches; it has a deep groove passing through the whole length. It has much the appearance of a tongue. It begins by two kinds of crura, which are spongy, and the veins about each crus are large, so as to give fullness to these parts.

Of the Female Parts.—There is an ovarium on each side, of a yellow colour, situated on each side of the rectum. They are near 2 inches long, half an inch broad in the middle, and very thin, having one edge attached to the surface of the lungs by a thin membrane. They are granulated. The oviducts begin laterally on the fore-part of the lungs,

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[1] [Compare the preparation No. 1109 A, added by me to the Hunterian Phys. Series, with Nos. 1110 A, and 1111.]

[2] [The vestibular part of the cloaca, Hunt. Prep. Phys. Series, No. 2447.]

being attached to them by a thin membrane or meso-oviduct, which begins much higher. In the floating edge of this membrane the duct begins by an oblique division of the membrane into two, [the 'ostium abdominale'], and its coats become thicker as it approaches the neck of the bladder or urethra: it is considerably convoluted in this passage. The two oviducts would seem externally to be united across the rectum just before their openings. They open by the ureters just before they open into the rectum [uro-genital canal], and exactly where the vasa deferentia open in the male. The clitoris begins at the opening of the urethra by a shallow groove, which becomes deeper and deeper, owing to the two edges rising higher, until at last they make a slight projection in the anus[1].

A [Freshwater] Tortoise, from Mr. Parkins, No. 40, Upper Wimpole-street [*Emys*].

This was about 9 or 10 inches long, and 7 wide; with the skull [comparatively] flat, similar to the common German tortoise [*Cistudo europœa*]. The ileum was continued into the colon, but there was no cæcum; however, when blown up, the colon had a swell on one side more than the other. The length of the small intestines was three times the length of the animal. The gall-bladder lay in a hollow of the right lobe of the liver, attached by a broad surface.

The Small Turtle from Mosquito Shore [*Emys ornata*, Gray[2]].

This is about the size of a large crown-piece, and is prettily marked. It lived with me about two years in a hot-house, in water, and sometimes out of it. It ate worms. The viscera were similar to those of the tortoise.

[Family *TERRESTRIA*, Land Tortoises.

Genus Testudo, Cuv.]

The body, or what is commonly called the shell in this genus, contains the whole of the animal; for the head, extremities, and tail are only occasionally projecting parts, and the bases whence the four extremities spring, as the bones of the shoulder and pelvis, are wholly contained within the shell; and the thigh when drawn up projects in the lower and lateral parts of the abdomen. These last circumstances make a

[1] [Hunt. Prep. Phys. Series. No. 2720.]
[2] [It is dissected, and forms the Hunt. Prep. Phys. Series, No. 1271.]

distinction between them and the turtle. The tail of the female is much shorter than that of the male, and they turn, or rather fold, it to the right.

The Land Tortoise from South America [*Testudo tabulata*, Walbaum[1]].

The cavity of the body of this animal is but one, containing the whole viscera. It may be wholly called abdomen, there being no division for respiration similar to the diaphragm; but in those that have a division the heart is also enclosed in its proper membrane, without making any more divisions. There is nothing similar to the cavity called 'pelvis;' for whatever passes through the bones composing this part, fill the passage entirely. The cavity of the abdomen is one large cavity within the shell, in which lie the heart, lungs, stomach, intestines, liver, spleen, pancreas, kidneys, bladder, and internal parts of generation. The peritoneum, which lines the fore and lateral parts of the shell, is attached in many places to the lower edge of the liver, and passes over it, attaching itself to its upper surface in several places, as also to the pericardium, making as it were its lower surface, and forming by these attachments large capsulæ or cells on the upper surface of the liver. But these attachments are not in all animals in whom the peritoneum makes a kind of diaphragm. This is somewhat similar to the crocodile; but its attachments are not so uniform; [for, in the crocodile, it] makes a separation between the cavity of the abdomen and that part which constitutes the heart, which might be called 'thorax.'

The œsophagus, when got below the liver, dilates into the stomach, which immediately bends towards the right, having no projection towards the left. Its small hollow curve is closely connected to a branch of the vena portæ, passing along the under surface of the liver to the left, having a projection of the liver behind it, answering to the lobulus Spigelii.

The stomach is thick in its coats, and has an oblong glandular part in its coats with orifices on its inner surface. As the stomach passes to the right it becomes smaller, not appearing to terminate in anything like a pylorus; however, there is a regular termination[2]. The first intestine then passes down the right side, connected closely to the anterior surface of the lungs and posterior surface of the ascending part

[1] [The skeleton of this tortoise is No. 1044: the skull is No. 1045, Osteol. Series.]
[2] [Hunt. Prep. Phys. Series, No. 512.]

of the colon, and near the lower part of the abdomen becomes a loose intestine, making one pretty large sweep round, then coming round towards the right again, as also towards the cæcum. The cæcum [1], lies in a sulcus in the lower edge of the right lobe of the liver. It makes a turn or twist upon itself downwards, and terminates in the colon, which is continued a little further down, and makes a turn up before the duodenum, and is closely attached to it; thence it passes to the left side, behind the stomach, becoming pretty large; next it makes a quick turn towards the right, across what would be called the spine in other animals; then it turns back to the middle of the body and bends down into the pelvis, forming the rectum.

Where the colon makes its first turn across the spine it is firmly attached to the posterior parts, which are principally composed of the lungs: its other turns are also attached thereto. The rectum is large, and is a common part to the intestine, the bladder, and the parts of generation; and, as the pelvis is within the cavity of the shell, the rectum [cloaca] is obliged to be elongated under the tail so as to become a projecting part: it is lined with a thin cuticle. The valvulæ conniventes are longitudinal[2], as in the crocodile; there are none in the colon; the great arch of the stomach has a membrane attaching it to the posterior parts, which might be called a tight epiploon, for the attachment of this membrane to the stomach is the same with the epiploon in other animals, only it is not loose, but is a stretched membrane. I could not find any passage leading to it behind the vessels of the liver, as in many other animals, for there is hardly any distance betwixt the liver and pylorus in this animal.

The liver reaches from side to side of the abdomen; its thickest portion is principally in the right; however, the middle is the thinnest portion; and where the pericardium lies there is no liver, but only a membranous attachment of the right and left lobes of the liver; so the apex of the heart lies, as it were, in a sulcus of the liver. It is very irregular, as if made up of different parts. In some, where the peritoneum is fixed to the liver, it would seem to make the division between the cavity for the heart and the abdomen below. The liver is large for the size of the animal. The gall-bladder lies in a deep sulcus, on the concave surface of the right lobe. The liver in this animal, as in other Amphibia, and in the Bird, has a great many veins from the anterior part of the body entering its substance, especially two that come from the anterior parts of the pelvis, and pass along the inner surface of the shell of the abdomen at the attachment of the peritoneum, similar to

[1] [Hunt. Prep. Phys. Series. No. 671.]

[2] [Ib. No. 660.]

the vena portarum; these veins enter near the attachment of the liver to the upper part at the heart; therefore there is more of that kind of circulation [the portal venous] passing through the liver than in quadrupeds.

The pancreas lies in the hollow of the duodenum as that gut passes down the right side. The spleen is an oval body, lying immediately on the hollow curve of the duodenum behind the pancreas, and beginning of the colon[1].

The heart is not attached at its apex to the pericardium, as in the [Chelydra, turtle and crocodile]. The kidneys are two, one on each side of the lower part of the cavity of the abdomen; they are thick bodies a little oblong, having three edges. Their external surface is convoluted, very similar to the cerebellum of the human brain. The ureters begin, like the biliary duct, by branches which converge and unite with one another: they enter the bladder near the urethra. The bladder is large and thin in its coats, as in most of this tribe; adheres but very little to the surrounding parts. The urethra is very short, not above half an inch long; and enters the rectum about 4 inches above the anus. The two testicles were large; although the animal was brought from the West Indies, and kept in the cold, even dying from cold and probably hunger; they are oblong, lying somewhat across the abdomen upon the upper side of the kidney[2]. The vas deferens passes from the outer end of the testicle, running along the body of the testicle, gets behind the bladder, and enters the urethra by a very small nipple. From this part of the urethra passes a groove which joins the penis, and is continued along it. The penis is very large for the size of the animal; it is a flattened body, and terminates in a broad end, pointed at the extremity. It is composed of two bodies whose coats are thick, and appear to be muscular. At the basis of each there is a spongy substance, which becomes in some degree filled by injecting the arteries; and from this spongy substance passes along each body in its centre an artery which seems to be enclosed in a cavity or canal[3], and the artery sending off small arteries as it passes along: I suspect the canal forms a sort of corpus cavernosum.

Between these two bodies passes the groove of the urethra, and when it comes near to the end it terminates in a kind of broad opening, which is irregular, and having two processes in it. This groove is so deep as to hide a bougie in it[4].

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[1] [Hunt. Prep. Phys. Series, No. 830.]
[2] [Ib. No. 2449.]
[3] [The 'peritoneal canal:' see Hunt. Prep. Phys. Series, No. 2449.]
[4] [As in the Hunt. Prep. Phys. Series, No. 2452.]

We may suppose that in the act of copulation this groove is made a complete canal or pipe by its edges coming together, from the opening of the urethra to the end of the penis. Whether these two processes conduct the semen into the two oviducts, I do not know. There are four muscles to the penis, which appear to be for its protrusion and retraction, and are very well adapted for that purpose.

In the female there are two oviducts, one on each side near the shell; from the lower part of the cavity of the abdomen they pass up, attached to the outer edge of the lungs by a thin membrane, which goes as high as the liver.

Of the Eye.—On the inside of the levator palpebrarum is a broad glandular part [lacrymal gland], whose duct probably enters the eyelids through the tunica conjunctiva that lines the upper eyelid. There is a membrana nictitans, but not much larger than in many quadrupeds. I could not find any retractor muscles. On the inner canthus is an oblong gland [Harderian], whose anterior end passes into the membrane, and whose duct enters on the inside of the membrana nictitans. The eyeball has two sets of straight muscles, and two of oblique. The cornea is small. The sclerotic coat is grey, approaching to black; as is also the tunica conjunctiva that covers it. The anterior part of the sclerotic is bony. The pupil is round. The crystalline lens is flat on the fore, and very convex on the back part. There is a great deal of nigrum pigmentum on the inside and outside of the choroid coat.

Large Tortoise from the East Indies[1] [*Testudo indica,* ? forsan *Test. elephantopus*].

The anatomical construction of this tortoise appeared to agree almost wholly with that from South America, excepting in the lobulus Spigelii being very broad behind the stomach. I observed two ducts, which appeared to come from the liver, passing down, attached to the duodenum where the pancreas was, and uniting together pretty high up; their common duct entered the cystic duct before that entered the intestine[2]. Whether this is an hepatic duct or a pancreatic, I do not know. It is very similar to the pancreatic duct in its coats; not like the hepatic. The gall-bladder was more than half surrounded by the liver: it had thick coats, pretty smooth on its inner surface. Its duct passed out at one end.

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[1] [The skull of this tortoise is No. 1058, Hunt. Osteol. Series. The œsophagus is No. 459; the stomach, Nos. 510—513; the intestines, No. 659; the pancreas and spleen, No. 830; the heart, No. 920; the kidney, 1194; the tongue, No. 1461; the male organs, Nos. 2450—2452.]

[2] [Hunt. Prep. Phys. Series, No. 830.]

The Land Tortoise [*Testudo Græca*, Linn.].

The stomach is pretty transverse[1]. The duodenum passes to the right, and down; then to the left, and forms the jejunum; from thence to the right again, in its convoluted course; it next passes across near the back, and is tucked down or adheres to the posterior parts in this course; and finally passes down the left to the pelvis: just where it is going to pass down it swells suddenly into what may be called colon.

The œsophagus has no rugæ or small processes, as in the turtle. The liver has two lobes, a right and a left: they are united by a very small union just across the basis of the heart. The left lobe lies in the curve of the stomach, as it were, adapted to it, and adheres to it; behind which is the mesogaster. The gall-bladder is a round body attached to the posterior surface of the liver. Its duct is short and pretty thick. There does not appear to be a hepatic duct, but a hepato-cystic one.

The capsula renalis is large and flat, situated above the kidneys; it looks like a pancreas, being conglomerated: but when cut into it appears to be all of the same substance[2]. This tortoise has a membrana nictitans.

[Order Lacertilia.]

Of Lizards.

The legs of most lizards are not for the support of the body of the animal, but for their progressive motion, and to enable them to climb trees, walls, &c. However, their progressive motion is not confined to their legs; for, by the serpentine course that they throw their body and tails into when in motion, they are capable of moving much faster. This motion of body and tail is extremely quick.

The tails of lizards[3] are so tender as to be easily pulled off by the strength of the animal when held by the tail; but this tenderness is only confined to the part of the tail beyond the bed of the penis, for there the tail is very strong. The reason why the tail should be so brittle, is perhaps to allow the animal to make its escape when caught by the tail, for it is generally broken in that way.

The lizards in Portugal sleep very little in winter; for, whenever a warm day comes on, they come out of their holes, as in summer. This is owing to the weather in winter in that climate being often very

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[1] [Hunt. Prep. Phys. Series, No. 509.]

[2] [Ib. Nos. 1277, 1278, showing not a conglomerate structure, but a convoluted surface.]

[3] [Ib. Nos. 2208—2223.]

warm; so that more insects in general live, such as flies, &c., which are the food of the lizard. Lizards sleep in cold weather, and are therefore sleepers or not sleepers according to the climate. In this climate they would sleep half of the year: in Jamaica perhaps not at all. They become very fat before the cold comes on; and by the end of the winter they become very lean. This shows they have been absorbing their fat for nourishment.

Of the Male Parts[1].—Lizards have two penises, which are in structure similar to the two horns of a snail; for when erect, they are only an everted canal, or tube, with a muscle arising from the tail and running through the centre to pull them in, or invert them. There are two ridges which make a groove; this is on the outside when the penises are external, but upon the inside when they are reinstated.

Of the Eggs.—The eggs of the lizard seem to advance within the abdomen nearly equally fast, not in a regular succession, as in the hen. They seem to remain for some time in the abdomen after they appear to be at their full growth.

I should suppose that the egg is but a very short time in the oviduct, as I never found one there. I should likewise suppose that the skin [chorion or outer coat] is formed in the oviduct.

Of the Organ of Hearing.—All of this order, as far as I know, have no external ear. The membrana tympani is almost on a level with the skin of the head; it is convex externally, or rather appears to be pressed out in the middle.

[Genus IGUANA.]

THE GUANA[2] [*Iguana tuberculata*, Linn.].

In this lizard the thorax and abdomen are one cavity, there being no diaphragm. The heart is at the upper part of the thorax, the basis of which is higher than the first ribs; the upper part of the sternum and bones of the shoulder making part of the cavity of the thorax in this animal. The heart is enclosed in a very strong pericardium which is in contact with the convex surface of the liver[3].

The stomach is similar to a bent gut; it is not a large bag, of a particular shape, as in the human, but rather as if the great end of that viscus in the human was cut off: it lies more from behind forwards than in most animals, as it were obliquely, the œsophagus being close

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[1] [Hunt. Preps. Phys. Series, Nos. 2426—2437.]

[2] [The skeleton of this animal is No. 666, Hunt. Osteol. Series.]

[3] [The structure of the lungs is shown in the Hunt. Preps. Phys. Series, Nos. 1107, 1108, 1109.]

to the back, and the pylorus close to the abdomen, which is the cause of the vena portarum entering at the edge of the liver. There is a strong and broad mesogaster, which is not attached to the liver transversely from the right to the left, but from the edge, where the porta is, backwards towards the œsophagus. Some kinds of seeds or nuts were found in the stomach, and some twigs of trees or shrubs.

The upper part of the small gut does not pass behind the mesentery, and become bound down as in the quadruped, but becomes loose from the pylorus. The convolutions of the jejunum and duodenum pass behind and below the lower end of the stomach.

The liver is very much as in the human; however, it goes higher up at the fore-part, as the lungs do not come so far forwards as in the human subject, or in [mammalian] quadrupeds: it consists of one lobe, extending from the right to the left, convex above, but not so uniformly as in those animals which have the diaphragm; it is concave below in all directions. A small process runs down the right side as low as the testicle, into the tip of which enters the inferior vena cava, which runs up through the substance of the liver, receiving the vena cava hepatica in its passage. It has the falciform ligament, which is very narrow. The gall-bladder is at the lower edge in a notch; it is a circumscribed bag, having the cystic ducts passing out at its broad side and the cyst-hepatic entering in the same manner. The hepatic duct passes out of the liver on the side of the bladder, running along to the duodenum, which it enters, not an inch from the pylorus, distinctly, not joined by any other duct. The vena portæ and arteries enter the lower edge of the liver, on the left of the gall-bladder: into the same vein passes a vein from the abdominal muscles.

There is only one pancreas, which lies in the mesogaster close to the pylorus: it is very small and thin, hardly observable, even for the size of the animal; its duct enters the duodenum close to the pylorus[1].

The attachment of these viscera to the body is not by broad surfaces, but by broad membranes, which are pretty strong; resembling a mesentery stretched all along the back, and which is double behind the stomach.

The depressores costarum are very strong, and arise posteriorly from the bodies of the vertebræ. The sternum is but short; but the thoracic part, or ribs, or rather false or short ribs, go low down behind.

The kidneys are oblong bodies placed behind the rectum near to the anus, at the termination of the abdomen. They receive their vessels as the trunks pass along that surface, which is next to the rectum: also

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[1] [The spleen is shown in the Hunt. Prep. No. 828.]

along this surface runs the ureter, which is collecting its branches as it passes backwards, or nearer to the anus [cloaca], where it terminates in a ridge just by the termination of the vasa deferentia[1]. In the ureters, from the animal whence this description was taken, were calculi, or rather one calculus in each, of a brown colour, almost filling up the duct.

What appears from its situation to be the vesica urinaria is an oblong bag, large, and opens into the termination of the rectum and beginning of the anus by a very large opening: it was filled with a white fluid like milk; there were some small calculi in this, of a white colour. Is this the bladder of urine? If it is, then the urine must pass across the anus to it. I did not find any white fluid in the ureter; nor was the calculus, formed in each, of the same colour; nor did this bladder appear to be glandular in its coats, so as to be able to secrete the white fluid contained in it.

The Organ of Hearing.—The tympanum is a large cavity, immediately on the inside of the membrane, along which passes the bone of the ear. The Eustachian tube is a very large passage from the mouth or fauces, to the cavity of the tympanum; it is oblong at its beginning; its longest axis being in the direction of the mouth and fauces. This passage is short and passes almost directly outwards, and enters the tympanum by nearly as large an opening as at the beginning: it is lined with a thin dark membrane; there seemed to be no cartilaginous part[2]. From the membrana tympani there passes inwards, through the cavity of the tympanum, a small bone which is attached to the upper part of the tympanum, making a ridge there; its length is equal to the depth of the tympanum. The bony vestibulum is a small cavity having the three semicircular canals, going out much as in the human subject, viz. two perpendicular, and one horizontal. The bony vestibulum and semicircular canals are lined, or rather contain a kind of gristly substance, which makes a cartilaginous vestibulum and semicircular canals. Within this last-mentioned vestibulum is a small white body something the shape of a lens; this is a calcareous earth of the consistence of powder of chalk wetted and dried; rather harder than that which is in the turtle's ear[3].

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[1] [Hunt. Prep. Phys. Series, No. 746. The male organs are shown in Hunt. Prep. No. 2434: the female organs in No. 2717.]

[2] [See Dissection of the Turtle, p. 355.]

[3] [Hunt. Prep. Phys. Series, No. 1576. The tongue and sublingual pouch are shown in the Hunt. Prep. No. 1457.]

THE AUSTRALIAN LIZARD [*Cyclodus*, Wagler; *Tiliqua*, Gray[1]].

This comes nearer to the genus *Scincus* than any lizard I know, but it is still a distinct species. In the two specimens sent over by Mr. White[2], one had a process on the upper part of the tail near the tip, almost like a supernumerary or forked tail; but which I rather conceive to be natural; and, as this one was a male, I am apt to think this is peculiar to that sex. This would in some degree have been more clearly made out if the other, which had not this process, had proved a female; but as it had been gutted and stuffed before I saw it, which prevented my examination, this still remains to be proved; but what makes this conjecture very probable is, that it is mentioned by Mr. White that some are without, and some with this process. Now, if it were a monster, arising either from accident, or originally so formed, it would hardly be so common as to be taken notice of. The tail is longer than in the scincus, and is not so taper.

The animal is of a dark iron-grey colour, which is of different shades in different parts, forming kind of stripes across the back and tail. The scales are strong, but not so much so as those of the scincus. The legs are short and strong, covered with the same kind of scales as the body; but the scales on the feet are not so. On the cuticle are small knobs, as if it were studded.

The toes on each foot are pretty regular, the difference in length not being great; the same on both the fore- and hind-feet; which is not the case with the scincus, it having a long middle-toe. There is a small short nail on each toe. The toes on their upper surface are covered with a series of scales, which go half round like a coat of mail.

Just within the verge of the external opening of the ear, on the anterior edge, is a membrane covering about one third of it, which is scalloped on its loose or unattached edge. This can hardly be called an external ear, nor can it be called the reverse, viz. a valve: it is probably an assistant to hearing; if so, then it should be called an external ear[3].

The teeth are a row on each side of each jaw, becoming gradually larger backwards. They are short above the gum, and rounded off, fitted for breaking or bruising of substances, more than cutting or

1 [Parts of the skeletons of the *Cyclodus niger* (Nos. 655, 656), of the *Cyclodus scincoides* (No. 657), and of the *Cyclodus gigas* (Nos. 659, 660, 661), are preserved in the Hunterian Osteological Series.]

2 [See Note, p. 249.]

3 [Hunt. Prep. Phys. Series, No. 1605.]

tearing[1]: this is similar to the scincus. The tongue is both very broad and long[2].

The œsophagus is large, and is continued into the stomach without changing its direction, so that the œsophagus and stomach form one continued tube; only that the stomach is rather thicker in its coats. The first intestine makes a turn out towards the right; then makes two or three convolutions as it passes downwards to terminate in the colon. The colon, or what may be called the rectum, is pretty large at its beginning, becoming rather smaller towards the anus. The intestines are very short, not exceeding the length of the animal from mouth to anus.

In the stomach I found vegetable substances; some seeds, which probably were of some fruit; some fibrous substance like weeds or the bark of a tree; and even some pieces of wood which was rendered very soft, but whether by the stomach, or naturally so, I do not judge.

Between the anus and back-bone are two glandular substances, but whether they have ducts or not I do not know.

The liver is, as it were, forked, dividing into two; one lobe passing down the right, which is continued into a long process into which the vena cava inferior enters. The vena portarum enters the sulcus or union of the lobes. The liver is attached forwards by two membranes, one to each lobe, which unite at top: the same takes place behind. The gall-bladder lies in a sulcus made by the union of the two lobes of the liver. The spleen lies behind the stomach. The whole of the above viscera are attached to the back by four membranes. The kidneys lie in the lower part of the abdomen, close to the spine; they are long bodies terminating in a point at the upper end. There is a small bladder before the rectum. The testicles are pretty large oblong bodies, the right the highest: the tubular substance is very loose[3].

The heart consists of two auricles, with two ventricles intercommunicating. The valve of the ventricle is attached to the septum of the auricle. The lungs are two large oval bags, which are honeycombed at the upper ends, becoming gradually less so towards their blind ends. The trachea is very flexible. All about the trachea and œsophagus above the heart, there is a cellular texture which is easily inflated.

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[1] [Hunt. Prep. Phys. Series, No. 386 (*Cyclodus nigro-luteus*, Wagler).]
[2] [Ib. No. 1458.]
[3] [Ib. No. 2427. The female organs of a *Cyclodus* are shown in No. 2715.]

The Gallywasp [Australian Gallywasp of Shaw (*Cyclodus Whitei*), *Trachysaurus*, Gray].

The œsophagus is very large, and only dilates a little to form the stomach. The stomach, being but a continuation of the œsophagus a little enlarged [and thickened], lies in the same direction: towards its lower end it gradually contracts to form the pylorus: it hardly can be said to bend to the right at this part. The pylorus would appear to be no more than a valvular contraction of the stomach. The duodenum bends to the right and a little upwards upon the last part of the stomach; thence the gut passes down to the anus, making several bendings or folds upon itself. There is no cæcum, and no colon. The heart accords with the *Tricoilia*: it sends off two aortæ, which join to form one as they descend. The lungs are as in the lizard. There are two glands on the lower part of the neck, or beginning of the thorax, similar to those in birds. There are two penises, as in the lizard.

The stomach contained broken snail-shells, some snails with part of the shell on them, bits of skins of lizards, grubs, and a great quantity of a kind of fruit which had a hard shell in its centre: but these appeared not to be digestible, as they were all whole, and a great number of them were in the last gut.

Quære: Perhaps it fed upon these, after being caught, contrary to its inclination?

The Lacerta Gecko, Banks[1] [*Platydactylus guttatus*, Cuv.].

This is a flat lizard, with a short body, making an approach (in appearance) to the toad. The head is much the shape of that of the toad, with raised orbits. The scales terminate in pretty sharp points; some of them about the back and lateral parts of the head and on the side of the neck are like prickles; on the legs and tail the scales are thick and strong, with a ridge all along the back of the tail, somewhat higher than the others. The colour is dark, but studded with yellow spots, especially about the legs, head, and tail, with a yellow ridge or line along the back from the nape of the neck to the root of the tail. There are scales on the eyelids, and it has a membrana nictitans. There are five toes on the fore-foot, the middle the longest: also five on the hind-foot, but not so regular, two being of nearly equal length; and the little toe stands at some distance from the other, rather like a

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[1] [No doubt Sir Joseph Banks, P.R.S., who had supplied Hunter with the Linnean name of this lizard.]

thumb. The teeth form a row on each side, with seeming long gums; there are two tusk-teeth and three fore-teeth; so far like many animals.

The liver is a triangular body; one angle points upward toward the heart, another in the small curve of the stomach; the third passes down the right side along with the vena cava. The gall-bladder lies in a hollow in the angle between these two last described lobes or angles, and the ducts pass along the right edge of the second lobe to the duodenum. The heart is as in the turtle: there is more than one artery arising from the heart.

There are two lumps of fat in the lower and lateral parts of the abdomen, as in the lizard. Two penises. Two oviducts. The tongue is fleshy and thick, and has two small white bodies on the lower surface of the tip, which makes it somewhat forked: but it is not thin and forked like the lizard's. The opening of the trachea projects a little forwards.

[THE SHEATH-CLAWED GECKO, *Thecadactylus levis*, Cuv.]

The lizard, commonly called the "Savage of the Wood," has two oviducts, the lower end of which are enlarged like the shell-forming part of the oviduct in the hen. The ovaria appear to form but one ovum at each time of impregnation, having always but one in each oviduct; and having none in the ovarium ready to drop. (*Vide* Preparation[1].) Whether this lizard be viviparous or oviparous, I do not know.

THE CHAMELEON [*Chamæleo vulgaris*, and *Ch. planiceps*].

The chameleon is more of the toad than the lizard: it has the tongue of the toad: it has the appendicula adiposa as in the toad.

The tongue of the chameleon consists of four parts: first, a bony basis; second, a pulpy or bulbous part at the tip; third and fourth, elongating and contracting parts, both which run almost through the whole length. The basis, or bony apparatus of the tongue, consists of an os hyoides [basi- and cerato-hyals] and os linguæ [glosso-hyal] somewhat similar to that of the bird; therefore there is nothing very remarkable in their construction. The bulbous or thick part at the end of the true tongue, is that part which is to manage the food when caught; it is the operator within the mouth; besides which it is the pincher or catcher, from its being formed at the end into two opposite points, similar to the

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1 [Hunt. Preps. Phys. Series, Nos. 3332, 3333. There is no trace of embryonic development in the ova shown in these preparations.]

elephant's snout. This surface is rugous, and covered with a gelatinous slime. The basis and true tongue or tip are united by an elongating and contracting medium, which is very extensive. This length of tongue, its extension or elongating, when contracted [transversely] is very singular, and, if well understood, most probably very curious. The cause and mode of the contraction of its length is not very evident, but not uncommon: the elongation of the tongue is perhaps like nothing we are acquainted with in an [any other] animal body. The apparatus for this purpose is a small rounded body which passes from the apex of the os linguæ to the bulbous part, and then through the centre of the bulb. The part between bone and bulb consists of two different substances, one a whitish substance which is the firmest, and appears to be capable of keeping its form, the other softer and more transparent. That part which passes through the bulb, consists only of one substance, and appears to be a sheath for the passage of the os linguæ.

The first of these [*i. e.* the whitish, firmer substance] appears to be composed of rings, or parts somewhat similar, placed obliquely in contrary directions, so as to appear to be two spirals crossing one another. Whether the other, or softer substance, has any direction of fibres, I could not observe, but I suspect it is muscular. If I am right in my conjecture of this structure, and of its disposition, it will be no difficult thing to show how it may be elongated; for if these rings are placed transverse, they may be brought so near to one another as to shorten the whole very considerably; and if they allow of being placed almost longitudinally, they must of course lengthen it very considerably; and this position can be easily produced by muscles, which I take the pulpy substance to be.

Its [the tongue's] contraction is owing to a degree of elasticity, but this appears to be only in the cellular membrane acting as an assistant to the muscular. The muscular contraction is owing to two muscles, one on each side of the tongue; each arises from the os hyoides, on the inside of the os linguale, and passes along the side of the tongue to its bulbous part, but before it gets to the bulbous part it spreads itself all round.

In the centre of each of these two muscles passes a considerable nerve to the bulbous part, and also two arteries. When those two contractions [elastic and muscular] act they draw the tongue back upon the os linguale, which, as it were, passes through the centre elongator, then through the centre of the bulb, till the whole tongue is retracted. Although this middle body is drawn upon the os linguæ, yet it does not appear to be a hollow, like a pipe: it rather appears to be filled with a very ductile cellular membrane, as in every part of the elongating substance of the tongue, in order to allow of the great difference in the situation of parts with respect to one another[1].

The eye is large for the size of the animal. The eyelids are stiff, not moveable on the eye, but they are made to move with the eye: at their attachment to the orbit the skin is pliable and soft. The sclerotica is thin for more than the posterior half, having the pigmentum nigrum appearing through it: anteriorly it is thick and white. The cornea is small. The crystalline lens is almost round. The capsula of the vitreous humour is very plain. The nigrum pigmentum is very dark. The lacrymal gland is white[2].

The abdominal viscera appear to be like those of the toads, lizards, &c., consisting of a straight stomach, passing in the direction of the body, then making a small inclination to the right. There it forms the intestine, which is short and makes a few convolutions on itself, and terminates in the colon or rectum, which is a straight gut something larger than the other. There is a cæcum which is short. The rugæ of the small intestines are like lozenges or rhomboids. The rectum has two mesorectums attaching it to the loins between the kidneys. The peritoneum that covers the intestine is very black.

The liver consists of one lobe. The gall-bladder is a round body, placed at the lower edge of the liver. The gall was not bitter. The vena cava anterior runs on the inside of the abdominal muscles: the posterior vena cava enters the lower part of the liver.

The lungs are very singular; they consist of two large bags, a right and a left; each bag is divided into two, longitudinally, by an imperfect partition. They are composed of two parts; one for immediate respiration, the other as a reservoir of air. The first is the part nearest to the shoulders, and is cellular or honeycombed on its inner surface, and extremely tender: the other is smooth, thin in its coats, pretty strong, and appears to be principally, or to terminate in, a vast number of appendages or cæca[3]. On the right side they are attached to the right edge of the liver the whole length of the liver; on the left side only attached to the left edge for a little way.

The testicles were pretty large, although it had been kept some time, and had died from the effects of long confinement. They were black, like the intestine, and were placed pretty low down, just before the upper end of the kidneys[4].

The chameleon is oviparous: there is one cluster of ova on each side,

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1 [Hunt. Preps. Phys. Series, Nos. 1452—1455, and Hunterian Drawing, engraved in plate 32 A of my 'Catalogue of the Physiological Series,' 4to. vol. iii. 1835. p. 67.]

2 [Hunt. Preps. Phys. Series, Nos. 1695—1699.]

3 [Ib. Nos. 1105, 1106.]

4 [Ib. No. 2437.]

the left being the lowest. When the ova are enlarged, fit to be laid, they are nearly all of equal size. As they most probably lay them nearly all at one time, not [consecutively at intervals] as birds and insects do, and as it would appear that every part of which the ovaria are composed has formed its egg, there being no smaller ones to come on in another year, therefore most probably each nidus for the ovum forms its ovum every year. I believe this is common to all of this tribe. There are in each ovaria about twenty-four ova. There are two oviducts which are very convoluted, and begin almost by one opening like a kind of funnel which divides into the two: this opening is between the liver and the heart; each oviduct passes round the convex surface of the liver to the loins[1].

[Order OPHIDIA.]

Of Snakes.

Snakes drink by suction, not by lapping as lizards do.

The œsophagus in snakes is very thin; therefore, as they are capable of swallowing very large bodies, such as would appear to be beyond the power of the gullet to push along, the power of deglutition must be in the muscles of the trunk.

The young snake as it forms upon the yolk, sinks into it and becomes almost enclosed. The outer edge of the yolk would seem to rise round the little animal, and then to be drawn in over it, only leaving a small space covered by a transparent membrane, through which the snake is seen with the head in the centre of the coil. They are often so coiled up as to make a knot[2].

Of their Membranes.—At a pretty full-grown age there are two membranes, one [allantois] enclosing the whole, which now lines everywhere the egg-shell [chorion], and which encloses the albumen, yolk, &c. It is extremely tender, and appears more like the retina of the eye than any other membrane I know. Its vessels, which are but small, pass out from the [umbilical] cord through the other membrane. The other membrane [vitellicle] is that which encloses the yolk, and which I suspect is a double membrane now united, as in the chick, and probably formed in the same way; for without its being a double membrane it could not cover the space over the snake, through which it is seen. These vessels of the membrane unite, and, within the inner membrane they form the cord, which enters the abdomen of the animal. There is a duct [vitelline duct] whose end begins at the yolk, having its mouth open there: it passes along in the substance of the cord, and

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[1] [Hunt. Preps. Phys. Series, Nos. 3327—3329.]
[2] [Ib. Nos. 3316, 3317.]

enters the abdomen with the vessels; it then passes up towards the stomach and enters the gut a little below the stomach. This duct allows of the gradual passage of the yolk into the intestine during the time of incubation [1].

Snakes [the non-venomous kinds, as the *Coluber natrix*], although they lay eggs, as does the lizard, yet they are somewhat different; for they take the whole of the eggs into the oviducts at nearly one time, placed at little distances from one another [2], like the viper [3], and then they are laid to hatch out of the body as in the lizard. They must lay them at very different times, for in one hatching I found the young of very different sizes and formations.

The eggs of snakes have no air in them as in birds; probably as the egg is softish and is capable of compression, there is no occasion for such; yet this is not a sufficient reason for the presence of air in the bird's egg, viz. from their eggs not being compressible; for it is increased in the time of incubation, therefore it might be wholly accumulated at that time.

The egg of a snake has a strong coat or shell, which is slightly intermixed with calcareous earth, under which is a pretty strong membrane similar to the hen's egg [4].

The two penises of the snake are formed on the outside as if erect [5]. At what time they are drawn into the prepuce I do not know. This is contrary to the quadruped.

The parietes of the belly of the snake are formed open and unite before they are ready to be hatched, and this union is so perfect that it is not at first observable: even when not united, and when they may be separated by the slightest touch, when they have run into one another, it is impossible to conceive there was ever a separation. How high the separation goes I do not know, but I suspect no higher than the basis of the heart; for, in the youngest I have examined, the whole cavity containing the viscera was open, and it did not seem to have gone higher and now united, for I could not separate the ring or transverse scale above, which I could easily do in older ones, where union had taken place at and below the heart.

The union begins first at the upper part and goes on towards the anus, where it finishes around the umbilical cord, leaving no space there, as in the chicken, for the entrance of the yolk just before birth or hatching. In this animal the yolk is consumed in the time of

[1] [Hunt. Preps. Phys. Series, Nos. 3318—3324.] [2] [Ib. Nos. 3301—3303.]
[3] [Ib. Nos. 3309, 3310, 3311: in the two latter specimens the embryo viper may be seen in the ova within the oviduct.]
[4] [Ib. Nos. 3304—3308.] [5] [Ib. Nos. 3321, 3322, 3324.]

hatching, for the older they are [in the egg] the yolk is less: it passes through the duct to the intestine near the stomach, and in the lower end of the stomach I found a substance like the yolk. This is the reason why such eggs have so little white and so much yolk beyond those of the bird.

Observations on Young Vipers.

"Having cut off the head of a viper, it was soon after skinned, and found full of young contained in their membranes, which, being cut open, the young vipers came forth with much activity, one in particular attempting to bite the nearest object as soon as released. The mouth of one of these was examined, but no teeth observed. They were immediately after put into a large wide-mouthed glass half-filled with moss brought a few days before by the viper-catcher to keep the vipers in. After a day or two they shed a cuticle, and were now more beautiful than before, being covered with a bloom resembling that observed upon the fruit of the plum-tree.

"They continued alive for more than a month without receiving visibly any food except what they appeared to lick with their tongues from the moss, which was occasionally, when supposed to be dry, lightly sprinkled with water. When about a month old, some young frogs were put into the glass with them, but did not seem to be noticed. Teeth being now observed, one of these young vipers being held by the skin of the neck in one hand, and with the other the hinder leg of a frog was put to his mouth, and being therewith irritated, he bit it. The frog did not seem much disabled. Next morning the. frog was found dead with this remarkable appearance, viz. the side bitten appeared as if nicely injected with a red liquor, the other side pale as when alive.

"Being opened, the gall-bladder was much distended.

