GENERAL FUNCTION OF THE GALL BLADDER FROM THE EVOLUTIONARY STANDPOINT

BY

FRANK W. GORHAM
RESEARCH ASSISTANT, DEPARTMENT OF PHYSIOLOGY
NORTHWESTERN UNIVERSITY

AND

ANDREW CONWAY IVY
PROFESSOR OF PHYSIOLOGY, NORTHWESTERN UNIVERSITY

FIELD MUSEUM of NATURAL HISTORY
FOUNDED BY MARSHALL FIELD 1893
CHICAGO

ZOOLOGICAL SERIES
FIELD MUSEUM OF NATURAL HISTORY
VOLUME XXII, NUMBER 3
JUNE 21, 1938

PUBLICATION 417

GENERAL FUNCTION OF THE GALL BLADDER FROM THE EVOLUTIONARY STANDPOINT

BY

FRANK W. GORHAM
RESEARCH ASSISTANT, DEPARTMENT OF PHYSIOLOGY
NORTHWESTERN UNIVERSITY

AND

ANDREW CONWAY IVY
PROFESSOR OF PHYSIOLOGY, NORTHWESTERN UNIVERSITY

FIELD MUSEUM of NATURAL HISTORY
FOUNDED BY MARSHALL FIELD
1893
CHICAGO

ZOOLOGICAL SERIES
FIELD MUSEUM OF NATURAL HISTORY
VOLUME XXII, NUMBER 3
JUNE 21, 1938

PUBLICATION 417

PRINTED IN THE UNITED STATES OF AMERICA
BY FIELD MUSEUM PRESS

GENERAL FUNCTION OF THE GALL BLADDER FROM THE EVOLUTIONARY STANDPOINT

BY FRANK W. GORHAM AND ANDREW CONWAY IVY

It has long been known to anatomists that certain animals do not possess a gall bladder. The evidence offered has usually been from individual dissections, and the explanations of the absence have been rather unsatisfactory. Therefore, an effort has been made to accumulate from the literature and dissections[1] a list of species in which the state of the organ is known. From this list certain physiological conclusions can be drawn.

This work was stimulated by the physiological investigations of Schmidt and Ivy (1937) who studied domestic and wild animals, some with, others without, a gall bladder. They found that animals varied in the amount of bile produced by the liver, the size and concentrating ability of the gall bladder, the motility of the common duct, and the resistance offered by the choledochoduodenal junction to the flow of bile into the intestine. From their data, they concluded that animals without a gall bladder produce large quantities of bile, while those with a gall bladder which concentrates well, produce small quantities of bile. Between these extremes lies a series of intermediate types, and, in general, it may be said that the amount of bile formed by the liver varies inversely with the efficiency of the concentrating apparatus associated with the biliary ducts. These observations suggested that by ascertaining the presence or absence of the gall bladder throughout the various vertebrate orders, evolutionary evidence might be obtained pertaining to the function of the organ. Also, information would become available, serving to further physiological and possibly genetic research.

PHYSIOLOGICAL EVIDENCE

To indicate the academic and practical significance of this problem, an outline of the physiology of the organ will be given.

General Functions Assigned to the Gall Bladder.—The general functions theoretically assigned to the gall bladder are those of serving (*a*) as a bile reservoir for digestive purposes, and (*b*) as a pressure

[1] Field Museum of Natural History has been most generous in allowing the authors to use its collections and libraries. Without the aid of its staff members, this work could scarcely have been begun. We desire to express our thanks especially to Dr. Wilfred H. Osgood, Mr. Colin C. Sanborn, Mr. Karl P. Schmidt, and Mr. Rudyerd Boulton.

regulatory mechanism. These functions are suggested by the following evidence: (1) A sphincter is present at the junction of the common bile duct with the duodenum, and this sphincter is necessary for filling the gall bladder. When the sphincter is relaxed the gall bladder does not fill. (2) In some animals the secretory pressure of bile is markedly less than the pressure necessary to overcome the sphincter. To prevent injurious back pressure on the liver when the sphincter is forcefully contracted, a regulatory device is essential. (3) Cholecystectomy in animals that have a relatively powerful sphincter, leads in most instances to dilation of the common ducts. (4) Those animals which do not possess a gall bladder, physiologically have no sphincter or only a very weak one. Thus, when the gall bladder is present, a sphincter (Sphincter of Oddi; *Sphincter ductus choledocus*) is essential for its filling; and when an efficient sphincter is present a gall bladder is necessary for the regulation of biliary pressure. It is evident, however, that these observed facts bear more directly on pressure regulatory function than on that of bile storage for digestive purposes.

Concentrating Activity of the Gall Bladder.—In some animals, as man, the dog, and the cat, the storage function of the gall bladder is augmented by its ability to concentrate hepatic bile from five to ten times. In such animals, the gall bladder is literally a reservoir itself, of small volume but of large concentrating capacity. In other animals, as cattle, the gall bladder concentrates bile only twice or less. This ability of the organ to concentrate may be interpreted as supporting either or both of the aforementioned functions.

Volume Output of Bile by the Liver.—Animals vary widely in regard to the amount of bile secreted per kilo of body weight or per gram of liver. For example, the guinea pig secretes from 154 to 220 cc. of bile per kilo of body weight per day. Man, however, only secretes 20 cc. of bile per kilo per day.

Physiologic Capacity of the Gall Bladder.—Since the size of the gall bladder, the bile output, and the ability of the gall bladder to concentrate varies in different animals, the physiologic capacity will vary. By this term is meant that fraction of the daily output of bile which the gall bladder is capable of storing. If it were known with certainty that this bile was stored for digestive purposes, this should be a part of the definition. A contrast in physiologic capacity is demonstrated by man, who can store the bile secreted during 12 hours, and a guinea pig, which can store only the bile secreted for 12 minutes.

An Additional Function of the Sphincter.—It should be considered that this structure probably prevents the regurgitation of duodenal contents into the common bile duct. This prevents ascending infection of the liver. It suggests that animals devoid of a competent sphincter should have some compensatory mechanism. Several such mechanisms do occur. There may be a one-way valve; large quantities of bile may keep the ducts flushed out; or the extra-hepatic ducts may show peristaltic activity. Investigations show that the horse, which lacks both a competent sphincter and a gall bladder, has both a valve and a liver, which forms large quantities of bile. On the other hand, the adult pigeon,[1] which also lacks a gall bladder, has motile ducts, and a liver forming large quantities of bile.

Practical Significance of the Problem.—It is not generally agreed that the gall bladder serves for the storage of bile for digestive purposes. This is because physiological studies have not as yet demonstrated detectable disturbances of digestion or nutrition after cholecystectomy. However, when a gall bladder which concentrates efficiently is removed, certain changes are known to occur. These are (*a*) incompetence of the Sphincter of Oddi, with a variable return of competence; (*b*) dilation of the extra-hepatic ducts; (*c*) small areas of local necrosis in the liver. These changes certainly indicate that the gall bladder has a function, even if its general role is not to store bile for digestive purposes. Unfortunately, it is not known why all these changes occur, but dilation of the ducts is generally attributed to the return of competence of the sphincter. If this interpretation is correct, and if no direct digestive disturbances result from cholecystectomy, then the chief function of the organ in man, the dog, and the cat, for example, is to regulate the pressure in the extra-hepatic ducts, and this regulation is rendered necessary by the Sphincter of Oddi. Hence, from an evolutionary viewpoint, a gall bladder was developed secondarily to the sphincter, and the sphincter served primarily to prevent regurgitation from the intestine. However, given an animal whose liver produces relatively small quantities of bile, it is then reasonable to assume that such an animal might possess a better digestive apparatus if a gall bladder and a sphincter were present to render possible the storage of bile for digestive purposes. The following facts force the consideration of such a hypothesis: (*a*) Bile plays an important role in the digestion and absorption of fats; (*b*) it is essential for the absorption of vitamin D and carotene, the precursor of vitamin A; (*c*) it is important in the

[1] A gall bladder is seen in the embryo.

absorption of iron and calcium; (*d*) all domestic animals that form a small quantity of bile have a gall bladder of large physiologic capacity; (*e*) the absorption of bile salts from the intestine augments the secretion of bile by the liver. From this, it seems that a reserve supply of concentrated bile, which may be discharged into the intestine in small amounts during the first 20 or 30 minutes after a meal, would have a favorable effect in initiating digestive processes in the intestine. In fact, the gall bladder bile is sometimes referred to by physiologists as "ignition bile."