"I am, Sir, your obliged humble Servant,

"T. Lane."

"Aldersgate, Aug. 2, 1778.

"*To Mr. John Hunter.*"

The Rattle-Snake [*Crotalus horridus*, Linn.].

The rattle-snake appears to have but one hepatic duct, which is continued into the gall-bladder; but from the duct passes a vast number, which may be analogous to the ductus communis, and enter the gut after piercing the pancreas, which is a thick body attached to the gut[1].

[1] [The hepatic duct is subdivided into a plexus near its termination in *Python;* but, in *Dryinus*, it is convoluted at the same part. Both apparently to prevent the

THE WATER-SNAKES [*Hydrophidæ*].

The animals of this tribe resemble very much in their general appearance a snake, from which they probably received the name of 'Water-Snake:' but they differ, perhaps, as much from the snake, as the water-newt does from the lizard; and therefore the term lizard to the newt is as applicable to that animal, as that of water-snake to the other. They differ from both of those tribes [lizards and newts] in having only one lung; but they come nearest to the water-newt in the form of the anus, although not exactly; which part in the newt is very different from either that of the lizard, snake, viper, &c. They partake more of the snake in the parts of generation than of the frog, toad, chameleon, &c.

THE WATER-SNAKE, with a dark back and yellow belly [*Pelamys bicolor*, Daud.].

It is pretty round near to the head; but, as it approaches nearer to the tail, it grows flatter and flatter, and at the tail it is extremely thin [from side to side]. Its back, having the bone and muscles for motion in it, is thick; but towards the belly it becomes thinner, terminating almost in an edge like a knife[1]. The ribs are continued as far as the anus, which preserves this shape. The scales of the skin do not overlap, tile-form, but are formed into a kind of irregular hexagonal figure, placed in rows. The teeth are like those of a snake. The abdominal viscera are united together by cellular membrane, and thereby to the abdomen. The œsophagus and stomach form one straight canal; the intestine going out at one side of the bottom of the stomach[2].

The intestines are folded or coiled on one another, like the vas deferens where it begins to form epididymis; which folds are united to one another. The liver is only one lobe, placed on the right side; it is small. The gall-bladder is detached from the liver, lying in the first bend of the first intestine. The duct of the liver passes down from the liver to the intestine; and a duct also passes from the gall-bladder to the intestine about half an inch long. These ducts passed through that end of the pancreas which lies on the intestine. The gall was

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bile from being driven directly into the gut when the liver is pressed upon by the swallowed prey, in course of deglutition.

The anatomy of the rattle-snake is shown in the Hunterian Preparations, Nos. 778, 802, 1091, 1819, 1921, 1922, 2106, 2162, 2419, 2709, 3314, 3315, 3316.]

[1] [They have a poison-fang, with smaller teeth, on each side of the upper jaw, and their bite is dangerous.]

[2] [Hunt. Prep. Phys. Series, No. 508.]

of a pale clear yellow colour. The pancreas lies in the bend of the intestine behind the gall-bladder: it is conglomerated.

The heart appears to be as in a snake. The trachea begins soon to be cellular on one side, and semi-annular on the other, which is at last lost, and the whole becomes cellular on the inner surface, which may be called lung, although probably answering another purpose. There is but one lung, which passes down the back the whole length of the cavity of the abdomen. At the upper part the trachea is gradually lost in the lung, which becomes larger and larger towards the middle and less sacculated or cellular, and then begins to contract again, and terminates in a small duct at the lower part of the abdomen. The lung, I imagine, acts as an air-bladder [1]. Two oviducts. Two ovaria. Two kidneys, which are placed near the lower part of the abdomen, with ureters about 2 inches long.

The form of the anus is different from either that of the lizard or the newt, but it seems to be a mixture of both. It terminates in two lips, as in the newt, but they are in a deep sulcus, having a semicircular edge opposing them. If this had the broad thin scale covering the whole, it would be somewhat similar to the anus of the lizard or the [land] snake.

This animal, although it breathes air, yet must be a constant inhabitant of the water; for in one of the same colour I found a vast number of barnacles [2] on its tail. Now, if it left the water occasionally, we could hardly suppose that barnacles would be allowed to form or take root on the body or skin, and we must suppose that these barnacles could not be above a year old, for they must come off when it casts its skin, which we may suppose from analogy to be once every year.

This animal was near casting its old skin, for it was loose, and there was the new one formed underneath, which was of a clearer colour, and which was also separated from the cutis in many places, by a degree of putrefaction, looking as if it had two cuticles. The barnacles came off with the old skin.

[Order Batrachia.]

The Toad [*Bufo vulgaris*, Laurenti].

Toads, when they spawn, have the ova taken up by the mouths of the oviducts; and, as they are conducted down the tube, they are

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[1] [Hunt. Preps. Phys. Series, Nos. 1089, 1090.]

[2] [*Cineras Hunteri*, Owen: the preparation is described in my 'Catalogue of the Invertebrate Natural History of the Hunterian Museum,' 4to. 1830.]

enveloped in the transparent gelatinous part; then they pass into the last turn of the ducts, which is enlarged; from thence they are thrown into the rectum, the two ducts communicating before they enter the rectum [cloaca]. This gelatinous matter is, as it were, spun out of the general reservoir, having the ova in its centre. I suspect that the two oviducts spin alternately, because one oviduct was empty while the other was nearly full[1].

The stomach and whole intestinal canal of a toad is just the same with the 'Savage of the Wood,' which is of the lizard kind (which see)[2].

THE FROG [*Rana temporaria*, Linn.].

Frogs have their eggs taken up as in the toad. In some which I examined, which had been deprived of the male, I found that the ovarium on the right side was quite empty of ripe eggs, and also none in that duct; the ovarium of the left side was almost empty. There was an opening in that ovarium where they had made their escape. The oviduct was filled with ova, each of which was surrounded with its jelly, which stuck to its neighbour by contact. The fimbriæ had continued to absorb till the duct could not contain any more; so that it had burst; and, the absorption still taking place, they had made their escape out of the duct into the cavity of the belly. The ova, so absorbed, are carried along the oviduct to its reservoir: in their passage they are surrounded by the transparent mucus, each ovum having a distinct circumscribed substance to itself.

These ova get into the last and largest part of the oviduct, where they are ready to be thrown out when stimulated by the male; when they are thrown out, they can only come singly, or in pairs at most. By the stickiness of the transparent part they form themselves into a large cluster, and in this procedure they unite with or take into their interstices, small globules of air, which make them somewhat lighter than the water they swim in.

Frogs, toads, newts, &c., all leave the water in the winter; for, although the water may be as warm as the places they inhabit, yet, as the water might freeze, they then would be froze over and could not breathe.

THE SURINAM TOAD [*Pipa monstrosa*, Laur.].

In a frog with webbed hind-feet, and star-pointed ends of the toes

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[1] [Hunt. Preps. Phys. Series, Nos. 2857, 3274, 3275, and 3276.]

[2] [*Thecadactylus levis*, p. 371.]

on the fore-feet, I found shrimps in its stomach, from which I conjecture that it either swims in the sea, or goes about the shore[1].

The —— [Qu. Larva of *Rana paradoxa*.]

This animal appears to be one of the tribe of the siren, at least in its circulation and respiration.

The tongue is just within the fore-part of the under jaw, for there is placed a flat part which is villous, and which most probably is the organ of taste. From that, back to the opening of the passages into the lungs, is a smooth surface: the opening into the lungs is upon a prominence which is thick, forming an obtuse eminence. This opening is a little slit upon the most prominent part, which is what must be called the opening of the trachea; but it is rather an opening directly into the cavity of this projection, which is hollow, and which hollow is the common opening to both lungs. That on the right side consists of a pretty long pyramidal cavity, the base at the upper end, and terminating in a kind of point. The lung of the left side is composed of one lobe exactly similar to that of the right: but, besides this, there is another going out from its basis, not so long, but broader, as it were enclosing the other; something like an auricle to the ventricle in some animals; and whether the right had one similar to this I do not know, but I suspect it had, allhough I do not know that I could have destroyed it in the examination. They are composed of a cavity at the upper part, which is honeycombed on its internal surface, but at the lower ends or point, they are cellular, and united across[2].

The heart is composed of two auricles and one ventricle, with one artery, which may be called aorta pulmonalis. The vena cava of the lower parts, viz. of the legs and tail, which should be called 'vena cava anterior' [*i. e.* as being near the front or 'sternal walls' of the belly], passed forwards and upwards along the inside of the belly, almost like the umbilical arteries and veins in the fœtus; and, when got as high as the union of the liver with the heart or pericardium, and what would be called diaphragm in the quadruped, it dips down and passes into the vena cava hepatica. There must be another vein to carry the blood from the kidneys, &c., which (if so) may be called 'vena cava posterior.'

The union of the whole veins within the pericardium, before it

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[1] [Hunt. Preps. Phys. Series, Nos. 801, 1103, 1104, 1817, 2416, 2706, 3277, 3278, 3293, 3779—3781, showing the anatomy and marsupial economy of this toad.]

[2] [This description agrees with the structure of the glottis and lungs in the Hunterian Preparations, Nos. 1067—1069, which I determine, by comparison, to be parts of a larva of *Rana paradoxa*.]

enters the auricle, makes a considerable swell: I should suspect that the superior veins come down to enter this swell also. A small vein enters the left auricle, which is most probably the pulmonary vein.

The œsophagus is small. The stomach is an oblong body, which makes a bend and half a twist upon itself, which bend lies in a sulcus of the liver, almost like a gall-bladder. Then the whole small intestine makes four or five spiral turns upon itself, which are returned back again, making in the whole eight or nine turns; they then go down to form the rectum, which is larger. There is no cæcum.

The pancreas is very large, lying in a fold of the stomach, and beginning of the duodenum. The spleen is a round body lying on the left of the stomach.

The liver is principally in the right side, is pretty large and irregular, having a great number of deep sulci in it, and at the bottom of one lays the gall-bladder [1].

The kidneys lie along the back, and are pretty large. The bladder is large.

It has a pair of very large appendiculæ adiposæ attached to the back, and between these attachments were two bodies, but whether testes or not, I could not say.

THE VIVIPAROUS NEWT, commonly called "Salamander" [*Salamandra maculata*, Laurenti].

This newt is pretty universal. I have had them from Portugal, Spain, and Germany.

I suspect there may be different species, or varieties of the same species, in the same country; for those I had from Portugal were not similar in colour to those from Gibraltar; yet I should suspect they have the same in Spain that they have in Portugal.

There is a great variety of newts [*Triton*, Laurenti] in this country; but I believe they are oviparous; and I suspect are more in the water than the others. They [*Triton*] are more like the frog in that respect, while the others [*Salamandra*] are more like the toad.

Their food is most probably insects; I found woodlice in the stomach of the one from Gibraltar. I believe they [*Salamandra*] do not inhabit the waters except when they bring forth their young, but they live in moist places.

The eft or newt in Portugal, which is often called the salamander, is very large, and I believe only appears in the autumn, when the rains in Portugal come on. They are an amphibious animal like the frog,

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[1] [The Hunterian preparation, No. 3289, showing part of the liver, the pancreas, spleen, and spirally coiled intestine, is from the *Rana paradoxa*.]

and are mostly about standing water. They are viviparous *ex ovo*, having from fifteen to twenty young at one time; they are placed in the lower part of the oviduct, which part becomes enlarged as the young increase in size; but the upper portion seems to continue of the same size; therefore the lower part should be called the uterus, and the upper the oviduct; the latter probably furnishes something similar to the white in the egg[1]. They bring forth their young in the water, in which place we most commonly find them. The young are completely formed in the oviduct, and part of the ovum, probably that part which came from the mother or ovarium, is taken before birth into the belly, as in many other oviparous animals[2]; when they come forth they are surrounded by the transparent bag or membrane [chorion] which covered them in the oviduct; but they soon get out of it and swim in the water. If they are not born in the water they soon die. There is a fine floating fringe at that part of the head where the gills of fish are placed, which are the gills of this animal[3]. How long they are entirely aquatic, I don't yet know. The old would seem at first to be lizards[4]; but they are very different; for they are amphibious, viviparous, and perhaps sleep in dry weather, and not in wet.

The stomach is in the direction, principally, of the œsophagus; but its lower end bends up and to the right, to form the intestines. The intestine immediately makes convolutions; there is nothing that can be called 'duodenum.' The small ones are short, and terminate a little lower down in the belly, in the rectum, which seems little more than a quick enlargement of the intestine, passing straight on, and being more immediately attached to the back.

The liver is pretty large, and consists of but one lobe, with a fissure in its lower edge[5]. The gall-bladder of the Gibraltar one was extremely small.

The oviducts are long canals passing from above the liver where they begin, winding round the liver towards the back, down which they pass on each side. They are convoluted, or make turns upon themselves; and, in the unimpregnated state, there is but little difference through the whole tract of the canal, only it becomes rather larger[6].

On the Pneumobranchiata [*Batrachia perennibranchiata*].

Different species of a new genus of animals have come of late years

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1 [Hunt. Preps. Phys. Series, Nos. 3296—3298.] 2 [Ib. No. 3299.]
3 [Ib. Nos. 3296, 3300.]
4 [They were so regarded by Linnæus, who named them '*Lacerta Salamandra*.']
5 [Hunt. Prep. Phys. Series, No. 799.]
6 [Ib. No. 2701. The male organs are shown in Nos. 2407 and 2408.]

from South Carolina in America, to Europe, three of which I have seen, and it is probable there are many more. The first of them that came to Europe were brought to London in the year 1758 by Mr. Lake, who had resided many years in that province. I bought his whole collection of things, in which were two different species of this genus; and since that time I have got a third. Some time after Dr. Garden, of Charles Town, South Carolina, sent one of this species to the late Dr. Linnæus[1], which he called the siren.

To the eye, two of them may pass as different species of the same genus; but the third might be supposed to belong to another, to which, however, it has but little connexion, being in its internal economy closely connected to the above two.

This tribe of animals is widely different from all hitherto known. They are compounded of two grand divisions of the animal kingdom, yet not so as for all their parts to partake equally of both; for some parts incline more to the one of these divisions, other parts to the other, while a few are pretty distinctly made up of both, so as to be truly double, just as the parts of generation are in perfect hermaphrodites; and these parts are the organs of respiration, to which the circulation must of course correspond. They hold with respect to respiration a middle rank between fish, which breathe water, and those immediately above them, which breathe air, viz. those called Amphibia[2], and they are placed in this respect between the two, filling up the scale.

The manner of life and general economy of the animal determine the structure of less important parts.

These animals give the true idea of the Amphibia, while all those others which have got this appellation do not in the least deserve the name. This appeared to me long ago to be the case, and therefore I supposed there was not properly any such animal as an amphibian; for because an animal can dive, and stay, or live a considerable time under water, it is not to be reckoned a bit more amphibious than any other animal, whose stay under water is shorter. The circumstance of being terrestrial or aquatic depends entirely upon the medium in which an animal respires. One of the Tetracoilia can live in water if you will allow it to breathe air, but not otherwise; and the cetaceous fish can only stay under water between every inspiration and expiration, as is proved by the whale, &c.; and a fish can live out of water, if it is still allowed to breathe water. The animals usually named Amphibia in like manner can only keep under water during the interval between inspiration and expiration; but as their times of respiration are much less

[1] [Linnæus died in 1778.]
[2] [By Linnæus, 'Systema Naturæ,' Ed. xii. 1766, vol. i. p. 19.]

frequent than those of the Tetracoilia, whether under water or in the common air, they can of course dive much longer: but an animal to be truly amphibious must have its respiratory apparatus compounded of the pulmonary and branchial organs, which is the case with this tribe, for these only can be said when in the air to be truly terrestrial, and when in the water truly aquatic.

In the description of any very uncommon animal, in which the parts upon which life immediately depends differ very much from those commonly known, and bear a strong analogy to others which are but very indifferently understood, it becomes necessary to give some idea of the preceding and succeeding links in the general chain of organization, before the connexion of that in question can be distinctly understood. As the animals now before us, therefore, differ remarkably in the circulation of the blood and organs of respiration from all others yet known, our first business is to consider the different forms under which those two essential principles of animal life appear.

The heart is acknowledged to be the grand organ of the motion of the blood in those animals which have it. In some animals it acts a double part, serving also for digestion[1], but these have no connexion with the present subject. Where its use is confined entirely to the circulation, its structure is different, according to the different motions the blood is destined to receive; for in some animals the heart has only one, in others two, in others three, and in the most complete of all four cavities; and this difference of structure forms so many grand divisions of the animal kingdom, which I must be permitted to call by the names of *Monocoilia*, *Dicoilia*, *Tricoilia*, and *Tetracoilia*[2].

The last order comprehends the animals whose hearts have only one cavity, as is the case in the insect, therefore they may be called Monocoilia; but as these have no connexion with the present subject, it is sufficient just to mention them.

The animals of this class have but a single circulation, and of course are furnished only with two cavities to the heart, viz. an auricle and ventricle, similar to and answering the same purposes with the right half of the heart in the most perfect animals. To this order belong all the fish with gills; therefore these may be called Dicoilia.

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[1] [Hunter here alludes to the central cavity of the body of the Medusa. See his injected preparations of the Rhizostoma, Nos. 847, 848, 982, 983.]

[2] [These should be written *Monocœla*, *Dicœla*, &c.; but they are spelt as above in in the 'Treatise on the Blood and Inflammation,' 4to, 1793, p. 135, where these names for the Divisions of the Animal Kingdom were first proposed. Like all classifications founded on the variations of a single organ, the cardiac arrangement is too artificial for general application. For Cuvier's Radiated Division of the Invertebrata, Hunter proposed the term *Acardia*.]

The third order of animals are those commonly called Amphibia: in these the circulation is twofold, although not so distinctly as in the next, because the two circulations become blended in the heart. Their hearts consist of two distinct cavities, which are the two auricles, and of two ventricles; but the ventricles communicate so freely with one another that they are to be considered as only one cavity; therefore these may be called *Tricoilia*. There the blood from the lungs, and that which has gone through the other parts of the body, mix together, instead of being separated, as in the more perfect animals; so that some of the last sort [venous] is thrown back through the body again without passing previously through the lungs, and some of the first sort is pushed a second and perhaps a third time through the lungs, without being first employed in the general circulation.

The last division comprehends the most perfect animals, which have a double circulation, one through the lungs, the other through the whole body, and for that purpose are furnished with a double heart. The two auricles and two ventricles of which they are composed make up the four cavities by which they are distinguished, and they may be called *Tetracoilia*.

This general account being premised, it is to be now observed, that the tribe of animals before us are an intermediate link between the second and third of the divisions above mentioned, by which they are connected with, or, as it were, run into, each other. For Nature, always proceeding by the nicest gradations, has formed two animals which partake so much of the structure of the two classes, that they gently lead us on from the one to the other. The first of these, as being nearest to the amphibious tribe, are the animals now before us [1], which, indeed, form the next link in the chain that we are acquainted with, as will be easily seen by comparing them together. The present have but one auricle [2] and one ventricle, sending off one artery, which is common to the gills and lungs, and which might be called 'pneumobranchial.'

Here is a falling off from the Amphibia of an auricle, and in some measure of a ventricle, notwithstanding which, the effect of the heart upon the blood is nearly the same.

The artery passes out of the heart, sending off the pulmonary arteries, which are ramified upon the lungs as usual, and then divides into two branches, which are analogous to the two arteries in the turtle; but

[1] [*Amphiuma didactylum*, Cuv., and *Menopoma Alleghaniensis*, Harlan.]

[2] [I found this auricle divided by a complete septum: see Transactions of the Zoological Society, vol. i. p. 213. 'Animal Economy,' 8vo. p. 396, note.]

as these animals [*Amphiuma* and *Menopoma*] are a degree nearer fish, these arteries are each again subdivided into two, which afterwards wind round those singular parts—in some measure similar to the gills of fish,—with which they are furnished. Having made this circuit, the subdivided vessels again unite so far as to form only two trunks, and these two presently join into one in the same manner as we have remarked in turtle and fish.

The other animal—the siren—completes the gradation by being one remove nearer to fish: in this the subdivision is not into two branches only, as in that above described, but the whole aorta divides and subdivides into infinite ramifications, similar to the artery in the gills of fish, while the lungs are supplied in the same manner as those of the preceding animal and of the Amphibia.

Thus the gradation is formed from perfect lungs, first to perfect lungs and imperfect gills, then to perfect lungs and perfect gills, till at last we have no lungs, but simply perfect gills, as in the fish.

THE CHUAH CHISSTANNAH, or Craw-fish Eater [*Menopoma Alleghaniense,* Harlan].

This animal may be said to be the third link in the chain between the fish or *Dicoilia*, and the *Tricoilia*. It is a quadruped, and is peculiar to some of the inland waters; but is scarce in the rivers, and is seldom caught except when the Indians fox [stupify] the fish with buck-eye roots, made into a paste.

The colour, when first taken out of the water, is a dark brown on the back, and on the belly a faint yellow; the skin is without scales and slime. The body is long, with a protuberance on each side of the back, which forms a hollow that extends to the root of the tail: on the sides of the body there is a loose skin, which they can extend or contract at pleasure, to swim with; and when out of the water it appears like a furled sail.

They live but a short time on land, and appear almost motionless till disturbed; and their actions then are like those of a rattlesnake when much fatigued by long teazing. Their bite is sharp, and they will seldom quit their hold till compelled. It is somewhat like a frog elongated, being about 7 or 8 inches from the tip of the mouth to the posterior part, or joining of the hind legs; but this will depend on the size of the animal.

It is flat on the back and belly like a lizard; it has four short thick legs; its feet are broad with four short toes on each fore-foot, and five toes on each hind-foot.

Its legs come out from its sides, somewhat like those of a frog, lizard, or alligator. It has a tail above half the length of its body. It is flat sideways, having an upper and under edge, like some water newts, and which is very thin, forming a kind of fin. It has a broad thin flat head, the anterior termination of which is a semicircle. It has small black eyes, which are placed near the anterior edge of the head. The two nostrils are small holes, placed in the anterior part of the edge of the mouth, or upper jaw, and communicate with the mouth at the termination of the second row of teeth, in an oval orifice about $\frac{2}{12}$ths of an inch long. There is no visible external ear. It has no ribs [1], as the frog.

The mouth is wide, opening along the whole semicircular sweep of the anterior part of the head, as in the frog, &c. The teeth are two rows in the upper jaw, which are about $\frac{2}{12}$ths of an inch asunder, and in which space is a sulcus, into which the teeth of the under jaw go. The outer [maxillary] row is continued much further back than the inner [vomerine], making nearly a semicircle, while the inner row makes only a quarter of a circle.

The under jaw has but one row, which is continued as far back as the outer upper row; they may be said to be styliform. The small tongue can hardly be called such, as it hardly projects; however, it may be made to project a little: it is broad and flat, with cells on its upper part, much like the inside of the stomach of many ruminating animals [2].

The œsophagus is wide and short. The stomach and intestines are similar to those in the lizard, frog, toad, &c.[3] The rectum is considerably larger than any other part of the intestines, and in the enlarged part was found a good many feathers undigested. The anus is a little slit in the direction of the animal, as in the newt, alligator, &c.

The liver has nothing remarkable: it is one mass, with the lower end a little forked. The gall-bladder lies between the bifurcations of the lower end of the liver; its ducts are short, and pass into the duodenum as that gut passes up this part. The pancreas lies in the curve or curves of the convolutions of the duodenum. The spleen is a round body placed behind the stomach, and is attached to it by a broad membrane or membranes.

There are two ovaria, one on each side of the spine, pretty loosely attached; they are oblong, and when not prepared for generation appear more like testicles, or the ovaria of the quadruped than of the

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[1] [They are short and straight, like transverse processes.]

[2] [Hunt. Prep. Phys. Series, No. 1450.] [3] [Ib. No. 654.]

oviparous animals; but when prepared for propagation they become large, and the inside of the bag is lined with ova. There are two oviducts similar to those in the lizard[1]. The kidneys are long bodies on each side of the spine, nearly the whole length of the abdomen. There is a bladder of urine.

The most extraordinary thing in this animal is the circulation, with its dependent function, viz. respiration. In this respect it is a mixture of the fish or Dicoilia, and the amphibia, or Tricoilia, having an opening similar to gills, and lungs similar to those of the frog. Like the fish, it has but one auricle and one ventricle, and of course but one artery arising from the heart; but this artery is very singular in its distribution.

The openings, which are similar to those of the gills in fish, would seem not to answer any such purpose, for the arteries do not in the least ramify so as to divide the blood, in order that it might be influenced by respiration through these openings. This is one degree nearer the Tricoilia than the other two.

The auricle is large, and is placed principally on the left side of the ventricle and behind. There is but one artery arising from the heart or ventricle, which at first goes on towards the head, a little contorted, and swells into a considerable bag: from each side of this bag are given off four vessels, three of pretty considerable size, the other a very small one, which is the first or undermost. This passes out laterally, adhering to the œsophagus, giving vessels to it, as it were, spent upon it; but one of its branches is joined by a branch from the second, forming one trunk, which makes the pulmonary artery. This passes down along the œsophagus, between it and the auricle, gets upon the upper part of the lungs, along which it passes and ramifies.

The second and third [aortic] branches, which are the largest, pass outwards, but a little more upwards; they both get upon the upper part of the gill-opening, then pass along two bones which are probably intended as 'os hyoides,' and also for assisting in the dilatation of this passage; and, when got to the outer and posterior end, the second sends down the branch to join the first, as above described; and then they [second and third] unite into one, there getting upon the upper or posterior surface of the œsophagus, and sending several branches to the head: when [the common vessel has] got to the middle of the body, behind the œsophagus, it is joined by the branches of the other side, which follow the same course. These four [aortic] branches, two on each side, now form one trunk and pass downwards, behind the

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[1] [Hunt. Prep. Phys. Series, No. 3264.]

œsophagus and back-bone, giving off vessels to the neighbouring parts; and when it has got as low as the intestines, it sends off the mesenteric artery which supplies the intestines and liver. The main trunk goes down the back to all the other parts.

The fourth [aortic] branch passes out, gets above the before-mentioned bones, running along the upper edge of the uppermost bone, sends down branches to the tongue, &c., gets upon the œsophagus behind, and joins a branch from the united trunk of the other two, going up to the head.

The veins set out from the rectum and bladder in two directions, one in front, the other behind; the anterior vein runs along the abdominal muscles to the liver, and is there joined by the other. The posterior vein runs up the back, receiving the blood from the kidneys, oviducts, &c., passes forwards at the upper part and dips into the liver.

The mesenteric vein, after having formed the 'vena portarum,' passes also forwards to the lower edge of the liver, and is joined by the anterior [front or sternal] vena cava. From the left there are veins running from the stomach, œsophagus, &c., which join the same. All these pass through the liver, and are collected at the upper part and enter the auricle [1].

The Ounkishee [*Amphiuma didactylum*, Cuv.].

This animal is the second remove or link in the chain from the fish towards the Tricoilia.

The general shape of this animal is that of the eel, excepting the tail, which at its anterior part is pretty round, but thence by degrees it becomes laterally flattened towards the tip, which is almost a point. There is nothing of the fin-kind in the edges of the tail. The one from which this description was taken was about 29 inches long. It is of a very dark colour, with scarcely any difference in this respect between the back and belly [2]. The general form of the head, its direction, as also the shape and direction of the mouth, are pretty similar to those of the eel. There are four small processes, which, from their situation, may be called legs; the anterior are placed a little way from the head, just behind the openings of the gills: they are small projecting bodies, straight, and without any appearance of joints; and, at their terminations, they are a little forked or divided into two small toes, the lowest of which is the shortest. There is nothing like nails on the

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[1] [Hunt. Preps. Phys. Series, Nos. 916, 917; and original drawings, Nos. 83 and 85, engraved in the second volume of the 'Catalogue of the Hunterian Physiological Series,' 4to, 1834.]

[2] [Hunt. Preps. Nos. 915 (anterior moiety), and 2397 (posterior moiety).]

ends of these toes. The length of the whole leg is about half an inch. The hind-legs are exactly similar to these: they are placed near the anus, but are somewhat before that part.

The animal has a pretty thick cuticle, which is continued over the cornea of the eye, but in this part it is transparent. The lip of the lower jaw, on each side of the mouth, has a thin fold which is turned outwards and downwards, terminating in a thin edge. The lip of the upper jaw on each side is thin and broad, where it laps over that of the under jaw, when the mouth is shut; but, at the fore part, both lips seem to come simply into contact.

There are two rows of teeth on each side in the upper jaw, and only one in the lower. The internal [vomerine] row in the upper jaw is placed entirely in the roof of the mouth, and opposite to the tongue. They are small pointed bodies, placed pretty near one another, and standing perpendicular to the general surface of the mouth: they are a little bevelled off on their inner surface, similar to the incisors of the human subject[1].

The external nostrils are placed at the anterior point of the head: the internal open at the roof of the mouth, on the posterior ends of the internal row of teeth. There is no external ear.

The cavity of the fauces is very large, and will hold a considerable quantity of water. The œsophagus is large and short. The stomach looks like a continuation of the œsophagus, being in the same direction; and, indeed, is only to be distinguished from it by the thickness of the coats, and by its soft, spongy, internal surface at the lower end; towards which it becomes smaller. The first intestine runs on in the same direction for some way, then becomes convoluted, making some pretty quick serpentine turns, and, pretty near the anus, it becomes larger and less serpentine, which part may therefore be called the rectum. The anus is a slit in the direction of the canal, a little projecting, so as to form two protuberant lips, like those in the same part in the newt.

The lower end of the œsophagus, the stomach, and the whole track of intestines, are connected to the back by a thin membrane. There is no proper mesenteric artery, but the descending aorta sends forwards small branches along the mesentery, &c. to the intestine as it passes along; and, although the stomach might be supplied in the same manner, yet it has a pretty large branch reflected upwards expressly to its lower end by the aorta descendens.

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[1] [The amphiume has about 20 maxillary, 15 vomerine, and 16 mandibular teeth.]

The liver is a long small body running in the same direction with the abdomen, and is nearly two-thirds the length of that cavity. Its upper end begins a little way below the heart, upon the left side of the inferior vena cava: at this part it is small or thin; but, becoming thicker as it passes down, it comes at length to enclose the vena cava entirely; at the lower end it becomes smaller again, and this is the place where the vena cava enters into it. The gall-bladder is a rounded body lying in the sulcus of the liver near its fore part, and a little to the left side; the duct arises from its superior and left side, and, passing upwards and somewhat to the left, it enters the gut a little way below the stomach (after having perhaps divided in its course). The vena portarum enters the liver a little way below the gall-bladder. I could not find any pancreas, but the part was torn where the pancreas is usually situated. The spleen is a long small body lying on the left of the stomach, to which it adheres by a thin membrane, and having its lower end attached to the left side of the upper part of the mesentery.

The kidneys are placed at the lower part of the belly, behind the rectum. They are flat bodies smaller at their upper ends: the ureters enter the rectum near the anus.

The ovaria are oblong ash-coloured bodies[1] situated near the lower part of the belly, on the side of the mesentery, behind the lungs. Where the oviducts begin, I could not observe; but there is a ligamentous line beginning at the upper part of the abdomen which runs down on the outside of the musc. lumborum, going behind the ovaria; then is attached to the outside of the kidneys, and joins the rectum close upon the anus: this [cord] is hollow[2] from the anus upwards to a little way above the ovaria. Along the fore part of the ovaria is placed a long small piece of fat, which will probably be larger or smaller according to the condition of the animal.

The bladder is a very long tube, reaching more than one-third the length of the abdomen, and is connected to the inside of the abdominal muscles. It opens into the rectum on the fore part near the anus.

Of the Circulation of the Blood.—This is very singular. The heart consists of an auricle and a ventricle. The auricle is large in proportion to the ventricle, and is placed on the left and upper end, but projecting forward, so that the ventricle is, as it were, sunk in the sulcus of the auricle. The aorta, or 'arteria pulmo-branchialis,' arises from the upper part of the ventricle, larger than one would expect in such an

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[1] [These bodies having the structure of the testes, I placed the Hunterian preparation showing them in the series of male organs, as No. 2397, 'Phys. Catal.' vol. iv.

[2] [The dilated vesicular part of the vas deferens.]

animal: it is somewhat contorted, passes up before the œsophagus, and soon dilates into a cavity of nearly the same size as the ventricle.

This enlargement is somewhat grooved, so as to look as if made up of different vessels; but, on examination, it appeared to be one bag. It terminates in two branches, which are much smaller than the bag from which they arise, and continue diminishing as they pass towards the head: near their origins and posterior surfaces, arise two arteries, one on each side, which are reflected downwards to the lungs, and enter them at their upper end. The two trunks diverge a little from one another, as it were, winding round the œsophagus; after which each divides into two branches of nearly equal size. These two branches on one side, for instance the left, pass outwards to the gills, and there wind round and between the cartilages of those parts, approaching towards the back; then, beginning to converge round the posterior surface of the œsophagus, they continue their course to the back-bone, where both branches unite into one trunk. The single trunk thus formed, runs down on the same side of the back-bone, attended by a similar trunk on the other side, which has passed through exactly the same course. These two, still converging, having run a little way down on the opposite sides of the back-bone, and having given off branches to different parts, unite upon that bone into one principal trunk, similar to that of fish, which, from this point, may be called the descending aorta; this passes down the back, abdomen, and tail, giving in its way vessels to the different parts.

The inferior vena cava, which collects all the blood from the parts below the heart, is pretty large, and runs through the whole length of the abdomen. At the lower end it lies between the two kidneys; but, after this, it is very loose, running upon the right of the mesentery, to which it is attached by a thin membrane, as also to the back in the same manner. Being got to the lower end of the liver it enters that viscus, passes on and emerges at the upper end near the heart; then, after proceeding a little way, it enters the posterior part of the auricle, having first received the vena cava hepatica, and the veins from the head; so that there is but one vein entering the auricle.

The gills are composed of three cartilages, which are placed in the same manner as gills in fish; but these cartilages have neither the pectinated part, nor the mushroom partition, which the gills of fish have: their ends are articulated together, and the whole is joined to the extremity of the same bone as that of the tongue.

From the fauces there is an opening outwards, between the two inferior cartilages of the gills, for the water to pass. In this opening, which is oblong, is placed a structure composed of two valves, which will obstruct the water passing in from without. The circular cartilages, which are above the opening, above and between which the two arteries pass, are lined on the inside by the membrane of the fauces, which is not very thin.

The lungs are small tubes passing nearly through the whole length of the abdomen, behind and on the inside of the abdominal viscera. Their upper ends are behind the heart, the lower are within three inches of the anus; here they become small and end in a point. They are attached through their whole length by a thin membrane to the root of the mesentery, to the aorta descendens, and, on the right at the lower end, to the inferior vena cava. The whole of their inner surface is honeycombed; their substance is amazingly vascular, receiving many arteries from the pulmo-branchial trunk. A vessel passes down all along the anterior edge of the lungs, where the [mesentery?] is attached.

The vein corresponding to the artery is just such another vessel, and is continued from the lower end of the lung to the upper as one pretty uniform canal, collecting the small branches in its way, and at length opening into the vena cava a little below the termination of that vein in the heart[1].

The Siren [*Siren lacertina*, Linn.].

This animal is the nearest of this tribe to the fish; therefore, at present[2], is the first remove, or link in the chain, above the fish.

This animal, in shape, is very much like the freshwater eel: the largest that I have seen is about 15 inches long. It is of a dark colour on the back, but rather lighter on the belly. Its head is broad from side to side, but flatter from the upper surface to the lower: the eyes are very small, situated near the anterior part of the head, only a little way behind the nose; therefore I should suppose their extent of locomotion is not great. On the lateral and posterior parts of the head are the external openings of the gills, and, immediately behind them, are the two legs or arms. From thence the body of the animal is continued back to the anus without much alteration of shape: it then becomes smaller, and flattens on the sides, forming a superior and inferior edge, which edge is a kind of superadded structure, answering the purpose of a fin, and becoming sharper and narrower to the end of the tail.

The two legs or arms come out from the shoulders: they are composed of arm, forearm, hand, and four fingers; each finger is made up of three

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1 [Hunt. Prep. Phys. Series, No. 915.]

2 [Had Hunter known the *Lepidosiren* and its anatomy, he would, most probably, have recognized it as an intervening link between the siren and the fish.]

bones, as in the human hand: the ends of the fingers terminate in a hard point, not a distinct nail as in most animals; this termination is rounded on the upper or outer surface, and flat, or rather hollow, on the under, as in the nails of most animals.

The motion of the joint of the shoulder is quite free, and admits of considerable variety: that of the elbow is limited to flexion and extension, and the fingers the same.

The arms will serve either as legs or fins; but can be of but little service in either way; however, I should suppose of most in the way of legs.

The mouth is but small, not extending far back on each side of the head. Just within the lips there is a curved edge, answering to the form of the mouth, similar to a gum; this is covered by a horny or rather tortoiseshell substance, which has a cutting edge all round. There is one of these on each jaw, having a deep groove on that side where they are attached to the gum, enclosing the gum for their fixture, not being fixed in sockets. The cutting edges of each oppose one another. That which is on the lower jaw is longer, or goes further back in the mouth than that which is on the upper; they seem to be made for the simple division of substances. Within these cutting instruments, which should be called the 'bill,' are two series of teeth on each jaw [one on each side] which may be called 'holders,' acting until the above-described bill divides the morsel. Those in the upper jaw are the largest. The two sets of teeth in each jaw are near one another at their anterior ends, but diverge as they pass backwards; the teeth form [short oblique close-set] rows of processes perpendicular to the surface, so that this animal has both bill and teeth[1].

The tongue is broad and has very little motion; it has a bone as in birds, frogs, toads, turtles, &c. The nose is very singular: there are two small nostrils, one on each side; the external openings are situated midway between the fore-part of the mouth and its angles, very near the lip. The upper part is membranous, so that they look like a slit: the [nasal] canals pass back towards the eyes, becoming something larger, and near the bottom of the orbits they pass downward to the mouth, and enter that cavity on the outside of the posterior ends of the superior [palatal] teeth, by a narrow opening like a slit. They are somewhat irregular in their passage, and in the size of the cavity[2].

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[1] [Odontography, p. 188, pl. 62. figs. 5 and 6.]

[2] [Cuvier says, "Les narines communiquent avec la bouche par un trou percé, comme dans *le proteus*, entre la lèvre et l'os du palais qui porte les dents" (Oss. Foss. v. pt. ii, 420); and he adds in a note, "J'ai fait cette recherche sur l'invitation de M. Oken (Isis, 1821 xii. Cahier) qui y mettoit avec raison de l'importance, attendu

These internal or posterior openings are entirely out of the direction of the air from the lungs; therefore it can hardly be supposed that they respire through them; and from this circumstance of their not being perfectly adapted for air in respiration, we may suppose they also smell in the water as fish do, especially as they breathe both water and air.

On the posterior and lateral parts of the mouth, or fauces, are three openings on each side; these are similar to the slits of the gills of fish; but their partitions do not resemble gills on their outer edges or inner surfaces; for they have not the comb-like structure. Above, and close to the extremity of these openings, arise so many processes; the anterior the smallest, the posterior the largest: the inferior edges through their whole length, are slit, or are double; the superior or anterior division being the broadest; and both are serrated, or formed into a kind of fimbria: those processes can be folded down, so as to cover the slits externally. The sulcus between the two edges is villous on the surface; and each sulcus leads directly out from its respective opening, and would seem to answer the comb-like part in the gills of fishes.

At the root of the tongue, nearly as far back as the openings reach, the trachea begins, much in the same manner as in birds, turtle, toads, &c. It passes backwards above* the heart, then divides into two branches; one going to each lobe of the lungs.

The lungs are similar to those of the Tricoilia, being two long bags, one on each side, which begin just behind the heart, and pass back through the whole length of the abdomen, nearly as far as the anus. They are largest in the middle, and honeycombed on the internal surface through their whole length. The lungs at the hinder end are loose, having no attachment; at the fore-end they are attached by a double membrane to the back and to the liver.

The heart is of the Dicoilia [type]; it is situated near the head, as in fish, and is enclosed in a pericardium which almost fills the thorax, makes a kind of diaphragm or distinct cavity between the fore-part and the cavity of the belly, as in fish. It consists of one auricle and one ventricle.

The auricle does not consist of one regular bag, but is divided into a number of processes or branches, which makes it very irregular both on its external and internal surfaces: it almost encloses the ventricle,

* To avoid confusion in our ideas, which might arise from the use of the words 'anterior,' 'posterior,' 'upper,' 'lower,' &c., in the whole of the description the animal is considered as horizontal, and the head the fore-part, the back upwards.

que cette communication des narines avec la bouche est pour lui le principal caractère distinctif entre les reptiles et les poissons."]

being a large bag with two lateral portions lapping round the right and left of the ventricle. The lowest of these, or what would be called the anterior in the human, is divided into a vast number of processes which come round the ventricle like fingers. The ventricle is one cavity as in fish, is more regular in its shape, and is like that of a snake. Its apex adheres to the pericardium by a pretty strong adhesion, as in the turtle, &c. The aorta pulmo-branchialis at its origin, and while one trunk, as also in its first division, is similar to the [branchial artery of the] fish. It goes out from the anterior or upper edge of the ventricle, and after passing a little way in a loose spiral turn, becomes straight, where it seems to be muscular. At this part the branches go off, somewhat as in the branchial artery in fish; or it rather divides into six branches, viz. three on each side, going to the gills; at this part, and within the area of the artery, there is a rising like a bird's tongue, with the tip turned towards the heart[1].

These three arteries on each side pass outwards, towards the three lateral slits of the gills; one passing along the partition of each slit, and getting to the basis of one of the three fimbriated gills, which it enters and ramifies in. I believe a branch goes off from the lowermost, which is bent down, enters the chest, and forms the pulmonary artery. These arteries of the fimbriated gills open into converging vessels or veins, which afterwards become arteries. These pass back in a contrary direction to the arteries, as also principally on the back of the gills, and form themselves into one trunk, which passes inwards towards the fore-part of the spine; from thence go out the different arteries to the other parts of the body, as in the fish. One trunk goes to the head, and divides on the basis of the skull; the larger trunk goes down the back, coming nearer and nearer to the middle of the spine, and unites with the similar branch on the other side, forming one trunk which passes down the back to supply the body and viscera. The hepatic artery arises from the large trunk as high as the heart, and passes down loose to the liver.

Of the Veins that enter the Heart.—At the lower part of the heart, where the inferior vena cava enters in the quadruped, there is a swell or bag in the vein answering to it, like an auricle, into which the whole veins of the body enter before they open into the auricle. There are two venæ cavæ superiores, on each side passing down to this cavity. The inferior vena cava passes up to it, as also the two pulmonary veins[2].

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[1] [Hunt. Preps. Phys. Series, Nos. 912, 913.]

[2] [In the abstract from these notes, printed in the 'Philosophical Transactions

The œsophagus, which is pretty large, passes back, and is continued into the stomach in the same line. The stomach at the posterior end bends a little to the right, where it terminates in the pylorus. The intestines pass back, making many turns. At the posterior end they become nearly straight, ending in what may be called the colon, or rectum, which is a little larger; but, at the beginning of this larger part of the intestinal tube, there is no valvular structure, and it runs to the anus in a straight direction[1].

In the stomach there was some grass and a good deal of moss that grows on stone near waters; and in both stomach and intestines were a great many small pebbles, as in birds.

The pancreas is a small body lying above the duodenum, and is attached to the left side of the mesentery.

The liver is principally one long body, chiefly on the right side of the abdomen; it is pretty close to the heart at the fore-part, and passes back on the right side of the stomach and intestines. The vena portarum enters the liver: the inferior vena cava passes forward in the sulcus of the liver to the auricle. There are two superior venæ cavæ, one on each side, coming down from the arms and head to the auricle. At its anterior extremity it would appear to be made up of two lobes; but

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for 1766, Hunter writes, "What answers to the inferior vena cava passes forwards above, but in a sulcus of the liver, and opens into a bag similar to the pericardium;" and he appends the following note characteristic of his candid devotion to accuracy of statement:—

"* This account of the venæ cavæ opening into the cavity of the pericardium may appear incredible; and it might be supposed that, in the natural state of the parts, there is a canal of communication going from one cava to the other, which being broken or nipped through in the act of catching or killing the animal, would give the appearance above described. I can only say that the appearances were what have been described in three different subjects which I have dissected; and in all of them the pericardium was full of coagulated blood. But besides the smallness of the subjects, it may be observed that they had been long preserved in spirits, which made them more unfit for anatomical inquiries. They had been in my possession above seven years." There is no preparation in the Hunterian Collection demonstrative of the structure described in the text. I took the first opportunity of dissecting a siren, to test Hunter's description of the heart and veins, and was led to the discovery of the two distinct auricles, communicated to the Zoological Society in 1834, and published with figures in the 'Transactions,' vol. i. p. 213. The inferior vena cava terminates at the lower part of a large membranous sinus, which also receives the blood from the two superior cavæ by two separate orifices. The common trunk of the pulmonary veins seems also to end in this sinus; but it merely traverses it, and opens into a distinct auricular chamber, which is not separated externally from the apparently single and capacious fimbriated auricle receiving the venæ cavæ. See my Preparation, No. 913 A, following No. 913 in the Hunterian Physiological Series.]

[1] [Hunt. Prep. Phys. Series, No. 444.]

that on the left side is short, and ends abruptly as if cut off. The gall-bladder lies in a fissure on the left side of the liver, near its middle; there is no hepatic duct; but the hepato-cystic ducts, which seem to be three in number, enter the gall-bladder at its anterior side or fundus. The cystic duct passes out from the posterior end, and terminates in the gut, about half an inch from the pylorus[1].

The spleen is a very long small body; its anterior or upper end is attached to the upper or posterior surface of the stomach, and it is continued back or down along the left side of the mesentery, to which it adheres nearly as low as the lower part of the belly.

Below, or before, the rectum lies a long bag like a bladder. It adheres all along to the inside of the abdominal muscles. At its mouth it opens into the rectum, having no urethra. This bag is similar to that in the toad, frog, &c., and is not the bladder of urine.

The kidneys lie at the hinder part of the belly above the rectum. They are loose before and behind, only attached by their inner edges and lower end to the termination of the belly. They receive their vessels by their inner edges; at the fore-end they terminate in a point close to the back.

The ovaria are two, one on each side, about 4 inches in length, thickest at the middle, becoming smaller to a point at each end. They lie below the hinder end of the lungs; their hinder end is attached to the fore end of the kidneys; from thence to the fore-end by a thin and pretty broad mesentery to the common attachment of the intestines, lungs, &c. They are of a yellow colour, plainly granulated, some of which granules are black: the external surface is smooth. They are a hollow bag from end to end, having the small ova attached to its inner surface, which makes it irregular, as in the toad.

There are two oviducts, as in the snake, toad, &c. They seem to run along the back on each side, as far as the anterior part of the belly: they are a little contracted where the turns are pretty sharp. They begin at the anterior part of the abdomen by a thin membrane, which is, at its anterior part, fixed to the pericardium laterally, and, about an inch from this, is the [abdominal slit or] opening, as it were, on the other edge. From this the duct runs back, towards the posterior part of the belly, increasing a little in size, and when near the back part, it runs pretty straight; when as far back as the kidneys it attaches itself to either edge, runs along that edge to the anus, where it opens in the anus by a little rising or protuberance; which protuberance is surrounded by a doubling of the gut, making a valvular appearance[2].

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1 [Hunt. Preps. Phys. Series, Nos. 796, 797.]

2 [Hunt. Preps. Nos. 2695, 2696, showing the short transverse folds of the oviducts.]

[Class Pisces[1].

Order Plagiostomi.]

The Grey Shark[2] [or Tope (*Galeus communis*, Cuv.)].

This shark is long and small, of a greyish colour, darker on the back. The head is flat upwards and downwards, terminating in an obtuse point. The eyes are placed upon the lateral edges. The mouth is placed under the head, about halfway back; it is of a semilunar shape, having two rows of teeth in each jaw[3]. The nostrils are somewhat nearer the mouth than midway between it and the termination of the head, or snout; but they are placed, with the mouth, upon the under surface of the head, and their openings look backwards, perhaps to prevent the rushing in of the water when swimming. The openings to the gills are five slits situated in the neck between the head and first fins, about half an inch from one another, decreasing backwards in size.

It has two pairs of fins upon the body [pectoral and ventral], a single one near the tail [anal], and two single fins upon the back [dorsal]. The first pair are the longest, and are placed upon what we may call the shoulders; the second pair are at the anus and are small: the single one is placed midway between the last and the tail: the two upon the back are, the first and largest one, placed a little way further back than the two lateral ones [pectorals], the second is almost placed directly opposite the single one upon the belly. The tail is flattened sideways; and the finny part is chiefly beneath.

The skin is not scaly, but is of a strong horny toughness, and very rough, like a cat's tongue; the points being all turned backward.

All about the nose and mouth, and indeed on the whole head between the mouth and snout, and about the eyes and face, there are a vast number of orifices which spew out a greasy mucus, just of the consistence and colour of a common jelly: and a vast quantity of the same is between the nose and snout under the skin. It lies in long cells like a honeycomb, parallel to one another, having large nerves terminating at their bottoms. Everywhere about the head of a shark there are a vast number of orifices which transmit a transparent mucus like a jelly: these orifices are terminations of canals which lead to the anterior and

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[1] [The following notes occupied vol. viii. of the original Hunterian MSS., entitled 'On the Anatomy of Fishes.']

[2] [The skeleton of this shark is No. 397, Hunt. Osteol. Series.]

[3] [The true number, partly concealed by the gum, is shown in the Preparation No. 383 A, added by me to the Hunterian Phys. Series.]

upper part of the head, where lies a pulpy substance mixed with a kind of cellular membrane, as it were filled with the mucus: this is the glandular apparatus which secretes it.

The pupil is not round, but seems to be quadrangular[1]. There is a membrana nictitans, pretty thin and hard, covered by such a skin as that of the animal's body; but it is not so rough, though becoming rougher towards the edge[2]. Its muscle is a pretty strong one arising from the hind part of the head, and passing round the anterior or rather posterior canthus; then, passing forward along the under eyelid, it is inserted into the inferior horn of the membrane. The membrane is mostly beneath the under eyelid, not quite at the inner angle as in birds. The motion of this muscle can but bring the membrane over one-half of the eye, excepting the eye is very much depressed: but, as there seems to be little or no motion in the eyelids, this membrane seems to supply their want of motion: indeed, the skin of the eyelids will not allow of any; and the membrane not being a transparent one, seems to preclude one of its uses in birds; for they can see in some measure through it, when it is doing its common office. The tunica conjunctiva is very strong. The eye and muscles are surrounded by a fine pulpy substance extremely slippery. The muscles of the eye are four, straight, arising from the bottom of the orbit, and two, oblique, arising from the inner or rather anterior canthus: the superior oblique has not a trochlea. These oblique muscles cross each other, which gives a greater length of muscular fibre[3]. The optic nerve passes into the orbit half an inch from the insertion of the muscles nearer the fore-part[4]. Just by where the muscles arise there is a small stalk fixed, which is very strong and hard in substance, in some cartilaginous; it passes out towards the eye, and is spread and lost on a glarey substance that is on the bottom of the eye, and among the muscles. This stalk seems to be in the direction of the axis of the eye, and to be the centre of motion of the eye, for the muscles arise nearer to it than to the optic nerve. Just behind the posterior angle of the eye there is an opening [spiracle, 'l'évent' of Cuvier], which I took to be the ear, which passes inwards and downwards, becoming larger and larger, and opens into the mouth just before the first gill. The mouth, or what may be called the lips, is wide, and becomes rather wider inwards. There is a sort of tongue, which seems to be no more than the lower fixtures of the bones of the gills; this surface is rough, and so is the roof of the mouth.

The œsophagus is a continuation of the mouth, hardly becoming

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[1] [Hunt. Prep. Phys. Series, No. 1670.]
[2] [Ib. No. 1762.]
[3] [Ib. Nos. 1761—1763.]
[4] [Ib. No. 1670.]

smaller; and about three inches below the diaphragm it terminates in the stomach; and this, indeed, is a continuation of the œsophagus; for it passes on in the same direction, not becoming much wider, but is somewhat stronger. The stomach is about half a foot long, going near the lower part of the abdomen in the direction of the œsophagus, and terminates below in a blind pouch: it is pretty strong, and is thrown into longitudinal rugæ. At its lower end and upon the right, passes out a gut which is very small at its beginning. The orifice leading from the stomach into this is extremely small; therefore they must either digest everything they swallow, or have the power to regurgitate; which last I think most probable, as a brickbat has been found in the stomach of a shark[1]. The gut passes up upon the right of the stomach, adhering to it for some way; then makes a turn down and enters another gut which is larger. The whole of this canal, between what I suppose to be the true stomach and the valvular intestine, appears to me not to do either the office of a stomach or an intestine. It appears no more than a conductor of the contents on to the intestine, for I do not imagine any absorption takes place here; and, as the stomach is straight, not bent across the abdomen, and as the gut is also straight, and from the construction of its valve cannot bend, the two are obliged to lie alongside each other. Therefore, as the lower end of the stomach cannot oppose the upper end of the intestine, this canal of communication is provided, and as this canal in its structure does not appear to be calculated for the whole office of an intestine, the above use becomes more obvious: at the termination of this canal there is a valve like a pylorus, and this is what I have called pylorus in the description of the ducts of the liver. From this the gut passes straight to the anus, and is similar to the rectum in other animals, as to course, shape, and situation. It has one spiral valve in it, which is very broad, about 3 or 4 inches broad. This, in some, is very close, so as to make the whole of the inner surface of the gut. It is very much honeycombed on the inner surface, so as to increase the surface or subdivide it[2]. This is the true gut, and is where the chyle is absorbed from. The mesentery is very irregular, and attaches the viscera to the back, as also to one another, such as the stomach, pancreas, spleen, so that they are all loose. In many places it is muscular.

The liver, which is larger in proportion to the size of the animal than in those of the land, is divided almost into two, being only united at

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[1] [See p. 404.]

[2] [Hunt. Preps. Phys. Series, Nos. 651, 652, determined by dissection of a recent specimen to be of the *Galeus communis.*]

the base, and hardly there, by [the glandular substance of the] liver. It is made up of two long bodies lying on each side of the spine, almost through the whole length of the abdomen: each terminates in an obtuse point below, becoming smaller to that point. At the union above, the vessels enter, viz. the arteries and the vena portarum. This vein passes up between the two lobes, and when got at the upper part, it divides into two, one going to the right lobe, the other to the left, which two branches are obliged to be reflected down to ramify through the substance of the liver. The vena cava hepatica forms a large bag between the liver and the œsophagus; then passes through the diaphragm in two canals, which join and form one vena cava above the diaphragm which enters the auricle.

In a shark sent me by Dr. John Hunter from Brighthelmstone, the vena cava hepatica formed a very fine network, or spongy body, just between the liver and diaphragm, in some degree surrounding the œsophagus there. This, in texture, is very like the corpus cavernosum of the penis. The gall-bladder is in some degree sunk in the left lobe near the union; for it is partly covered by the substance of the liver. It is seen in many on the convex surface, in others not, probably owing to size, fullness, &c.: it is globular, and smooth on the inside. The cystic duct passes out at the lower part of the gall-bladder (as the animal lies on its back), and runs through the substance of the liver some way, then passes along a membrane that attaches the stomach to the liver, and at about 2 inches from leaving the liver it joins the hepatic, which common duct passes on to the duodenum, and enters the coats of the canal leading from the stomach to the duodenum, before that canal is lost in the pylorus: it then runs between the coats of that part of the canal and the pylorus, and nearly 3 inches of duodenum; lastly enters that gut, not by a nipple, but by a smooth surface. The hepatic ducts are two, one from the left, the other from the right lobe: they pass out of the liver at the same part with the cystic, and join each other about an inch from the liver; the duct then passes on for another inch, where it joins the cystic.

In the shark which Dr. John Hunter sent me, the common duct did not run in the coats of the uniting canal, but entered the duodenum obliquely near its origin.

The spleen in colour and consistence is very much like a dog's; it lies at the fundus of the stomach and upon the left side; as it were, enclosing that viscus, but it sends up a long small process along the last part of the stomach towards the pancreas, which lies on the pancreas, adhering closely to it.

The kidneys lie along the back, becoming thicker by degrees towards the tail: they are conglomerated like those of a bird: the ureters come out of this substance about the middle, and lie on the surface; each ureter opening into a bag which lies behind the oviducts in the female, which bags communicate at the lower part, and open by one orifice just within the ring of the anus, next to the back. These bags run up the back close to the kidney at the insertion of the mesoarium, becoming smaller and smaller. The urine is a thickish mucus.

The heart has but one auricle and one ventricle[1]. There is a pair of valves at the opening of the vena cava which are pretty long. The auricle is large and thin in its coats, and a good deal fasciculated on its inner surface. The valves between the auricle and ventricle are two, and not nearly so long as those between the vena cava and auricle, but they are stronger. The branchial artery begins at the upper part of the ventricle, but is muscular at the beginning for nearly an inch, and then becomes elastic before it gives off any of the branchial arteries; upon its inside are placed three valves, something like the tricuspid [valves of the right ventricle in man], which have cords passing out from their points to be fixed to the semilunar valves at the beginning of the true elastic artery: the corpora sesamoidea are very large. The coronary arteries do not arise from the branchial artery that comes out of the heart; so that the alternate contraction of the heart cannot arise from the coronary arteries arising behind the valves.

Near the upper part of the oviduct are two cæca, like those of the rectum of some carnivorous birds: these are partly enclosed in an entire peritoneal capsule. The one I had from Dr. John Hunter might be called a maiden one. The oviducts were no larger than crow-quills: they winded round the upper part of the liver, on the spongy substance, and bent a little down between the two lobes, and, as it were, joined [one another], and opened by a slit between the upper part of the two lobes[2]. The ovaria are two long bodies lying on the back behind the upper part of the liver.

There is no dura mater either to the brain[3] or medulla spinalis. An elastic ligament runs along the spinal processes of the back, from the head. The nerves of the head mostly terminate in the blind ends of the mucus bags or canals, which are in vast numbers in the head, in many places close upon one another, like a honeycomb. They [sharks] have no cauda equina, the medulla spinalis terminating in the tail in a point. The nerves from the medulla spinalis are very small: their number seems to be equal to the number of interstices between the vertebræ. The

[1] [Hunt. Prep. Phys. Series, No. 911.]
[2] [Ib. No. 2679.]
[3] [Ib. No. 1311.]

nerves from the brain are in number [nine pairs[1], including] the olfactory and optic. The nerves seem to grow larger as soon as they have passed through the skull. There is a white mucus in the ear[2], instead of bone, as in the cod, &c.: this is partly mucus, and partly calcareous earth, as it is partly soluble in an acid.

On the inside of the anus, just on the outside of the ring, there are two protuberances like flaccid nipples: these are two openings which communicate with the general cavity of the belly. This structure will allow of water to pass out, but none to pass in[3]. There is no 'sound' [air-bladder]. How this fish contrives to keep itself of the same specific gravity with the water I do not know. Sea-water is heavier than fresh.

Galeus, or Carcharias.

The shark, the jaws of which I had of Mr. Bowater[4], was 11 feet from the snout to the end of the tail; and, when killed, had several young in its belly. It had also a brickbat in the cavity of the stomach; it therefore must have the power of regurgitation.

The Dog-fish [*Spinax acanthias*, Cuv.[5]].

There are two fins on the back, one near the middle of the fish, the other near the tail: upon the anterior edge of each fin stands a sharp-pointed thorny substance: that on the posterior fin is the largest. By these it defends itself, and perhaps assists in tearing its food; for, when anything offends its head, by laying hold of it, or if it be hooked, it immediately turns round its tail and darts this horny spike into it [the offending object] and tears it away.

There are two rows of teeth in the lower jaw, and three in the upper. The rows in one (when the mouth is shut) pass in between the rows of the other. The teeth stand obliquely with their points turned back,

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[1] [The homologue of the gustatory nerve of mammals is wanting; but the glosso-pharyngeal has an origin distinct from that of the par vagum.]

[2] [Hunt. Prep. Phys. Series, No. 1574.]

[3] [Dr. Andrew Smith informed me that he had found a quantity of sea-water in the abdomen of sharks which he had dissected at the Cape.

Qu. Does it enter to defend the viscera from external pressure? or to compensate for the want of power or facility in the abdominal parietes to accommodate themselves to changes in the dimensions of the contained viscera, the water entering, for example, after the evacuation of the ova or semen? But the fact should, first, be expressly sought for and determined by analysis.]

[4] [In the Hunterian Osteological Collection are preserved the jaws of *Galeus ferox*, No. 405, and of *Carcharias macropterus*, No. 417, either of which answer to the dimensions above given.]

[5] [Parts of the skeleton of this fish form Nos. 390 and 391, Hunt. Osteol. Series.]

like the teeth of a sickle, which is, perhaps, for the better holding and cutting of their prey. Each row becomes stronger and longer as it becomes more inward. The ductus cysticus is not above $\frac{1}{8}$th of an inch long.

The male dog-fish has two long processes close to the anus, connected to the posterior lateral [ventral] fins, which pass backwards in the direction of the body of the fish, just as in a skate, &c. As the female seldom have such processes, and those that they have are very short, I did suppose that their use in the male was to embrace the female in the time of coition; but I do suppose that they are the two penes. The vasa deferentia swell into oblong bags and terminate within the anus into a pyramidal body. The testes are higher up in the abdomen, and are very large[1].

The female has a small clitoris, in shape like the penis of the male: some females have small processes at the anus.

I did suppose that the dog-fish were young sharks, but I now rather suppose that they are not; for in these dog-fish the parts of generation were complete and full of semen. It is, perhaps, a small [kind of] shark.

The Nuss, or Spotted Dog-fish [*Scyllium canicula*, Cuv.].

I bought two fish for 'dog-fish.' These differences appeared. There were no spurs on the back; therefore they were similar to the shark. The nose communicated with the mouth as in the skate or thornback. The teeth were not in distinct rows, as in the dog-fish or shark; but a pretty broad surface was studded with them, as in the skate, but they were not so strong or so broad. The snout did not project so far beyond the mouth as in either the dog-fish or shark: it likewise was more transverse, not so semilunar. In the shape of body, skin, fins and tail, these were just like the dog-fish or shark: so were the external parts [of generation].

This is the fish called the 'nuss.' It lays eggs, similar to the skate.

The Kingston Fish [Monk-fish (*Squatina Angelus*, Cuv.[2])].

The kingston fish and torpedo would seem to be in a middle state between the shark and the skate, thornback, &c. They have not the

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[1] [Hunt. Prep. Phys. Series, No. 2395.]

[2] [The jaws and teeth of this fish form No. 441, Hunt. Osteol. Series. In Collins's 'System of Anatomy,' fol. 1685, the viscera of a *Squatina* are represented in plate 27, as "A Kingston opened."]

thin sharp-pointed teeth of the shark, but much more so than the skate has.

The crystalline humour coagulated in the kingston fish's stomach; therefore there is a coagulating property in the stomach of that fish. The testicles of the shark, thornback, Kingston, and dog-fish, become larger at the time of copulation, like the ovarium in the female[1].

On the inner and unconnected edge of the spiral valve of the gut of a skate, &c., there is an elastic ligament running the whole length of that edge, which always keeps it out of one length[2].

The Fire-flare [*Trygon Pastinaca*, Cuv.].

A fish, called the fire-flare, is very much of the skate-kind; only darker on the back, having the upright holes [spiracula] close to the eye, as it were, through the orbits. It was, anatomically, a skate. The external characteristic of these fishes is the small mouth on the under surface [of the head]; five slits in the skin on each side, viz. the openings for the gills; and the holes [spiracula, 'évens'] leading from the mouth to the upper part of the head. There are two flat fins by the sides of the anus: the tail is a continuation of the body[3].

[Order Holocephali.]

[The Southern Chimera (*Callorhynchus antarcticus*, Cuv.[4]).]

It is to be observed that Nature has a certain number of modes of performing every one of her actions, no two of which are alike; and, in a general way, she has united her various operations so as to form a compound, which in the whole has a specific quality, and which union constitutes a genus of a species.

Each mode may be reckoned like a letter in the alphabet; by uniting them a word is produced; and by diversifying them different words are produced, only that words do not approach nearer in meaning by having more of the same letters in them. If Nature was uniform in this mode of union of her operations, then the Natural History of these compounds would be more easily attained. It would be like a universal language; and, in natural things, it would only be necessary to see one part of any of the compound to judge of the whole[5]. But she appears

[1] [Hunt. Preps. Phys. Series, Nos. 2677, 2678.] [2] [Ib. Nos. 650, 776.]

[3] [The tail, with the serrated spine, of a *Trygon Pastinaca*, form the specimen No. 531 of the Hunterian Osteological Series. The organ of smell is preserved in the Physiological Series, No. 1529.]

[4] [This article is headed "New Shark:" the description accords with the specimen No. 2676, Hunt. Phys. Series.]

[5] [Cuvier's 'Law of Correlation;' applicable, in certain well-defined and natural groups, to palæontology.]

to be whimsical in disposing of these modes out of the general order, diversifying them in such ways as to make a vast number of species in most tribes; not only diversifying the properties of a tribe, but making such a combination of those properties in some tribes as is most distant from the general combination; uniting [in one] an operation belonging to another tribe most distant from [that one] in all its other properties.

The animal before us appears to be the most remarkable instance of these observations of any I know. It seems to be a mixture of as great a variety of properties of different tribes or genera as can possibly be. It is a fish in all those properties on which the economy of life depends.

Externally it has the tail of the shark, having the fin-part of the tail on the under edge[1]. The ventral fins, which answer to the hind-legs in quadrupeds[2], are very similar to those of the shark, but are more fleshy than common: as also are the arm-fins [pectorals], which are very broad, and more fleshy than in fish in common, or in any of the ray-kind. There are two fins on the back; however, the anterior one is rather further forwards, and has the spur on its anterior edge like the dog-fish. But, in other external appearances, it is not of the shark-kind; for it has but one opening from the gills, which is an oblong orifice as in the eel, but which is covered by a fold or flap of the skin of the head: nor is it similar in some of its essential parts; for its gills are similar to those of bony fish, not at all like those of the ray-kind. Its mouth is like the mouth of no fish that I know; nor is it similar at all to that of the porpoise, to which the animal is similar in a most striking instance[3]. It has a projection at its nose peculiar to itself, and its eyes are [peculiar?], as far as I could judge. It has no scales, but a soft skin which is pied. Its intestine is that of the ray-kind. The female has two oviducts, similar to those of the ray-kind, which appear to open above the liver; at least I suppose so, from analogy, being in some respects similar to those of the ray.

These two ducts get to the sides of the abdomen, winding round the liver, and descend along the back, coming nearer each other to the anus, but where they open I could not discover, being too small for examination. There are two ovaria, one on each side of the spine, near the upper part; they are flat bodies somewhat similar to those of the dog-fish. But what is the most curious of the whole is a union of the most distant parts, and of course principles, that I know in Natural History. It has two nipples[4], as in the whale-class of animals, one on each side

[1] [The 'heterocercal' form of Agassiz.]
[2] [A homology also appreciated by Linnæus, in forming his order *Apodes*.]
[3] [Viz. in the supposed nipples.]
[4] [The rudimental homologues of the 'claspers' in the male.]

of the abdomen, a little above the anus; and therefore is most probably viviparous and gives suck[1]. What part of the world this fish came from I do not know[2].

[Order Ganoidei.]

The Sturgeon [*Acipenser Sturio*, Linn.[3]].

The anus is near the tail, viz. the lower part of the abdomen. The œsophagus[4] passes down below the pericardium, and before the sound [air-bladder], adhering to it: the stomach is continued some way in the abdomen, appearing like an œsophagus, then makes a short turn to the left, and passes up nearly as high as before: it then makes a turn down and to the right; this last lies in the concave hollow of the liver, and where it is going to pass down, it terminates in the pylorus. The duodenum passes down 8 or 10 inches, and makes a short bend up upon itself as high as the pylorus, then makes a short bend again down, and terminates in a valvular apparatus like a pylorus, into the colon which runs straight to the anus. The whole length of the intestine from the pylorus to the anus is honeycombed, and the rectum has a spiral ridge running through its whole length[5], something like that in the shark, dog-fish, skate, or thornback. Below the second turn of the stomach is the pancreas[6]. These parts are more spread from one another than natural (in the sketch), for they rather lie before one another. The dotted line above is where the liver[7] is situated, the left lobe of which passes down as low as the first turn, lying, as it were, between the two behind, as the pancreas lies before[8]. The spleen lies all along the upper surface of the duodenum, or that surface next to the back, passing a little lower, and at the upper end it divides into two, as it were, enclosing the first turn of the stomach. The pancreas opens by large orifices into the duodenum, close to the pylorus, and is no more than a

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[1] [The *Callorhynchus*, like the *Chimæra*, is oviparous: the nidamental glands of the oviducts are shown in the preparation No. 2676. The singular eggs of which they secrete the albuminous shell are shown in Nos. 3235 A & B. Hunter's preliminary and characteristic remarks, introductory to this dissection, are invalidated by his odd mistake of the parts he describes as 'nipples.']

[2] ["Mr. Hunter got it in 1792, and Mr. St. Aubin made a drawing of it.—W. C." The last-named gentleman was one of the numerous French emigrants in London at that date. Mr. Hunter received him into his house, and some drawings of Natural History objects were made by him. The *Callorhynchus* inhabits the Australian and Antarctic Seas.]

[3] [The jaws and parts of the dermal skeleton of the sturgeon are preserved, Nos. 376—379, in the Hunterian Osteological Series.]

[4] [Hunt. Prep. Phys. Series, No. 463.]

[5] [Ib. Nos. 636—644.]

[6] [Ib. No. 504.]

[7] [Ib. Nos. 793, 794.]

[8] [The rough 'sketch' referred to is omitted.]

number of cæca, as it were, united into one mass. The duct of the liver opens in the notch or angle that the pylorus makes with the duodenum, and the opening of the pancreas.

The ovaria lay along the back on each side of the ducts passing down to the anus, at whose verge they open.

There is no urinary bladder.

The sturgeon has fat about the head, muscles, &c. or interstices of parts, which is very yellow[1]. From the gills pass up two holes [spiracles] to the upper surface of the head. In the head there is a crust of bone covering the cartilage. There is fat in the muscles about the gills; those muscles are red; therefore the red blood is pushed further than in other parts. The coats of the intestines are very thick. The muscles about the head are proportioned in length to the quantity of motion wanted in the parts. The fasciculi are very much detached. I have found no bones of fish in the stomach of the sturgeon. The stomach appears like a gut. Is not the sturgeon nearest to the shark of any other fish? both from the spiral valve in the intestine, as also the opening on the upper part of the head with the gills?[2].

[Order Acanthopteri.]

The Frog- or Devil-Fish [*Lophius piscatorius*, Linn.[3]].

This fish has a large round stomach, with the œsophagus nearly as large; short intestines; two large cæca at the pylorus; and a valve near the anus. The liver passes from right to left, not down the sides in two lobes as in the shark. The gall-bladder lies upon the lower and fore part of the stomach. There are two hepatic ducts, which pass from the liver towards the duodenum, and both enter a cyst or bag at the duodenum, from which goes out the cystic duct to the bladder.

The Wolf- or Cat-fish [*Anarrhicas Lupus*, Linn.[4]].

The wolf-fish is so called, most probably, from the tusks. It has

[1] [Hunt. Prep. Physiol. Series, No. 1809.]

[2] [The sturgeon is one of the few living representatives of a vast order of extinct fishes, showing, in the main, the affinity suspected by Hunter; but with distinct ordinal characters. The heart, with the numerous rows of valves in the bulbus arteriosus, is shown in Nos. 707, 908.]

[3] [Parts of the skeleton of this fish are preserved in the Hunterian Osteol. Series, Nos. 310, 313—316, 319—324. A portion of the jaw with teeth and their elastic ligaments forms the Prep. No. 381, Hunt. Phys. Series: the heart is No. 904; the ovarium No. 3218.]

[4] Parts of the skeleton of this fish are preserved in the Hunterian Osteol. Series, Nos. 301, 303—306, 308.]

only a bone on the upper lip on each side, none on the lower; besides which it has two lips similar to land animals, and a kind of lip between the anterior teeth and the three rows of posterior teeth. The nostrils are two small holes in the anterior part of the face with projecting edges: they lead backwards, becoming larger, as far as the posterior part of the roof of the mouth, terminating in a blind end, being irregular on the internal surface, but not so uniform as in many others. There are large olfactory nerves.

The stomach[1] is short, and round at the bottom; something in shape like that in many birds. The duodenum passes out on the right side, having a small constriction just at its origin, which may be called pylorus; it then makes a pretty quick turn down, which angle is rather a little bagged, into which passes the duct of the liver. The gut[2] makes some slight turns to the rectum; the whole length of the canal being only about the length of the animal.

The œsophagus, stomach, and intestines are attached to the back, by almost one straight mesentery; that of the œsophagus and stomach is much the thickest: the vessels go out from the back, and then ramify upon the liver, stomach, and intestines. Those to the mesentery are two arteries and two veins, and pass along the mesentery to the rectum, giving off the branches to the intestines on that side next to them; from each of these two arteries go to the intestine and mesentery, so that it is double at this part. On each side of the mesentery is attached an epiploon; these unite with one another over the pylorus like a ruffle: at this part it is very narrow and double-edged. The liver has two lobes, not so long as in the shark or dog-fish: there is no oil in it: the lobes are united at the basis; so that it is rather one body with two flaps, the right being the largest. The gall-bladder, large and round, lies between the two lobes of the liver: the bile is green. Cyst-hepatic ducts, eight or ten in number, enter the bladder near where it is going to terminate in the ductus vesicæ. There is no ductus communis[3].

The pancreas appears to be extremely small, just at the entrance of the duct of the liver, but I suspect that it is somehow diffused in the epiploon. The duodenum would appear to be glandular in its substance, which, if so, answers the same purpose.

The spleen is a pretty round body, only a little depressed on some of its sides. It is of a dark slate colour, placed nearly with its middle in the mesentery at the upper part of that membrane; one half on one side of the mesentery, the other half the other, covered with a pretty strong coat, which separates easily like the coat of a human kidney.

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[1] [Hunt. Prep. Phys. Series, No. 501.] [2] [Ib. No. 631.] [3] [Ib. No. 811.]

The kidneys are in the usual situation, viz. along the back. The two ureters enter the bladder about half an inch from the neck upon its left side. The bladder is pretty large and oblong, lying on the right side of the rectum and ovibags: it is pyramidal, as in the ox: the urethra is an inch long, and opens close to the anus.

Two very long bodies lie on the back on each side of the rectum or behind it, which I suppose to be testicles, but where they enter I do not know; nor did I see anything like a penis.

The ovaria are two pyramidal bags lying behind the rectum; they communicate before they open externally; their internal surface is laminated with pretty broad laminæ, which surfaces are studded very thickly with a vast number of ova, as if granulated. The common opening is close to and behind the anus[1]. In what manner this fish spawns I have not been able to determine.

Upon the sulcus made by these two bags, lies another bag, but not so large, which opens by a small orifice close to the verge of the anus: it was filled with a white matter. This bag I suspect to be the bladder of urine.

As a wolf-fish has no sound [air-bladder]: quære, what is its specific gravity? The wolf-fish has the skin of the body continued over the eye; but at the cornea it is transparent; here the skin is joined to the cornea by a loose transparent cellular membrane[2]. The ear is oblong in the direction of the head of the fish. The valves of the branchial artery are at the beginning, not at the termination, as in some fishes[3].