If it can be established that the storage of bile for digestive purposes is a function of the gall bladder, it will be obvious that cholecystectomized patients, or patients with chronic disturbances of the biliary tract, should be fed frequently with the idea of promoting the flow of bile by the liver, and thus keep it thin and moving as in animals where there is no gall bladder. That frequent feeding should be employed is an old clinical impression still held by some internists, but such management will not generally be recognized as essential until its physiologic importance is proved. For example, formerly it was debated whether fats and acid fruits should be avoided by the patient with acute cholecystitis. Now, since it is known that fats and acids are potent excitants of gall bladder activity, doubt no longer exists.

In summary, the physiological evidence indicates that the chief function of the gall bladder is pressure regulation; but the possibility that storage of bile for digestive purposes also occurs in those forms which concentrate bile, is one which cannot be easily dismissed. While this remains unproved, it may be surmised that the gall bladder developed secondarily to the appearance of a sphincter at the junction of the common duct with the intestine.

ANATOMICAL EVIDENCE

Bearing the physiology of the gall bladder well in mind, it should be interesting to examine various vertebrate groups for the organ, to ascertain its presence or absence, and to correlate other facts pertaining to the economy of the animal. Thus, diet, other modifications of the digestive tract, and even taxonomic relationships, may bear on the existence of the organ in an individual species.

Little effort has been made to describe variations in the form or anatomical relationships of the organ. Suffice it to say that this hardly seems necessary, since the organ is either present or absent, and no series between the extremes can be easily demonstrated.

"PREVERTEBRATES."—Among lower forms, the liver has not consolidated and migrated to become an organ distinct from the gut. In *Balanoglossus*, the liver is represented by structures called "hepatic caeca," which are groups of cells surrounding numerous ductlike processes which connect with the alimentary tract. In the sea-squirts (ascidians), a group of glands communicates with the stomach by a duct. This is referred to as the digestive gland or liver. In *Amphioxus* the liver is similar. It is thus seen that none of the known predecessors of higher vertebrates possess an organ resembling a gall bladder. The gall bladder then becomes a typical vertebrate structure and very characteristic of the group.

CYCLOSTOMATA.—These are among the simplest vertebrates, but differ from all the others in lacking true jaws. The hagfish (*Myxine*) and the lamprey (*Petromyzon*) both have a gall bladder at some time during their lives. The adult hagfish has a bilobed liver, a gall bladder, but no discrete pancreas. The lamprey has a similar liver and gall bladder in the larval form, but the organ and its ducts are absent in the adult.

FISHES.—Recent fishes are divisible into six orders. Two of these, the sharks and rays (Elasmobranchii), and the chimaeras (Holocephali) have cartilaginous skeletons. The others have true bony skeletons. They are the sturgeon-like fishes (Chondrostei); forms related to the dogfish (Holostei); the true bony fishes (Teleostei); and the lungfishes (Dipnoi). The sharks and rays are representatives of a relatively primitive group which prospered during Devonian times. They all apparently possess a gall bladder.[1] The lungfishes are interesting in that they represent a group similar to that from which Amphibia arose. They, too, retain the organ. The teleosts are the most successful of recent fishes and have been dominant since Cretaceous times. In them the gall bladder is occasionally absent and neither Cuvier (1835) nor Owen (1846) could offer any explanation for the variability. In those fish (Bullheads) which have been studied, the gall bladder was found to contract and evacuate on the administration of fatty foods, but its concentrating ability is not known.

AMPHIBIA.—These all have a gall bladder in so far as they have been examined. This general statement is only superficially attested in the present work (Table 1). From the amphibians of the Coal Measures arose the reptiles which flourished during the Mesozoic,

[1] J. F. Daniel: The Elasmobranch Fishes. Univ. Calif. Press, 1922, p. 139.

and which gave origin during this period to the first mammals. Reptiles, therefore, are of current interest.

REPTILES.—All existing forms possess a gall bladder. Early workers reported its occasional absence, but their information was apparently erroneous. In Table 2 the presence of the organ is recorded in 42 families and 70 species. An attempt is made in this, as in subsequent lists, to select genera characteristic of their respective families.

It is perhaps unfortunate that no recent reptile approximates those from which mammals arose. But it is probable that these and, in fact, all reptiles possessed gall bladders. Therefore it is reasonable to believe that all early mammals likewise had the organ.

The habit of intermittent feeding in reptiles is well known. Some of them are carnivorous and others herbivorous. These habits support the suggestion that the gall bladder is a reservoir of bile for digestive purposes. However, nothing is known concerning the physiology of the organ in this group.

BIRDS.—This group appears to have been evolved from reptiles at about the same time as mammals, but it has attained a high degree of specialization and the number of the existing species is very large.

With the available information, conclusions are difficult. Tendencies are perceptible, however. The carnivorous birds (hawks, owls, etc.) all retain the organ, while the herbivorous forms (parrots, pigeons) and the insectivorous forms (woodpeckers) may retain it or lose it. In no order yet examined is the organ invariably absent. It has been suggested (by R. Boulton, of Field Museum staff) that the insectivorous birds which have lost the organ were immediately derived from an old herbivorous ancestry. An example of interest here is the Kea parrot of New Zealand, whose carnivorous habits are as recent as the introduction of sheep into that region.

The list of species in Table 3 is given as a matter of record, with the hope that its evident deficiencies will stimulate investigation by those who have more available material.

MAMMALS.—In this paper, mammals are of prime interest. This is largely because of man, and because it is more logical to correlate the physiology of man with that of other mammals than with that of some lower group. The orders will be considered separately.

Monotremata.—The monotremes are in many respects the most primitive of living mammals, yet in some respects they are highly specialized. It seems not unlikely that they represent a line which descended directly, but independently, from the mammal-like reptiles. It may be recalled that they have a bill or beak devoid of teeth, and that they lay eggs but nourish their young on milk.

The spiny anteater (*Echidna*) and the duck-bill (*Ornithorhynchus*) differ in their habits. One is terrestrial, and the other is semi-aquatic; one feeds on insects, and the other on shellfish and mollusks. Both have a gall bladder, and the cystic duct and the pancreatic duct join the common duct before it enters the intestine. Nothing is known concerning the physiology of the gall bladder or bile ducts.

Marsupialia.—Marsupials are considered higher than monotremes because they have abandoned the oviparous method of reproduction and now bring forth very immature young which are nursed in the marsupium, a structure characteristic of this group. The American opossum is a simple form which represents an ideal ancestor which has apparently passed almost unchanged from Cretaceous times. At the end of the Cretaceous, placentals began to appear and later became dominant. Somewhat previous to this, Australia with her mammalian fauna became isolated. With no other competition, marsupials there radiated adaptively until almost every ecologic niche was filled. Thus, we have marsupial forms which parallel superficially almost every other mammalian type.

Food habits vary widely. The opossums (Didelphiidae) are essentially omnivorous. Forms like the Tasmanian wolf (Dasyuridae) are usually carnivorous, but other members of the family are insectivorous. The marsupial mole (*Notoryctes*) represents a monotypic family (Notoryctidae) which is insectivorous. Species allied to the Koala (Phascolarctidae) are herbivorous and the honey-bear, itself, eats only the young shoots of a single species of Eucalyptus. The wombats (Wombatidae) are herbivorous. The kangaroos and wallabies (Macropodidae) are herbivorous, and the large kangaroo is said to practice a kind of rumination. The interesting American marsupial, *Caenolestes* (Caenolestidae), is insectivorous with an omnivorous tendency. The anteater, *Myrmecobius*, is the lone representative of its family (Myrmecobiidae).

As might be expected, the stomach of marsupials shows adaptations related to the diet. The stomach is simple in the zoophagous, entomophagous, and carpophagous forms. In those types which feed on the bulkier parts of plants, the stomach becomes complex. The gall bladder is present in all marsupials (Table 5) and is of large size, with no tendency to reduction in volume. Nothing is known concerning its concentrating ability. It contracts weakly, but the ducts and extraduodenal ampulla of the common duct are motile.

The fact that all marsupials possess a gall bladder, even those which are strictly herbivorous, is of great interest. Among placental mammals, where the herbivorous type of diet has been assumed, the organ is absent in certain species. Remembering that marsupials are rather low in the scale of mammalian evolution, it would seem that the gall bladder is a primitive structure not easily lost.

Table 5 affirms the presence of the organ in 26 species, representing the 10 existing families.

Most living mammals belong to a more advanced group known as the placentals, in which a true placenta is constantly found. This structure permits a longer pre-natal period, and the need for the marsupial pouch is consequently lost. Other marked differences occur.