There is no lateral nerve. There is no duct running along the body, but a good many about the head; a row of which pass along the side for some way, and communicate [with one another].

[Order Anacanthini.]

The Ling [*Lota molva*, Cuv.].

The ling has a sound. The nostrils are as in the salmon. It has the complete tunica conjunctiva, as in the cod, and has a fine eye for showing the retina; viz. the internal layer is strong, and the external one pulpy. There are two choroid coats, an internal brown and an external silver-coloured. It has a vast number of cæca at the pylorus, filled with a white mucus.

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[1] [Hunt. Preps. Phys. Series, Nos. 2674, 3219.] [2] [Ib. No. 1660.]

[3] [The heart is No. 906, Hunt. Phys. Series.]

WHITING PAULET [or Pollack (*Merlangus Pollachius*, Cuv.)].

It is very much like a cod; and has a sound which divides at the top. The anus is in the middle of the belly, so that the guts go much lower towards the tail than the anus does. There are many cæca at the pylorus. There were a vast number of small red worms in the abdomen and about the cæca, which seemed to have been formed first in the stomach and to have ate their way through. The liver extends the whole length of the abdomen, and consists of two lobes; there is a complete tunica conjunctiva: the optic nerve runs across. The ear is like a cod's. The two ureters pass by the side of the cæcum into the bladder, which passes upwards to the anus, when it opens externally. The ovaria are two bags which have one canal opening between the anus and urethra.

[Order MALACOPTERI.]

THE PIKE [*Esox Lucius*, Linn.[1]].

The stomach passes down almost as low as the anus in a straight line, then turns quickly; but at this bend is the pylorus. The intestine goes straight up as high as the upper part of the abdomen, then makes a quick turn down, and passes all the way to the anus in a straight line. The soft melt, or testicle, lies all along the side of the abdomen; that on the left lies on the outside of the stomach and close to it, that on the right lies on the outside of the last intestine; they are almost the whole length of the abdomen. The lower end has the vas deferens passing from it, which terminates at the opening of the urethra externally[2].

The liver consists of one long lobe, having the gall-bladder attached to the posterior or upper surface, of a pyramidal figure, the small end terminating in the duct which passes towards the tail along the upper surface, or that surface which is next to the back, in a contrary direction to the human; and goes in a straight line to the gut, where it enters, about two inches from the pylorus: they have no pancreas that I could see.

The spleen lies at the pylorus, close on the bend at that part, and pretty strongly connected there.

The kidneys lie along the back; at the upper part they project for-

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[1] [The skeleton of this fish is No. 48, Hunt. Osteol. Series.]

[2] [Hunt. Prep. Phys. Series, No. 2381. The female organs are shown in Nos. 2672, 3216.]

ward with the upper end of the sound. The upper half is divided into two, but at the lower end they are united into one; and these have but one large ureter, which opens into the bladder at its neck: the urethra opens close to the anus just behind it.

There is fat[1] about the stomach and intestines, but none on the liver.

The Salmon [*Salmo Salar*, Linn.].

The intestine first goes a little way in the direction of the last part of the stomach; it then bends down towards the tail, which is continued to the anus in a straight line, and about half-way down it becomes a little larger. The villous coat at the small part is in small plicæ: before it becomes larger, there are small valvular parts; and just where it becomes larger, there is a large one like a pylorus, projecting downwards; from thence downwards there are smaller folds, which are continued to near the anus[2]. There is a large gall-bladder, the duct of which is large and like the ? . The hepatic duct has branches going into it, as it passes along a sulcus of the liver; besides which there is a distinct hepatic duct which comes from the liver which is very small, and becomes large just at the duodenum, and enters with the other duct by a very small orifice[3]. The urinary bladder is long and small, behind the rectum. The ureters join into one, which enters the bladder at the fundus. That part which may be called urethra, which is a continuation of the bladder, has a number of veins forming a plexus; it opens behind the anus or at the posterior verge of the anus. The sound has a mucus in it like that in the stomach, and it opens into the œsophagus. The veins of the sound open into, or anastomose with, the vena portarum.

There is a large vessel anastomosing with the vas deferens from the testicle, towards the anus, which I suppose to be a lymphatic vessel, arising from the testicle[4].

The brim of the orbit of a salmon, or the termination of the external surface of the head, is a thin semi-transparent cartilaginous edge; under which the outer parts of the eye roll; this is different from some other fishes. The internal surface of this is not united to the edge. The sclerotic coat is pretty thick, thicker anteriorly than posteriorly. There are two choroid coats, the external one thin and of a silver colour; the other thicker and black. It is divided near the optic nerve

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[1] [Hunt. Prep. Phys. Series, No. 1803.]
[2] [Ib. No. 635.]
[3] [Ib. No. 773, showing the pancreas.]
[4] [Ib. No. 2392; the female organs are Nos. 3203, 3204.]

into two lamellæ, between which lies a fleshy substance that surrounds the nerve in a serpentine manner. The nerve passes through the whole, and would seem to be flattened and broadened, like the head of a nail. The optic nerve through its whole length is a continuation of the substance of the brain, and is a very different substance from the retina.

It has two nostrils on each side, close together, only divided by a thin partition; they are placed just before the eye. One orifice [in each nasal sac] answers to the anterior nostril, the other to the posterior one.

Spawning of the Salmon.

"River Itching, near Southampton.

"Information from the fishermen. The salmon in this river begin to come from the sea in the middle and end of May; and are generally all returned again to it by the middle or end of July. They spawn in June, and almost all of them go as far up the water to deposit it as they possibly can. They deposit their spawn in pits made in sand or gravel. They (the fishermen) believe that they cover as much of the spawn as they can; and think also that only the parts so covered are vivified. The pit is made by the female, and the spawn covered by the male, who is sometimes so exhausted as to die in or soon after the operation.

"The young are divided into three kinds: first, the 'fry;' second, the 'smelt;' and third, the 'peal;' to these is added a fourth, called a 'bouge:' this is supposed to be a mule got between a salmon and trout; it is never found above 8 lbs. weight, and they suppose it incapable of propagating. The reason for supposing it to be from the connexion mentioned, is, by its having red spots upon its sides and belly, and in other respects like the salmon.

"The young salmon are first observed about Michaelmas, and remain in the river till the season following, when they return with the old fish to the sea; and the season following that they return again to the river to propagate. They never call the young a salmon until their weight is 8 lbs. The spawn they suppose to be devoured by the eel, jack, and birds; the last, particularly the cormorant, destroys vast quantities of the fry.

"The eels in the same river begin to run in March, and return in November. They are often found with spawn in their belly; but where or when they deposit it is not known. Young eels are often found in the mud earlier in spring. The congers are, also, frequently found in this river; they differ from the eel in size and colour, the last of which in them is in general much lighter; they have also a larger jaw and mouth, and are more ravenous than the eel.

"The eels live in winter on the roots of grass, and in summer on worms, and the spawn of such shell-fish as they can come at.

"The fish besides those mentioned, are flat-fish and mullet. Of the last they have three kinds, the grey, yellow, and red."—*Anon. MS. Memorandum.*

The Electrical Eel [*Gymnotus electricus*, Linn.[1]].

This fish I shall consider in three lights; its singularity simply upon account of the organ; its singularities from other fish as a fish; the organ itself.

This fish, on the first view, appears much like an eel, from which resemblance it has most probably got its name, but it has none of the specific characters of that fish. Its colour is in general dark, very nearly black, but it is said to have several brown spots [when alive]. The general shape is long in proportion for its thickness. Its head is broad from side to side, especially at that part where it is joined to the body. The body generally is much narrower from side to side than from the back to the fore or lower part, owing in some degree to the under fin. It is much thicker near the head in proportion to its breadth than at the tail. It loses its thickness laterally, by degrees, towards the extremity of the tail, where it is very thin. The transverse section is an oval, of which the back of the animal makes the thick, and the lower part the small, end; which is continued out into a long point by means of the fin. It keeps its breadth to pretty near the extremity of the tail, and then becomes narrow by the back being bent towards the fin, which keeps nearly a straight edge. The fin grows gradually broader towards the end of the tail.

This animal may be considered, both anatomically and physiologically, as divided into two parts, viz. the common animal part, and a part which is superadded, viz. the peculiar organ. I shall at present consider it only with respect to the last, as the first explains nothing relating to the last nor any thing relating to the animal economy of fish in general. The first, or animal part, is so contrived as to exceed what was necessary for itself, in order to give situation, nourishment, and most probably the peculiar property to the second. The last part, or peculiar organ, has an immediate connexion with the first; the body affording it a situation, the heart nourishment, and the brain and nerves probably its peculiar powers.

For the first of these purposes the body is extended out in length, being much longer than what would be sufficient for the progressive

[1] [Hunt. Prep. Osteol. Series, No. 45.]

motion of what may be called its body; for the real body, or that part where the viscera and parts of generation lie, is situated with respect to the head as in other fish, and is extremely short, so that, according to the ordinary proportion, this should be a very short fish; therefore the tail, or that part which is extended beyond the cavity of the abdomen, is much longer than what is absolutely necessary for the progressive motion of the body, or fore part of the animal, as it is much longer than what is to be found in fishes in general, which have no other use for this part; therefore we may reasonably suppose it was extended out for the purposes of this organ only. However, it is still adapted for progressive motion and the specific gravity [of the fish]; for there is a continuation of the spine, medulla spinalis, muscles, fin, and air-bladder, through its whole length. Its great length, therefore, seems chiefly to afford a surface for the support of the peculiar organ; however, the tail part is adapted to the progressive motion of the whole, and to preserve the specific gravity; for, besides the above parts, there is a membrane passing from the spine to the fin which runs along the belly. This membrane is broad at that end next to the belly, terminating in a point at the tail. It is a support for the belly-fin, gives a greater surface of support for the [electric] organ, and makes a septum between the organs of the two opposite sides.

The gymnotus has three fins; two of them are pectoral, situated one on each side, just behind the posterior openings of the gills, very much like those called the pectoral fins of an eel. The third is the anal fin, and is continued along the lower surface of the fish, almost its whole length. It begins upon the belly, and is continued to the tail, being narrowest forwards, and becoming broader towards the tail: it consists of small bones laid close to one another, and placed a little obliquely, pointing backwards towards the tail. These are articulated to another row of small bones, but rather longer bones, within the body of the animal. These again are fixed to the edge of a pretty strong tendinous membrane or septum, the upper part of which, after enclosing the large air-bag, is fixed to the thinnest. This septum is broadest at the anterior end, towards the abdomen, where it begins and terminates in a point, at or near the end of the tail. All this part of the fish is divided into a right and left side; each of the bones of the fins have four muscles, two lateral and two interstitial; the lateral muscles are immediately under the skin and arise from it; the others are between the bones of the second row. The lateral muscles give the fin its lateral motions, and the interstitial ones give each bone more or less obliquity, which may be called flexion and extension.

The Skin.—The skin is smooth, and in general pretty strong and tough; it is thickest on the back and sides, becomes thinner towards the belly fin, and upon this fin is quite thin and not nearly so strong. It is attached to the parts which it covers by cellular membrane, which is of a finer texture where it unites the skin to the large electrical organ, than on the back, where it unites the skin to the muscles, &c. Upon the skin, especially about the head, are a great many openings of the excretory ducts which contain the mucus for lubricating the skin, as in other fishes. The line which passes along from the head to the tail in fishes is their common excretory duct, having a great number of branches which open laterally; the glandular part for the formation of the mucus generally lying on the head. Under the skin, almost everywhere, lies a very thin membrane, spotted with numberless small dark spots: this is more firmly united to the parts which it covers than to the skin.

The Senses.—The eyes of this fish are placed near the nose or extremity of the head, and are extremely small: these are, therefore, only adapted to see near objects. This will probably confine the [fish's] sphere of action; which I believe is, in most animals, regulated by the senses. [Each olfactory sac of] the nose has two openings, as in the eel and many other fishes; one anterior and a little projecting, the other posterior, and even with the common skin of the head. These, perhaps, answer to the anterior and posterior nostrils of some other animals. The organ of hearing is upon the same principle with that organ in fishes in general, consisting of three bent canals, similar to the semicircular canals in the human subject, opening into one cavity, in which lies a loose bone. This, in some fishes, is of a particular construction; it is chalky in others; whilst a few have nothing in this cavity. These canals are generally formed of a transparent cartilaginous substance. The tongue projects very little, less so than in many other fishes. In the mouth there is a very singular structure, consisting of four rows of regular risings; one placed along the upper surface of the tongue, one on the roof of the mouth, and one on each side, which are smaller than those on the tongue and roof of the mouth[1]. It is not easy to conceive a use for them; as they are upon the tongue, it may be conjectured they are for the sense of taste: if so, then taste is conveyed by different nerves. The mouth is neither large nor small, when compared to other fish of the same size. The teeth have nothing remarkable in them.

The œsophagus is short, strong as in fish in general, and pretty large, having the air-bags opening into it. The abdomen is an oblong cavity,

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[1] [Hunt. Prep. Phys. Series, No. 1449.]

somewhat longer than it is wide. The viscera which it contains are all adapted to the shape or figure of this cavity, being short and thick, as it were proportioned to a much smaller and shorter fish. The stomach[1] is a pretty large and almost round bag, a little flattened from side to side, with a very fine internal villous coat. The intestine is small[2], but rather long in proportion. The duodenum passes out at the right side about the middle of the stomach, then down and round the lower end of the stomach to the left side, and comes up on this side as high as the œsophagus, and then makes a turn backward and downward, encircling the left side of the stomach; it then comes towards the belly, and passes along the inner surface of that cavity towards the under surface of the head, in a pretty straight line, which may be called the rectum, and opens just under the lower jaw or root of the tongue *.

The liver[3] is divided into two lobes: it is small and flat, not proportioned to the whole animal, but only to the vital parts; the large trunks of the vena cava hepatica ramify on its external surface, and there is no fat in its substance. The gall-bladder is large, lying between the two lobes and upon the stomach above the pylorus. The cystic duct enters the duodenum just at its beginning. The pancreas is appendiculated as in many fishes, and opens by many orifices into the duodenum at its beginning. The spleen is large and very vascular. The kidneys are large and long, lying on the whole back part of the abdomen, thickest at the lower end, which is bent a little forwards on the lower part of the abdomen, where the ureters open into a pretty large duct, or long bag, which passes along the belly towards the head, accompanying the rectum and opening externally close by the anus. This bag seems to be intended as a bladder, for it is of a sufficient size to contain a considerable quantity of urine.

There are two roes, one on each side of the urinary bladder: they are oblong bodies of a considerable length, and are of the true roe-kind, similar to all of the fish class except the ray-tribe. The roes were in an imperfect state; therefore I could not distinguish the male roes from the female; but, perhaps, the specimens were all males or all females[4]. However, they were said to differ when alive.

Of the Motion of the Blood.—It is a true fish, having but two cavities

* Many animals have this retrograde direction of the last gut, particularly fish, but none in so great a degree as this.

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[1] [Hunt. Prep. Physiol. Series, No. 500.] [2] [Ib. No. 628.]
[3] [Ib. Nos. 790, 791.]
[4] [The male organs are shown in the Hunt. Preps. Nos. 2379, 2380; the female organs, in Nos. 3220, 3221, 3222.]

to the heart, viz. an auricle and ventricle, answering to the right auricle and ventricle in the animals which have four cavities. It has a branchial artery, similar to the pulmonary [in function]. The great artery which arises from the gills runs along the back-bone, sending out branches as it passes. The great vein runs along the spine in the contrary direction, collecting the smaller veins as it passes along.

The respiratory organs are gills: they have no small bones, but two pretty broad ones, acting as ribs for the dilatation of that part which is similar in use to the thorax; besides the laminæ branchiarum, which are so much fixed to the other head-bones, as not to move forwards and downwards. The electrical gymnotus has, in its membrana branchiostega, three flat rays or radii, connected by the tough membrane, and moveable forwards and downwards.

Air-bags.—There are two air-bags, a large and a small one. The large one begins at the termination of the cavity of the abdomen, and passes back along the under surface of the spine, as far as within a few inches of the end of the tail, becoming smaller and smaller towards this part. It has a pretty strong external covering, which appears to be a continuation of the septum which divides the two electrical organs: this is lined with a proper or distinct soft membrane. As these parts are appropriated for the specific gravity of the animal, their size and extent are such as answer this purpose without any connexion with any other known circumstance in the animal economy.

The small air-bag is placed forwards under the posterior part of the head or beginning of the body; it is a circumscribed cavity terminating at the fore part in two blind ends; its substance is of a firm tendinous consistence, lined with a soft membrane like the large air-bladder. These air-bags have each a small duct which unites into one near the œsophagus, into which it opens near its termination in the stomach. The duct of the larger air-bag comes out at the upper or anterior end, and passes along the surface of the kidneys towards the œsophagus. The duct of the small one comes out at the posterior end, and passes almost directly towards the œsophagus, where it joins the large one; and these two form a common duct, which becomes cellular, and then opens into the œsophagus near its termination into the stomach. These ducts are very small; not much larger than a large brad-awl.

The bones of this fish are like those of the eel, cod, and many other fishes.

This fish abounds with fat, having it everywhere in the interstices of the muscles, and also in other parts of the body. Besides which there is, under the skin of the back, and more particularly near to the end of the tail, a whitish yellow substance of considerable thickness, nearly half the breadth at this part*. It is very similar to fat in very small cells, but affords very little oil when boiled, although it is very inflammable in the open air.

Mr. Walsh informed me that two electric eels fought and bit one another, especially in the night. They did not appear to strike one another by their peculiar powers. This is like bees, which do not sting each other, but bite.

[Then follows the description of the electrical organs which was extracted from the above 'Notes' for communication to the Royal Society, May, 1775. As this description is printed in the 65th volume of the 'Philosophical Transactions,' and in my edition of the 'Animal Economy,' 8vo, 1837, p. 415, it is not given here. That description, however, in Mr. Clift's copies of the Hunterian Manuscripts, constitutes an important proof of their authenticity.]

The Conger Eel [*Anguilla Conger*, Cuv.[1]].

The anterior nares [openings of the nasal sacs] are at the anterior point of the head; [the sacs] pass backwards and open just before the eye: there are cartilages at the nose, which serve for the dilatation and contraction [of the sacs]. The motion of the under jaw upon the upper is more like that of a quadruped than of fishes in common. The three semicircular canals do not communicate with the vestibulum: they do not pass through bony or cartilaginous canals, but through ligamentous substance. There is a small bone in the semicircular canals.

The Eel [*Anguilla latirostris*, Yarrell[2]].

The stomach has two mesenteries attaching it to the back, which unite into one at the lower part of the stomach; whence this mem-

* It may not be improper to take notice here, that there are in general two situations for fat in fishes; which are, the body in general and the liver. When in the body, it is diffused through the whole, as in other animals; but, when it is not to be found in the body, it will be found in the liver. The salmon-tribe, herring-tribe, jack, &c., have their fat diffused all over the body: the cod-tribe, ray, shark, &c., have it only in the liver. These facts, although not known as a constant rule, yet are so far observed as to be made the foundation of parts of commerce.

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1 [Parts of the skeleton of this fish are preserved in the Hunt. Osteol. Series, Nos. 41—43. The following are Hunterian preparations of the conger in the Physiological Series: Nos. 1035—1038, branchial organs; No. 2092, air-bladder; No. 2660, female organs.]

2 [The skeleton of a small eel is No. 40, Hunt. Osteol. Series. The jaw and teeth of *Anguilla latirostris*, Yarrell, forms No. 393, Hunt. Phys. Series.]

brane passes down to the lower part of the abdomen, continuing to be attached to the back, and to the fore part of the intestine; it is very loose and fat, and would seem to answer the purpose of an epiploon. The duodenum, &c. form all one gut, which is almost straight, making only a few serpentine turns to the anus. The intestine has also a mesentery attaching it through its whole length to the vena portarum. This is a long and straight vein, running the whole length of the abdomen, receiving the veins of the guts, spleen, &c.; it then passes along the concave surface of the liver, sending its branches into that viscus, and, by the time it has reached the diaphragm, is entirely lost in it. The gall-bladder is detached from the liver, and adheres to the beginning of the duodenum. The heart is attached to the pericardium by a number of small filaments at different places.

The aorta is a union of the branchial veins. There are five openings of the gills in the mouth [on each side]. The external opening is one, like a slit upwards and downwards, just before the pectoral fin, which is very oblique, like the entrance of the ureters into the bladder, being much further back than the openings from the mouth, and it is membranous like that of the conger eel.

The Zebra Eel, from Sumatra[1] [*Muræna Zebra*, Cuv.[2]].

It is of a dark colour, but striped almost transversely with whitish narrow stripes, some of which do not go all round, nor are those which do perfectly parallel. It has a broad tail but no fin. The skin is very loose, more especially towards the anterior end. There is one opening into the [cavity containing the] gills, which are five in number [on each side]. The teeth are flat, [the jaws being] as if studded by them.

The œsophagus is large, which is continued into the stomach. The stomach is a continuation of the œsophagus, being in the same line, terminating in a point at the lower end. The duodenum comes out on the fore and right side of the stomach, near the termination of the œsophagus, and bends down directly, passing along the right side of the stomach. It is large, about the size of the stomach, being irregularly honeycombed on the inside[3]. At the lower end it contracts pretty quickly, and then is thrown into short bends upon itself, being attached or kept in this state by a thin membrane; it is continued in

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[1] [From Wm. Bell, in 1792.—W. Clift.]

[2] [Skeletons of two species of *Muræna* are preserved in the Hunt. Osteol. Series, Nos. 36, 37.]

[3] [Hunt. Prep. Phys. Series, No. 630.]

this form to the rectum or anus. These small intestines contained a vast number of claws, shells, &c. of crabs.

The liver is small, long, and lies alongside of the lower part of the œsophagus. The gall-bladder is not attached to the liver as in the fowl, amphibia, &c.; its duct passes into the duodenum just as it bends down.

I could see nothing like testicle or ovarium. The whole viscera were attached, anteriorly, to the parietes of the abdomen, by a membrane like the mediastinum in the thorax; and, when slit up longitudinally, it looked like a double mesentery. This is more like the snake than the eel, as if it was approaching the snake.

[Order Dermopteri.]

The Lamper Eel [*Petromyzon fluviatilis*, and *Petr. marinus*, Linn.].

The mouth is longitudinal: when fully opened, it becomes round and makes a kind of cup, studded all over the inside with teeth: the lips have small processes placed all round. The tongue is a projecting body at the bottom of the mouth, and of a particular shape, having a great many teeth upon it for holding[1]. The eyes are placed on the sides of the head, and pretty far back. The nose is placed on the top of the head as far back as the eyes, having but one nostril which opens forwards. The fins on the back are placed near the tail and on the tail.

The œsophagus passes down through the chest and opens into the stomach: as it passes down it is perforated laterally on each side by seven large openings, so that it may be called both œsophagus and trachea[2]. The stomach passes in the same direction with the œsophagus, or in the direction of the abdomen, and appears to be only an enlargement of the œsophagus. The stomach is not attached to any thing excepting the liver by means of the vena portarum, which at this part adheres closely to both, as it were running between and uniting them together. The stomach contracts, and may be said to terminate in the gut.

The gut passes in a straight line from the stomach to the anus; so that the œsophagus, stomach, and intestines form one straight tube from the mouth to the anus. The intestine is not attached to any thing through its whole course; that is, it has no mesentery. Near the anus there are the arteries passing to the gut, and there are communications between the vena cava and the veins of the gut or vena portarum. The

[1] [Hunt. Preps. Phys. Series, Nos. 396, Osteol. Series, No. 35.]

[2] [Ib. Nos. 1022, 1023.]

stomach and intestines have longitudinal valves on the inside passing through their whole length, but nothing similar to a pylorus. There is no pancreas, and, of course, no cæca.

The liver is one lobe; is rather small for the size of the animal, but large for the size or length of gut. There is no gall-bladder, and where the ducts enter the gut I do not know. The heart is at the lower part of the chest, composed of an auricle and a ventricle, enclosed in a pericardium which is cartilaginous. The trunk of the branchial artery, which is one as it passes up, sends off the seven pairs of branchial branches.

They have seven inspiratory holes, crossing from the œosophagus, viz. one to each branchia, which enter the cavity of each at the union of the edges. They have seven expiratory passages leading out at the opposite edge, and open externally separately from each other. The branchiæ are placed in the chest of the animal, which is of some length, and not in the setting on of the head to the trunk, as in most other fishes. The chest is composed of ribs which are cartilaginous [1]. There are fourteen branchiæ in the whole, viz. seven on each side, which are in pairs: each gill is composed of two parts opposing each other, making a flattened cavity between them, each side of which is composed of longitudinal folds, the edges of which are loose in the cavity [2]. Each branchia is enclosed in a distinct capsula or pleura.

The air-bag or 'swimmer' passes along the back as low as the ? and opens into the œsophagus near the mouth; at this opening, and for some way down, it is valvular, or has a number of ridges in it, as if for the increase of surface, similar to the branchiæ [3].

The kidneys are long, small, thin bodies, passing from the anus upwards, one on each side, running in the same direction, almost contiguous to each other: their length is somewhat more than the half of the lower part of the abdomen: they are attached by one edge to the back, where they receive their vessels, somewhat similar to the kidneys in snakes; and on the other, or loose edge, passes the ureter, which is large in this fish, it having no bladder. The ureters become smaller when near to their openings, which are into one cavity, just above and close to the anus; which cavity is common to them and the openings of the belly [peritoneal canals] for the exit of the ova. This common

[1] [They are analogous to ribs; see 'Hunterian Lectures,' 'Vertebrate Animals,' 8vo, 1846, p. 52. fig. 11.]

[2] [Hunt. Preps. Phys. Series, Nos. 1024—1030.]

[3] [This is the median branchial canal, beneath the œsophagus, terminating in a blind end behind, and communicating anteriorly with the œsophagus near the mouth by a double valvular orifice.]

cavity opens externally, almost within the verge of the anus, in a projecting part like a kind of nipple.

Of the Female Parts, or Ovaria.—The ovaria are placed almost all along the back, in the centre of the abdomen, from the liver above, to near the lower part of the abdomen, the lower end lying between the two kidneys. They are attached to the back through their whole length by a doubling of the peritoneum, receiving their vessels at this attachment between this doubling. From this one attachment go off the two ovaria, as if dividing into two lamellæ, but which join one another across at their common union. Each ovarian lamella is made up of, or divides at its edge into, a number of processes which float loose in the abdomen. They are composed of two transparent membranes, which may be called doublings of the peritoneum, united at a little distance by a number of partitions, which form cells in the interstices between the two. That part of the external membrane which covers each cell has a whitish speck or body in it, and which seems to have a dent in its centre. These bodies I suspect are the nidi of the ova. The ova are formed on the inside of this doubling of the membrane which composes the ovarium; probably one in each cell. This circumstance of the formation of the ova on the inside of the ovaria is somewhat similar to the formation of the ova in the frog and toad. As the cavities or cells of the ovaria do not communicate, or open, externally, as in fish in common, and as there are no proper oviducts as in the ray-kind, it is at first view difficult to account for the mode of propagation or the mode of exit of the eggs.

It would appear from every circumstance that the coat of the cell of the ovarium opens as in the frog and toad, and that the egg passes through it into the general cavity of the abdomen, being there perfectly detached. [In Batrachia the ova are received into oviducts, but, in the lampreys,] by certain operations of the abdominal muscles they are worked towards the anus, and are at last squeezed out by the passages which lead from the abdomen into the common passage of the two ureters before mentioned, and then they are thrown out at the nipple [valvular outlet of peritoneal canal]. In one fish there were several ova lying loose in the cavity of the abdomen; and, by handling the ovaria which had some of those eggs in their cells, the eggs readily made their escape. The eggs are round bodies, flattened on the two opposite sides[1]. I never saw any thing like a stone in any of the cavities of a fish.

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[1] [Hunt. Prep. Phys. Series, Nos. 2658, 2659, 3196, 3197, 3198, 3199, 3200, 3201. See also vol. i. p. 218.]

[Subkingdom MOLLUSCA.]

Class CEPHALOPODA.

THE CUTTLE-FISH [*Sepia officinalis*, Linn.].

The cuttle-fish would seem to be a complete animal in itself, both male and female; but how far it is so, I have not yet been able to discover. I should suppose that it impregnates its own eggs. It has a gland on the left side of the belly, which forms or secretes its yolk or the substance of the yolk; which substance passes backwards to the tail or posterior end, and there gets a covering; it has a passage on the right for the exit of these yolks when completely formed; so that these yolks as it were pass round the other viscera. It has two bodies whose outlines are oval, and very much flattened, made up of thin bodies whose sides are in contact, and lie between the gland above described and the opening for the exit of the ova, with their apices forwards, and whose mouths open near the passage of this yolk, as if intended to impregnate these yolks as they pass out, as the male toad does the eggs of the female: or they may be like the soft roe of fishes. It has no parts for receiving or being received.

Behind, and somewhat between these two testicles[1], is a bag filled with a black liquor: on one side of this bag, upon its inner surface, is a thick substance, which is also black. This substance I imagine to be the kidney, as I find nowhere else any thing similar to the kidney, and the bag to be the bladder[2]. From this bladder passes forwards a duct which passes over and between the two bodies [nidamental glands] which I call testicles or soft roes.

Mem. The tentacula of a cuttle-fish, caught in Newfoundland, 35 feet long[3].

Animals, whose construction is uncommon, may have parts similar to

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[1] [They are the 'nidamental glands' of the female: see my description of the Hunterian Preparations of the female organs of the *Sepia officinalis*, 'Physiological Catalogue,' vol. iv. p. 125. Nos. 2652—2656. Hunter seems subsequently to have recognized the male cuttle-fish: see Hunt. Preps. Nos. 2371, 2372.]

[2] [Ib. No. 2126.]

[3] [Banks and Solander, in the first voyage of Captain Cook, discovered floating in the sea, between Cape Horn and Australia, in lat. S. 30° 44′, long. W. 110° 33′, a huge cephalopod, upwards of six feet in length from the tips of the arms to the hind end of the mantle. The parts of this animal (*Enoploteuthis unguiculata*) were presented to Hunter, who preserved sections of the arms (Phys. Series, No. 63), the beak, mouth, and fauces (No. 308), the heart (No. 903), and the hinder end of the mantle, with the terminal pair of rhomboidal fins, in the series of dried preparations.]

those whose construction we are well acquainted with; yet we may not know what they are. For instance, the ink of the cuttle-fish may be supposed to be the urine: if it is not, then most probable they have no kidneys; but as it is so unlike the urine in other animals, it would never be suspected to be such, until the knowledge of their having no such bodies as kidneys, similar to those in other animals, was obtained, and no other animal having 'ink;' therefore it is reasonable to suppose it is the urine[1].

[Class Lamellibranchiata.]

The Ship-Worm [*Teredo navalis*, Linn.].

This worm eats a canal for itself in the outer plank of a ship: it is a small animal when compared with its length. They are found of very different lengths; but, of whatever length the animal may be, the canal in which it is found is always of the same length; therefore its tail is in all cases to be found at the external surface of the wood where it first began, and its head at the other end of the canal.

As it grows in length, it eats its way into the wood, and lengthens its canal; its increase in thickness is but small in proportion to that of its length; and that increase is always at the head; so that the tail of one an inch long is nearly as large as one two feet long.

They in general bore in the direction of the wood: at first they go obliquely inwards, and then they follow the grain; but this is not constantly so: they are often put out of this direction by some other worm in the same piece of wood; for, whenever they come near the canal of another, they then change their direction. There are often so many of them together in the same piece of wood, that it shall be bored so thick of holes as it possibly can, without running into one another. But they seldom or ever do go quite into another's canal: how they avoid this is not easily ascertained.

The canal is lined by a white shell, for it appears to have no connexion with the body of the animal, although it is formed from it. It is pretty thick and strong at the tail, becoming thinner and thinner towards the head: it also grows larger. This increase of thickness is owing to this part being first formed and still continuing to thicken while the animal is alive, and the fore part of the animal while it grows is, as it were, creeping out of it and extending the shell forwards, which is at first thin. The canal in the wood is very smooth; and, where it terminates at the head, it is by a smooth concave surface, as if drilled, or turned in a lathe.

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[1] [See Art. 'Cephalopoda,' Cyclopædia of Anatomy, vol. i. pp. 536, 540.]

The wood would appear to be the worm's only subsistence; and, if so, it is one of the most curious and singular circumstances respecting the food of animals; for, in most animals, the food far exceeds the size of the animal; but in this they must be well proportioned.

[Subkingdom Articulata.

Class Insecta.]

Of Insects.

A singularity in the external figure of some animals, arising from the mode of union of the three great parts of which animals of a certain degree of perfection are composed, has given rise in the mode of classing to a division called 'insects.' These three parts, in the more perfect animals, are the 'head,' the 'chest,' containing the heart, lungs, &c., and the 'belly,' containing the digestive powers, with the parts of generation.

Although in the insect these three divisions do not exactly contain the above-mentioned parts, yet they do in some degree. The insect is the first of the imperfect [invertebrate] animals that have most of their particular parts brought together into their respective places; the head, for example, being distinct for the brain and all the senses. But although the parts appropriated for particular uses are distinct in themselves, yet they are of different shapes, so as not all to come into the same places [as they do] in the more perfect [animals]; for in this class [Insecta] the heart is continued along the back, and the lungs are dispersed over the whole body: but the belly is allotted to the digestive powers, and, in most, to the parts of generation. The union between the head, thorax, and abdomen in this class of animals being very slight, gives the idea of an incision. The part which is analogous to the thorax is only a fixture to the legs and wings with their muscles, not being a containing part: therefore the abdomen becomes the common reservoir; even the salivary glands are within it. Their cuticle and bone is the same, besides answering many of the other purposes of life, as claws, pincers, &c. They are the first [animals in the ascending scale] which have the five senses; and the first that are of distinct sexes[1]. They have nothing similar to a pelvis; therefore all their feet come out from the thorax: of these they are obliged to have three pairs, and the last go as far back as the belly to support it, or the weight of the belly would tilt up the head or fore part.

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[1] [Many Entozoa and certain plants, *e. g.* palms, are diœcious.]

This class of animals, respecting external figure, and also respecting their animal economy, may be divided into two kinds; for instance, the spider, louse, &c. may be put into one class, and those that go through changes, or fly, into another. This latter is the class I here mean to treat of; and, as they undergo several changes before arriving at perfection, I shall call them the metamorphosing insects[1]. The other class have all their parts gradually formed, from the first formation to its most perfect state; this I believe to be the case with the spider, lobster, &c.

For the first class I shall keep the term 'insect,' as it has been long applied, and become familiar.

Most insects belong to a country where there are seasons; and such as live [through the year] I believe sleep during the winter, excepting the common bee. Where they do sleep is not fully known. One would suppose, and I believe it is commonly observed, that severe winter kills many insects, and that mild winters preserve them; and this is known by the numbers that come forth in the spring or summer following; but contrary to this general rule was the effect of the mild winter in 1789 and 1790, for there were fewer insects of all kinds in the summer of 1790 than I had ever seen[2]. This may have arisen from the mildness of the spring bringing them forward too early, and then a few cold days coming on killed them, as it did the blossom of the fruit trees.

This class of animals is perhaps as remarkable an instance of the play of nature, as any that we find in the animal world; and it is principally owing to the changes they undergo.

The most perfect animals that we know of undergo a change which divides their life into two stages, in which there is a considerable difference in the economy of life. For this purpose, the formation of some parts are altered or lost, and others are consequently put into use; but these parts are but very few in number. All the adult parts are regularly forming while the animal is still in the womb or in the fœtal state; in which state it has a few parts not to be found in the second stage. These chiefly respect the circulation, and of course the mode of nourishment; as, *e. g.*, the ductus arteriosus, ductus venosus, and foramen ovale, which fits the fœtus for the way of life it is then in. The human is one of the instances of this kind. The life of the fœtus, in such, being very different from what it is afterwards; therefore, the above-mentioned parts become soon obliterated upon the commencement of the new life; in which the lungs are put into play, and the sensitive

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[1] [Answering to the *Metabolia* of Leach, MacLeay, &c.]

[2] [The effect here noticed is rather the rule than the exception.]

principle takes upon it the power of receiving impressions, or becoming a sensitive being. Here we have only one change, and of course two states.

In another class of animals, viz. frogs, toads, &c., there are two changes, and of course three states. They are first changed from the fœtus (their state in the egg or spawn) to the aquatic state; and then are changed from the aquatic to the land state, but this change from the aquatic to the terrestrial is very little; and it is a gradual change from the one to the other, not so immediate as in the first, or from the fœtal to the aquatic state. The second change in these animals is mainly in the mode of respiration, from respiring water to breathing air; for, when in the aquatic state, they have a kind of gills fitted for such a situation, and these are gradually lost, and the lungs as gradually come into play. Some other trifling changes take place in some of this tribe and not in others: some parts are lost, as the tail in frogs; new parts are added, as the legs in the same: other parts are altered, as the tails in some newts. But none of these changes are so complete as in the insect; none of them going into a new state, in which they are losing many of their first formed parts, and acquiring the second,—a state in which it has neither the character of the preceding nor of the succeeding animal. Perhaps it is one of the great characteristics of this class of animals, these very changes which they go through before they arrive at the adult or perfect state.

This class of insects may be said to have two states of fœtation and two births, and therefore they have four different modes of life. The first or fœtus, while in the egg, is the stage of hatching, similar to the chick in the egg, or the fœtus in the womb; save with this difference, that in the chick or the child all the adult parts are forming, and they pass into the last mode of life immediately upon being born; while the insect only goes into the larval or second state. This second state of birth, viz. the caterpillar or maggot, is that in which the insect is increasing in size in all its parts, whether they be those that are to remain or not; and is forming some new parts, as the parts of generation (as we see in the silk-moth), fitting them for the condition of the adult state. The third state, or the second fœtation, is called the 'chrysalis,' when they appear to live upon themselves, or on what they accumulated when in the state of a larva. They now become intersected, whence they got the name of 'insect;' and there are forming many parts necessary for the adult, which were not necessary for the larva, as, *e. g.*, eyes, legs, wings; and they now complete the parts of generation. The fourth state is the consequence of the second birth, and forms the complete animal. The fourth differs as much from the second state as any two distinct genera of animals possibly can do.

Neither the first nor the second states of the insect produce the formation of every part which is afterwards to be found in the third and fourth states. But this we find to be the case in the first life of the most perfect animals; for, whatever parts we find in the adult, are also to be found in the fœtus. However, the second state of the insect, or the caterpillar, is producing some parts that are found in the adult, such as the parts of generation. It is a life preparing for the adult, and is itself endowed with parts some of which are only adapted for the second state, and do not exist in the adult, while others do; and many of those that do remain are altered, as much as the same parts can differ from one another in any two distinct animals, viz. the digestive organs; although they continue to live upon the same food in both states, as the wasp, hornet, bee, &c. This is, perhaps, to adapt better the shape of the one part to that of the other. However, there are alterations in the conformation of the parts that must answer other purposes.

So different are all these changes, that few traces of the first are left, and no one would believe, when they are compared, that they both originated from the same parent, or that the second would ever be like the third or fourth. This circumstance of a double birth, with such a deviation from themselves, obliges insects to be considered in four distinct views, both as to their Natural History and their anatomy. In their Natural History is to be considered, first, their propagation; secondly, their ways of life in the four states; thirdly, their figures in the last three states. Anatomically they are to be considered, first, as to what parts are peculiar to each state; secondly, what parts are entirely gone; thirdly, what are changed; and fourthly, what are new or added.

The external form of this class of animals in all their stages is well marked, and, I suppose, understood; especially the last, in which state they have been principally considered and classed. When in their second stage, or after their first birth, I think they may be distinguished into two kinds; for they appear to have two very distinct characters. I would call one 'caterpillar,' the other 'maggot.' The first will most probably include all the butterfly and moth-kinds. The other, or second, the fly, wasp, ant, and beetle-kinds. I suspect the caterpillar is not stationary, but moves from place to place for food, at least as far as it is necessary, viz. from leaf to leaf, or from branch to branch. But I believe the maggot is more stationary, commonly keeping to the same place, more especially those that are fed, as in the bee-tribe. I suspect this last, or maggot, may be divided into several classes: there is one class at least which is aquatic, as the second stage of the dragon-fly. Their food in the different stages is very different. In the first it is the contents of the egg which nourishes them; in the second and fourth stages they live on extraneous food; while in the third they seem to require no nourishment, excepting what the changes they are undergoing may produce. Their first extraneous food, or that which they eat in their second stage, is commonly not what they eat in their fourth: more especially in the case of those whose eggs are laid in the proper place for food; as many of the butterfly-kind, humble-bee, common fly, and gnat. But of those which are fed by the parent, many I believe are fed on a great variety of food, as the wasp, ant, &c. But I suspect that the maggot of the common bee is either fed with honey, or what is called the bee-bread, which is also the food of the fourth stage. However, I am apt to believe the bee-bread is the food of the maggot-bee in store.

When in the second stage they eat much more than when in their fourth or full-grown stage: and probably those that live on vegetables eat more than any other known animal. Some insects eat no food after being full-grown. This shows what a quantity of nourishment is necessary for growth.

Of the Caterpillar.—Although I shall keep to the terms head, thorax, and abdomen, yet they do not wholly correspond in their uses to those parts in the more perfect animals. The thorax in the insect is not a reservoir for the organs of respiration; but may be considered as thorax, as far as that part in the more perfect animals is a fixed part for the anterior extremities to take their action from: and, in this light, it may be reckoned in the insect as thorax and pelvis combined; for the posterior legs arise from it. Insects have no circumscribed visceral cavities; for the cavity of the abdomen, which is the only one that can be called a cavity, has all its contents united to one another by means of the air-cells and vessels, as if they were entangled in the air-vessels. Both the caterpillar or maggot, when full-grown, are larger than when in the fourth or perfect state.

The caterpillar is a long body consisting of rings, forming many points, giving origin and insertion to muscles for both the progressive and lateral bending motions.

During this state a perfect conformity subsists between all the rings; the head and tail being only distinguishable from their shape and manner of termination. Most, if not all, caterpillars when young throw out a thread from their mouths, which fixes them to the part on which they are placed; and, if at any time they are thrown off, so as to threaten a fall, this stops them. But they are often moved from the fixed point, and often thrown off so as to be suspended. In such case they can climb up by laying hold of the thread above, by their feet alternately, and coiling it up about their feet till they arrive at their usual place.

Of the Maggot.—The maggot is not so long as the caterpillar in proportion to its thickness, and is smaller at the two ends than in the middle[1]. Both caterpillars and maggots, as far as I know, have a line of dots on each side, some more, others fewer; the silk-worm has nine on each side: these are the mouths of the air-canals, which serve as lungs in the caterpillar, as also in the maggot. But, besides this use, in the maggot they serve as air-bladders in those which live in water, and suspend them to the surface of the water, as in the gnat and rat-tail maggot[2], keeping a globule of air at the tip of the tail, which keeps the maggot near the surface, and water from entering. Some caterpillars have feet for progressive motion, such as those of the butterfly and moth, and these are of two kinds, the six anterior differing in formation from the posterior ones. Some maggots have tails for progressive motion in the water, as those of gnats; others have them to suspend their bodies by near the surface of the water, as the rat-tail maggot[3]; while others, which have no progressive motion, as the young ant, and those [larvæ] which live in cells, such as of bees, wasps, &c., have neither tails nor feet, although they have progressive motion; which is by a kind of shortening and elongating alternately their bodies; and sometimes jumping, as in the maggot of the common nut[4], and also those in cheese.

The progressive motion of those that have feet, is a mixture of creeping and walking: the creeping motion is an alternate elongation and contraction of one half of the length of the body at each time. First, the anterior half lengthens and stretches forward, while the posterior is contracted. The stretched-out head fixes, and this half shortens itself out of the posterior half, which lengthens it; and, when the posterior half has been pulled out to its full length, then the tail, which was all this time the fixed point, loses its hold, and is drawn forward by the contraction of the posterior half upon itself. The walking is performed at the same time by a successive motion of each pair of feet, which assists in these alternate contractions and elongations of the body, by making a greater number of fixed points, making the head and the tail alternately the fixed point. Those which are aquatic, move their tails like a paddle, as fishes do theirs.

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1 [The experienced entomologist, Mr. Fred. Smith, who has kindly revised the pages relating to *Insecta*, cites the 'wire-worms,' or larvæ of *Elateridæ*, as exceptions to the above general rule.]

2 [*Musca pendula*, Linn.]

3 [Ib. Hunt. Prep. Phys. Series, No. 596.]

4 [*Balaninus Nucum.*]

Of their external Surface.—The caterpillar in some is smooth, as that of the silk-moth, and probably of most of the moth-kind. In others it is extremely rough and hairy; pencils of hair coming out from the skin, as in many of the butterfly-kind. They are of various colours, both those that are smooth and those that are rough. The maggot has a smooth skin, and is commonly of a light cream colour.

They are all, I believe, produced from an egg; but how far this egg is similar to that of a fowl I know not.

Of the Disposal of their Eggs.—The whole concern of the female about the egg is, in some species, the proper soil for incubation. Some, as butterflies and moths, choose vegetables. Others choose living animals, as the bott [*Œstrus Equi*] in the stomach of the horse, the *Œstrus Bovis* in the backs of cattle, the *Œstrus nasalis* in the nose of the deer, the *Œstrus Tarandi* in the back of reindeer, the *Œstrus* [*Gastrus*] *hæmorrhoidalis* in the rectum of horses, the *Œstrus Ovis* in the nose and frontal sinuses of ruminating animals, especially sheep, the little insect in Mexico called 'Migna,' [Chigoe?] under the skin, the *Vena medinensis*[1] in the flesh. Others, as several flies, select dead animal matter which is moist and in a state of putrefaction: others, as the moth called [*Tinea tapezata*, Fabr.], and several *Dermestides*, select dry animal matter; and others, as the gnat, choose stagnant water. Some, as the ant, lay their eggs in common earth, without any formation of it into a nidus; while others, as all of the bee-kind, the *Scarabæus*, &c., are at great pains to make proper places for the eggs.

Some insects may be said to lay their eggs in society, others to be solitary, while there are a few of the mixed kind. Of the first is the bee and the wasp; of the second are most of the butterflies, moths, beetles, &c.; of the mixed kind are those, as the common fly, that lay their eggs as may be most convenient, one, two, or a hundred in one place. The silk-worm moth lays its eggs as it goes along upon the parts where it chooses to lay them.

Of the Time of Laying and Hatching.—Some, as the silk-worm and the black-beetle [*Geotrupes*], lay their eggs in the months of August and September, and these are not hatched until the summer following; the greater number, as most flies, the little white moth with a brown tail [*Porthisia chrysorrhæa*], the bee, wasp, gnat, &c., lay eggs which are hatched in the same summer.

Of their Economy when hatched.—When hatched, many, as the *Phalænæ*, spin a network or covering for themselves, where they retire in the evening.

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[1] [*Filaria medinensis*, or 'guinea-worm,' an entozoon, not a larva.]

Of their Food when hatched.—The [larvæ of the eggs] that were laid upon particular substances generally feed thereon, the parent taking no further concern about them; such are the silk-worm, most moths, butterflies, flesh-flies, &c. Some feed upon the substance which the parent provided as both nidus and food; such are many of the ichneumons, the humble-bee, an insect in rotten wood [*Xylocopa*, Latr.]. Some of those which provide places for the reception of the egg, generally provide food for the young, as the hive-bee, hornet, wasps, &c. (although this is not always done by the parent, but by others, which therefore may be called nurses); while there are some which do not provide any nidus, but lay their eggs in the common earth, yet nevertheless take care of their young; as the ant, which not only feeds the young, but moves them from place to place according to circumstances or dangers, even when in the chrysalis state; which last is, I believe, peculiar to them. The food, therefore, of all those that feed on the substances in which the eggs are laid is either vegetable or animal; and those also which are fed by the parent may have either vegetable or animal food, and some have both, as the wasp, hornet, &c. The substance which the humble-bee, or *Apis terrestris*, provides for its young, is a kind of wax; and the substance which the *Scarabæus* [*Geotrupes stercorarius*] provides for the nidus, is cow-dung, which is a compost of animal and vegetable matters. The maggot of the bee is fed most probably with vegetable substance, viz. bee-bread, or properly honey; while the wasp feeds its young with fruit, meat, or almost anything it can get. Those, as the silk-worm, which only live a short time, have their eggs neatly formed at once; but those, as the common fly, which live a considerable time, have a series of formations, a gradation from the full-formed to the smallest being observed in their ovaria at the same time.

The mode of hatching is extremely various.

All of the first class, or caterpillars, change their coat several times. Those of the *Phalæna* first weave a kind of network upon the large branches of the tree on which they feed, which serves them as a bed, to which place they retire in the evening, laying upon it alongside of one another, or pretty parallel with each other; and on this bed they change their skins, which frequently remain entangled in it. I believe that of those of the second class, which I have called maggot, some do not change their skin [several times]; but that the skin grows in proportion to the growth of the animal.

Both classes are preparing themselves for a second state of fœtation, called 'Chrysalis;' though not all, for the gnat appears to move directly from the maggot to the fly-state. Some, during their caterpillar state, *e. g.*, the silk-worm and some other moths, as also during the maggot-state, *e. g.*, the wasp, common bee, humble-bee, form secreting organs for a second nidus. These are glandular tubes for the secretion of a slimy mucus, which is capable of being drawn out to a considerable length, and when exposed to the air, forms immediately a solid substance. Others, as many of the butterfly-kind, have not more of this substance than is enough to form a single thread, to suspend them to some wall or ceiling; while others, as the common fly, gnat, beetle, are not provided with any such organs, but go immediately into the chrysalis state, as sometimes the silk-worm does when it is weak.

When about to accomplish this change they cease to feed. Those that were fed by their parent are no longer so provided, and all prepare for the chrysalis state. Some go to proper places, as the sides of walls, ceilings of old houses, &c.: others make their way under ground, hollowing out an oval cavity for themselves, and lining it with their silk: others, beetles, wasps, &c., stay in the same nidus in which they lived in the maggot-state; some of these line the cell with a kind of silk, as the common bee: the humble-bee may be said to spin and weave a complete cell for itself, covering its mouth with the same substance; others, as the wasp, hornet, &c., only complete their cell by covering its mouth. Some, as the silk-worm, work a nidus for themselves; while others, as the common fly, get into a dry place and pass into the second embryo state without any nidus; the ants pass into their chrysalis in the place where they have lived in the maggot-state, where no nidus had been formed either by their parents or themselves.

Those which spin a cell for themselves, as the silk-worm, generally before they begin to spin, empty their stomachs and intestines: but I believe this is common to every other caterpillar, as also to the maggots. Many, as the bee-tribe, in which I include the wasp, &c., which had been fed by their parents or nurses while in the maggot-state, are not forsaken by them.

However, the last action of the bee is to cover with wax the web on the mouth of the cell which the young bee had woven. The ant takes care of the chrysalis the whole time it is in that state. Insects do not immediately pass into the chrysalis state, many having a tedious operation to perform, viz. making their nest, as does the silk-worm. They first become inactive, indolent, without eating food: in this state of inactivity there are certain parts formed, viz. the wings and adult legs; and the body is beginning to form itself into different divisions, resembling a kind of middle state between the maggot and chrysalis. When it goes into the chrysalis state, the caterpillar casts its last coat, and exposes a gradation between it and the complete insect; such as very small wings: but this is not so in all; the wings in some, as the ant, being a much later process. The formation of the adult legs is accompanied with the loss of the posterior [larval] feet, and of the tail or holders, in those that have them, such as all those of the butterfly and moth-kind. But every insect does not do this; for the gnat, when it shifts its last maggot coat, immediately becomes a fly.

Of the Chrysalis.—The animal now passes into the chrysalis state, or second state of fœtation; and, in exchange for the last coat of the caterpillar, there would appear to exude from the skin another coat, which wraps up the whole like a mummy-shroud: but I believe that in the maggot the coat which served them through that state, forms the coat of the chrysalis. In some insects, as the stag-beetle [*Lucanus cervus*], the chrysalis covering makes distinct sheaths for each part, viz. for the wings, legs, &c.[1]; in others, as the ant, humble-bee, &c., it makes one common covering for the whole[2]. In some, as the silk-worm, this coat becomes dry; in others, as many beetles, it keeps moist: this difference arises, most probably, from situation; the chrysalis, in one, being placed in dry places, in the other in moist. In some, as in the silk-worm, butterfly, &c., the chrysalis coat is strong and hard; in others, as in the bee-tribe, it is very thin.

In form the dry chrysalises vary but little from one another; in general they appear like a case enclosing something of an oval or oblong shape, much smaller at one end than at the other. However, they are not all so, for the ant is a pretty regular ellipsis. Some are pretty regular and smooth, such as the silk-worm or common fly; others have knobs or points on them, near to the head or thick end, such as the butterfly. The moist chrysalises, such as those of the bee, wasp, black-beetle [*Geotrupes*], are very much the shape of the perfect insect. The dry chrysalises are of various colours; some shining like polished brass or copper, as the[3] ; others grey, as the chrysalis of the white butterfly; or red, as the chrysalis of the fly. These colours belong not to the animal, but to the chrysalis case. The moist chrysalises are at first commonly white; then begin to take on the colours of the perfect animal; but this is owing to the animal being seen through the coats.

A chrysalis in general may be divided into two parts, one the head and chest, the other the belly. Their stay in this state is various;

[1] [Hunt. Prep. Phys. Series, No. 3076. Such chrysalises are the 'pupæ incompletæ' of Linnæus.]

[2] [See also the hawk-moth, Hunt. Prep. Phys. Series, No. 3061, as an example of the 'pupa obtecta' of Linnæus.]

[3] [See that of a butterfly: Hunt. Prep. Phys. Series, No. 3056.]

some rest much longer than others, as the hawk-moth the whole winter; but, I believe, not many rest very long. The gnat can hardly be said to enter into the chrysalis state at all; it cannot be said to stay any time in that state.

When in the second state of fœtation, insects are undergoing the changes peculiar to each kind; losing some parts, acquiring others, while certain parts are changing.

Of the Parts that change.—The digestive organs go through the greatest change; for, in some, the power is entirely annihilated. The form of the mouth undergoes considerable change: some lose their mouth altogether[1], as the silk-worm; others change one form to that of another, according to the different foods and different ways of getting them: of this kind are the humble-bee, common bee, and common fly. In the first, viz: the silk-worm, the stomach is wholly lost, although not the œsophagus (this is to be reconsidered); and the part of the gut at the anus is elongated into a small canal, extending the whole length of the abdomen, which cannot be called a gut, as it is not now a passage for food. The second is where the stomach of the worm and caterpillar is changed in size and shape, contracting in all directions, and becoming extremely small in comparison to what it was. The œsophagus is elongated into a stomach and intestine, which in some, as the beetle, is of considerable length.

The bags near the anus, in such as have them, as the black-beetle [*Geotrupes*], contract until there is not the least vestige left. The parts of generation are forming in both males and females, but arrive at very different degrees of perfection. In the silk-moth they are completed with the other parts of the adult, which renders them fit for propagation the moment they come into the perfect state, as the wasp, hornet, common bee; but in others, especially of the female, the parts are not to be found, even long after the insect is perfected. But then these do not propagate the same year; but as, probably, the males copulate the same year, we find the male parts perfect. The adult legs are forming. The horns (antennæ) are forming. The wings, in those that have them, which is by much the greatest number, are formed in this state. The ant is an exception to this time of the formation of the wings; for in them the wings are not formed until the insect has performed every natural function, even generation, which is the greatest. Some, as the bee, wasp, &c., complete their wings in this state: in others, as the silk-worm, fly, &c., the wings appear to be only partly formed, and immediately expand upon being exposed. The air-vessels are forming

[1] [This is too emphatic a statement of the change from the mandibular to the suctorial mouth; although the latter may not be put to use by the domestic silk-moth.]

in several places, and the air-bladders in the abdomen, [which, besides] answering the purposes of respiration, become necessary for flight.

When arrived at full maturity, they then work their way into life or action a second time; the chrysalis coat splits in several places; first, at the head, through which that part passes, and then along the body, which soon follows, all the parts [in the pupæ incompletæ] being drawn out of their sheaths. Those which have either made a nidus for themselves, or have lined their cell, are obliged to work their way through this; and with the silk-worm it is a pretty difficult task. Those which are under ground are obliged to work their way to the surface, which, as in the case of the black-beetle, is sometimes eighteen inches. They all, at the second birth, throw out the excrement which has accumulated in the time of their chrysalis state: it is generally a brown or yellow fluid, or rather a fluid mixed with a brown or yellow substance.

Of the complete Insect.—When the insect is completely formed and emerges from the chrysalis state, its colours, whatever they may be, are not so bright as they are some days after: thus the bee, wasp, &c. may be known to have just come from their cell. The external form of the insect consists of three parts; a head, chest, and abdomen; the head the smallest, the chest the next, and the belly the largest. The legs come out from the lateral and lower parts of the chest; the wings, from the higher and lateral parts of the same. They have six legs, three on each side. The two fore-legs are the shortest, the hind-legs are the longest, and by much the strongest: they are obliged to be so, as they arise so far forward, they must pass back to support the hind parts of the insect, especially when the insect walks horizontally; for the hind parts would, otherwise, fall to the ground while the head would be raised; acting upon the feet of the middle legs as a fulcrum. The legs are in pairs; and, in progressive motion, the right and left move alternately. The motion of the three on each side is more complicated, wherever we set out with the first motion. It is, if we begin with the fore-foot, as follows: fore-foot, hind-foot, middle-foot: if we begin with the hind-foot, it is then hind, middle, fore; or, if we set out with the middle-foot, it is middle, fore, and hind. When they move fast, they appear to lift up the fore-foot, before they set down the hindmost one.

Those insects which live through the winter are then inactive, in countries where there are considerable changes in the seasons; but in countries where there is no great difference in the seasons, they continue longer in their annual actions. This state of inactivity arises from cold, and has its different effects upon different insects. It may be divided into two kinds; one, where they admit of being nearly as cold as the atmosphere in which they live, when they are almost perfectly inactive, requiring no nourishment: this includes most insects. The other is where they cannot admit of a considerable degree of diminution of their heat without suffering death: when, therefore, they retain nearly their native heat, their actions are confined within smaller limits; but in such degrees of heat they always require nourishment; of this the bee is an instance.

Insects have a great deal of blood in them while in the maggot or caterpillar state. In the second change there is hardly any blood to be seen; they have but little unnecessary weight, that they may fly the better. The blood of the insect is a transparent fluid.

The blood of the large caterpillar of the privet-moth [*Sphinx Ligustri*] appears, in the microscope, to be made up of globules floating in a watery fluid. The globules are oval, but rather irregular in their figure, and are pretty nearly of the same size. They seem to be very numerous, and almost in contact with one another.

The air-vessels in the maggot and caterpillar are only for the purpose of respiration, and are therefore only vessels or canals: but, when the chrysalis has completed its purpose, the lateral air-canal forms itself into lateral air-bags, as reservoirs for air to increase the size and diminish the weight of the animal for flight: from these reservoirs pass the respiratory vessels to the different parts.

Of the common Age of Insects.—I think we have reason to believe that no insect lives beyond the year of its perfection; that most insects are perfected in one year, and many in the same season; and that all insects die the season they lay their eggs, whether they themselves were hatched from eggs laid in that season or not.

Every female insect does not come to perfection in the same year or season in which it goes through its changes, and come to the fly state: of this the bee-tribe is an instance[1]; but, I believe, the males of this tribe [do come to perfection in the same year].

As in many instances it will be difficult to find out what insects live through the winter, and what die, also what females live, while the males die, it will be necessary to come as near to the truth as possible, so as to be able to say, with some probability, that such live and such die. If, for instance, we find the females, which we know to live

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[1] [Hunter here refers to the labourers or sterile females of the social bees, which "do not come to perfection" by reason of their abortive ovaries; although they may have "gone through their changes" to the winged state. Only the queens or fertile females live beyond the year of their perfection; provided they have not laid their eggs during that year.]

through the winter, to be fat in the autumn, and those which we know to die in the winter to be lean, we may presume to reason from these appearances in insects we know but little about. The same may be said respecting the males; for, if we find that although the females live through the winter, as in the bee-tribe, and are fat in the autumn, yet that the males are lean, then we may conclude that the males die*.

And in regard to those insects of the longevity of which we know nothing directly, if either their females, or males, or both, be fat or lean in the autumn, we are to conclude of their living or not through the winter accordingly.

Insects have no ovaria similar to those in many other animals; the small oviducts at their beginning are to be reckoned the ovaria of the insect, for there the first parts of the egg are formed.

Insects appear to lay a number of eggs in proportion to the trouble they are at in providing for their hatching and rearing; thus, although the bee, wasp, hornet, &c. are at considerable trouble, yet it is trifling when we consider the number of hands they have that do not breed, but are employed on nursing; but where the whole falls on one insect, and the care is great, they then lay but few eggs, as, for instance, the black-beetle (*Geotrupes*).

All soft eggs of insects I imagine hatch soon after laying.

There are three modes of propagation in insects respecting the hatching of their eggs. It is immaterial which we call first, second, or third; but we should call one *first*, so as to fix which we mean when considering it.

First Mode.—This is where an egg is laid in the autumn, keeps the whole winter, is hatched in the beginning of summer, and the insect forthwith goes through its changes, copulates, lays its eggs, and dies; it therefore does not live above four or five months; although twelve months elapse between the egg being laid and the insect from it laying its own eggs. Such is the progress of the silk-moth.

Second Mode.—This is where the egg is laid in the summer, earlier than the former, is hatched in the same season, and about the same time [as the other]; but the insect, when arrived at the caterpillar state, leaves its food, buries itself under ground and goes into the chrysalis state; in which it lies the whole winter, comes out in the summer as a moth, lays its eggs and dies: so that this insect lives nearly a

* The common bee is an exception to this rule; for the females are not obliged to be fat in the autumn, because they have a store; and which, from analogy, would prove them to live through the winter; and this is a corroborating circumstance in favour of the opinion that all those insects that are fat in autumn, and lay up no store, live through the winter on that fat.

twelvemonth; a few months in the caterpillar state, a whole winter in the chrysalis, and a few months in the moth state. Such is the case with the privet-moth [*Sphinx Ligustri*], large hawk-moth [*Acherontia atropos*].

Third Mode.—This is where the eggs are laid in the beginning of summer, as in the second; but are continued to be laid for several months in that season: they hatch in the same season; go through their several stages pretty quickly, as the first do; but do not propagate the first season: they go into winter quarters, and propagate in the summer following through the whole season and die in the autumn, as their parents did. Such I believe is the case with the common fly; and is certainly the case with all the bee-tribe, excepting the common bee. In this third class, I apprehend only the females live through the winter, the males dying in the autumn. How far the female, in the common bee, after breeding, is an exception to this rule, I do not yet know.

Insects, such as the dragon-fly, gnat, &c., whose first life is in the water, and which undergo their change in this element, do not go into the chrysalis state, but change almost immediately. This is because a chrysalis could not remain under water without change of air, and as a chrysalis has no motion it could not have this change.

[Order Coleoptera.]

A beetle has no increase of canal which can properly be called a stomach. The œsophagus is extremely small in the head, but soon becomes larger and forms the 'stomach.' The œsophagus, stomach, and intestines are one canal; the two last of equal size throughout their whole length. From the mouth it is straight till it gets into the belly, and may be called œsophagus; it then becomes considerably convoluted; and near to the anus it is again straight. The whole intestine appears to have a spiral valve running through it. One would naturally suppose that digestion goes on everywhere in this canal. A little way from the anus is a small stricture, and then the gut, in many [beetles], is a little larger, although not in all. At this stricture open some canals, to be hereafter described. The rectum has longitudinal rugæ. The anus and oviducts are capable of being pushed out, or can be projected some way beyond the body of the animal, for which motion they are loosely connected to the external covering of the animal by a thin membrane, which, when the parts are drawn in, forms a kind of prepuce or capsule. The contents of the intestine are a slimy mucus of deep greenish yellow, as if mixed with a great deal of bile. Three or four small canals or tubes lie loose in the cavity of the abdomen, as it were interwoven with a convolution of the intestines; they appear to take their rise from no part, but begin by blind ends. They pass in a very convoluted direction towards the anus, and open into the gut at the above-mentioned stricture. These are exactly the same with those in a silk-moth; only those of the silk-moth appear to enter higher, just at the termination of the stomach: but it is to be observed that the gut in the silk-moth is much shortened, and the stomach is a bag, so that the entrance of these canals, in the moth, is altered from what it was [in the larval state] when the operation of digestion was going on.

The liver is composed of two bodies, very large, and placed in the middle portion of the animal close to the back; they are best seen by removing the wings, and then the shell which covers the back close to the insertion of the belly into the chest. Under the smooth shell of the back, near the head and higher than the insertion of the wings, would appear to be nothing but the muscles for the motion of them and of the legs. Everywhere within the body of the animal there are oblong bladders having in them air, and a white liquor. These bladders communicate with one another by small ducts [trachea], and by small ducts they are attached to the intestines, muscles, liver, and every part of the body; and as soon as the ducts attach themselves to these parts they ramify upon them like vessels. In the cavity of the abdomen, on each side, there are two air-vessels running along the lateral parts of the cavity, just upon the inside where the back and belly scales meet, similar to the lateral communications of the air-vessels in the caterpillar. These vessels have short ones passing from them directly to the skin, where they open externally, I suppose, as in the caterpillar. From them two lateral vessels arrive at a vast number of smaller ones, which pass inwards towards the contents of the abdomen. These vessels in general ramify everywhere on the contained parts, as *e. g.*, the stomach and intestines, the parts of generation, &c.; and, in their manner of distribution, appear like the ramifications of blood-vessels in other animals. Many of them swell into a kind of aneurisms or bags, which are of various shapes and sizes; some nearly round, others oblong, &c. Then they become small as before, and ramify as above described. The air-bags are continued from the abdomen into the legs, &c. of the animal: the coats of their vessels are extremely thin and tender, and white, not transparent, but opake, like white paint. They have a great deal of fat, which is very much detached, and floats in the cavity of the belly. It is very white, and so mixed with the air-cells as to obstruct their distinct appearance, in those which are very fat. When the contents of the abdomen are examined in water this fat escapes from its cell, and appears floating as a pure oil on the water. In lean beetles the air-cells are very distinct; yet something may be observed mixed with them, which is the empty cells of the adipose membrane. This may serve as epiploon.

The female parts of generation consist of two ovaria, two oviducts, and a common duct, which answer to the vagina, two horns of the uterus, and ovaria of quadrupeds. These are situated in the anterior part of the belly, just before the intestines. The opening of the common duct is pretty large, and just before the anus; however, they are distinct openings. Pretty near the union of the common oviduct with the rectum is a small bag, which in appearance communicates with the oviduct. On each side of its external opening, just in the angle between it and the border of the body, are parts apparently connected with the parts of generation, therefore most probably glandular.

In the ovaria are formed the eggs, several at one time; thence they come into the first oviduct on each side, at one time, so that they are always in pairs. The eggs are oblong, rounded off at the ends, which are nearly of an equal size; they are yellow, but when put into spirits, black. This may be owing to coagulation, as the redness in the lobster is owing to that.

I found eggs in the oviducts [of *Geotrupes*?] in October, when they had returned to their winter quarters, and been dug up.

The male parts of generation[1] consist of five or six testicles on each side; they are round white bodies lying on the sides of the abdomen, connected to the intestines, &c. by means of the air-vessels and the yellow substance above described. From each passes a duct, all of which unite into one, which is coiled up into a sort of epididymis. This common duct passes towards the tail, where it joins its fellow from the other side, forming there a knob or bulge. Besides the testicles there is a canal arising from no particular body, but by a blind point, which hangs loose, and is coiled up in the lateral part of the abdomen, reaching higher than the testicle; its general course is towards the tail; and it joins the duct from the testicle. This canal can hardly be reckoned part of the testicle, but may answer the purpose of a prostate gland or vesicula seminalis. The common [sperm-]duct is much stronger in its coats than those leading to it, and is pretty straight: it enters

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[1] [Hunter left many preparations of the male organs of *Coleoptera*. In preparing the Catalogue of his Physiological Series, I was able to determine the following genera and species:—*Melolontha solstitialis*, No. 2352; *Melolontha vulgaris*, No. 2353; *Blaps mortisaga*, No. 2354; *Geotrupes stercorarius*, No. 2355; *Scarabæus*, No. 2356; *Cetonia aurata*, Nos. 2357, 2358, 2359; *Megasoma Titanus*, No. 2360; *Lampyris splendidula*, No. 2362; *Cerambyx moschatus*, No. 2363.]

the point of an apparatus of a horny substance, which is to serve as a basis for the penis to act from: the duct passes through and opens externally. Within these lies the penis, but of what shape, &c., I have not yet seen.

[Order ORTHOPTERA.]

THE GRASSHOPPER [*Acrida* (*Phasgoneura*) *viridissima*].

The stomach[1] and intestine is one continued canal; only larger at the stomach part. There lies upon the stomach, and in the same direction, long bags with blind ends, largest next to the œsophagus: there are six or seven of them. About their middle they are attached to the stomach, and there communicate with it by openings in their sides. They contain a curdy substance. I should suppose them to be the pancreas; or perhaps they may form the gastric juice, as [the proventriculus does] in the bird.

The air-vessels are very numerous, and ramify over every part of the body; they are of a red colour.

The air-bladders are made up of spiral threads, as in the large moth.

The grasshopper has a large hole on each side of the thorax, from which goes a tube to a joint of the second leg[2], and a branch of this tube goes down the leg for some way.

The noise of the grasshopper is not produced by the mouth, as they have no determined lung, and consequently no larynx. It is produced by a vibratory action of their wings, and the abdomen seems to work as if driving out the air. It would appear that the air is driven out at some holes, which, lighting on the vibrating wings, may increase the sound like the blowing on the jews' harp[3].

THE FLYING MOLE, or Mole Cricket [*Gryllotalpa vulgaris*].

The ovaria are two large bags, one on each side, filled with eggs which are loose in those bags. Each bag forms a duct, which unite into one at the lower end, and the common duct opens at the anus. These two ducts are extremely tender, so much so as to make it difficult to remove the scales of the belly without tearing them: the better way is to remove the scales of the back, as also the intestines, &c., to expose them.

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1 [Hunt. Preps. Phys. Series, Nos. 473, 474.]

2 [J. Müller, 'Zur Vergleich. Physiol. des Gesichtssinnes,' &c., 1826, p. 439, and v. Siebold, 'Ueber das Stimm- und Gehörorgan des Orthopteren,' 1844, have described a similar structure in the first pair of legs of the *Gryllus hieroglyphus* and allied grasshoppers.]

3 [Modern entomologists attribute the sound to rapid friction of the femora of the hindmost legs against the elytra, as the sound of a violin is produced by friction of the bow on the strings.]

This animal lives much under ground, and, like the beetle, lays its eggs in some moist place under ground to hatch. Its legs are very strong, more especially its fore-legs, for digging. Its head is in some degree covered by the back scale of the fore-legs, like the armadillo, which probably fits it better for burrowing.

The œsophagus begins just between the roots of the two pincers, behind the anterior flap that covers the parts about the mouth, and above the root of the tongue; which is composed of different parts. It passes through the head in a kind of horny case; then through the neck and chest to the abdomen. It then opens laterally into a bag or crop, but it appears to go to an oblong or pyramidal body or cavity, which I suppose to be a gizzard. The internal structure of this is very curious; full of cells placed in rows parallel to the axis of the body or cavity; but whether they are covered with a thick cuticle or not, I do not know.

This is similar to the gizzard of the large green, small-eyed grasshopper[1].

From the apex of this passes a duct which dilates into a bag, which I suppose to be the stomach. This stomach, as it were, encloses the gizzard on the fore and back part, like two cæca, as in the grasshopper. From this bag passes out the intestine somewhat straight; but, at its lower part, it becomes convoluted or twisted upon itself, where it receives the ducts of the liver; it then forms the rectum and goes to the anus. On each side of the rectum is a white bag, which I believe opens at the anus. The ducts of the liver appear to begin from a round bag, which lies in among them[2].

In a small one, which I suspected to be a male, I found the air-ducts of a dark colour, very regular, one on each side of the abdomen, communicating across; a good deal like the silk-worm when it is casting its coat. Was this a young one? and do they grow after they are perfect? I rather suspect it was a young one, because it had no wings, only small flaps, which were hollow, somewhat like those in the chrysalis-beetle.

From the intestine, this animal should be classed with the grasshopper[3].

[Order Hymenoptera.

Section Aculeata.]

Of the Bee-tribe.—This tribe of flying insects is a very numerous

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[1] [Vol. i. p. 97.]
[2] [Hunt. Prep. Phys. Series, No. 611.]
[3] [See Kidd 'On the Anatomy of the Mole-cricket,' Philosophical Transactions, 1825, p. 203.]

one, even in this island. They have so many characters peculiar to them, both in their outward parts, internal structure, and economy, that they admit readily of being formed into one distinct tribe. Yet some of their parts are not peculiar to them, and those that be so are not exactly similar in all.

They would seem to admit of being divided into two genera; one, which I would term 'bee;' and the other, which includes the hornet and wasp. All of the bee proper, as far as I know, have hair on their scales, more or less; but what I call the second genus have none.

The bee appears to be the most numerous genus; although there are many which come in with the hornet or wasp. Some species are more numerous [in individuals] than others; and this arises from some being assisted immediately by their first offspring; whilst those that are obliged to do the whole work, through the whole season, can have but few in comparison. The number of eggs in the ovaria corresponds with this difference. The common bee in the one genus, and the common wasp in the other, are the most numerous [in individuals].

The food, perhaps, makes the great distinction between the two; in the one being sugar or honey, in the other both flesh and fruit; and this requires a difference in the apparatus for procuring it. The first [bee-genus] has a proboscis of some length for extracting the honey from flowers; which, when not employed, is folded upon itself so closely as not to project; and this gives free use to the pincers or forceps [mandibles]. This folding I should imagine to be performed by muscles; because, when the bee is in the chrysalis state, its proboscis is not folded upon itself; and, when a bee dies, it is always extended: therefore it is not folded by any mere elastic power.

The wasp-genus has no such proboscis. I believe the young in each genus are fed much in the same way, viz. by vegetable food, as in the bee; by mixed food, as in the common wasp and hornet; and by wholly animal food, as in some uncommon wasps.

The ovaria of the female, and the parts of generation in the male, are different in the two genera.

The economy of this tribe is with some difficulty followed, and with more in some species than others. When we consider that most of them are not seen, or known to exist but from reasoning, for one half of the year, there becomes a blank in their history; and those that are under observation all the year round, are so numerous, that one individual is not to be easily traced.

Their structure we may suppose is well adapted to perform the various offices in their economy; but we would not, *à priori*, from this structure affirm that they were fitted for a greater variety of actions than many other insects. They are certainly endowed with greater variety of instinctive powers than most, and probably than any other insect; coming, in appearance, nearer to human reason than perhaps in any animal we are acquainted with. In most animals the economy of life is simple; therefore they have little occasion for great variety in their instinctive principles, while the bee-tribe would seem to imitate art or invention.