Primitive placentals are known to have existed at the end of the Age of Reptiles. These primitive placentals were insectivorous, and from them arose the ancestors of our existing higher mammalian fauna. Members referable to the same order (Insectivora) as some of the early forms, still exist.

Insectivora.—Table 6 records the existence of the gall bladder in 34 species, representing all families. The name of the order implies the nature of the diet, but a number of species eat fresh flesh when it is offered.

Chiroptera.—Rather closely related to the insectivores, but of ancient and unknown origin are the bats. Bats have been very successful, and many families and species exist. They fall into two suborders, the Megachiroptera being the more primitive. The majority of these are large, and subsist on fruit and pollen. The stomach is rather complex. Most of the Microchiroptera are small and more highly specialized. The construction of the stomach differs according to the diet, which includes all types. Some 17 families and about 2,000 different species and subspecies of bats are said to exist. Table 8 records the gall bladder present in 13 families and 59 species. Therefore it is very probable that it is present in all bats.

Dermoptera.—This order is represented by a single living genus, *Galeopithecus* (or *Galeopterus*). This animal, known as the flying lemur, is interesting, as it represents a form possibly similar to the progenitors of bats. It is a fair-sized, herbivorous, tree-living form with a moderately complex stomach. The gall bladder is present (Table 7).

Primates.—Paleontologically and structurally, the primates are closely related to the primitive arboreal insectivores, the chief advances having been made in the development of a large brain, and stereoscopic vision. Three suborders are distinguishable. These are represented by the lemurs (Lemuroidea), by *Tarsius* (Tarsoidea), and by the true monkeys and apes (Anthropoidea). The lemurs

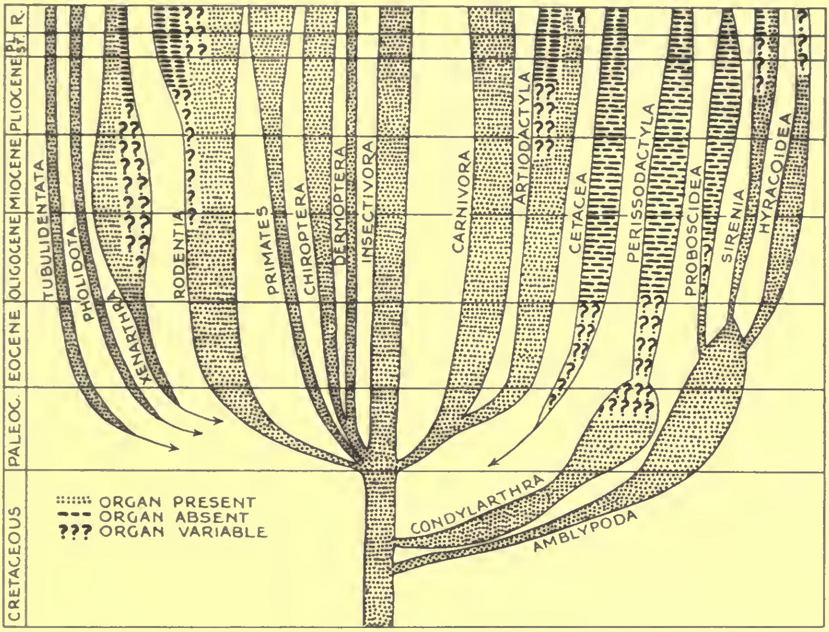

FIG. 1. Probable history of the gall bladder in placental mammals (adapted from Romer).

are the most primitive of living primates, and they possess many insectivore affinities. Between the lemurs and the true monkeys is *Tarsius*, possessing some of the features of each group. The anthropoids include monkeys, apes, and man. They are separable into the New World forms (Platyrrhines) and the Old World forms (Catarrhines). The latter include the family Hominidae, of which man is the only member.

The diet of primates is quite varied. As a group they are omnivorous. The more strictly herbivorous forms subsist chiefly on the more concentrated portions of plants, such as the seeds or fruit. The stomach of the lemurs and of *Tarsius* is simple. In the New World monkeys the stomach is simple except in the spider monkeys (*Ateles*), and the howlers (*Alouatta*), where there is some tendency to sacculation. In the Old World monkeys, the stomach is simple in the species which possess cheek pouches. In the langurs (*Presbytis*) and the guerezas (*Colobus*), which have no cheek pouches, the stomach is complex. In these monkeys, there is accumulation and retention of vegetable food in the stomach, and bezoars are not rarely found. The stomach reaches its maximum complexity in this group, which includes the sacred ape of India, one of the langurs.

The gall bladder is present in representatives of all families of primates. Table 9 includes 68 species.

Carnivora.—Fossil evidence indicates clearly that all terrestrial fissiped carnivores arose from one creodont family (Miacidae) probably since Eocene times. Eocene and Paleocene carnivores were known as creodonts and are directly descended from primitive insectivores of the preceding era. The ancestry of the marine forms is not known but is probably very similar. From the direct ancestry, diet, and feeding habits, these forms would be expected to possess constantly a gall bladder and this is well shown in Table 10 where 65 species representing all families were found to have the organ.

Edentates.—Under the general term "edentates" convenience may allow an inclusive discussion of three unique mammalian orders, the Xenarthra, Pholidota, and Tubulidentata. Linnaeus, Cuvier, and other early investigators noted the queer dental structure and the lack of relationships with other orders, and therefore placed all these together in a distinct but somewhat heterogeneous order. Careful examination of anatomical and paleontological evidence failed to reveal any true relationships, and separate orders were indicated.

The order Xenarthra includes the armadillos, anteaters, and sloths. Existing species are only a shadow of a previously large and varied fauna. Recent forms are, for the most part, highly specialized. The anteaters subsist mostly on termites; the armadillos are insectivorous but feed frequently on carrion; the sloths are herbivorous. As in other orders, the stomach is adapted to the diet. A gizzard-like pylorus occurs in the insectivorous forms, while the stomach tends to become complex in the sloths. The gall bladder is present in all forms except *Bradypus*, the three-toed sloth. It is significant that variation in this order first appears in the herbivorous types. However, the question immediately arises as to why the organ exists in *Choloepus*, the two-toed sloth. Has this species been long distinct or has it only recently diverged? The existing limited fauna with its paucity of species speaks against recent divergence and so also do marked structural differences other than the gall bladder. Therefore, Miller's (1923) classification is followed in which *Choloepus* stands as the only genus of a family.

The order Pholidota, containing three genera, is the scaly anteater of the Old World. The two genera examined, *Manis* and *Smutsia*, possess a gall bladder and a gizzard-like pyloric antrum.

Orycteropus is the single living representative of the order Tubulidentata. Its relationships are also unknown, but the work of Jepson (1932) suggests that the order was distinct by the end of the Eocene. The pyloric antrum is moderately thickened, and the animal possesses a gall bladder.

The condition of the gall bladder among the Edentates is shown in Table 11.

Artiodactyla.—Existing artiodactyls form three distinct groups: (*a*) Suina: pigs, peccaries, hippopotamuses. (*b*) Tylopoda: camels and llamas. (*c*) Pecora: chevrotains, deer, giraffes, prongbucks, and bovids. These suborders were all separate by the end of the Eocene, but more primitive forms are found earlier in this epoch which give evidence as to the ancestry of the whole group. Matthew (1909) and Gregory (1910) believe that the Artiodactyla have been derived from unknown creodonts allied to the Mesonychidae. These are carnivorous, so it is perhaps correct to say that a cow is more closely related to a lion than it is to a horse.

Among the Suina, the true pigs (Suidae) constantly possess the gall bladder. The peccaries (Tayassuidae) have lost the organ. As to the hippopotamus, the gall bladder was absent in one of the four recorded dissections. More data would be desirable. It is interesting that the pig has a simple stomach, while that of the hippopotamus and the peccary is complex. It has even been suggested that the two latter ruminate.

The Tylopoda, camels and llamas, have long been distinct from other artiodactyls. They have complex stomachs and ruminate. They lack the gall bladder.

All Pecora probably arose from forms similar to existing Traguline deer, the chevrotains, which have a gall bladder. True deer (Cervidae) have probably all lost the organ, with the exception of the musk-deer (*Moschus*). This Asiatic form represents a species which is transitory between the true deer and their Traguline ancestors. The retention of the gall bladder adds to the evidence afforded by the lack of horns and the excessive development of the canines, which indicates the primitive nature of this deer.

The American prongbuck, not a true antelope, has a long separate history, and is the single living representative of the family Antilocapridae. It has a complex stomach and a gall bladder.

The giraffes (Giraffidae) offer the curious possibility that the organ may be anomalously present in a very small percentage of cases. It has been reported in two of twenty recorded dissections.

The gall bladder is probably present in all members of the family Bovidae, with the exception of those in the subfamily Cephalophinae, a group of small African antelopes known as duikers in which it is constantly absent. The absence of the organ has been made a characteristic of this group by Pocock (1918). Crisp's (1862) report of its absence in two species of the subfamily Bubalinae should be rechecked in view of other errors made by this author. The report of the organ in two closely related groups by Garrod (1877) also needs confirmation. *Tetracerus*, a form which has long been juggled between the Cephalophinae and the Tragelaphinae, should by gall bladder evidence be classed with the latter, as is done by Weber (1927).

In such an early distinct order, which has shown such great radiation and which has claimed so many now extinct genera, diversity of structure in existing species might be expected. The rather uniform presence or absence of the gall bladder in the various families lends significance to the gall bladder as an important structural characteristic. Its occasional appearance in the giraffe and the primitive musk-deer is of interest in connection with their supposed Traguline origin. The retention of the organ in the Antilocapridae and most of the Bovidae lends support to the theory of the rather recent radiation of these families from the Tragulidae. The absence of the organ from the Cephalophinae may indicate a divergence of this subfamily from the Bovidae. At least, the presence or absence of the gall bladder follows quite well the taxonomy of this rather heterogeneous group (Table 12).

"*Sub-ungulates.*"—Three orders of mammals are generally referred to under this name. They are the Hyracoidea, Proboscidea, and the Sirenia. Although existing species show few affinities, the earlier representatives had many similarities which suggest a common origin (Romer, 1936).

The Hyracoidea, known as conies or dassies, have one principal living genus (*Procavia*), confined to the Old World, and including various species. Superficially, they resemble rabbits, but dentition and foot structure unmistakably ally them to hoofed animals. Their stomach is rather complex and Lydekker reports that they ruminate. The Biblical[1] description is fitting: "Cheweth the cud, but divideth not the hoof." Records of dissections of these animals are confusing either because the gall bladder was variable, or the interpretation of the structure found was not uniform. The first explanation is probably correct.

The order Proboscidea includes the elephants. These are highly specialized forms with a rather unique biliary anatomy. The gall bladder is absent but the common duct is wide, long, and has a reticulated mucosa. A large duodenal ampulla, called the terminal bile pouch, is present. It is divided irregularly into sacks and the pancreatic duct enters it. Owen (1866) says it is contractile. The structure is reminiscent of that found in some whales, and of the extra-duodenal ampulla of the guinea pig and opossum.

The order Sirenia includes three recent families, one of which has become extinct in historic times. This last, Steller's sea-cow, apparently is the only one which lacks a gall bladder. This is difficult to explain, but the stomach is very complex.

In animals which have evolved in the direction of these forms, a tendency to disappearance of the gall cyst is perceptible. In the elephants, this tendency is completely manifest; in the sirenia and hyraces it is less so. It seems that the latter are about to lose the organ. There is a pouch in the elephant which seems analogous to structures seen in some whales, but the elephant is a herbivorous type and the need for this compensatory structure is not obvious.

Perissodactyla.—This order, once more abundant, is now represented by horses, tapirs, and rhinoceroses. In many respects, these forms have become highly specialized. It is well to point out that the order is an ancient one, first appearing at the base of the Eocene. When curiosity is expressed concerning the reason why two animals whose habits are as similar as those of the horse and the cow differ in respect to the gall bladder, it should be pointed out that they are of diverse ancestry. Thus, the gall bladder is constantly absent in the Perissodactyla (Table 14),

[1] Leviticus 11:5.

but only occasionally so among the Artiodactyla. The stomach in this order is simple, but the immense size of the caecum is almost characteristic. In the wall of the common duct are some microscopic sacculi which may have compensatory significance. These are found in the horse but not in the tapir.

Cetacea.—Whales are highly specialized marine mammals of very wide distribution. Unlike most other aquatic mammals, they are incapable of any locomotion on land. Structural vestiges, however, indicate that they were not always so confined and paleontologists agree that they were probably derived from terrestrial carnivores some time in the Paleocene. By the end of the Eocene, they constituted a distinct mammalian order. Thus, as were the horses so were the whales, exposed to evolutionary tendencies over a long period.

Table 15 shows that the gall bladder was absent in all except one of the species recorded, and examination of this exception (Williams, 1838) leaves the impression that a mistake might well have been made.

The absence of the gall bladder in the Cetacea is indeed odd, for these forms are highly carnivorous. They have very complex stomachs like ruminants, but the proventriculus is aglandular. The whale-bone whales (Mysticeti) feed on small marine invertebrates like cuttle-fish and squid; the toothed whales (Odontoceti) feed on fish and at least one genus, *Orca*, the killer, feeds on seals. The nature of the whale's diet makes continuous feeding highly improbable. But the complex stomach and the observation that whole food is regurgitated when the animals are harpooned, led Beddard (1900) to suggest that the animals feed hurriedly and store their food in an accessory stomach. The digestion of this food would then be protracted over several hours.

In *Tursiops* (Hein, 1915), and probably a good many other Odontoceti (Weissberg, 1933), a dilated bile reservoir is found in the course of the common duct. Into this drains the pancreatic duct, and between the reservoir and the intestinal outlet the common duct contains a valve similar to the *valvula spiralis* of the human cystic duct. This structure is very interesting and may represent a true compensatory mechanism. Were these animals of herbivorous ancestry, such biliary anatomy might be explained by suggesting that the whale was an animal which lost the gall cyst, changed its habits, and, when the need for the organ reappeared, developed the structure which is described above. With a proven carnivorous ancestry, however, explanation is difficult, but it may be associated with the complex stomach, or a depth-pressure modification.

Rodentia.—Rodents are known from a long paleontological record, and they were early divisible into two suborders. One, Simplicidentata, has two upper incisors; the other, Duplicidentata, has four. The rabbits and their allies comprise the latter group.

More superficial divisions are quite natural. The squirrel-like forms, Sciuromorpha, are the simplest and the most primitive genera. Radiation at an early era resulted in our present diverse sciuromorph fauna, including six rather distinct families.

Mouselike rodents, Myomorpha, are a more recent offshoot from early rodent lineage. Structural modifications indicate a degree of specialization not seen in the squirrel-like forms. Three families are included among the existing genera. The dormice, Myoxidae, retain a simplicity of structure indicating that forms similar to them may have been ancestral to the more highly specialized Dipodidae and Muridae. The jerboas, Dipodidae, are saltatorial forms of unknown ancestry. However, the greatest number of living rodents are found in the true rats and mice, the Muridae. Excepting man, they are the most successful of recent mammals, and, like man, their terrestrial range is practically unlimited. Radiation was apparently from the Old World.

The other division of simplicidentate rodents, the Hystricomorpha, includes a variety of forms of which the porcupine and the guinea pig are representative. The hystricid rodents are largely confined to South America, on which continent a great multiplicity of species has developed.

The rabbits and hares have been placed in a distinct order (Lagomorpha) by many authorities. The possession of a pair of extra incisors was a differential point in Oligocene times, but morphological similarities probably best find recognition if a single order is used.

Rodents are essentially herbivorous, but a number of them will accept a more omnivorous diet. The families may be considered separately:

Aplodontiidae: These live near mountain streams and in dense vegetation of the Pacific northwest. They feed on various green plants.

Sciuridae: These feed chiefly on nuts, seeds, and grass. They probably occasionally eat birds' eggs and insects.

Castoridae: Beavers are aquatically adapted forms which fell trees. The bark of the trees is utilized for food.

Heteromyidae: Kangaroo rats and mice of the Americas which live abundantly in arid, subdesert regions where plants bloom freely for only a few days during the year. The result is a large number of seeds. These are gathered and stored by the animals for future consumption. Apparently they hibernate.

Geomyidae: Pocket gophers are fossorial and eat roots, bulbs, grass, and seeds. They may feed more or less constantly. They do not hibernate, but tunnel extensively under the snow when necessary.

Pedetidae: These are fossorial and saltatorial forms, the Cape Jumping Hares. Their food seems to be entirely of a vegetable nature.

Myoxidae: Arboreal and nocturnal creatures of small size. They feed on nuts and seeds, and probably hibernate.

Dipodidae: Feed upon buds, leaves, twigs, and many kinds of plants; on seeds, grain, wild berries, chestnuts, acorns, grass, and bark.