When we consider that many of the species live in families, in which all work to the same end, providing for tomorrow, making habitations for themselves and for the offspring, many, as the common labourers, working for the latter while they themselves have not enjoyed the functions of a mother, and do not even possess the powers,—all this (although instinctive) comes nearest to the effects of human reason of anything we know. We must admit that there is a considerable extent of instinctive powers. Nevertheless it is confined; its uniformity shows this, as all instinctive principles are uniform.

The attachment of the young to the old [as of the labourers to the queen], in many of the species, is as curious a part as any in the natural history of this tribe. They are not only attached to her, but to her offspring, as to their brothers and sisters; for, as soon as they are fit to work, they do all the second part of propagation. In the common bee this is done by the labourers only, but it is not the case with all of the bee-tribe. Many are only male and female. In such the female makes her nest or hive, deposits her eggs, and takes no further notice of them.

All this tribe of insects have pincers or forceps at their mouths; which, in the bee, serve as a weapon of offence and defence, for holding anything they want to move from place to place; as also to model their wax in the making of their cells. The blades of the forceps cross one another, but it is not always the same that overlaps.

The females of this tribe of insects, so far as I am acquainted, have stings[1], while the males have none; which might make us suppose, without any other knowledge of them, that the females were the active part of the community. When we consider that it is not with each other that they fight, as is the case with many animals, and particularly with the common cock, their stings appear to be a defence against enemies of other classes of animals. And when they do fight with each other, it is not the sting that they use, but their nippers or forceps.

They do not all colonize; and those that do, congregate in different ways. It is probable that the humble-bee, hornet, wasp, colonize in the same way. The common bee goes off in a large colony from a stock

[1] [Two genera of exotic bees, *Melipona* and *Trigona*, have since been discovered, which are stingless.—Fr. Smith.]

that still remains a large colony; while all the others colonize from a single bee, which is a female, not from a stock. The females of the stock that survive the winter, have left their nest like a bird, and have sought out each her winter quarters, to lie dormant in. Thus, gregarious bees might be divided into two classes; one which forms a family for one season only, and the second which continues the family for several seasons.

The different species of the bee-tribe are not equally irritable. The common bee appears to be the most so; they will make an attack when a person is only standing near their hive; but a wasp or hornet must be attacked before it attacks: it is in them rather defence than offence. It appears that the humble-bee is the least irritable of any.

Some have an instinctive knowledge of the living surface of an animal they mean to sting: this is most remarkable in the wasp. A wasp shall run over the surface of your clothes, and the moment they come to the skin, shall immediately sting it; or, if they alight on the skin at first, they sting immediately. But the common bee does not seem to make the distinction so accurately; if pressed by anything, they sting or attempt to sting it, whether it be animate or inanimate. They have the power of moving the sting in all directions, so as to strike the object on any side. The common bee commonly leaves its sting in the wound. Why this should happen I cannot tell: they do so when they sting things inanimate. The sting and the two projecting parts [the sheath] in the bee-tribe[1] are formed on the outside in the chrysalis, just at the time when the wings and legs are elongating. They are afterwards enclosed as the perfect animal forms.

They are not equally early in their propagation. I believe the common bee is the first, the humble-bee next, and the hornet and wasp the latest. The reason of this is, probably, because the common bee is always of an equal heat, and has always provision ready for the young: but they leave off breeding sooner, because they have to fill the breeding cells with honey for the winter stock. The humble-bee can only come forth in warm weather; but she is earlier than the wasp and hornet; because wax and honey are earlier than fruit; and of course the fruit-eaters breed later.

They differ very much in the number of young they produce in one

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[1] [Hunt. Preps. Nos. 2156 (wasp), 2157—9 (humble-bee). The structure of the sting in the hive-bee is shown in the Hunterian drawing, engraved in plate 67. figs. 1 & 2, Physiol. Catalogue, 4to. vol. v. p. 217: but the magnifying power employed was not sufficient to show the teeth of the saw-like sting. Mr. Fr. Smith remarks, that "by reason of the serrate structure, the bee's sting will not easily leave the wound. In the sand-wasps (*Sphegidæ*) there is no serration, and the sting is not left behind."]

season. The common bee rears the most, the wasp and hornet the next, and probably the humble-bee the least in quantity. We may judge by the ovaria of any of the bee-tribe whether the species lays many eggs or not.

The natural history or description of any of this tribe of insects should begin with the commencement of a new colony, and each species should be traced through the various actions in establishing and increasing the colony, with the other parts of their economy; in which history we shall find great variety.

In their habitations, whether for propagation only, as in the hornet or wasp, or for both propagation and storehouse, as in the common bee, and in some degree in the humble-bee, there is a certain degree of uniformity. This is greatest in those of the hornet and wasp, in which the neatness and regularity of the whole structure are wonderful. It is considerably so, as regards structure, in the common bee; but not so much as regards the arrangement of a whole piece of comb; for they dispose of, or place, it in a hive, according to the greatest convenience, sometimes in one direction, sometimes in another. The form of the cell is commonly extremely accurate. The humble-bee appears to have no kind of rule. The reason of this difference is evident. The hornet- and wasp-kind themselves make the external shell of their nest, in which they place the divisions and cells; whereby the whole has a more uniform and compact structure. But the common bee makes only the divisions or combs in some cavity already formed; therefore it is obliged to adapt the partitions to the cavity, which renders the structure less uniform.

The instinctive powers are not equally extensive through the whole tribe. I believe the common bee claims the superiority; and probably the humble-bee the next; for the first provides for the year or season, and the last only for a wet day; while most of the others only provide for the young.

The species of the bee-tribe are not equally hardy; some being more so, as the hornet and wasp; for as they lay up no food, either for themselves or young, they are obliged to go out in all weathers: others are more delicate, as the humble-bee[1]; and the common bee is particularly so: this is a reason why the humble-bees lay up food for a wet day, both for themselves and young ones; and the common bee is obliged to keep up the same degree of heat all the year round. However, I suspect that the power of keeping up a uniform degree of heat preserves the bee more than the others that are more hardy; for the winter kills

[1] ["My experience is the contrary: humble-bees are seen about even in cold wet weather, when wasps are benumbed and inactive."—Fr. Smith.]

most of the latter. Hornets, wasps, humble-bees, &c., which may be called families of one season, do not destroy their males; for probably every female requires to be impregnated; and, as the males find themselves in provisions, they are not so obnoxious to the females as the males of the common bee are. In investigating the economy in any one class, we may observe here that the male is hardly worth taking notice of, excepting as regards copulation; unless he assists the female in providing for the young. Some males, as those of the common bee, do not labour even to support themselves.

Bees, or rather all of this tribe, are probably more on the wing than other insects; and this is because they are obliged to provide [materials of the nest] for hatching, and food for the young after being hatched.

Although the common bee and the humble-bee are more alike [than either is to the wasp-genus], yet they differ in the mode of feeding the young, and in the mode of colonizing; while the wasp and hornet are more like the common bee in their mode of feeding their young, but are less so in other parts of their economy.

The species of this tribe on which I have had opportunities of making [a series of] observations, are the *common bee*[1], *the humble-bee*[2], *the hornet*[3], and *the wasp*[4]; each of which species I shall treat of separately.

There are species in this country of a smaller size than any of the former, which I detected with farina on their hind-legs; and therefore they are most probably similar to the two first [common and humble-bees]; but I have never found any of their hives, and from what I can observe they are few in number. The females have a sting, one of which stung me through the cuticle on the end of my thumb. They collect their farina on the inside of their hind-legs.

Of Bees.

Of uncommon or Solitary Bees.—Bees may be divided into family bees and solitary[5]. The first, or family, are, as far as I know, of two kinds; the permanent family-bee, and the temporary. The permanent family-bee is the common or useful bee (*mellifica*), the temporary is our humble-bee.

The solitary bees have a considerable similarity among themselves in most of their operations, and these are simple. Their economy is found out rather by accident than by experiment, or by a series of observations: it is known to me only by detached observations, which afterwards I have put together. I should suspect that these bees were simply male

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[1] [Philosophical Transactions, 1792; Animal Economy, 8vo. 1837, p. 422.]
[2] [Vol. i. p. 60.]
[3] [Ib. p. 73.]
[4] [Ib. p. 82.]
[5] [As, *e. g.*, *Anthophora retusa.*]

and female; that is, none of the females have properties distinct from the others, constituting 'queens,' 'labourers,' or one living longer than the rest, as the queen humble-bee. The males in solitary bees are not so readily made out as in the family-bees; and when of a particular colour, distinct from that of the female, it is still more difficult. The only mode of detecting the male, is by having their nests and finding the males in them. It is possible they may be in pairs, or they may copulate promiscuously, as they do not breed a colony. This division, which I have called "solitary bees," are divisible in the same way in which I divided the whole tribe, viz. respecting their food, the parts formed for catching or collecting it, as also appearances, shape, &c. They are all very similar to each other in their mode of propagation, and not at all similar to the family-bees. They make no comb, nor any cells for the young so arranged as to be called comb; but they look out for a hole, either in a piece of wood, in a brick wall, or in loam, whose face is perpendicular: one species passes downwards [burrows] on a smooth grass-plot. Into these passages they deposit farina, which they bring in on their legs; and upon this they deposit an egg, which hatches into a maggot, goes into the chrysalis state, and comes forth at the proper time. The period of their maggot-state is very short, for the store of food is but very small; but the time they are in the chrysalis state is very considerable; for, as they breed but once a year in one summer, the chrysalis is quiet through the whole remaining part of the summer and the winter, and comes out in the month of April or May.

The Black Humble-Bee [*Anthophora retusa*, Latr.].

This species may be reckoned the second of the wild bee in this country, and the first of the solitary; because it comes nearest to the humble-bee, or first of the wild. The queen comes nearer to the size of the humble-bee, being about the size of the labourers of that bee, and is in shape exactly like the humble-bee. This species have no labourers, and therefore there is no society, only the male and female; but how far that male and female are to be considered a pair, as in birds, or only meet accidentally, is not easily determined. I should doubt the former; for they are not seen in pairs, nor does the male concern himself in the provision for propagation, as the male does in birds. They only live [an active life] the same summer in which they come forth: but the whole life may be said to be nearly a year and a half; one year being taken up in the first two stages of their life. I believe the first or maggot stage, in which it feeds, is not above a month. The chrysalis stage may be divided into two; one which, in structure, is nearly the same as the maggot, but is changing; and the second which has the structure of the fly, but is at rest. The first lasts probably nine or ten months; exemplifying one of the longest periods during which an animal can exist without food, while considerable actions are going on; such as a change of all the parts, and a formation of many new ones. The female has a long proboscis, which, according to my division, constitutes her a true bee. The two last scales are small, and project with a kind of process which gives more the idea of the male parts than a female. The gland for the white juice for the sting is very large, consisting of a duct having a number of smaller ones passing into it: it is larger than the intestines and ovaria, and is bent down on the opposite side to where it opens or terminates: the one containing the transparent fluid is very small, smaller than that in a common bee.

In May the females are in search of places to build in, which are in holes in walls[1]. In April 1790 I found them at work with farina on their legs. The same in 1792. Therefore I believe they are the earliest of the wild bee; for, although the humble-bee is abroad at this season, yet I have found them only sucking honey; probably for their own food, not for store, as they afterwards do.

In old brick walls that have had trees trained against them for a long time, and where the lime is much broken, we find them going into such holes: and, by putting one's ear to such a hole, we may hear them either humming or making a noise like 'chick,' 'chick,' which it may be supposed is not loud: we may even detect them by this noise alone. The female carries the farina on her hind-legs, as do the common and humble-bees, and deposits it at the bottom of the hole in which she lays her egg or eggs, and she covers them with the same. In this they hatch, and on it the maggot lives. This is done about the latter end of May or the beginning of June.

Of the Feathered-leg Bee, one of the [*Scopulipedes*, Latr.].

April 4th, 1790, in taking down an old brick wall, where I suspected bees had built their nests, in the latter part of the previous summer I ordered my gardener to examine every crevice for such nests; and he got this as one in which there were three brown bees, almost ready to make their exit, and which, when taken out of their cells, could fly. They were all males. In size they were rather thicker than the common bee, but not longer. The colour of the hair, which is pretty considerable, is of a dun, somewhat like the dun humble-bee. The proboscis was very long, especially the sucker. The pincers [mandibles] very

[1] [*Anthophora retusa* and *Anth. acervorum.*]

small, and not broad as in the wasp. The two middle legs have a vast quantity of hair upon them, which made me call them 'feathered-legged,' but this may belong to the male only[1].

[*Osmia* ?]

In July I observed a small bee, less than the common, and not so brown, but of a greyish colour, with farina upon its legs; it went into a hole in a brick wall, but not out of sight: next day I observed the mouth of the hole was closed up. I broke it down, and the day following it was again shut up. A month after I opened the hole by taking out the brick, and found the hole for about two inches filled with wax.

THE LEAF-CELLED BEE [*Megachile centuncularis*, Latr.].

This bee is smaller than the common bee, especially shorter; it is somewhat like it in colour, but rather lighter; its hair is lighter-coloured, and more especially so in the male. In the month of July they are emerging from their cells; and, I apprehend, are very soon fit for propagation, as I find them about the latter end of the same month building their cells. This is known, without seeing them, by the oval notches taken out from the edges of the rose-leaf, strawberry-leaf, and dogwood-leaf; and we may catch them at work the same month. Whether they eat holes in wood, or take possession of holes already formed by other insects, as for instance the beetle, I do not yet know. I should suppose both; for I have found them building their cells in holes of a brick wall that were not made by them, and I have found them carrying in leaves into holes in wood which appeared to have been made by the bee; for there was the rind of sawdust lying on the ground underneath: likewise I have found in some of their (shall I call them?) hives, that the first cell, which was formed at the bottom of the canal, was only five or six inches from the surface. Now a canal of this length is too short to have been formed by the maggot of a beetle burrowing during the whole of its maggot-state. The hive of this bee is commonly in old rotten wood, which is also rather in favour of their making their own canals or hives; for I believe no insect lives in rotten wood. The canal in which they form their cells is from five to twelve inches in length, and is considerably wider than the size of the bee; because it has to form a cell of leaves, or line it with several layers of leaves, which are wrapped round itself. The first pieces of leaves it takes in are oval; and to see it flying with so large a piece of leaf is curious, and afterwards dragging it into the canal. How it models the leaf afterwards I do not know, but it is done extremely

[1] ["No doubt the male of *Anthophora*."—FR. SMITH.]

neatly. The further end is curved in, so as to form the bottom of the cell; and, when it has formed about three layers of leaves within each other, it looks almost like a small deep thimble. Into this cell it brings some farina, and deposits it at the bottom; and, when it has collected a sufficient quantity, it lays an egg in it. Then it goes and cuts out round pieces of leaves, of the size of the mouth of this cell, and it covers the mouth, thrusting them a little within the first, which makes them gently concave externally. It puts on, in this manner, two, three, or four pieces. When this is done, it begins another in the same manner, making the lid of the last cell, as it were, the bottom of the canal. It continues forming three, four, five, or more cells in this manner, in the same canal; making what I call a 'hive.' Whether these are all that the same bee does in a season, or whether it forms a number of these hives, I cannot say; it being impossible to know the extent of what an individual bee does in one season.

The bees that enclose their farina and egg in a cell made by the leaves of plants, do it commonly with the leaves of the strawberry, dog-wood, or rose; these have soft pliable leaves. I discovered a nest or hive, built in a piece of wood, in July 1792; and the young bees did not come forth till June 28th, 1793; indeed, one of the same nest did not come forth till July the 6th in that year.

This bee sets out immediately to build its nest; for, while some are hatching, we find others cutting out pieces of leaves.

[Chelostoma.]

A small solitary bee, which carries in farina into canals in wood and lays an egg; then makes a small division, carries in some more and lays another; and so on three, four, five, or more times; and then seals up the last with a kind of firm substance; and, at the very mouth of the hole, puts in some loam (by which they are known), and leaves the eggs to hatch.

In one that I was led to by the above appearance, which earth appeared to be recent, when I was digging it out, I found the nest very much in the state above described; and, opening on to the last division, I was led further on into the wood by an artificial termination, not wood; and, beyond this, I found five others in the chrysalis state. The last of all in this canal was just ready to come forth; for when the pod was broken, the bee was of its natural colour, alive, and active. The bees in the others, which were the first, second, third, and fourth, were not so complete. Here there was a recent, or second, set of eggs placed nearer the outlet than the former or first set, the first being almost ready to come forth when the eggs of the second set were just laid.

The question is, how would the first set have got out; for they would have been obliged to have destroyed the second set? Another question, somewhat similar to the former, is, as the last in this canal of the first brood was the first laid, and of course the earliest in perfection, how could it get out while there were four cells between it and the outlet, independently of the new set? I suppose it must have staid until the others came to perfection. Another question starts up in the mind:—Were the first and second the same species of bees? and, if they were, was it? [something wanting here.—W. C.]

If the chrysalis at the bottom of the canal be first hatched, it is clear that it must do one of three things:—either it must remain quiet until those more external are hatched; or it must eat its way out through or past the other larvæ or chrysalides to the surface; or it must eat a new passage out from the bottom of the canal to the surface [which last is not the least probable.—W. C.].

Of the small Bee which I caught on the St. John's Wort, collecting Farina.

I caught four or five of this species in the month of July, collecting farina: they were all females. They are longer than the small common fly, but not thicker. They have two pincers [mandibles] and a proboscis. The proboscis is attached under the head: it first passes a little back under the head, and then folds immediately on itself, passing forwards to the anterior part of the head between the two pincers, lying there as in a groove; and, when it opens or unfolds for use, it falls back and down. The first fold or joint consists of two horny parts [maxillæ], passing nearly parallel to each other, having a joint at the head; the last fold consists of three parts, also horny and passing parallel to each other: the middle one is the broadest, and is an additional one just between the outer ones. There is a soft springy part, I believe feathered, as also with a horny process which is moveable, or has a joint. This is just the contrary way to the situation of the fixing and unfolding of the proboscis of the humble-bee or common bee. They gather their farina on the inside of the hind-legs near the thigh. There are very few of them, and their duration in the summer, I believe, is shorter than any of the others. Where they build their nests I do not know. I once saw one go into a hole of the wall with farina on its legs. I should suspect they are more like the humble-bee than any of the others. Their ovaria I could make but little of: from each of them a small oblong body came of a white colour, very like a small maggot; I thought it too large for an egg.

In the morning I saw a vast number of these bees employed upon the flower of the shrub—St. John's Wort. Those that were collecting farina, employed their fore-feet in burying several of the anthers at once under the belly, which were again pushed back by the middle legs to the hind legs; and, by the motion of these legs, I did conceive that the farina was collected and stuck upon the hind thighs. I have often seen the same operation upon the anthers of poppies. It appeared that this farina was the pollen, for it was of the same colour; and I always observed in those bees which were gathering the farina upon the poppy, that it was also of the same colour with the pollen of the poppy from which they were gathering it. Other bees pushed out their proboscis and sucked honey at the roots of the filamenta or germina.

Of the Wasps [*Vespa vulgaris*, Latr.].

A wasp is an insect of the bee-tribe, and probably makes one genus, of which there are many species. I shall rank the hornet and wasp of the same genus; for the wasp appears only to be a small hornet, or the hornet a large wasp. There appears to be a great number of species of this genus in this country, the natural history of all which I do not perfectly know; but, from their appearance, external form, mode of life and propagation, I should class them with the wasp. Probably the hornet ought to be reckoned the first of the genus. The wasp is a colonizing insect, and they are males and females; but, like several species of this tribe, the females may be divided into two classes—breeders and non-breeders; and, from the last not breeding, and from their use in the colony, they are called 'labourers.' The males in this, as in many other tribes of animals, have but little variety in their economy; therefore their peculiar history is but a short one.

The male, in most birds, assists in building the nest, hatching, and feeding the young. But the female and the labourers, in the wasp, are the principal individuals to be considered. However, we cannot complete the history of the female without giving the economy of the male as far as concerns her.

They are a very hardy insect, working in almost all weathers, the reason of which must appear from their laying up no store either for themselves or their maggots: and, as it is in the summer only they require food and are employed, there is hardly any continuance of weather so bad as to interrupt their common employ. From the circumstance of not hoarding, they appear to be more industrious than even the bee.

Of their being offensive and defensive Animals.—As these animals have property to protect, the females and labourers are provided with the instruments called 'sting;' but the males have none; therefore we cannot say, absolutely, that wasps are offensive or defensive animals;

but the females may be so called. I call the sting an 'instrument,' instead of a 'weapon,' because the mischief, arising from it simply, could do but little hurt: it is an instrument to conduct poison.

They have two modes of offence; one by their pincers [mandibles] and feet, which I believe they only use among themselves, or when they fight with animals of their own size, the other by their sting. The latter is a provision against larger objects, where the forceps would avail but little, and against an enemy which can not only destroy the individual but the colony. They never attack small animals excepting for food, or when obstructed in their pursuit of food; as, when they attack a bee-hive, they are obliged to defend themselves; but I believe in such cases they never use their sting. They do not even attack large animals except when they are disturbed, or an attack is made on their hives; and then they make an attack. For it is not simply a defence, as in the humble-bee; but they make a formal attack, and pursue if fled from. Yet they can be subdued; for if their hive be taken to a strange place, those that are taken with it become very inoffensive, until they become familiar with their new situation: and if confined under a shade with the maggots, they appear pretty well contented; and if food is introduced they will feed the maggots; and probably, even in this situation, they would go on increasing their hive, or repair it if they had proper materials. However, they are not so offensive as the common bee; for a common bee will make an attack on a person that comes near their hive; but if we refrain from meddling with a wasp's nest, they will pay no attention to us. However, if we have teased them to offence, they become extremely irritable and are ready to attack.

The wasp hits extremely well where she intends to sting, seldom missing the intention; and strikes with great force, so as to pierce a thick glove: they often leave the sting in, but not always; not nearly so often as the common bee does. The wound is very painful, and in some, swells to a considerable degree; it is of the œdematous kind of inflammation. This makes the pursuit of their natural history often disagreeable; for, in many of the necessary modes of investigation, it is almost impossible to escape being stung several times. I have had my face so stung as to have defaced all my features.

I have heard of cures, but I never experienced one. Laudanum sometimes eases the pain a little, and might be of service in one sting; but, when there are many, it can hardly be applied with any hope of success. Cold water has been recommended as infallible; it gives ease while applied, but I think the pain is increased afterwards. It certainly does not produce permanent relief[1].

[1] ["I have seen a lump of indigo, dipped in water, and rubbed on the part which

Of their Food.—The food of wasps, probably like all those animals which lie inactive at one season of the year, is only to be found at that season in which they are active.

Wasps have a variety of foods. They eat fruits; especially those of the sweetest and softest kinds, as nectarines, cherries, peaches, pears, &c.: they are fond of meat, especially such as liver, which they can divide readily with their forceps. They are very fond of insects in every stage. They are fond of sugar, and, of course, honey; but I do not know if they ever suck flowers: however, I should imagine they would suck such as they could get at. I have seen them on the leaves of the cherry tree when those leaves were covered with a sweetish substance. About the beginning of October I have seen vast numbers of both labourers and males on the leaves of a willow, but I could not taste anything sweet on them. When they are very strong of labourers, as towards the month of September, they often make an attack on bee-hives, the bees often becoming more indolent at this season, and therefore are less a match for the wasps, which often destroy them for the honey. I have seen several conflicts, but the wasps generally got the better of the bees. In glass hives I have often seen wasps on the combs. I imagine they rob the bees both of their honey and of their maggots; for they are very fond of such food: they also feed upon flies. We see them often catching flies and turning up their bellies and feeding upon the entrails.

Of their Digestive Organs.—I believe the whole tribe of bees have nearly the same digestive organs; they consist of an œsophagus, craw, stomach, and intestines. The œsophagus dilates immediately into the craw, whose situation in the abdomen is the same with that of the stomach of other animals. It is a large bag, and very thin in its coats, and which holds the materials either to be regurgitated or pass into the stomach to be digested. The opening into the stomach is of a singular construction; it is a projecting part into the craw, so that nothing can pass it into the stomach but which must be by an operation of that part, and which can be easily seen through the craw. The stomach appears more like an intestine in shape, being full of circular or spiral valves, and is continued into the intestine without any particular structure. The intestines make up some turns upon themselves, and pass towards the anus, where it becomes larger, serving as a reservoir for the fæces [1].

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has been stung, give almost instantaneous relief from the pain; and the swelling soon subsided, although the indigo had not been applied until some ten or fifteen minutes after the injury had been received. This is a universal application in some parts of Essex."—W. C.]

[1] [Hunt. Prep. Phys. Series, No. 477.]

Of the Heat of Wasps.—The heat of wasps is about one degree or one degree and a half above that of the common atmosphere; for, by having about eighty wasps in a phial with a thermometer, I found, in different trials, different degrees of heat; but, upon an average, the phials with the wasps were commonly about two degrees warmer than the other phial with a thermometer in common air.

[*Anthidium*]

In August I caught two bees, which I imagined at first to be wasps, although they had not all the characters. They were hardly so large, not so long in the abdomen, nor so pointed at the anus. They are spotted with yellow like the wasp, but not so much, and therefore were darker. Their legs are not so long as those of the wasps or bees: they were more rounded and more clumsy. They were females, had the sting, and two ovaria, very similar to those of the humble-bee. Their proboscis was long, more like that of the humble-bee than of any of the others; they therefore suck honey. The proboscis is composed of five parts, as in the following description from the humble-bee.

The Humble-bee [1] [*Bombus terrestris*, Latr.].

Of the Proboscis, or rather Tongue.—It is composed of five parts; two outer scales [*maxillæ*], which I imagine are principally coverings, or a kind of case for the whole when shut. There are two other cases [*palpi*] for the absorber or true tongue [*lingua*], which is a long flexible feathered stalk, moveable in all directions. I have observed them, when they put it through a hole, to move it in all ways round to catch whatever might be in the way. The salivary glands in the humble-bee are two: they are placed in the head, one on each side of the œsophagus as it passes along the under side of the head. They are small white bodies; a white duct passes from the anterior end of each, and goes forward along the sides of the œsophagus near the beginning. They are very small, probably because there is little necessity for such, as the bee sucks honey. The long tongue is feathered on the edges. The œsophagus passes through the thorax and opens into the stomach, which is placed in the upper part of the abdomen; in which lies the honey. Thence the intestines go out, are disposed somewhat in a spiral convolution, and terminate in a very large bag like the cloaca of a bird, but much larger in proportion [2].

Of their Nerves.—The humble-bee has its nerves similar to those com-

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[1] [The chief of Hunter's observations on the humble-bee had been arranged and reduced in the MS. volume of 'Natural History.' See vol. i. p. 60.]

[2] [Hunt. Preps. Phys. Series, Nos. 476, 601, 602, 603.]

monly seen in the insect, having a ganglion within the abdomen; and when it passes behind the oviduct, there are other ganglions.

Of their Oil.—They have an oil, or rather fat, in the inside of the abdomen, which is in flakes, or very small cells, something like the marrow, only not so firm. It is fluid in the summer months; and if an humble-bee is opened and allowed to remain in spirits in warm weather, the oil escapes from cells and swims on the top: but this appears to be principally the case with the bees of the same summer; for in the queen, which is a bee of the last summer's breeding, the fat is not so oily, is of a light brown, and less transparent; which is one way of knowing the queen of the hive in which the following summer's queens are formed. Thus, the fat seems to change in the winter; for those which come from their hiding-places in May, have the remaining fat yellow, and much less in quantity. When collected and dried on paper, the paper burnt bright when it came to that part. In the month of September the females are full of it.

Of their Voice.—The humble-bee has several sounds; one is when they fly, which is round, full, and uniform: it is probably caused by the wings striking against the air; but they can form various sounds independently of the common air. They have a sound when the wings are closed, but moved with short vibrations, which is probably caused by the air expelled from the air-cells striking the wing at the time: this is a kind of peevish noise. They can make nearly the same noise when I could not observe any motion in the wings. I have also observed them to make a humming noise when no motion could be observed in the wings. They can make a noise by shaking their heads: I suspect this is done by throwing out the air from the air-vessels at the time that the head is in motion, which probably has the same effect as the vibration of the glottis in the human subject; and there may be even some analogy with the motion of the head, in the human, in performing a shake. It is possible, as they have a number of tracheæ, that each may have a sound peculiar to itself.

Of the Breeding-cell and Maggot.—The cell in which the humble-bee lays its egg, is very small, and is made of a waxy substance, which the maggot eats; and, as it eats on the inside, the old bee is laying more and more on the outside; so that the cell and animal increase together equally. When the maggot arrives at its chrysalis state, it lines this cell with its silk, making a membranous part like that of the wasp, on the outside of which is the remains of a soft waxy substance very irregularly placed.

In the maggot, the stomach passes almost the whole length of the body; and, at the lower part, it becomes small and makes a turn upon itself. There are two convoluted vessels on each side which enter the canal at the termination of the stomach part. The canal was filled with a substance similar to the waxy part of the cell. There are ten air-holes: the air-canals are made of spiral turns of a small line.

Of their Lice.—The humble-bee has a number of small animals upon it, which are of the tick-kind, and they get fuller and fuller towards the autumn; but this insect is not peculiar to them, being found on the black-beetle [*Geotrupes*] and earth-worm. It is probable that this insect attaches itself to those animals when they are under ground; and, what makes this still more probable, is that the large queens are much more infested with them than the others, probably because they stay much more at home.

In many I have found in their abdomen what I suspect to be 'worms,' but of a particular kind; some of which are very small, only to be distinctly seen by a magnifying glass.

Experiments to ascertain some facts.—In one of my bee-traps where there was only the queen, she began to work, and had gone so far as to have made a square-shaped mass, or hive, in which were a vast number of maggots. I removed the honey-reservoir, which was a complete globe: the day following I looked at the hive again, and found that she had formed another, but had not completed it all round: an opening was left to fill it with honey, and this was nearly done. On this day I took from her the mass containing the maggots, and put her into a mass broken off from another hive containing maggots, &c. On the evening of the same day, and on the following morning, she was observed going out and in; but, on this day, I found she had forsaken the hive. The reservoir and maggots in the mass were all devoured by the ants.

As the size of females differs very much, so as to make it uncertain what ought to be called queens, I believe our best guide in this respect is to observe the size of those which come forth in the spring; as we know they are to be the breeders of the season, and we shall find that they are all of the largest size. The difference in size between the queen and the very smallest labourer is considerable. I have been able, in some hives, to distinguish six or eight different sizes among the labourers. The proportion that the different classes, viz. queens, males, and labourers, bear to the other is uncertain, for each class differs in number at the different seasons very much. At first there is but one, and that is the queen: afterwards it is queen and labourers; and very soon males; though the labourers may increase to 100 or 150 before a young queen is formed: and when they come to be formed, the labourers are often in part destroyed; but towards the latter end of the season, the queens and males are becoming predominant in number.

Food.—I believe the humble-bee is the cleanest feeder of the whole tribe; for I have observed the common bee on meat. Their food, I should suppose, was in general honey. However, I have found in the crop, stomach, and intestines, as also in the rectum, a yellow substance like farina. From its being in the rectum, one would imagine that the substance was not digested, but only what was expressed from it, as perhaps it is in most if not in all caterpillars. The honey found in the pods of the chrysalis is not exactly like the honey of the common bee; I think it is rather darker. This difference may be owing to this bee collecting its honey from a much greater variety of flowers: for they can, and I believe do, collect it from every flower that the common bee does; they can likewise collect it from flowers that the common bee cannot, where it requires a much longer tongue; besides, I have seen them collecting from where the common bee might, yet, I believe, does not, get honey, viz. the foxglove. They seem very partial to the foxglove and the sunflower.

Through the summer they find their food at large: I believe the females only lay up a small store for a wet day, and the males only take their daily subsistence, which is in great plenty, for at this time their crops are to be found full of honey. About the beginning of August they are enlarging their cells from whence the young queens have emerged; that is, they are making them somewhat deeper, with, I should imagine, farina mixed probably with a little wax, and likewise with some other juice of vegetables, and then filling many of them with honey, and covering them over with the same as the above; but not as a provision for the winter, but for the months of September and October only, when they give up all food. They are also at this time laying up large portions of farina in which there are no eggs. Whether this is to be considered as food I do not know.

The Hive-Bee [*Apis mellifica*[1], Linn.].

The common bee lays its egg in an empty cell. The egg is very small. The time when this egg hatches is not easily ascertained; but when hatched, it sticks with one end to the cell at the bottom, and is fed by the [labourer] bees till it arrives at its full growth. When it is large, it lays in the direction of the cell with the mouth towards the

[1] [The major part of Hunter's observations on the hive-bee was communicated by him, in the year 1792, to the Royal Society, and the Paper appeared in the Philosophical Transactions for that year. See also 'Animal Economy,' 8vo. 1837, p. 422.]

opening of the cell. We may suppose that the bees are at great pains to keep the cell clean of the excrements, as we do not find any in it. When the maggot arrives at its full growth, and has got the disposition to prepare for the chrysalis, it covers the mouth of the cell, and lines it with a thin membrane formed of its silk*.

When this is finished it turns its head to the mouth of the cell, and goes into the chrysalis state; then, over that part of the membrane which covers the mouth of the cell, the old bees lay a thin covering of wax. How long it lies in the chrysalis state I have not been able to determine. When arrived at its full maturity, it eats or makes a separation of the covering from the edge of the cell about half-way round, and pushes itself through. When it first comes out it is of a grey colour, but soon becomes brown.

On dissecting maggot-bees I found a brown substance in their stomach and intestines, similar to the bee-bread, but not so solid or thick: it was about the consistence of honey. It yields little or no taste, at least it was not sweet. It is to be presumed it is the bee-bread somewhat diluted.

In the bee-tribe, we find that what was the stomach at one time, viz. in the maggot, becomes the crop in the adult; therefore it must lose the power of forming the gastric juice; and what before was only intestine must acquire it. This is a curious fact.

Of the Management of Bees.—The management of bees is very simple. I believe the less that is done to them the better they thrive. The great object commonly in view is to make them pay a tax for their situation, by depriving them of some of their honey, and leaving them only what is necessary to serve them through the winter. But this should not be done with too exacting a hand, for fear of losing the whole. Some go further, and allow them [artificial food for] their daily support. But I believe that a swarm in this country can seldom spare much of their summer's labour; and the [artificial] mode of feeding is but a bad substitute. When they are robbed of some of their winter's food, many of the bees should be killed [to proportion the remainder to the honey that is left].

* Do the old bees remove this silk lining or not? If they do not, then the cell must become smaller and smaller as the hive grows old. I suspect that they do not remove this lining, for I find a vast difference between the consistence of a new comb and an old one. A new comb is brittle, and almost wholly wax. An old one is tough, and yields a great deal of refuse upon melting. What makes this still more probable is, the common moth does not lay its eggs in the cells of a new comb, but in an old one, the lining of which is an animal substance. Bees use combs already formed, as materials for new combs. Put near a bee-hive a piece of comb, they will carry it all away, so that they can work it up again.

As there is some evil to be expected in making too free with bees, and as they are objects worth robbing, and that not without danger, a great deal of contrivance has been devoted to effect this.

Towards the autumn, when the busy time is over, it is right to lessen the hole or door: this makes it more difficult for (thieves) to get in, for the bees are at this time obliged to guard the pass, and the less it is the easier it is guarded. The diminished size of the hole should remain through the winter for another reason, viz. to keep them as much as possible from the cold.

The hives[1] best for examination are commonly the worst for preservation. The bees in them are disturbed in their progress, therefore they are not capable of laying up so much store. Besides, thin hives do not allow them to form a round body or cluster in the winter; therefore they are more liable to be benumbed by the cold. The management of bees in one country will not do for them in another; but when it is described in one, the variations fitting the management for another will be easily seen.

An early spring, a good summer, and a dry autumn, form the best season for bees; but such is not to be expected: an early spring with a cold wet summer, even with a dry autumn, is bad; for the flowers are all gone before the good weather comes on. A good summer with a good autumn is very good for bees; the kind of spring is not so essential.

Of the Noise Bees make before they swarm.—That the peculiar sound of the bees is only heard when they are about to swarm was very evident in April 1792, in my bee-house. For where there were several hives, we only could hear the sound in one, which was so full of bees that many of them lay out all day. There were two sounds in this hive, one stronger than the other; but still the same kind of note, as if it were two bees answering each other: it was probably the old and the young. This sound was hardly ever heard before ten o'clock at night.

In another hive which was not expected to swarm, as the bees had not hung out in the day, a noise was heard about ten o'clock one night, similar to the above, viz. the two sounds of different shrillness, as of two bees answering each other. Besides these there was another noise similar to the cluck of a clucking hen, but not so loud or strong; and that hive swarmed the next day. In visiting in the evening bees which are threatening to swarm, we find sometimes a variety of sounds in the same hive; so that bees have a great variety of sounds. When bees hang out in a cluster, they commonly hang by one another by the

[1] [See Hunter's description of his hives, 'Animal Economy,' 8vo. 1837, p. 424.]

lower bee laying hold of the wing of the one above with its pincers. They hold so fast as hardly to be separated.

Bees drink water. Whether this is for their own economy, or to soften the honey, is not easily determined: but if it be true, as is asserted, that the honey near the sea is saltish, and that the bees are seen on the sea-side drinking sea-water, we must suppose they drink it to dilute their honey.

That bees do not make comb, or collect either honey or bee-bread, when they lose their queen, appeared to be the case with a hive I had in the year 1792. It was a fine swarm of the same summer, and was put into a hive with comb belonging to a hive of the year before, [the bees of] which had died in the spring from the want of honey. Some time after being settled in this hive, I observed they made no progress in making comb, nor did I see any honey or fresh bee-bread, or eggs, or bees in any of their stages in any of the cells, and they began to grow fewer in number. From all these circumstances I began to suspect they had lost their queen, and the only way to ascertain this was to kill the swarm, which I did; and, on examining every bee, I saw no queen, only labourers and a few males. In this hive, whose comb had been made the year before, there were no royal cells.