Spalacidae: The Cape Mole-rats live in subterranean burrows, which they dig in search for bulbs and roots.

Muridae: This family includes a variety of rats and mice, whose habits were probably originally herbivorous. They easily modify their needs to the available supply. Their diet has in many cases become that of man, whom they parasitize.

Bathyergidae: Members of this group are fossorial and subsist on a vegetable diet.

Hystricidae: Old World porcupines whose food is entirely vegetable and consists mainly of roots.

Erethizontidae: Arboreal forms, which eat the bark of trees. They do not hibernate. They are restricted to the New World.

Dasyproctidae: The agoutis are tropical rodents, whose food consists of foliage, roots of ferns, fallen fruit, and possibly nuts.

Caviidae: The best-known member of this family is the common guinea pig. In their natural state, the cavies feed on roots, corn, and other vegetable substances.

Chinchillidae: Grass and roots form the chief substance of their diet. Long arid seasons may deprive these animals of water for considerable periods, but they seem to survive on the dried grass.

Capromyidae: Arboreal forms which live in the dense forest. Feed on fruits, leaves, and bark, but may also eat the flesh of small animals, particularly that of a kind of lizard.

Octodontidae: The octodonts are represented by both African and South American variations. Both of these are herbivorous.

Thryonomyidae: The African cane-rat which digs for roots and ground nuts. Extensive runway systems are formed under the grass and reeds.

Ctenodactylidae: An African diurnal form. It lives among rocks and is herbivorous.

Leporidae: The rabbits are diurnal and strictly herbivorous.

Ochotonidae: These interesting mammals live in alpine rock slides. They gather grass which they stack and allow to dry. This supply keeps them during the winter months.

It has been impossible to investigate thoroughly all the available rodent material, but a few noteworthy points may be mentioned. The stomachs of rodents vary markedly in their form and even in their histologic structure. This variation has been the subject of at least one paper.[1] Arrangement of rodent families into two groups, one with simple stomachs, and the other with complex stomachs, failed to reveal any correlation with the presence or absence of a gall bladder.

The gall bladder is present in some families, absent in others, and variable in still others (Table 16). Further investigations are desirable and will probably alter these lists:

	Present	
Castoridae	Spalacidae	Capromyidae
Anomaluridae	Bathyergidae	Thryonomyidae
Myoxidae	Dasyproctidae	Leporidae
Dipodidae	Caviidae	Ochotonidae
	Chinchillidae	

	Absent	
Aplodontiidae	Heteromyidae	Petromyidae
Geomyidae	Pedetidae	Erethizontidae

Inconstant	
Sciuridae	Hystricidae
Muridae	Octodontidae

Conclusions are not accurate with such meager evidence. The whole order seems to be in a rather plastic state. Evolutionary tendencies are perceptible.

The gall bladder is absent in the Aplodontiidae. In the Sciuridae it is usually present. The Pedetidae are intermediate between

[1] K. Toepfer. Die Morphologie des Magens der Rodentia. Morph. Jahrb., **17.**

the Sciuromorpha and Myomorpha and, as they are in other respects highly specialized, the gall bladder absence is not surprising. However, the apparently close relationship which these forms have to the Anomaluridae, which are cholecystous, and the variation of the organ in the existing Myoidea, suggest an origin of this latter group from separate forms, some in which the organ was present and others in which it was absent.

The geomyids and heteromyids are closely related and have been distinct since Oligocene times.

Among the Myomorpha, the Myoxidae, Dipodidae, and the Spalacidae show simpler dentition than the Muridae. These three possess a gall bladder. The Muridae claims more genera than any other mammalian family and probably more individuals. In this family, the gall bladder is constantly present in some genera and absent in others. Its presence or absence may even be found in different species of the same genus.

Some tendencies among the subfamilies are distinguishable. The Cricetinae, Lophiomyinae, and Hydromyinae usually do not possess the organ, while the Gerbillinae apparently tend to retain it. Among the Murinae proper, available records (nine genera) indicate variability in this subfamily. The present distribution and the large number of species and subspecies show that these rodents are not only very successful, but that they are at a morphologically plastic stage in their development. The habits of the group and the variable presence of the gall cyst hint at its eventual disappearance.

Hystricomorph rodents generally possess a gall bladder, but in a few instances the organ is absent. The New World porcupines, the Erethizontidae, all lack the organ, but it was present in six out of eight dissections of the Old World forms. The Erethizontidae have been distinct since the Oligocene.

DISCUSSION

From the above evidence, several facts are forthcoming. In the first place, it will be seen that the gall bladder is present in all carnivorous forms (except whales), and that it may be lacking among omnivorous or herbivorous forms. A carnivorous animal of necessity consumes only occasional meals, and these have a high fat content. From a physiological point of view, storage of concentrated bile should be a great aid in the digestion of such meals, and it is significant that the organ is constantly present in animals having these habits.

The absence of the organ in species of other dietary habits, is indicated by the evidence of Schmidt and Ivy. They found species in which the organ had no apparent or demonstrable function. It may be said that the organ was "physiologically absent." Species possessing this type of gall bladder are usually members of an order in which there are other species in which the organ is anatomically absent. Further, the gall bladder is not absent from those species which have descended most directly, or with the least specialization in regard to body form, from the ancestor of mammals.

Another factor which may influence the existence of the gall bladder in a given species is the proximity of this species to the ancestral form. It will be noted that those species, families, or orders which most closely resemble the ancestor of a given group tend constantly to retain the gall cyst, while those which vary most, tend to lose the organ. The fact that other parts of the digestive tract adapt themselves quickly to dietary habits, suggests that the gall cyst may be the least plastic of the digestive organs. It is true, however, that it has completely disappeared in some mammalian families, whereas the stomach, caecum, and colon have not, although they frequently have undergone marked variations in form.

The stable nature of the gall bladder suggests that it may have taxonomic value. In only nine families was the organ found to be present in some members and absent in others. In at least six of these the variation occurred between species or individuals. In the remaining three, it was possible to arrange subfamilies, and here, for the most part, definite tendencies following the lines of arrangement were demonstrable. Individual variations in the organ are probably comparable to the anomalies occasionally seen in the human cadaver. The frequency with which these anomalies occur may be a measure of the declining "need" for the organ. Thus in the dissections of *Procavia*, three observers found a gall bladder; five did not. On the other hand, with the giraffe the records show only two gall bladders out of about twenty dissections. From these records, it might be concluded that these animals will soon lose the organ completely.

It is interesting that closely related species, particularly among the Muridae, may differ in the possession of the organ. Besides this, the occurrence of anomalous absences in individuals of the same species suggests that it might be possible to study the mechanism of the inheritance of the organ.

CONCLUSIONS

(1) The gall bladder is a typical vertebrate structure, found first in larval agnathostomes and generally throughout the rest of the group.

(2) All reptiles and amphibians have a gall bladder.

(3) In birds the presence of the gall cyst is extremely variable, but carnivorous birds generally retain it.

(4) The gall bladder is a primitive mammalian structure. It is not easily lost. It is not as readily lost as the form of the stomach, caecum, and colon is changed; i.e. a complex stomach may appear in a line of descent without the gall bladder's being lost. It is usually retained in forms which most closely resemble the ancestral type; forms which vary most widely may lose it.

(5) Carnivorous mammals (except whales) possess a gall bladder, while mammals with other dietary habits may lose the organ. This apparently is related to the intermittent feeding habits of carnivorous types. Herbivorous forms with continuous feeding habits are most likely to lack the organ.

(6) From the evidence of the dietary habits of cholecystous and acholecystous forms, one may conclude that if the gall bladder is removed from a given individual of any species, digestive efficiency will be diminished only if (*a*) the organ has a large physiologic capacity, and (*b*) intermittent meals of a high fat content are given.

(7) There is no anatomical evidence to indicate that the *Sphincter ductus choledochus* developed before a gall cyst. Yet the presence of such a sphincter renders a gall bladder essential as a pressure regulatory apparatus, unless the common bile duct manifests definite peristaltic activity, as, for example, in the guinea pig.

TABLES

Unless otherwise indicated all numbers are catalogue numbers of specimens in Field Museum. The presence of the gall bladder is indicated by + its absence by −. The name in parentheses is the one used by the original author. References to Gorham, 1936, are to Field Museum specimens dissected but not preserved.

TABLE 1.—AMPHIBIA

Apoda	
Caecilidae	
+*Typhlonectes compressicauda*	
+*Typhlonectes natans*	Fuhrmann 1914.
+*Typhlonectes dorsalis*	
Salientia	
Pipidae	
+*Pipa pipa* (*P. americana*)	Beddard 1895a.
Pelobatidae	
+*Megophrys montana* (*Xenophrys monticola*)	
+*Megophrys hasseltii* (*Leptobatrachium*)	Beddard 1907a.
+*Megophrys feae* (*Megalophrys*)	
Rhinophrynidae	
+*Rhinophrynus dorsalis*	Günther 1858.
Leptodactylidae	
+*Pseudis paradoxa* (*Rana*)	Hunter 1861.
Microhylidae	
+*Breviceps verrucosus*	Beddard 1908.
Ranidae	
+*Rana pipiens*	Gorham 1936.
Caudata	
Necturidae	
+*Megalobatrachus japonicus*	Beddard 1903.
+*Cryptobranchus alleghaniensis* (*Menopoma*)	
Sirenidae	
+*Siren lacertina*	
Amphiumidae	Hunter 1861.
+*Amphiuma means* (*A. didactylum*)	
Salamandridae	
+*Salamandra salamandra* (*S. maculata*)	

TABLE 2.—REPTILIA

Sauria	
Gekkonidae	
+*Gekko gecko*	8914.
Eublepharidae	
+*Coleonyx mitratus*	5051.
Pygopodidae	
+*Lialis jicari*	13869.
Agamidae	
+*Agama agama*	19815.
+*Calotes mystaceus*	14492.
+*Chlamydosaurus kingi*	Beddard 1905.
Iguanidae	
+*Crotaphytus collaris*	637.
+*Phrynosoma blainvilli*	8056.
Cordylidae	
+*Cordylus giganteus*	19258.
+*Platysaurus guttatus*	17322.
+*Chamaesaura aenea*	17465.

Table 2.—Reptilia (*Continued*)

Sauria (*continued*)	
Anguidae	
+*Gerrhonotus infernalis*	11200.
+*Anguis fragilis*	22895.
+*Ophisaurus apus*	15680.
Anniellidae	
+*Anniella pulchra*	Coe & Kunkel 1906.
Helodermatidae	
+*Heloderma suspectum*	Shufeldt 1890.
Varanidae	
+*Varanus niloticus*	Beddard 1907.
Xantusiidae	
+*Lepidophyma flavomaculata*	21788.
Teiidae	
+*Ameiva ameiva*	16585.
Amphisbaenidae	
+*Amphisbaena alba*	17802.
Lacertidae	
+*Lacerta viridis*	15749.
Gerrhosauridae	
+*Gerrhosaurus nigrolineatus*	18506.
Scincidae	
+*Eumeces schneideri*	19636.
Feyliniidae	
+*Typhlosaurus vermis*	16031.
Dibamidae	
+*Dibamus novae-guineae*	14251.
Chamaeleontidae	
+*Chamaeleo pumilis* (*Chamaeleon*)	Beddard 1907b.
+*Chamaeleo parvilobus* (*Chamaeleon*)	Beddard 1907b.
+*Chamaeleo dilepis* (*Chamaeleon*)	Beddard 1907b.
*−*Chamaeleo verrucosus* (*Chamaeleon*)	Beddard 1907b.
+*Chamaeleo verrucosus* (*Chamaeleon*)	18277.
+*Rhampholeon spectrum*	19855.
Serpentia	
Typhlopidae	
+*Typhlops punctatus*	21081.
Leptotyphlopidae	
+*Leptotyphlops albifrons*	87.
Boidae	
+*Charina bottae*	Cope 1898.
+*Constrictor constrictor*	11404.
+*Sanzinia madagascarensis* (*Corallus*)	Beddard 1906a.
Pythonidae	
+*Python bivittatus*	8925.
+*Python sebae*	Beddard 1904.
Aniliidae	
+*Anilius scytale*	16943.
+*Anilius scytale* (*Ilysia*)	Beddard 1906.
+*Anilius scytale* (*Boa*)	Owen 1833a.

* Beddard could not find the organ.

TABLE 2.—REPTILIA (*Continued*)

Serpentia (*continued*)	
Uropeltidae	
+*Rhinophis blythii*	Peters 1861.
+*Rhinophis oxyrhynchus*	Peters 1861.
Xenopeltidae	
+*Xenopeltis unicolor*	11523. Thompson 1913.
Achrochordidae	
+*Chersydrus granulatus*	Cope 1898.
Colubridae	
+*Elaphe quadrivittata*	Cope 1898.
+*Heterodon contortrix*	Cope 1898.
+*Coluber constrictor*	Gorham 1936.
Dasypeltidae	
+*Dasypeltis macrops*	19455.
Homalopsidae	
+*Enhydris enhydris*	11556.
Boigidae	
+*Boiga dendrophila*	11128.
Disteiridae	
+*Pelamis platurus*	16926.
Elapidae	
+*Naja nigricollis*	12873.
+*Naja hannah*	Beddard 1903a.
+*Micrurus fulvius*	8488.
Amblycephalidae	
+*Amblycephalus moellendorffii*	6662.
Viperidae	
+*Vipera berus*	21766.
Crotalidae	
+*Crotalus viridis* (*C. confluentus*)	Cope 1898.
+*Crotalus horridus*	Owen 1833a.
Testudinata	
Dermochelidae	
+*Dermochelys coriacea*	Burne 1905.
Chelhydridae	
+*Chelydra serpentina*	Martin 1830b.
Testudinidae	
+*Emys orbicularis* (*E. lutraria*)	Hunter 1861.
+*Testudo elephantina* (*T. indica*)	Martin 1830.
+*Testudo elephantina* (*T. elephantopus*)	Hunter 1861.
+*Testudo graeca*	Martin 1830a.
+*Geoemyda trijuga* (*Emys*)	Anderson 1879.
+*Kachuga ahongoka*	Anderson 1879.
+*Clemmys leprosa*	Kollman 1912.
+*Testudo mauritanica*	Kollman 1912.
Cheloniidae	
+*Chelonia mydas* (*Chelone*)	Hunter 1861.
Crocodilia	
Crocodilidae	
+*Crocodylus cataphractus* (*C. leptorhyncus*)	Martin 1835b.
+*Crocodylus niloticus* ("Crocodile du Nile")	Geoffroy 1803.
+*Crocodylus acutus*	Owen 1831d.
Rhynchocephalia	
Sphenodontidae	
+*Sphenodon punctatus* (*Hatteria*)	Günther 1867.

TABLE 3.—AVES

Struthioniformes	
Struthionidae	
−*Struthio camelus*	Garrod & Darwin 1872. Hunter 1861. Rothschild 1900.
Rheiformes	
−Rheidae	Rothschild 1900.
Casuariiformes	
Casuariidae	
+*Casuarius*	Rothschild 1900.
Dromiceiidae	
+*Dromiceius*	Rothschild 1900.
+*Dromiceius novae-hollandiae*	Boulart 1900.
Apterygiformes	
Apterygidae	
+*Apteryx australis*	Owen 1838.
Sphenisciformes	
Spheniscidae	
+*Aptenodytes patagonica*	Reid 1835.
Procellariiformes	
+Procellariidae	Forbes 1882a.
Pelecaniformes	
Phaëthontidae	
+*Phaëthon lepturus* (*P. flavirostris*)	Beddard 1897a.
Pelecanidae	
+*Pelecanus rufescens*	Martin 1835a.
+*Pelecanus occidentalis* (*P. fuscus*)	Hunter 1861.
+*Pelecanus onocrotalus*	Hunter 1861.
Phalacrocoracidae	
+*Phalacrocorax carbo*	Hunter 1861.
Anhingidae	
+*Anhinga anhinga* (*Plotus*)	Garrod 1876b.
Ciconiiformes	
Ardeidae	
+*Ardea cinerea*	Hunter 1861.
+*Ardea purpurea* (*Nycticorax*)	Hunter 1861.
+*Botaurus stellaris*	Hunter 1861.
+*Nycticorax nycticorax* (*N. europaeus*)	Hunter 1861.
Cochleariidae	
+*Cochlearius cochlearius* (*Cancroma*)	Murie 1867a.
Balaenicipitidae	
+*Balaeniceps rex*	Beddard 1888. Fox 1929. Mitchell 1913.
Scopidae	
+*Scopus umbretta*	Beddard 1884.
Ciconiidae	
+*Leptoptilos crumeniferus*	Mentzer 1929.
Phoenicopteridae	
+*Phoenicopterus ruber*	Hunter 1861.
Anseriformes	
Anhimidae	
+*Anhima cornuta* (*Palamedea corniculata*)	Beddard 1894.
+*Chauna chavaria*	Beddard 1886. Mitchell 1895.