If bees are let loose in a room where there are a number of hives, they very soon fix upon the outside of a hive, and endeavour as much as possible to get in, and will not leave it. It does not appear that they are able in such situations to distinguish their own hive from the others.

About the latter end of August 1792, I observed strangers flying about the mouth of my hives, wanting to get in; and I could observe that the bees belonging to the hive were upon the watch; and, when the strangers ventured too far, they were often laid hold of and dragged over the shelf at the mouth of the hive. I did conceive that these strangers might belong to some hive that had lost its queen. But this continued through the month of September, at a time when four of my hives died; viz. two young swarms of the same year, and a last year's one which had swarmed twice this summer. They had been collecting honey, and storing it up about the beginning of August: but about the latter end of that month it was all gone; and, about the second week in September, two young swarms died in twenty-four hours. After they began to die off, the other young swarm, and that of the old hive, gradually became fewer and fewer until the whole were dead.

In wet seasons hives appear to lose many of their stock; for in the summer, or rather in the autumn of 1792, my hives were very empty of bees, although there was honey in the combs.

The flower of the pine-apple secretes a considerable quantity of honey, and bees are very fond of it. It has the flavour of the pine-apple, although the fruit has then no flavour, being green.

The leaves and stems of many trees form upon their surface a honey. When this happens, we may then observe the bees licking these leaves, and collecting it. I have seen the leaves of the morel cherry all moistened with honey, and the bees very busy collecting it.

In the months of May and June little honey is gathered, whether in old hives or new ones, it being the breeding season; therefore we should not attempt to rob them in either of these months. About the beginning of July they are filling their combs as fast as possible, and the males are going forth very fast.

As bees are in two very different states in this climate, one fitted for the summer, the other for the winter, two very different modes of management are required.

Bees work upward as well as downward: they work up from one hive into another; but their most natural way is to work down when in an entirely empty hive, where there is no direction for them. Bees model their cells with their two teeth [mandibles]. I have seen bees with a piece of wax $\frac{1}{10}$th of an inch long, one end of it between their teeth, the other lying on the head and back, and they have been kneading or fixing that end between the teeth to the cell in different places, while at the same time they took wax from the cell; for this piece of wax would be sometimes longer and sometimes shorter, till at last they disposed of the whole. This operation can only be seen when they are at work upon their backs.

It is probable that bees require to live in a greater degree of heat than any of the same order [do]. The warmth of the atmosphere in which bees live is generally that of their own bodies; for if we thrust a thermometer into a hive of bees, it is raised to about 80° [Fahr.], the heat of the atmosphere in which the innermost bees live.

[Order Lepidoptera.]

The Silk-Moth [*Bombyx Mori*].

The silk-moth, like all of this class of insects, is first an egg, then a caterpillar, chrysalis, and moth. The caterpillar[1] is a long body, consisting of a head, body, and tail with appendages. The head consists of two lateral superior horny substances, convex externally, to the under

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[1] [Hunt. Preps. Nos. 2979—2987.]

and fore parts of which are attached the teeth [mandibles], which are two horny bodies that oppose one another equally, and open laterally or from side to side, somewhat similar to a pair of nippers. The body is principally round, a little flattened on the under surface, made up of two parts, an anterior and a posterior: the anterior is that which is to compose the chest of the animal when perfect; the posterior, which is longest, is annular, made up of eight rings, which make the belly of the complete animal or moth. On the flat lower surface are placed the feet, consisting of two parcels; one, anterior, placed on that part which forms the chest of the moth, and probably the situation or roots of the adult feet; the other, posterior, placed on that part which forms the belly, and may be called temporary. The anterior parcel consists of six feet, three on each side, as in the adult; they are small, but of different sizes, the smallest being forwards. Each foot comes to a point, which is tipped with a claw. The posterior are eight in number, four on each side, arising from the third, fourth, fifth, and sixth rings, so that the two first rings and two last have no feet arising from them. These are longer than the anterior. The tail has something similar to feet, but they seem rather to be holders than for progressive motion. There are on each side of the body a number of dark spots with a lighter speck in the middle, ten in number on each side, one on each ring, and also one on the neck close to the head. These are the openings of the air-vessels.

While in the caterpillar-state they spin silk threads from their mouth by way of attachment. If the head is first removed from the object to which the animal may be attached, it then holds fast by its two holders at the tail; and when these are got the better of, it has no hold: but, if the tail be removed first, it fixes its head by its silk, and it is held by that means, and will allow of being pulled to any length from its hold, just as a spider is by means of its silk. If it be made to hang by its silk, it winds or coils up this silk thread round its fore-feet; therefore it has the same power with the spider.

Internal structure.—There is one straight canal passing from head to tail, which is nearly as large when full as the whole body of the animal: it is œsophagus, stomach, and gut. The œsophagus is about the eleventh part of an inch in length, at the termination of which the canal becomes a little thicker in its coats, but is thickest at its termination into the stomach. The canal goes on without altering until within about half an inch of the anus. The canal contracts, and then dilates a little, then contracts again near to the anus. This part may be called intestine, especially as it forms itself into that part afterwards, as will be observed hereafter. On the posterior end of the stomach, or what would be called the gut, lie ducts of a yellow colour, like thread, making two or three folds on one another, and at the beginning of the intestine they open into it. There is nothing answering to a liver or pancreas, excepting these thread-like ducts are such. Silk-worms eat an immense quantity; but their power of digestion is very weak, for the food passes out of the body very little changed, only a little darker in colour, and almost dry. When their excrements are steeped in water they unfold themselves like tea-leaves, and appear green and fresh again, and consist of the small pieces of leaves the caterpillar had bitten off, to appearance not the least altered.

Immediately on the outer surface of these digestive organs are the silk-vessels and ducts[1]; they are placed laterally, and consist of two canals, one on each side: they begin by a small blind end near to the posterior part or tail of the animal, then pass forward, and are pretty much convoluted: in their passage they approach more and more on the lower part of the belly, where they become straighter, being only folded on themselves in pretty long folds; and in this course they expand, and at last are pretty large: at this part appears to be the gland. From the thick termination arises a very small duct, or, it may be said, that the thick part contracts quickly into a small duct, which passes along the under surface of the stomach to the head, where the communication takes place with the one on the opposite side.

Of the Silk Mucus.—This mucus is of a yellow colour in the thick part of the duct, while it is clearer in the smaller part. It is thick and ropy, more so than the white of an uncoagulated egg. It seems to consist of two parts, one similar to the coagulable lymph, which coagulates upon exposure, and even in water, and will not mix therewith; but, while endeavouring to mix this mucus with water, another part is separated which readily mixes with the water, and tinges it, which is the only way by which we know it has mixed with the water, leaving the coagulable part white. This part, by standing in the water, forms the whole into a yellow jelly; which, when dried, cracks into separate portions, and is capable of being softened again, but does not resume its jelly-form again, like dried glue or gum.

From the dark spots on the skin, or openings of the air-ducts, we find a number of dark canals leading inwards, which, as they pass, ramify on the whole internal parts like arteries. All these openings communicate with one another by a dark canal, passing from one to another immediately on the inner surface of the skin.

The general cavity of the body is enclosed in a muscular covering, to

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[1] [Hunt. Preps. Phys. Series, Nos. 2985—2989.]

which the muscular parts of the feet and the edges of the rings are attached. This muscular covering is for the motion of the body. Round the whole is the cuticle or external covering: this cuticle they change several times before they arrive at their complete size. In one that I observed, I found it change three times, viz. June 11th, 16th, and July 3rd. On the 9th it began to spin. It would appear that the skin of the head separates from that of the trunk or body, not all coming off in one piece.

When these parts are completely formed, and the animal is full-sized and healthy, it then begins to set about its changes; and the first process is that of enclosing itself in its own substance. When they begin to spin their pod, they choose a corner or small hollow part, such as they can reach with their heads, while they hold fast on the opposite side with their posterior feet. The small threads are made to stick to the sides of the body composing the corner, as also each thread in some degree sticks to the other, where they come in contact.

At the very beginning of their spinning they throw out the last excrements mixed with a little yellow mucus. They begin at the circumference, or make the outer works, and go on towards the centre, enclosing themselves, making their own cavity smaller and smaller. Their first is composed of loose network, which serves as a basis, or means of suspension, of the cell or enclosing chamber. These outer beams are more or less in quantity in proportion to the distance of the walls or abutments from which they begin. When the network is sufficient to support the cell in the middle, and the enclosure becomes small enough for their future habitation, then they begin to weave close, hardly decreasing the size of the cell. They make this so close that the light can hardly pass through it.

When they have got the walls of their cells sufficiently thick, and probably most of the mucus is expended, then they lay it on a little looser, which makes a soft lining for the animal. The shape of the cell is an oval; and although they turn in every direction in making it, yet when they have finished spinning, they either leave off with their head at the wide end, or they turn their heads to it; for there we always find their head. They are about thirty-six hours in completing their pods; some more, some less, according to their strength. They now lie pretty quietly in their cells about twenty-four hours longer, only having a little vermicular motion within themselves, which begins at one end, and moves on to the other; and then they turn on their back or side, before they emerge out of this state. It may be observed that they do not all spin a cell for themselves; those that do not, I suspect are not healthy, for they do not produce such strong moths. While they are making the pod, they are themselves becoming smaller in proportion to the waste, especially shorter. In a silk-worm which had begun to spin, there was nothing in the stomach or gut; the whole animal was somewhat shortened, and the gut had two lateral bands running through its whole length, contracting it on the inside, which threw the intermediate surface into folds or cells, like the colon in the human subject.

Of the external changes in the parts, and the motions which bring it from the maggot-state to the chrysalis.—The cuticle or skin of the maggot becomes dry or hard, and of course somewhat transparent; the rings become rounder and narrower from joint to joint; when the separation is taking place the rings are flatter. About the end of twenty-four hours, at the union of the rings, a silky appearance is observed, which is in the direction of the rings, and which is the dried wrinkled skin. There is a considerable motion in the body of the animal, which separates the cuticle from the body, for the body is seen moving within the cuticle. The fore-legs are the last parts that are withdrawn. The dark spots before mentioned [spiracles] become more diffused, or spread; and at last a darkish line is observed running along the sides of the animal, uniting the dark spots into one line.

The worm now continues its vermicular motion pretty violently, and a small part on the upper part of the neck opens like a slit, which is continued over the head between the two horny bodies, and divides these into two as far as the mouth. The head now, being separated from its covering all round, slips backward upon the animal, and the animal passes forward through this slit in the neck and back part of the head, so that the covering of the head, the teeth, and face, fall down upon the breast. It now increases its motion and works itself out of the skin, by shoving it backward to the tail, until at last all comes off. In this operation it loses the tail and posterior feet. Before these operations take place, a new cuticle is formed, or perhaps that part which was muscular in the caterpillar-state for the motion of both the body and hind feet, becomes dry and forms itself into a new cuticle, which serves for the covering of the chrysalis. This new skin is at first soft and pale, but in a very little time hardens and becomes brown.

Of the addition it receives between spinning and the chrysalis.—Within the horny convex plates of the head (which to appearance compose the head) are formed the antennæ or horns; and upon the thigh part of the second and third pairs of the anterior parcel of feet are formed the wings; and the six legs of the parcel are changed in their form and adapted to their future state. These parts do not exist in the caterpillar-state; but, in a few hours before this change, they appear to acquire a considerable size.

Of the internal additions and changes.—The stomach is filled with a yellowish transparent ropy mucus, which very probably supports the animal in the chrysalis state, and the gut-part of the canal becomes one straight tube to the anus, and there increases and forms itself into a bag.

The white substances, like bits of fat, before mentioned, are increased in quantity, or appear to be so, from their being brought into a small space, especially at the anterior end. The parts of generation in both sexes are now formed, although, to appearance, imperfectly. The vessels, which are black, and ramified on the stomach, silk-canals, &c., whose origins are at the dark spots on the side, appear now to have thrown back their whole contents into the communicating canal on the side, making the line black, which we observed was thrown off with the cuticle, and which tubes appear now almost transparent. The silk-tubes are much diminished[1].

In the change from the caterpillar to the chrysalis, the antennæ, wings, and feet are denuded, and are at this time very wet; they fall down close to the body, and seem to exude from their surface a mucus which hardens or dries, and forms a coat for them, the whole being something like a hood and lappets laid over the breast. When all these changes have taken place, they are then in the chrysalis state, and of a very different shape from the caterpillar; and in this state the insect remains, having but few external changes, either in form or appearance, until it emerges a moth.

Of the external changes of the chrysalis.—We can observe the eyes becoming dark, the antennæ becoming darker, and their annular structure appearing through the chrysalis sheath. The wings are taking on their proper colours, which are also seen through the chrysalis sheath, and they are becoming firmer in texture. While in this state, a new skin is forming on the inside of the present; but at first it is so obscure as hardly to be perceptible: before a complete separation has taken place, we find its union to the chrysalis skin to be at the joints: upon this new skin the hair is formed.

Of the internal changes.—A new structure is going on in the fore-part of the animal; a thoracic as well as an abdominal part is forming; there is a kind of partition to divide the thorax from the abdomen, also a harder structure as a basis for the feet and wings to act upon, which is the thorax. On the inside of the belly the following things are taking place. The white substances, like bits of fat, appear to be

[1] [Hunt. Prep. No. 2989.]

forming themselves more into the nature of tubes, but not ramifying into smaller and smaller ones: I suspect that it is only the air-vessels dilating for flight when they come to the moth-state.

The digestive canal in the silk-moth is not changed into a future canal for digestion and absorption of the chyle, as in other insects; therefore the change in this part is not to be given as illustrative of such change in other insects. This canal is divided into œsophagus, stomach, and short gut. In the stomach is often a fine yellow mucus: the principal part of the contents of the stomach and gut is squeezed down the gut to the bag at the anus, which is increased in size and is full of this yellowish-brown mucus. The long yellow tubular bodies, like threads, that lie on the stomach and guts, are now detached from these parts, and are larger or more completely formed. They open into the stomach close to the beginning of the gut, and they are filled for some way with the same substance. The parts of generation are becoming more and more complete.

The new-formed skin, or moth-skin, becomes thicker and thicker, and in about eight or ten days it begins to separate itself from the external or chrysalis skin, which begins first at the tail. While the chrysalis is enclosed, its external surface is wet; therefore we may conclude that the chrysalis-shell does not readily admit of evaporation; yet they lose in weight; for, in one which I weighed, I found it had lost 22 grains. To observe their future operations, it is necessary to remove them out of their silk-cell or pod. On the fore-part of the head, between the eyes, the chrysalis is always wet.

They are about twenty days in the chrysalis state, and then they begin to shed their chrysalis-coat. The skin opens on the fore-part of the head and allows the body of the moth to be free, and then they begin to make their way out; but as they cannot escape from the chrysalis-coat while in the silk-pod, we find them at the same time throwing a juice out of their stomach, which had been secreted while in the chrysalis state, wetting the silk where they are to pass through, and then working with their feet to scratch and loosen the cement of the silk, and pushing themselves through it, leaving the chrysalis skin behind. For I observed that the silk in some degree sticks together where it touches, which sticky matter is softened by this juice; and, in unravelling the silk, the same means is employed with water. This would make us suppose that the exterior surface of the silk had on it a mucus capable of being softened by water, for the silk itself is not. As soon as the head emerges from the pod, we find the moth throwing out of its mouth some of the clear water before mentioned; therefore their œsophagus is still existing; and, just as they leave the cell, they generally throw out some of the excrement which falls upon the opening and wets it. Those that have not enclosed themselves within a pod, find more difficulty in getting out of the chrysalis-coat than the others do; for the pod fixes the coat, so that they can creep out of it; but in the other way there is nothing to fix the chrysalis-coat, so that it is carried along with the body.

As a silk-worm is a moth which is only awake in the evening, we find that very few come out of their chrysalis-coat in the day-time; most of them emerge in the morning, as it were, beginning the day. When they come out first, they work their bodies and their wings for some time; the wings are no larger than they were when they went into the chrysalis state, and appear like a pair of large hound's ears. In about twenty minutes the wings begin to expand, which is first at their roots; and the expansion goes on towards their edges. The expanded part is so much larger than the other, that the part not expanded appears as if shrunk. During the expansion, they throw out a good deal of the contents of the bags at the anus.

Of internal parts common to both male and female.—When in the moth-state there is an air-bag formed, which lies at the upper or fore-part of the belly, close to the thorax, and I believe between the remains of the stomach and back; it is attached to the thorax, as if a passage was leading from it through the thorax to the mouth, which is most probably the case. The little white bodies, which appear like fat, are now chiefly filled with air; so that they were principally formed for receiving air, at least when in the moth-state.

The silk-moth, although it does not eat, yet it has a mouth, œsophagus, stomach, intestines, and anus. Instead of two pinchers to cut vegetables, which belong to the caterpillar, it has two soft spongy protuberances [abortive mandibulæ], one on each side, and two small bodies like short feelers [palpi]. The œsophagus is small, passing through the head, neck, and thorax. The stomach is a pretty large bag containing a fluid for moistening the silk, which fluid is thrown up when the moth is making its way through the silk-pod. The intestine is small, and contains nothing: but near the anus it swells into a large bag, like a cæcum, which contains a reddish fluid, which would seem to have chalk mixed with it; and which is evacuated soon after its birth from the pod. How the whole of this canal is metamorphosed! The mouth is altered, rendered unfit for eating food or dividing it, and adapted to the future use of regurgitation. The short œsophagus is lengthened and narrowed: the long stomach is shortened and widened, and, instead of digesting for the support of the animal, it is forming a fluid to be thrown up to moisten the silk. The short intestine is lengthened and contracted, and the last part of it is enlarged into a bag, forming most probably a fluid, which is the whole excrementitious part of the animal while in the chrysalis state.

The ducts entering the gut become larger, and form themselves into kinds of bags near their opening into the gut, and have in them near to their openings some yellowish mucus, similar to that which we find in the gut and bag at the anus. The bag at the anus is generally pretty full of a yellowish mucus, mixed with some that is a little reddish. This mucus at first is the remains of the contents of the stomach and guts, which is in part thrown out in the intermediate state between the maggot and the period of spinning; in the intermediate state between the chrysalis and moth, they throw out more of it; also while they are in the moth-state; but most so when they are in the infant moth-state, viz. when copulating.

As they do not eat after the caterpillar-state, it appears strange how the gut can have a mucus in it, and even accumulate it, so that the bag at the anus should become a reservoir for the mucus.

The only way in which I can account for this at present, is to suppose that there is a retrograde motion given to the juices of the body; that the vessels which open at the beginning of the gut, which I shall suppose carried the chyle from the gut over all parts of the body for nourishment, are now employed in bringing back those very juices in the form of excrement.

The lateral tubes which ramify on the great gut, the canal for the silk, the skin, &c., which were black in the caterpillar-state, lose their attachment as these parts decay, and become larger and larger, more loose, and filled more and more with air, losing the dark colour and becoming white; and at last many of them appear to become floating air-tubes, loose in the cavity of the belly, so that the moth has a vast quantity of air in the belly.

Of the female.—The female is larger in the belly than the male; but I believe this is owing to the vast number of eggs in that cavity[1].

The external parts, which include the anus, project very much beyond the body of the animal (more especially before she has had the male), and form a rounded termination on each side of the opening, making a vertical slit between, on which there are a great many small hairs. Under the anus is a thin horny scale of some length from side to side, concave on the upper surface, as it were, half surrounding the lower surface of the anus.

The internal parts of generation consist, first, of eight oviducts, four

[1] [Hunt. Preps. Phys. Series, Nos. 2601, 2602, 3033—3035.]

on each side. These tubes are very small at their beginnings, so small as to seem to be united or arise from one part. As they pass from this union or origin, they become larger and larger, four going down on each side of the belly: each four at last unite into one tube near the anus, forming two ducts. These two tubes, formed by the union of the four tubes on each side, unite into one, which is continued to the termination of the tail, where it can be projected a little, forming two rounded lips, which can be protruded: this is the common oviduct, or in appearance what might be called vagina. These eight oviducts are filled with eggs from one end to the other, which gradually become smaller towards the beginnings of the tubes, as the tubes themselves become smaller; but at the time of laying they are all pretty well formed. Before this common tube, or what might be called vagina, lies a bag [spermatheca], very much in shape like the bladder of urine in the quadrupeds, viz. of a pyramidal figure, which is fixed by its apex to the horny substance at the anus (mentioned in the description of the external parts), and opens externally. Near to the apex of this bag, passes a very small duct, which enters the common oviduct, or vagina. Just above the oviduct, or between it and the rectum, is another bag, which is smaller, and of an irregular shape, terminating in a small end; its duct enters the oviduct, but not by a lateral communication as in the former. When these bags are examined before copulation, they are found perfectly empty; and, when they have copulated, they are found full of a semi-transparent whitish mucus. Behind, and on the side of these parts, are two long bags or canals [colleteria], which at their extremities become small at once, and from thence goes out a small duct which divides into several. These smaller ones are coiled up on the lateral part of the above-described parts and anus. They would appear to unite just behind the former, and they open into the oviduct at the union of all these parts. This is filled before copulation with a transparent mucus. I am apt to suspect that the use of this last-described mucus is to give the sticking coat to the egg.

The enlargement of the rectum and the anus lie above these described parts, and the opening of the anus is, I believe, in common with the oviduct.

Of the male.—The termination of the belly of the male is not so pointed as the female; it appears as if one ring had been cut off short, whose edges had pretty long hair, somewhat like a short tail[1].

On the edge of the termination of the last ring, and on its under surface, are two horny substances, I believe the remains of the last feet

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[1] [Hunt. Preps. Phys. Series, Nos. 2325—2328.]

or holders on the tail of the caterpillar. Their use is to hold in the time of copulation. At the anus are two horny hooks for the same purpose. For, when they copulate, they hold the female so fast as to allow her to hang by this hold; and I have seen them lay hold of another by the wing so fast, that they could be lifted up by it.

The internal parts consist of two testicles, one on each side, situated about midway between the anterior and posterior end of the belly, and near to the upper surface of the back. The two together would make about $\frac{1}{10}$th of the size of the whole animal. They appear as if composed of three or four smaller bodies rounded and a little compressed together. Each testicle has a duct which emerges out of it, in the hollow on their inner side, very similar to the ureter in the kidney. These ducts pass towards the anus in a convoluted course, and then the two unite into one duct.

At this part they are considerably enlarged. At this union enters a duct which is formed of two blind beginnings. The common duct or union of the whole is of considerable length, and is coiled up with the others in the natural state, and terminates at last in the penis. The penis is a horny substance, which is capable of being projected and drawn in, and is in a distinct part, not in the anus as in birds, yet they both open between the two last scales.

As soon as the chrysalis has emerged from its cell and got into the moth-state, they are fit for copulation, which takes place as soon as a male and female meet. The male appears to be in search of a female, and when he finds her, he immediately turns his side to her and bends his tail towards her, and creeps round her in this way, fluttering his wings, making a kind of rattling noise, touching her with his tail as he goes round, and when his tail comes in contact with her they then close. As she is the larger of the two, and probably the stronger, she often draws him after her.

They keep in contact ten, twenty, or thirty hours, and when they separate she often squirts out a transparent fluid, only a little yellowish; and about two hours after the separation she begins to lay her eggs. After having laid some eggs, they will take the male a second and a third time; indeed they will take the male several times, even before they begin to lay their eggs. They will take the male after they have laid all their eggs, even till they are almost dead; and often die in this state.

Observations on impregnation.—In science, whenever a new fact or principle is discovered, it becomes necessary to establish and prove it by observation and experiment; whereas in things already known and admitted, it becomes only necessary to describe the fact or principle.

This gives a prolixity to every description under such circumstance, which must afterwards appear tedious and even unnecessary; and, of course, in the end such descriptions and proofs are justly laid aside. Therefore, as I mean in the following pages to describe some new facts relative to the impregnation of the egg in the winged insect, I find it necessary to prove the fact itself; which necessarily leads me to describe the original observations, and the experiments in consequence of them.

Reproduction, or new combination, is a property in the operations of nature constantly acting; for every thing has a tendency to decay; and this excites the attention of almost every thinking being. The most simple change in matter may be productive of a new form; but, as many of the immediate causes of such changes are known, and are even at the command of the human will, they have become familiar to us and we regard them less; but those which are more obscure become the objects of closer attention and of direct investigation.

Chemistry has gone far (abstractedly considered) in the reproduction of properties in inanimate matter; but, when compared with that which is yet to be known, it must appear as nothing. The investigation of the properties of animal bodies has been carried to greater length, because it is connected with ourselves, and we become more interested in it; but much is left undone.

The reproduction of animal bodies has always interested us much; for, besides its being a fit subject for philosophy, we are the more nearly concerned, as we have a hand in it ourselves; it is, even, the ultimate of our earthly enjoyment. Moreover, its being put under restrictions by divine and human laws excites curiosity.

Various are the modes of impregnation in the animal kingdom: they are classable according to the class of animals; and sometimes according to the order of animals, and may even again be divisible according to the different genera. But in the present investigation I shall consider the subject no further than as it applies to the class of insects, leaving the divisions to some future occasion, as they require a much more extensive knowledge of the subject, the varieties being almost without end.

One would naturally suppose that the act of copulation, in the silk-moth, was the inserting the penis into the vagina leading to the oviducts, and there depositing the semen; but, in dissecting the parts of the female before copulation, as also after, I was able to ascertain several facts. When I dissected them before copulation, I observed the bag above described [spermatheca] was empty. When I examined the parts in those that had been impregnated, I found this bag full. Suspecting this was the semen of the male, I opened the female as soon as the male had united himself with her, and found the penis in the opening of this bag; and by opening the duct where the penis lay, I observed the semen lying on the end of the penis. In another I observed the bag to fill in the time of copulation; and in a pair that died in copulation, on examining them, I found the end of the penis in this bag[1].

When we consider all appearances with regard to the parts themselves, we shall find several singularities. First, many of the ova are completely formed, and covered with a hard shell before copulation, and a vast number are laid after the first copulation; secondly, the sexes are a vast while in copulation; thirdly, the bags at the anus are filled at the time of copulation.

From the first observation, it appears that the egg can receive the male influence through its hard or horny shell, and that one copulation can impregnate a vast number of eggs. To know how far the whole or only part of the eggs were impregnated by each copulation, I took a female just emerged out of its cell and put a male to her, and allowed them to have their full time. They were in copulation ten hours. I then put her into a box by herself, and numbered the different parcels of eggs as she laid them, viz. 1, 2, 3, 4, and 5. These eggs I preserved, and, in the summer following, I perceived that the parcel No. 5 was as prolific as the parcel No. 1. So that this one copulation was capable of impregnating the whole brood; and therefore the male influence must either go along the oviduct its whole length, and impregnate the incomplete as well as the complete eggs, which appears to me not likely; or the eggs not yet formed might be impregnated from the reservoir in the act of laying. For I did conceive that these bags, by their containing semen, had a power of impregnating the egg as it passes along to the anus, just as it passed the ducts of communication.

Experiments on impregnation.—Finding from the last experiment that eggs completely formed could be impregnated by the semen, I wanted next to see if they could be impregnated from the semen of this bag; but I conceived it proper first to see whether the ova of insects might be impregnated without the natural act of copulation by applying the male semen over the ova just as they were laid: the following experiments were made on the silk-moth.

Experiment 1.—I took a female moth as soon as she escaped from her pod, and kept her carefully by herself upon a clean card till she began to lay. I then took males that were ready for copulation, opened them, exposing their vesiculæ seminales, and after cutting into them, collected their semen with a camel-hair pencil, with which I covered the ova as they passed out of the vagina of the above female. This card had a

[1] [Hunt. Prep. Phys. Series, No. 2850.]

written account of the experiment upon it, and was kept in a box by itself. In the ensuing season, eight of the ova hatched at the same time with others naturally impregnated.

The ova laid by females that had not been impregnated, did not stick where laid; so that the semen would appear not only to impregnate the ova, but also to serve for attaching them when laid.

Finding that I could impregnate the completely formed eggs with the semen of the male without the act of copulation, I now wanted to know whether that bag in the female silk-moth which increased at the time of copulation was the semen of the male.

Experiment 2nd.—I took a female moth as soon as she escaped from the pod, and kept her on a card till she began to lay her eggs. I then took females that were fully impregnated before they began to lay, and dissected out that bag which I supposed to be the receptacle for the male semen, and wetted a camel-hair pencil with this matter, covering the ova [of the virgin moth] as they passed out of the vagina. These ova were kept upon this clean card, and kept carefully until the ensuing season, when they all hatched at the same time with those naturally impregnated. This proves that this bag is the receptacle for the semen, and this gradually decreases as the eggs are laid. To prove this still further, I made the following experiment.

Experiment 3rd.—I took a female after being fully impregnated by the male, and dissected out the bag or receptacle for the male semen. This operation affected the animal so much, that she laid very few of her ova. Those she did lay were kept carefully on a clean card. The ensuing season several of them hatched at the same time with the others. This experiment contradicts the others. But perhaps the bag was not cut off close to the vagina, or that, in cutting it off, part of the semen might have been squeezed into the vagina, and so have impregnated them: however, it was observed that these ova hardly stuck to the card.

The above experiment I repeated the following year, when the animal being weakened by the operation, she only laid seven eggs, which did not hatch.

Experiment 4th.—To see whether a female could be impregnated after the bag for containing the semen was taken out, I dissected out the bag and closed up the wound by applying a piece of the wing of another moth over the wound, which very soon stuck firmly by the blood coagulating; I then allowed a male to copulate with her the usual time. She laid all her ova, which were kept till the ensuing season, and they all hatched. It may be conceived here that the semen might get out at the duct of the bag into the abdomen, and by the exertions made to discharge the ova, might at the same time force the semen into the vagina, and so impregnate them. It may be observed that the first eggs that were laid stuck faster to the card, while the latter did but slightly, and the last not at all. This would prove that the bag serves to secrete a fluid to attach the ova as well as a reservoir for the semen, and that they first received this fluid from the duct of the bag.

To know whether one act of coition would impregnate the whole ova in a female silk-moth, I made the following experiment.

Experiment 5th.—I took a female as soon as it had escaped from its pod, and, when fit for copulation, I allowed a vigorous male to copulate freely. I then put her upon a clean card, where she laid all her eggs, viz. three or four hundred, numbering the parcels of eggs as they were laid. In the ensuing season the whole proved to be impregnated. They hatched irregularly, for some of the last laid, hatched as soon as those that were first. The experiment shows that one act of copulation is sufficient to impregnate the whole ova.

Experiment 6th.—To see whether it was necessary for impregnating the whole ova to allow the male to copulate the usual time (which is about seventeen hours), I allowed a vigorous male to copulate with a female for ten minutes, which is about $\frac{1}{93}$ of the usual time, the ova being carefully kept till the ensuing season. None hatched.

Experiment 7th.—Finding that the bag which contained the male semen was small before impregnation, and that it got gradually larger in time of coition, I made two moths copulate, and as soon as they were together, cut open the female and exposed this bag, which is of a plain uniform shining surface, hard, and rather of a whitish colour; after the act had continued for some time, I thought I perceived the bag gradually getting larger, but so slowly as to be hardly perceivable. I then opened another female about two hours after; and, on comparing these bags, the difference was very evident; but the pain in which the female was, occasioned violent exertions, and they separated. I now observed the penis of the male, and found that there was a whitish ropy fluid oozing from the end of it, which continued for some time; and on comparing it with the fluid in the female reservoir, found it exactly similar in consistence, colour, &c.

The eggs of the silk-worm are of that class that are laid one year and hatched in the following. As there is sufficient summer after being laid for their hatching the same season, it would appear that they required a certain time after laying, or impregnation, to become perfect. What time is required is not to be known without an experiment. It is certain, however, that it requires a longer time than the remaining warmth of the same season of laying. But in case the autumn of the same season might be too cold, and the winter coming on prevent their hatching, I made the following experiment so as to spin out the season for some time longer; I put some eggs of silk-worms into a hot-house at the following seasons:—

Times when put in.		*Times when not hatched.*
11th August, 1775, were not hatched		in April, 1776.
20th September, 1775	„	in April, 1776.
December, 1775	„	in April, 1776.
March 10th, 1776	„	in March 28th, 1776.

From the above experiment it would appear that a continued heat from the time of laying, does not bring them in the least faster forward; and, indeed, would seem rather to retard it; and that a certain degree of cold continued for a considerable time was necessary.

The coat of the egg is so hard and impenetrable, that in those which did not hatch, although exposed to a whole summer's drought, very little of their internal substance had evaporated; and, when cut into, the substance of the egg was moist and sweet; not putrified in the least.

Appearances after Natural Death.—When the silk-moth is dead, we find that the stomach is hardly to be perceived, and is only to be known by the gut and vessels going into it; and in some it is pushed backwards by the increase of the air-bag; but in many it still keeps the attachment by the remains of the œsophagus. The testicles are almost entirely wasted; the vasa deferentia are still perfect. The air-vessels become flat; there is hardly any air in them. The bag at the anus is much as when the moth was alive, full of a brownish-red fluid, with a whiter chalky substance, which is specifically heavier than water.

Although silk-moths do not fly in this country, it is to be supposed they do fly where they are native.

[Order Diptera.]

The Large Blue-Bottle Fly [*Musca carnaria*, Linn.].

Flies may be said to live on fluids, or such as may be raised by suction or capillary attraction. The organs of digestion are attended with a crop[1]. The organs of circulation and respiration are similar to those of other flying insects.

The œsophagus, when got to the neck, or through the head, has a swell, or is surrounded by a thickish substance, probably glandular. It there divides into two canals; one, and the smallest, passes across the

[1] [Hunt. Prep. Phys. Series, No. 596 (*Musca pendula*).]

neck along the thorax, and, when got into the abdomen, it dilates into a pretty large bag of a particular shape, swelling out laterally, having the long axis across the abdomen. The other canal passes down behind the before described, and along with it into the belly, then becomes larger, which increase of size may be called 'stomach;' and which again becomes smaller, forming 'intestine.' This is soon thrown into close convolutions, and then becomes a more straight canal, into which enter the ducts, which I suppose to be either liver or pancreas. Where it commences rectum there is a valvular structure, and then a swell forming a kind of reservoir for the fæces, in which there is a particular appearance or structure. It is there flat, more firm in texture, and has two lateral conical bodies on each side, whose base adheres to the side of the gut[1]; and the whole body projects into the cavity of the gut obliquely downwards. Into the base passes a dark vessel, which is an air-vessel. We may suppose these so many glands opening at the apex into the gut. Then the gut becomes small, and terminates at the anus behind, or rather above the vagina.

The bag belonging to the first-described canal [œsophagus] is to be considered as a craw or crop, viz. a reservoir for the food, to be ready for digestion; and, as the abdomen contains almost every internal part of the animal, it is obliged to be situated in this cavity; but why it did not communicate with the œsophagus, or true stomach lower down, I do not know. That it is a reservoir for food I proved by experiment. I kept some of these flies fasting for some time. I then gave them milk, which they drank readily; and when I thought they had filled their bellies, I put them into spirits, which assisted in coagulating the milk wherever it might be.

On opening the abdomen, I found this bag full of curd and whey, as also some in the stomach. That I might be still more certain that this bag was reservoir only, that it had no other business in digestion, and therefore that food would be taken into the stomach immediately, if immediately wanted, I repeated the above experiment with this difference. The milk was now coloured with cochineal. I not only found the bag full, but the stomach and intestines, so that the food when wanted was immediately carried into the stomach.

I kept a fly for twelve hours without food, and then gave it milk and killed it: I found no milk in the crop, but it had got through almost the whole tract of the intestine. Here the animal had immediate occasion for it; therefore it did not go into the crop. This experiment at the same time shows that, probably, every part of the intestine digests,

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[1] [Hunt. Prep. Phys. Series, No. 2123.]

for the stomach makes no distinct bag. Is the crop only a reservoir? or is it a preparer of particular food, as in other animals? I should suspect it is only a reservoir, as I find food in it that does not require being prepared, which is proved by the same food being found equally in both it and the stomach. Therefore it appears that when there is more food than what is immediately necessary, it is thrown into the crop to be used in future.

There are two salivary glands in the form of two ducts, which take their rise in the abdomen, among the intestines, and which pass up through the abdomen, join the œsophagi [the true gullet and the canal of the crop] and pass with them through the thorax to the head; at which part they are thrown into convolutions, and there enter the common œsophagus. Whether these are the remains of the silk glands, viz. the glands for forming the chrysalis bag, I do not know, but suppose they may be.

In the large fly each egg is enclosed in its oviduct, and at the outer part of each, a new egg forms, so that as many eggs so many oviducts. The points of the whole are upward and inward, making one plane, touching the crop. Their terminations make also one plane, which is downward and outward, and from each goes a duct to the main one; but the separate ducts are hardly visible[1].

[Order Aptera.]

The Louse [*Pediculus Hominis*[2]].

Take a louse and starve it, and it becomes almost transparent; but there is commonly a dark line in the centre, which is the stomach and intestine, having some of the blood digested or reduced to fæces. But let such a louse suck, it will fill itself with blood, and while it is sucking it will throw out at the anus the former contents, which are found to be dry: when it is full, view it in a microscope, and the stomach and intestine are seen contracting and dilating, keeping up a constant motion in the blood; so that if one were not acquainted with the facts, it would appear to be the heart moving, and disposing of the blood: but their own blood is not red; it is transparent. How small the vessel must be which they wound! for there is no mark visible to the naked eye, nor does any blood flow after, as in a leech-bite.

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[1] [Hunt. Preps. Phys. Series, Nos. 2963—2966.]

[2] [The anatomy of this insect is given by Swammerdam, Biblia Naturæ. tab. . ii.]

[Class ANNULATA.

Order ERRANTIA.]

THE SEA MOUSE [*Aphrodite aculeata*, Linn.].