TABLE 3.—AVES (*Continued*)

Anseriformes (*continued*)	
Anatidae	
+*Cygnus olor* +*Branta canadensis* (*Anser*)	Hunter 1861.
+*Branta bernicla*	Fox 1923.
+*Branta leucopsis* +*Cairina moschata* (*Anser*)	Hunter 1861.
+*Eulabeia indica*	Fox 1927.
+*Mergellus albellus* (*Mergus*)	Kuhl 1820.
Falconiformes	
Accipitridae	
+*Gyps fulvus* (*Vultur*) +*Aquila chrysaëtos* +*Haliaeetus albicilla* +*Accipiter nisus* (*Astur*) +*Accipiter gentilis* (*Astur palumbarius*)	Hunter 1861.
+*Aviceda leuphotes*	97002.
Falconidae	
−*Falco peregrinus*	Kuhl 1820.
Galliformes	
Cracidae	
+*Penelope purpurascens* (*P. cristata*)	Hunter 1861.
Phasianidae	
+*Arborophila brunneopectus*	97003.
Numididae	
+*Numida meleagris*	Hunter 1861.
Opisthocomidae	
−*Opisthocomus hoazin* (*O. cristatus*)	Young 1888.
Gruiformes	
Turnicidae	
−*Turnix tanki*	97007.
Gruidae	
+*Anthropoïdes virgo* (*Grus*)	Hunter 1861.
Aramidae	
+*Aramus scolopaceus*	Garrod 1876a.
Rallidae	
+*Porphyrio albus*	Hunter 1861.
+*Notornis mantelli*	Benham 1899.
Heliornithidae	
−*Podica senegalensis*	Beddard 1890a.
Rhynochetidae	
+*Rhynochetos jubatus*	Murie 1867a.
Cariamidae	
+*Cariama cristatus* (*Dicholophus*)	Martin 1836.
Otidae	
+*Otis tarda*	Fox 1929.
Charadriiformes	
Jacanidae	
+*Jacana spinosa* (*Parra*)	Forbes 1881a.
Charadriidae +*Vanellus vanellus* (*V. vulgaris*) Scolopacidae −*Erolia alpina* (*Tringa*) +*Calidris canutus* (*Arenaria calidris*)	Kuhl 1820.
+*Numenius arquata*	Hunter 1861.
+*Limnodromus griseus* Phalaropodidae +*Lobipes lobatus*	Gorham 1936.

TABLE 3.—AVES (*Continued*)

Charadriiformes (*continued*)	
Laridae	
+*Larus marinus*	Hunter 1861.
+*Larus argentatus*	Hill 1926.
+*Larus ridibundus*	Kuhl 1820.
Alcidae	
+*Uria aalge* (*troile*)	Hunter 1861.
+*Uria aalge*	Kuhl 1820.
+*Synthliborhamphus antiquus*	Shufeldt 1887.
+*Brachyramphus marmoratus*	
Columbiformes	
Pteroclididae	
+*Pterocles orientalis* (*P. arenarius*)	Gadow 1882. Garrod 1874.
+*Syrrhaptes*	Garrod 1874.
Columbidae	
+*Ptilinopus insolitus* (*Aedirhinus*)	Haswell 1882.
+*Coryphoenas crassirostris* (*Turacoena*)	
−*Columba*	Garrod 1874.
−*Turtur*	
−*Macropygia*	
−*Ectopistes*	
−*Chamaepelia*	
−*Metriopelia*	
−*Zenaida*	
−*Caloenas*	
−*Didunculus*	
−*Chalcopelia*	
−*Tympanistria*	
−*Ocyphaps*	
−*Leucosarcia*	
−*Phaps*	
−*Phlogoenas*	
−*Starnoenas*	
−*Geopelia*	
−*Goüra*	
+*Carpophaga*	
+*Lopholaemus*	
+*Ptilonopus*	
−*Treron*	
−*Columba vitiensis halmaheira* (*Ianthoenas leucolaema*)	Garrod 1875a.
−*Alectroenas pulcherrima* (*Erythroenas*)	
Psittaciformes	
−Psittacidae	Cuvier 1835. Beddard 1898. Fox 1923.
+*Kakatoe goffini* (*Cacatua*)	Garrod 1877b.
+*Kakatoe moluccensis* (*Cacatua*)	
+*Kakatoe haematuropygia* (*Cacatua philippinarum*)	
+*Nymphicus hollandicus* (*Calopsitta novae-hollandiae*)	
Cuculiformes	
Musophagidae	
+*Gallirex porphyreolophus* (*Corythaix*)	Owen 1834.
+*Turacus persa* (*Corythaix buffoni*)	Martin 1836a.
Cuculidae	
+*Carpococcyx radiatus*	Beddard 1901a.
+*Scythrops novae-hollandiae*	Beddard 1898a.
+*Cuculus canorus*	Hunter 1861.
+*Centropus sinensis*	97014.

TABLE 3.—AVES (*Continued*)

Strigiformes	
Strigidae	
+*Scotopelia peli*	Murie 1871.
+*Phodilus badius*	Beddard 1890.
+*Asio otus* (*Otus aurita*)	Hunter 1861.
Caprimulgiformes	
Steatornithidae	
+*Steatornis*	Beddard 1886a.
Podargidae	
+*Batrachostomus*	Blyth 1866.
+*Batrachostomus*	Beddard 1886a.
+*Podargus*	Beddard 1886a.
Aegothelidae	
+*Aegotheles*	Beddard 1886a.
Caprimulgidae	
+*Caprimulgus*	Beddard 1886a.
−*Chordeiles* sp.	Beddard 1886a.
+*Chordeiles minor minor*	Gorham 1936.
+*Nyctidromus*	Beddard 1886a.
Micropodiformes	
Trochilidae	
−*Archilochus colubris*	Crisp 1862a.
−*Campylopterus ensipennis*	97208.
Trogoniformes	
Trogonidae	
+*Harpactes erythrocephalus*	97017.
Coraciiformes	
Alcedinidae	
−*Halcyon smyrnensis*	97019.
Meropidae	
+*Melittophagus erythrocephalus*	97187.
Leptosomatidae	
+*Leptosomus discolor*	Forbes 1880a. Grandidier and Milne-Edwards 1875.
Bucerotidae	
+*Bucorvus abyssinicus*	Garrod 1876.
+*Dichoceros bicornis* (*Buceros cavatus*)	Owen 1833.
Piciformes	
Capitonidae	
+*Trachylaemus goffinii*	97232.
+*Megalaema virens*	Forbes 1882.
+*Cyanops franklinii* (*Megalaema*)	Forbes 1882.
+*Xantholaema rosea*	Forbes 1882.
Ramphastidae	
+*Aulacorhynchus prasinus* (*Aulacorhamphus*)	Forbes 1882.
+*Ramphastos discolorus*	Forbes 1882.
+*Ramphastos vitellinus*	Forbes 1882.
+*Ramphastos piscivorous* (*R. carinatus*)	Forbes 1882.
+*Pteroglossus aracari* (*P. wiedi*)	Forbes 1882.
+*Selenidera maculirostris*	Forbes 1882.
Picidae	
−*Picumnus squamulatus*	97216.

TABLE 3.—AVES (*Continued*)

Passeriformes	
Formicariidae	
+*Myrmotherula schisticolor*	97214.
Tyraniidae	
+*Mecocerculus leucophrys*	97220.
Pittidae	
–*Pitta oatesi*	97035. 97034.
Philepittidae	
–*Philepitta*	Forbes 1880b.
Hirundinidae	
+*Psalidoprocne fuliginosa*	97260.
Campephagidae	
+*Pericrocotus flammeus*	97029.
Dicruridae	
–*Chaptea aenea*	97032.
Oriolidae	
+*Oriolus chinensis*	97033.
Corvidae	
+*Chripsirhina temia*	97042.
+*Corvus brachyrhynchos*	Gorham 1936.
+*Pyrrhocorax pyrrhocorax*	Hunter 1861.
Paridae	
–*Aegithaliscus annamensis*	97142.
Timeliidae	
+*Mesia argentauris*	97109.
–*Alcippe nipalensis*	97092. 97090.
–*Mixornis rubricapilla*	97077. 97081.
+*Garrulax leucolophus*	97048.
+*Garrulax vassali*	97045.
+*Stachyris nigriceps*	97055. 97053.
Pycnonotidae	
+*Criniger gularis*	97129.
+*Otocompsa flavirentris*	97118. 97144.
Turdidae	
+*Luscinia calliope*	97149. 97152. 97153.
Sylviidae	
+*Orthotomus sutorius*	97186.
Muscicapidae	
–*Siphia parva*	97166.
+*Muscicapula rubeculoides*	97172.
+*Culicicapa ceylonensis*	97163.
Motacillidae	
+*Anthus hodgsoni*	97186.
Bombycillidae	
–*Bombycilla garrula*	Kuhl 1820.
Laniidae	
+*Laniarius atroflavus*	97257.
+*Lanius excubitor*	Hunter 1861.
Nectariniidae	
–*Cinnyris reichenowi*	97281. 97282.
–*Cinnyris jugularis*	97189.
–*Aethopyga saturata*	97194.