This animal, according to its parts, and being similar to a caterpillar, comes nearest to an insect in the first state. Its external hair[1] is in some degree similar: its stomach[2] and gut[3], also its pancreas or liver[4], are a good deal like the same [in insects]. The nerves[5] are similar, as also the circulation[6]; but I believe their respiration[7] is not similar.

[Class ENTOZOA.]

OF WORMS IN THE WHALE-TRIBE [*Echinorhynchus porrigens*, Rud., and *Echinorhynchus glandiceps*, Ow.].

Animals of every species have probably smaller animals living upon them, which are either situated upon the external surface of the body, or in some of the internal canals; and many species, besides the whale, afford a nidus, or a simple attachment, to such. The animals which live upon the external surface of others are commonly insects, and constitute, I believe, one order of that class. Those found in the internal canals are called 'worms' [*Entozoa*], but differ very much among themselves. Those which are contained in a nidus with an external opening, formed on living animals, are larvæ of winged insects [*Œstri*], and those which are simply attached are generally marine, and adhere to the larger fishes [*Epizoa*].

Perhaps every species of animal has a species of insect peculiar to it; as in the instances where the body affords a nidus to such. The same observation may in some degree hold true with respect to worms; and although many which are found in different animals appear to be similar, yet there is probably some specific difference[8].

These observations, although in general true, are not, however, without exceptions; for I have found the same kind of worm in the intestines of the whale[9] as in the eider-duck[10], and we know that the intestines

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1 [Hunt. Prep. Phys. Series, No. 2068.]

2 [Ib. No. 465.]

3 [Ib. No. 595.]

4 [Ib. Nos. 782, 783.]

5 [Ib. No. 1297.]

6 [Ib. No. 849.]

7 [Ib. Nos. 985—988. See also the beautiful figure of the vascular and respiratory system of *Amphinome capillata*, from a Hunterian drawing, in the Physiological Catalogue, 4to, vol. ii. pl. 14. fig. 10.]

8 [This idea has since been verified, chiefly by the labours of Rudolphi, in his 'Historia' and 'Synopsis Entozoorum.']

9 [*Echinorhynchus glandiceps*, Hunt. Preps. Phys. Series, Nos. 295, 415, 2323.]

10 [*Echinorhynchus lendix*, Phipps; *Ech. filicollis* and *Ech. versicolor*, Rud. This, though similar to, is distinct from, the *Ech. glandiceps* of the piked-whale. It is

of the same animal are often infested by different kinds of worms: *e.g.*, the human being has the large round-worm [*Ascaris lumbricoides*], the tape-worm [*Tænia Solium* and *Bothriocephalus latus*], and the ascarides [*Oxyurus vermicularis*][1]. It is probable that situation will often produce the same kind of worms in different animals, and different kinds in the same animal. There are worms which seem to be peculiar to different parts of animals, and perhaps each part may have its kind of worm; *e. g.*, the intestines one kind, the liver another[2].

In the whale there is an insect [*Pycnogonum balænarum*] that buries its head under the skin and sticks there, like the *Pediculus pubis* in the human body; and the skin of the whale becomes likewise a fastening place to a species of barnacle[3]. I do not now recollect seeing worms in the intestines of the porpoise; but in the Eustachian tube, in the cavity of the tympanum, and in the large cellular sinus leading from the tympanum into the surrounding parts, there were thousands of very small worms of the round kind: indeed, in many porpoises these canals are almost filled with them[4].

In the intestine of the piked-whale there are many worms of the round kind, some 7 inches long [*Echinorhynchus porrigens*], others shorter [*Ech. glandiceps*], being not above 1 inch long. Their heads are buried in the substance of the intestine, having pierced their way so deep that the heads of some go quite through the coats, and a new substance is formed on the outside, to prevent a communication being made with the general cavity of the abdomen. In some, the head and neck pass in a straight line; in others the neck is considerably bent, and in various directions. The canal in the coats of the intestines, in which the head and neck lie, is thickened and condensed into a kind of cyst; and at the extremity, where it is enlarged to contain the head, there is a good deal of curdy substance, just opposing the fore-part of the head[5]. Whether this was naturally curdled I do not know, for

described and figured as the *Sipunculus lendix* in Ad. Phipps', afterwards Lord Mulgrave, 'Voyage to the North Pole,' p. 194. pl. 13. fig. 1, A—C. See also the engravings from Hunterian drawings in plate 14. figs. 7, 8, 9, Physiol. Catalogue, 4to, vol. ii. p. 133.]

[1] [At least ten other species of *Entozoa* are now known to infest man. See 'Hunterian Lectures on Invertebrata,' 8vo, 1855, p. 57.]

[2] [Ib. p. 89, for the extent to which the above idea has been verified; and how the same Entozoon, at different phases of its metagenesis, may affect particular tissues, and even different animals.]

[3] [Two species, viz. *Coronula Diadema*, Hunt. Preps. Phys. Series, Nos. 613, 997; and *Tubicinella Balænarum*, Ib. No. 995.]

[4] [In the examination preliminary to the description of the Hunterian preparation of the organ of hearing in the porpoise, No. 1582, Phys. Catal. vol. iii. p. 121, I found some of the worms here alluded to, and identified them with the *Strongylus minor* of Kuhn.]

[5] [Hunt. Preps. Phys. Series, Nos. 289—294.]

these worms had been kept in spirit for some time before examination. This substance is probably lymph thrown out in consequence of irritation, and may be the food of the animal.

The body of the worm is thickened at its middle, but becomes extremely small towards the head: this contracted part I have called the neck, and it is grasped by the beginning of the canal as by a sphincter muscle. The head is perfectly round in the middle, becoming very quickly smaller towards the neck, and still more so at the [anterior] termination, in the centre of which is a small projection or mouth [uncinated proboscis]. All along the centre of the body is a canal passing from the head to the other extremity, which I take to be intestine[1]; the upper part as small as a very fine hair, becoming a little larger near to the anus. If this be the intestine, it is, indeed, extremely small; but it is possible that the worms had been starved by the previous death of the animal in whose intestine they lived. The substance between this canal and the skin is cellular and regular in its structure.

I found worms of the same shape and structure in the intestines of a different species of whale; but these were not an inch in length [*Echinorhynchus glandiceps*], being similar to what were found in the eider-duck [*Ech. lendix*], and the resemblance may arise from the whale and duck inhabiting the same seas[2].

Of Worms of the Guts.

In a dog that I opened, I found a great many worms of different sizes, both of the tape[3]- and round[4]-kinds. The large ones were in the jejunum; the small in the ileum. These small ones had the appearance of *Ascarides*. As they were only found in the last intestine, query, are they the young of the tape- and round-worms, and are they making their way against the stream? or are they formed above, and driven down the stream?

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[1] [Hunt. Preps. Phys. Series, Nos. 413, 414.]

[2] [Mr. Clift notes that: "On the outside cover of the above MS. Hunter had penned the following memorandum:—

"'Mr. Home called on Dr. Blagden, to ask the Doctor if the enclosed might be added to the whale-paper now printing; and, if it may with propriety, Mr Hunter wishes the Doctor to send it to the printer.'" The paper 'On the Structure and Economy of Whales,' here referred to, is printed in the Philosophical Transactions, vol. lxxvii. for the year 1787, at which period Dr. Blagden (afterwards Sir Charles Blagden) was Secretary; but the supplement on the worms in the whale was not printed; probably from not having been read before the Royal Society.]

[3] [Probably the *Tænia serrata*, Rud.]

[4] [Probably *Ascaris marginata*, Rud.]

As these worms are similar to some found in the human body, the same queries hold good.

In the autumn of 1764 I opened a dog. Upon slitting down the duodenum and ileum, I found a great many tape-worms. They were all alive, and crawled about while warm, but soon lost their motion when exposed to the cold. I observed their motions very narrowly, and could plainly see as follows:—that one link could, and often did, move independently of any other; I shall therefore confine my description to one link. This link would contract in its length, by which means it would become almost circular; then it would begin to elongate at one end, which I take to be the head: this point became sharper and sharper as it increased in length; and, at last, the whole circular body became changed into the long one. After the link had done this, it then contracted again, as before, and repeated these motions as long as it had any power to move. The effect of these motions in many, was an entire separation of the link at both ends [from the other links or segments of the tape-worm].

My next business was to observe what was to become of those links that separated themselves. They still continued this motion: by which means they moved from place to place, and crawled just as another worm does; but, when laid upon a cold place, they contracted in their breadth and took upon them all the shape of a round-worm or small maggot. Many of them, however, contracted in length, by which means they took upon themselves a particular shape. These I have, in spirits, to show at any time.

Most of these worms were tinged of a red colour. Whether this could be with the madder that the dog had eaten, is not to be easily known.

Since that time I killed another dog that had not been fed with madder, and I found some of the worms red[1].

In December 1764 I opened the stomach and intestines of a dog. I found in the pylorus a great many worms of the round-kind; and in the jejunum I found a vast number of the tape-worm. All of this last kind were small at one end: that end was fixed to the inside of the intestine, and the other end was in general the thickest part of the whole chain, and terminated just at once, or as if it had lost a part of it. This end seemed not to be capable of holding by the inside of the intestine, as the small end did; for it was loose, and seemed to be carried down either by the peristaltic motion, or with the course of the contents, or by both.

[1] ["In Mr. Nicholson's great dog I found them all of almost a snowy whiteness. —W. C."]

In the spring of 1765 I opened the guts of a dog downwards, from the duodenum; and about half-way down I found a great many beginnings or heads of tape-worms, all fixed to the inside of the guts. I slit no further, to let the worms die in the guts, to see if they would keep fixed after death. Next day I slit open the whole intestine, but found that, in almost the whole of the worms, the links were separated at their unions to one another; and that these single links or worms had formed themselves into round ones, as in the former case. When I observed this change they had been in water for some hours; but by letting them stay in the same water for about twenty-four hours longer, they had altered their shape, and were all become square and thick.

In a tape-worm taken out of a codfish[1], I pressed it flatways, to see if I could squeeze the mucus by natural passages out at the edges; but I could not do so without a visible rupture. I then squeezed it upon the edges, and found that I easily squeezed out the fluid on one of the sides, and not of the other. On squeezing in this way I found that the side where the mucus easily squeezed out became always round, and the opposite side concave. Whether it was owing to this circumstance that the mucus squeezed out more easily on the convex side than on the concave, I cannot tell, but it is probable. However, why the same side of the worms should always become convex through the whole length of the worm, I do not know[2].

Hydatids[3].

The hydatids of the second kind differ very much from the former: they appear to be principally new-formed parts. However, they may be said to be made up of two parts; one, a thickening of the parts in which they are placed, the other, an adventitious substance formed on the inside of this.

When the disposition takes place to form such bodies, it is only in a very small part: but whether the external coat is the first that forms, or whether it is only a consequence of the others, is not easily determined. From some circumstances it would appear to be the latter; because, when these internal ones have burst from their covering, and become loose in some cavity, they have produced such a stimulus as to have acquired for themselves a vascular coat, similar to that from which

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1 [Probably *Bothriocephalus rugosus*, Rud.]

2 ["This was the side on which the mouths are placed.—W. C." They are the orifices of the genital organs, and show the tape-worm experimented on to have been a *Bothriocephalus*.]

3 ["Part of this subject had been torn out, having probably been fairly copied; for that which remained had been scored across.—W. C."]

they escaped. This I have found more than once in the mocock's abdomen[1].

Do these hydatids proceed from cold or indolence? Many slow animals which have come to us from warm climates, die here of [or with] them in the liver, lungs, &c. I opened a mocock which had a great number of hydatids in the liver, some of which had escaped and got loose into the cavity of the abdomen, and some of them were as low down as the pelvis; many of them had adhered to the parts adjacent, and there were blood-vessels passing to them from the parts to which they adhered, and ramifying upon them. This shows that the external coat of a hydatid is alive. This second species of hydatid I never saw but in the liver or the lungs; indeed the liver may be said to have hardly any other kind of hydatid, but the lungs often have hydatids of another kind; therefore they are more peculiar to the liver than to the lungs.

Hydatids.—I saw an instance of some, of an irregular kind, in a woman that was dissected in the dissecting room[2], in the spring of 1759. She was fat, and that fat very oily: the liver adhered to the diaphragm upon the right side near to the transverse ligament, by long membranous adhesions. I found in the substance of the liver at this part a fluid, like that of an abscess surrounded everywhere by liver. On exposing it, I found that the fluid was contained in a strong bag, which made me suspect an hydatid. I opened it by a crucial incision, and found upon the inside a slimy mucus, pretty white, as if chalk had been mixed with it; and upon the inside of this I found a cluster of hydatids, but they were very much compressed and broken, and had some of the white substance mixed with them.

Sometimes hydatids are found within others, even a first, second, third, and fourth, and so on. This sort of hydatid may be justly compared to a nest of pill-boxes one within another; and may be called a simple and regular series of hydatids.

There is another species, but much more irregular; it has, as in the former kind, the strong external membrane; but, within this strong membrane, there are a vast number of simple or single hydatids; with this difference, they are not a series of them one within another, but are lying loose in the general cavity of the cyst.

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[1] [See pp. 28, 29.]

[2] [Dr. William Hunter's Theatre of Anatomy, Great Windmill Street.]

[Subkingdom RADIATA.]

THE RED-PIPED CORAL [*Tubipora musica*, Linn.].

This coral appears to be an aggregate of different animals, but there seems to be a connected principle that runs through the whole.

A piece of piped coral consists of tubes of various numbers, three or four inches long, mostly arising from one base, and they go from it in a radiated manner. Each tube is about $\frac{1}{14}$th of an inch in diameter, but not so much in the bore.

As they go from the base in a radiated manner, they ought to become at some distance from one another, at their mouths or terminations; but, where they become at some distance, a new one forms in this interstice like the branch of a tree: so that they are nearly as close to each other at their terminations or mouths as at the bottom. They are attached laterally to each other by several cross-bars or unions, about an inch from each other, so that they all support each other. These lateral attachments are pretty regularly formed, running across, nearly in the same place, through the whole. The substance of these is bone; that is, it is composed of animal substance and calcareous earth intermixed; either of which may be extracted without hurting the other[1].

Each pipe is lined through its whole length with a very thin animal substance, a continuation from the animal which may be said to be striped or ridged on its inside in a longitudinal direction.

Just within the mouth of the pipe is the body of the animal, which is composed of very few parts. The basis of this animal is attached to the sides of the lining of the tube by, we may suppose, a muscular attachment to pull the animal in when it is protruded. There is a very thin membrane, which encloses the animal and its tentacles, when these are drawn into the shell or tube, but which allows the animal to protrude through it, and acts as a prepuce.

The tentacula are four; two seem to be smaller than the other two, and almost form the larger part of the animal. They are firm, and seemed to be feathered on their whole inner surface: as far as I could judge, they looked like four pennæ marinæ joined by their stalks. They are of a yellow colour, and when drawn in, are all laid parallel to each other. In the centre of these is the mouth, which leads into the stomach: this viscus is a blind pouch[2].

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[1] [Hunt. Preps. Phys. Series, Nos. 83, 84, 85. This beautiful coral is from the coast of Australia, and was probably given to Hunter by Sir Joseph Banks.]

[2] [Ib. No. 421.]

The animal of this coral appears to be one degree higher in the scale than those [*Hydra*, e. g.] which have only one bag with a mouth; for it has a stomach within, distinct from the animal itself. It is a regurgitator.

I conceive its body is naturally rather long, although almost round in the figure[1], because the stomach was thrown into transverse folds, not longitudinal; it was therefore not contracted laterally, but probably rather stretched in this direction, on account of the longitudinal contraction: indeed the rugæ of the animal itself were transverse or rather circular from the same cause, like a worm when it contracts itself.

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[1] ["Qu. What figure?—W. C."]

APPENDIX.

A.

The following is a summary, with the dates, of the chief events of the life of John Hunter:—

Age.	Year.	Event.
	1728	Birth, 13th or 14th of February, at Lang Calderwood, Kilbride, near Glasgow.
20	1748	Migration to London to his brother, Dr. Wm. Hunter.
25	1753	Entered as 'Gentleman Commoner' at St. Mary's, Oxford.
28	1756	House-surgeon at St. George's Hospital, London.
29	1757	Prosector and Demonstrator in Dr. Wm. Hunter's Theatre of Anatomy, in Great Windmill Street.
33	1761	As Surgeon in the Army, accompanied the Expedition to Belleisle.
35	1763	Returned from Portugal to London.
38	1766	Communicated his first Paper, printed in the 'Transactions of the Royal Society,' entitled "Anatomical Description of an Amphibious Bipes." [Hunter had previously communicated a Paper 'On the Placenta,' which was not printed.]
39	1767	Elected Fellow of the Royal Society of London.
40	1768	Became 'Member of the Corporation of Surgeons.'
41	1769	Elected Surgeon to St. George's Hospital: had his first attack of the gout.
42	1770	Jenner became Hunter's House-pupil.
43	1771	Married Miss Home. Published his 'Treatise on the Natural History and Diseases of the Human Teeth.'
44	1772	Communicated his Paper 'On the Torpedo' to the Royal Society. Mr. (afterwards Sir Everard) Home, his wife's brother, became his pupil.
45	1773	His first attack of 'Angina pectoris.'
46	1774	Gave his first Course of Lectures 'On the Principles of Surgery.'
48	1776	Appointed Surgeon Extraordinary to His Majesty. Mr. Wm. Bell became Hunter's assistant.

Age.	Year.	Event.
55	1783	Purchased the lease of the house No. 29 Leicester Square, and the ground extending to and including a house in Castle Street, and began to build his Museum on the intervening space.
57	1785	Museum completed, and arrangement of the Preparations begun.
58	1786	Published his 'Observations on the Animal Economy,' and his work 'On the Venereal Disease.' Made Dep. Surgeon-General to the Army.
59	1787	Preparations arranged in the Museum, which was opened to Visitors.
61	1789	Mr. Wm. Bell left Hunter for an appointment in Sumatra, where he died in 1792.
64	1792.	The printing of the work 'On the Blood and Inflammation' was commenced. Mr. Wm. Clift was articled as an 'apprentice' to John Hunter.
65	1793	Died suddenly, October 16th, at St. George's Hospital: was buried in St. Martin's Church.
	1859	Was re-interred, March 28th, in Westminster Abbey.

B.

Mr. Wm. Clift, F.R.S., Conservator of the Museum of the Royal College of Surgeons, on examination before the Parliamentary 'Committee on Medical Education,' 1834, states:—

"I was Mr. Hunter's apprentice: I came to him in February 1792, and remained with him till his death, on the 16th of October, 1793. During that period I was employed every evening in writing for him, and many of those manuscripts were in my own handwriting."

To the question by *Mr. Warburton,* "How was it that you became so intimately acquainted with the nature of Mr. Hunter's manuscripts that were destroyed?" Mr. Clift replies, "I had them occasionally in my possession from 1793 to 1799."—P. 67.

"I had the collection left in my charge, and I was anxious to make myself acquainted with the nature of their contents; and they related chiefly to that subject."

Q. 5385. (*Mr. Warburton.*)—"What use did you make of the opportunities thus afforded you of becoming acquainted with the contents of those manuscripts?"

A. (*Mr. Clift.*)—"I had, I may say, no other books to read at that time; and, having possession of them, I frequently availed myself of the opportunity to read them. I was never restricted from reading them, or from making any extracts I thought proper from them."

Q. 5389. (*Mr. Warburton.*)—"Had you made any extracts from the manuscripts?"

A. "As I said, I was not restricted in the least, and thinking there was a great deal of useful information in them, I made large extracts from some of them."

Q. 5390. (*Mr. Warburton.*)—"What proportion of the papers have you been instrumental in preserving, in substance, by means of these extracts?"

A. "I hope nearly half."

Until the year 1800, the Hunterian collections and manuscripts were the property of the Executors of John Hunter. At the beginning of 1800, the collections having been purchased by Parliament, were transferred to the custody of the Corporation, afterwards Royal College, of Surgeons.

To *Q.* 5047 (p. 60), Mr. Clift replies,—"The MSS. were removed shortly before the collection was transferred to the College of Surgeons."

Ans. to *Q.* 5050 (p. 61).—"Those manuscripts were taken by me in a cart to Sir Everard Home's house by his order." It was absolute. In reply to another question, Mr. Clift answers,—"He," Sir Everard, "was the acting Executor. Nothing passed relative to their use, destination, or return."

In July 1823, Mr. Clift first received information of the destruction of the Hunterian manuscripts. He was returning with Sir Everard Home from a meeting of the Medico-botanical Club, which had been held at Kew.

"Sir Everard Home," Mr. Clift states, "began by telling me that an accident had very nearly occurred at his house; that it had been nearly on fire; that the engines came, and the firemen insisted upon taking possession of his house. They saw the flames coming out of the chimney. He did not wish to admit them, but they insisted upon being admitted. I asked him how it happened, and then he told me that it was in burning those manuscripts of Mr. Hunter."

"The Board of Curators of the College of Surgeons obtained a knowledge of the existence of those papers, and that Sir Everard Home had in his possession all Hunter's manuscripts, from Sir Everard Home himself, whilst he was a member of that Board."—P. 63.

It was not, however, until Mr. Clift had reported to the Board their alleged destruction, that the 'Board' applied to Sir Everard Home on the subject, when he returned the following answer:—

"Sackville Street, March 9th, 1824.

"Sir,—I beg you will acquaint the Board of Curators, that Mr. Hunter desired that, after his death, his manuscripts should not be entrusted to anybody, but were to be destroyed, being in too imperfect a state for the public eye.

"With a view to afford every material that could assist in the formation of the Catalogue, I spent my leisure hours in the Museum for ten years, taking every assistance these papers could afford, and at the end of thirty years, my own health becoming precarious, I closed my executorship by destroying them.

"I am Sir, yours truly,
"EVERARD HOME."

"*Mr. Belfour, Secretary, Royal College of Surgeons.*"

The following is the list of these MSS. Those copied by Mr. Clift are marked C; and reference is made to the volume and page of such as are printed in the present Work:—

Q. 5131. (*Mr. Warburton*, p. 65).—"Will you refer to any memoranda you have on the subject, and state, as nearly as you can, what the papers were that were destroyed?"

A. (*Mr. Clift*).—"Among them were nine folio volumes of Dissections of Animals, viz.,

"Vol. 1. Ruminants. (C. ii. 128.)
2. Animals *sine cæco*. (C. ii. 66—95, 176—196.)
3. Monkey and its gradations. (C. ii. 4—34.)
4. Lion and its gradations. (C. ii. 35—65.)
5. Scalpris dentata. (C. ii. 196—247.)
6. Anatomy of Birds. (C. ii. 270—331.)
7. Anatomy of the Tricoilia. (C. ii. 332—398.)
8. Anatomy of Fishes. (C. ii. 399—424.)
9. Anatomy of Insects. (C. ii. 427—483.)

Natural History of Vegetables[1]. (i. 340—368.)
Introduction to Natural History. (C. i. 1.)
Numerous Physiological Observations. (C. i. 113—183.)
Comparative Physiology—Comparison between Man and the Monkey. (C. i. 43.)
On Muscular Motion[2].

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[1] [This MS. was not destroyed; a copy of it was transmitted to the College of Surgeons in 1839, by Capt. Sir Everard Home, Bart., after whose decease the original was most kindly presented to me, by his nephew and executor, Ed. Rushworth, Esq., in May 1860.]

[2] [This MS., which formed the subject of the Croonian Lectures, read by Hunter

"Effects of extracting an Ovarium upon the number of young produced[1].
Experiments on Ewes, with a view to determine Impregnation and Uterine gestation[2]. (C.)
On Monsters. (C. i. 239.)
On the Skeleton. (C. i. 372.)
Dissection of the Tapir. (C. ii. 167.)
Dissection of the Armadillo with nine bands. (C. ii. 182.)
Animals from New Holland. (C. ii. 248.)
Anatomy of the Piked Whale. (C. ii. 113.)
Anatomy of the Bottle-nosed Whale. (C. ii. 109.)
Anatomy of the Fin-back Whale. (C. ii. 108.)
Anatomy of the Porpoise. (C. ii. 103.)
On Worms in Animals of the Whale-tribe. (C. ii. 484.)
On the Bell-barnacle[3].
On the Eel. (C. i. 216.)
Anatomy of the Priapism[4].
Anatomy of the Siren of North America[5]. (C. ii. 393.)
Account of a Unicorn-fish, from Hispaniola.
On the Earth-worm. (C. i. 109.)
On the Progress and Peculiarities of the Chick[6]. (C.)
Descriptions of Rymsdyk's drawings of the Incubation of the Egg[7].
General Observations on Insects. (C. i. 223; ii. 427.)

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before the Royal Society, 1776–82, is published in the edition of the 'Animal Economy,' 8vo. 1837, p. 195.]

[1] [Ib. p. 50.]

[2] [Printed from Mr. Clift's copy, by his permission, in the 'Physiological Catalogue,' vol. v. p. 120.]

[3] [The Hunterian notes on the anatomy of this animal (*Balanus Tintinnabulum*, Lam.), with those on the anatomy of the vitreous barnacle (*Pentelasmis vitrea*, Leach), accompanied the beautiful drawings by Wm. Bell, and are in the possession of the Royal College of Surgeons of England. They have been published, with my supplementary notes, in the 'Descriptive and Illustrated Catalogue of the Physiological Series,' &c., vol. i. p. 255. pl. 4.]

[4] [The notes on the anatomy of this animal accompanied the Hunterian drawings, and are, with them, in the possession of the Royal College of Surgeons of England. From them I determined the species to be the *Holothuria tremula* of Linnæus, and Hunter's notes, with supplementary explanations of the figures, were printed in my 'Catalogue of the Physiological Series,' &c., 4to. vol. i. pl. 3. p. 251; ib. vol. iv. pl. 49. p. 195.]

[5] [See also 'Animal Economy,' 8vo. 1837, p. 394.]

[6] [This MS. was not taken away by Home, and remains in the possession of the Royal College of Surgeons. It is printed, with my notes, in the 'Physiological Catalogue,' vol. v. p. viii.]

[7] [Qu. Home, Philos. Trans. cxii. p. 339. ?]

On the Bee-tribe[1]. (C. ii. 445.)
On the Humble-bee. (C. i. 60; ii. 459.)
On the Wasp. (C. i. 82; ii. 456.)
On the Hornet. (C. i. 73.)
On Beetles. (C. i. 93; ii. 441.)
Anatomy of the Silk-worm. (C. ii. 466.)
On the Red-piped Coral. (C. ii. 490.)
On Fossils, two parts[2].
Observations on Surgery.
Observations on Scrofula and Cancer.
Lectures on the Principles of Surgery[3].
Cases, with post-mortem examinations[4].
Cases, where no post-mortem examinations were obtained[4].
Cases, in two Solanders, written out separately and fairly[4]."

[The following note, written apparently during the life-time of Sir Everard Home, was confided to me by Mr. Clift, with his copies of the Hunterian Manuscripts, that it might be appended to them when published.]

"Mr. Hunter's Manuscripts.

"At Mr. Hunter's death, which happened on the 16th October, 1793, all his papers came into the possession of his Executors, Dr. Baillie and Mr. Home. Mr. Home was the acting Executor.

"The cabinets which contained these papers stood in Mr. Hunter's study, that he might have ready access to them in the evenings; and scarcely a single evening occurred, except Sundays, during my attendance on Mr. Hunter for the last twenty months of his life, in which something was not added to the contents of these volumes and papers. I wrote for him constantly during that period from seven o'clock till eleven P.M., and sometimes an hour or two later; as did also Mr. Haynes for a great part of that period. These cabinets were sealed up for a short time after Mr. Hunter's death.

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[1] [The part of this MS. relating to the hive-bee (*Apis mellifica*) was printed in the 'Philosophical Transactions,' vol. lxxxii. (1792), and in 'Animal Economy,' 8vo. p. 422.]

[2] [This MS. was not destroyed; it was transmitted to the Royal College of Surgeons, in 1839, by Capt. Sir E. Home, Bart., R.N.]

[3] [These have been printed in Palmer's Edition of Hunter's Works, 8vo. 1836.]

[4] [These MSS. were returned to the Royal College of Surgeons, by Sir E. Home, on application, in 1823–24. The seven last subjects, with the MS. on Vegetables, almost equal in amount the MSS. of which Mr. Clift made transcripts, and which are indicated by the letter C.]

"The greatest part of these papers were in the handwriting of Mr. Bell, who lived fourteen years in Mr. Hunter's house, for the purpose of writing and making drawings*. The cabinets containing the drawings also stood in the study for the sake of making reference to them, and the descriptions of many of them are in my handwriting, copied under Mr. Hunter's direction, a very short time before his decease. These are now in the Museum of the Royal College of Surgeons.

"Mr. Hunter kept an account of the dissections of the various animals that came under his inspection; and whenever he re-examined an animal, he overlooked his previous account, and corrected and added to it.

"Also an account of all remarkable and interesting cases that came under his observation, as well as others furnished by his friends. The histories of those cases where he had opportunities of post-mortem examinations, were kept separate from those where he had not that opportunity.

"He generally wrote his first thoughts or memoranda on all subjects, on the slips torn off from the ends, and the blank pages and envelopes of letters. Thousands of these were copied by Haynes and myself into the different papers and volumes; being generally inserted and frequently pinned into the place where they were to be written in. The following marks were those he usually employed to denote where these marks were to be inserted:—

"He appeared to have no desire for preserving his own handwriting, as we always scored these slips across, and returned them to Mr. Hunter, who usually folded them up, and put them on the chimney piece to light the candle with: and the rough or waste copies on all subjects, when copied out fair, were taken into his private dissecting room as waste paper to dissect upon.

"Had Mr. Hunter's writings been of a temporary or of a private nature, and had he left no collection, without a catalogue, expressly to be sold to the public, then his papers might or might not have been destroyed according to the discretion of his Executors or his family; but as it was, the public having purchased the collection, were evidently entitled to all which could have been beneficially extracted for the description and illustration of the collection which had become their property.

"Mr. Hunter in his Will, made only six months before his death, expresses, that '*all* his Collection of Natural History, and the cases

* Mr. Haynes succeeded Mr. Bell in this duty.—R. O.

and other things belonging thereto or used therewith, be offered for sale in one entire lot to the Government of Great Britain, at such price as may be considered as reasonable between both parties.'

"If the 'cases and other things belonging thereto' meant the deal shelves, and did not mean the 'Cases and Histories' of the Preparations themselves, then it must be inferred that Mr. Hunter himself intended an imposition on the public, by first desiring his papers to be destroyed, and afterwards to foist off the collection without a catalogue or the means of making one. No one will believe that Mr. Hunter had any such wish or intention, after reading the following paragraph, extracted from his 'Life,' p. 65, by Sir Everard Home, 1794:—

"'His disposition was candid and free from reserve even to a fault. He hated deceit, and as he was above every kind of artifice, he detested it in others, and too openly avowed his sentiments. His mind was uncommonly active; it was naturally formed for investigation. . . . . He was so diffident of himself that he trusted nothing to memory.'—Pp. 24, 25.

"Every one speaks of Mr. Hunter as a man of unusual talent and unexampled industry: Sir Everard himself speaks of his midnight labours: he did not make preparations at night. What, then, was he employed upon?

"Can it be believed that Mr. Hunter, with his sober and inquisitive mind, could have laboured so incessantly for thirty or forty years, and leave nothing behind him fit to be seen by anybody but Sir Everard Home? Had that been the case, Mr. Hunter would have little merited the high character which has been almost universally conceded to him: and, according to Sir Everard, his only praise must be that of a maker of preparations. His end and object in doing so must still remain a mystery.

"Can it be imagined for a moment that Mr. Hunter would have wrought even till his last hour on subjects the nearest to his heart, merely that Sir Everard might have the pleasure of destroying those papers, the result of so much patient toil and study? For however lightly Sir Everard may now pretend to value them, will he induce any one individual to believe that Mr. Hunter considered his papers to be too imperfect or too unimportant to meet the public eye, or any eye? If he had felt their imperfection, would he not have rendered them more perfect? But whatever the world might have thought, Mr. Hunter could not have felt their imperfection, as he had undoubtedly exerted his best abilities to render them what they were, good or bad.

"If these manuscripts were unfit to be seen, and useless, and inapplicable to the explanation of the collection, why were they not destroyed, *according to Mr. Hunter's alleged injunctions*, thirty years ago? Why preserve them till after the last sheet of Sir Everard's fourth volume was printed off; and till Dr. Baillie had left London never to return? Sir Everard Home told me of his having burnt them July 26th, 1823; Dr. Baillie languished till the 23rd of September following.

"Mr. Hunter died suddenly at the age of sixty-five, too suddenly to make any request of that kind had Sir Everard been present; and he was too well convinced of the value of his labours to have made such a request before.

"Mr. Hunter's Will is sufficient evidence that he intended the collection to be sold, and *in one entire lot*; knowing that it would lose much of its value if divided, and that everything relating to it as a whole must have its value. Everything he did, or wrote, all tended to this one object; they were not like other subjects written on the spur of the moment, or to suit a particular occasion, which when past would have no further interest; these were not the subjects which occupied Mr. Hunter's mind; and although every one who knew him was aware of the difficulty he had in expressing himself so as to satisfy his own ideas on any subject, yet it was not for want of great labour if they were not to his satisfaction at last; for I have many times written the same page at least half a dozen times over, with corrections and transpositions almost without end: and after all this labour, can it be supposed that he imagined or felt their imperfections so strongly, as to desire their indiscriminate destruction, while he evidently intended the collection to remain?

"Even had Mr. Hunter laid such an injunction on his executors, it is clear that no time was specified; that if they were to be preserved for thirty years after his death, it could only be with a view to their being usefully employed: and had he made the request at all, he would have little merited the high character which has been almost universally conceded to him. "WM. CLIFT."

C.

In the Minute Book of the "Committee" or "Board of Curators," preserved in the Archives of the Royal College of Surgeons, under date of April 2nd, 1839, is the following:—

"Mr. Clift laid before the Committee, presented to the Museum by Capt. Sir Everard Home, Bart., the manuscript of the first part of Mr. Hunter's Introduction to the Catalogue of his Collection of Extraneous Fossils, containing many of Mr. Hunter's corrections of the manuscript."

This minute was duly read in Council, and the "Minutes of Council" record the vote of thanks to the donor.

My application, dated 25th October, 1859, for permission to add this MS. to the present work, and the official reply thereto, are given in vol. i. p. 296. The MS. was sent, immediately after my application, to the printer by the Council of the College of Surgeons, and I received, on the 23rd December, 1859, a copy of the work, in 4to, in the Preface to which the following reason was assigned for its not having been previously published:—

"This Introduction, on which Mr. Hunter had bestowed so much thought and labour to within a short time of his death, revising and correcting it from time to time, was not prefixed, as he had intended, to the Catalogue of his Collection of Fossils, and is neither mentioned nor alluded to in either of the three volumes of the 'Descriptive Catalogue of the Fossil Organic Remains' in the College Museum, published respectively in 1845, 1854, and 1856. It is greatly to be regretted that it was not brought under the notice, either of the Museum Committee, or of the Council of the College. The attention of the Council was, however, unexpectedly drawn to it in 1856, when it was read from the chair by the then Hunterian Professor."—Page v.

As it was generally known that I was that Professor, and also the individual to whom had been confided the preparation of the Catalogue referred to, I addressed a letter, on the 29th December, 1859, to the President and Council of the Royal College of Surgeons, stating the fact of my having submitted to the Museum Committee, in the month of February, 1855, the propriety of publishing the manuscript in question in the concluding volume of the Catalogue of Fossils, then in course of preparation; and recalling to their attention the fact of my having brought before them the nature and importance of the MS. on Extraneous Fossils, in the Introductory Lectures to my Hunterian Course on Fossil Remains, delivered in the theatre of the College on the 6th, 8th, and 10th of March, 1855.

I also pointed out that the charge insinuated against me, as the Hunterian Professor and Author of the Catalogue of Fossils, of having failed to bring under the notice of the Museum Committee or Council of the College the existence of the Hunterian manuscript on Fossils, until the year 1856, and by implication, when it was too late to append it to the final volume of the Catalogue printed in that year, was based upon the ascription in the above-cited Preface, of a wrong date, viz. 1856, for the true date, 1855, when I read the manuscript in question from the Hunterian chair: and that, as the concluding volume of the Catalogue was not printed when I had resigned my offices in the

College, I ceased to be responsible for the omission, in its preface, of the Hunterian introductory MS., which I had previously recommended to be there published, and the value of which I had made known in the Theatre of the College.

I again addressed a letter to the Council, on the 2nd of January, 1860, urging a speedy reply, and received the following:—

"Lincoln's Inn Fields, W.C., 9th January, 1860.

"Sir,—The Council of the Royal College of Surgeons of England have had under their consideration your letters of the 29th of December and 2nd January, drawing their attention to a passage in the preface to the proposed publication of the Hunterian manuscript on Geology, which you consider to involve injurious reflections upon you, and calling upon them, after assuring themselves of the accuracy of the dates to which you refer, to publicly acknowledge the inaccuracy of the grounds of the charge of breach of confidence and duty on your part which you conceive the preface to allege against you.

"In consequence of your letters, inquiry has been made, and the Council find that the date of your Lectures as Hunterian Professor is, as you mention, inaccurately referred to in the preface, and that the actual date was 1855, not 1856.

"The Council, therefore, consider it to be due to you, as well as to themselves, to express their regret that such a mistake should have occurred, and to withdraw all imputations which the passage in question can be considered to cast upon you.

"They have also directed that the passage be expunged, and the preface reprinted without it.

"I beg to add that there is no such minute of the Museum Committee as you suppose, and that neither of the living members of the Committee have any recollection of your having suggested to them the propriety of publishing the manuscript.

"Edm. Belfour, Secretary."

"*Professor Owen, &c. &c. &c.*"

INDEX TO VOL. II.

THE END.

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