TABLE 3.—AVES (*Continued*)

Passeriformes (*continued*)	
Dicaeidae	
+*Dicaeum concolor*	97201.
Zosteropidae	
+*Zosterops palpebrosa*	97203.
+*Zosterops virens*	97284.
Ploceidae	
+*Estrilda melpoda*	97254.
+*Munia striata*	97205.
Icteridae	
+*Zarhynchus wagleri*	97229.
Thraupidae	
+*Calospiza chrysophrys guttata*	97217.
+*Thraupis cyanocephala subcinerea*	97218.
Fringillidae	
+*Atlapetes semirufus*	97211.

TABLES 4–16.—MAMMALIA

TABLE 4

Monotremata	
Ornithorhynchidae	
+*Ornithorhynchus anatinus*	Owen 1838. Crisp 1862. Flower 1872.
+*Ornithorhynchus anatinus* ("Platypus")	Mackenzie 1918.
Tachyglossidae	
+*Tachyglossus aculeatus* (*Echidna hystrix*)	Owen 1866. Rex 1888. Flower 1872. Chapman 1887.
+*Tachyglossus aculeatus* (*Echidna* sp.)	Mackenzie 1918.

TABLE 5

Marsupialia	
Didelphiidae	
+*Didelphis marsupialis*	Mackenzie 1918. Hunter 1861. Flower 1872.
+*Didelphis paraguayensis* (*D. azarae*)	Martin 1834a. Jones 1834a.
+*Didelphis virginianus*	Gorham 1936.
+*Monodelphis brevicaudatus* (*Didelphis hunteri*)	Hunter 1861.
Dasyuridae	
+*Dasyurus quoll* (*D. viverrinus*)	Mackenzie 1918.
+*Antechinomys laniger*	Alston 1880. Beddard 1908b.
+*Thylacinus* sp.	Crisp 1862.
+*Phascogale tapoatafa* (*P. pencillata*)	Hunter 1861.
+*Sarcophilus harrisi*	Mackenzie 1918.
Notoryctidae	
+*Notoryctes typhlops*	Carlsson 1904.
Paramelidae	
+*Chaeropus castanotis*	Parsons 1903.
Phalangeridae	
+*Phalanger maculatus* (*Cuscus*)	Forbes 1881.
+*Trichosurus vulpecula* (*Phalangista vulpina*)	Forbes 1881. Mackenzie 1918.
+*Pseudochirus* sp.	Mackenzie 1918.
+*Schoinobates volans* (*Petaurus taguanoides*)	Hunter 1861

TABLE 5—*Continued*

Marsupialia (*continued*)	
Phascolarctidae	
+*Phascolarctos cinereus*	Forbes 1881. Sonntag 1921. Mackenzie 1918.
Wombatidae	
+*Wombatus ursinus* (*Phascolomys wombat*)	Forbes 1881.
+*Wombatus ursinus* ("Wombat")	Cleland 1869.
+*Wombatus ursinus* (*Phascolomys* sp.)	Mackenzie 1918.
Macropodidae	
+*Macropus cangaru* (*M. major*)	Hunter 1861. Crisp 1862.
+*Macropus cangaru* (*M. giganteus*)	Flower 1872.
+*Macropus parryi* +*Macropus walabatus*	Mackenzie 1918.
+*Megaleia rufa* (*Macropus ruber*)	Crisp 1862.
+*Dendrolagus inustus*	Crisp 1862. Owen 1852.
+*Dorcopsis luctuosa* (*Halmaturus luctuosus*)	Garrod 1875.
+*Dorcopsis luctuosa* (*Halmaturus xanthopis*)	Crisp 1862.
+*Potorous tridactylus* (*Hypsiprymnus murinus*)	Hunter 1861.
Caenolestidae	
+*Caenolestes obscurus*	Osgood 1921.
Myrmecobiidae	
+*Myrmecobius fasciata*	Mackenzie 1936.

TABLE 6

Insectivora	
Tenrecidae	
+*Oryzorictes hova* +*Centetes caudatus*	Dobson 1882.
Potomogalidae	
*+*Potomogale velox*	Seabra 1901.
Solenodontidae	
+*Solenodon paradoxus*	Allen 1910.
+*Atopogale cubanus* (*Solenodon*) Chrysochloridae +*Chrysochloris asiatica* (*C. aurea*) +*Chrysospalax dobsoni* (*Chrysochloris villosa*) +*Amblysomus hottentotus* (*A. rutilans*)	Dobson 1882.
+*Amblysomus obtusirostris* (*Chrysochloris*)	Peters 1852.
Erinaceidae	
+*Erinaceus europaeus*	Dobson 1881. Hunter 1861. Flower 1872. Hill 1926.
+*Echinosorex albus* (*Gymnura rafflesi*)	Allen 1910.
+*Paraechinus deserti* (*Erinaceus algirus*) +*Paraechinus micropus* (*Erinaceus pictus*) +*Paraechinus amir* (*Erinaceus macracanthus*) +*Paraechinus blanfordi* (*Erinaceus jerdoni*) +*Paraechinus niger* +*Hemiechinus grayi* (*Erinaceus grayi*) +*Atelerix albiventris* (*Erinaceus*) +*Aethechinus angolae* (*Erinaceus diadematus*)	Dobson 1882.
+*Ericulus telfairi* (*Echinops*)	Martin 1838.
Soricidae	
+*Sorex vulgaris*	Arnback 1907.
+*Sorex araneus*	Hill 1926.
+*Crocidura hirta*	Peters 1852.
+*Blarina brevicauda*	16545.

* Called "Vesicula vermiculair."

TABLE 6—*Continued*

Insectivora (*continued*)	
Talpidae	
+*Talpa europea*	Hunter 1861. Flower 1872.
+*Desmana moschata* (*Myogale*)	Dobson 1882.
+*Scapanus latimanus* (*Scapanus townsendi*)	Dobson 1882.
Tupaiidae	
+*Tupaia belangeri*	Garrod 1879.
+*Ptilocercus lowii*	Clark 1926.
+*Dendrogale frenata*	46628.
Macroscelididae	
+*Rhynchocyon cirnei*	Peters 1852.
+*Nasilio brachyrhynchus* (*Macroscelides fuscus*)	Peters 1852.
+*Petrodromus tetradactylus*	Peters 1852.
+*Macroscelides rozeti*	Duvernoy and Lereboullet 1840.

TABLE 7

Dermoptera	
Galeopithecidae	
+*Galeopithecus* sp.	Flower 1872. Cuvier 1835.
+*Galeopterus temmincki* (*Galeopithecus volans*)	Chapman 1902.

TABLE 8

Chiroptera	
Pteropidae	
+*Pteropus rufus rufus* (*P. edwardsi*)	Flower 1872.
+*Pteropus giganteus giganteus* (*P. medius*)	Robin 1881.
+*Pteropus subniger* (*P. rubicollis*)	Robin 1881.
+*Pteropus edwardsi* (*P. edwardsii*)	Peters 1852.
Cynopteridae	
*+*Cynopterus brachyotis* (*C. scherzeri*)	Robin 1881.
*+*Penthetor jagori* (*Cynopterus*)	Robin 1881.
*+*Epomops franqueti* (*Epomorphus comptus*)	Robin 1881.
*+*Hypsignathus monstrosus*	Robin 1881.
*+*Nyctymene cephalotes* (*Eonycteris*)	Robin 1881.
*+*Roussettus amplexicaudatus* (*Cynonycteris*)	Robin 1881.
+*Roussettus collaris* (*Cynonycteris*)	Peters 1852.
+*Epomophorus crypturus*	Peters 1852.
Rhinopomidae	
+*Rhinopoma microphyllum*	Robin 1881.
Emballonuridae	
*+*Emballonura nigrescens*	Robin 1881.
*+*Rhynchiscus naso* (*Rhynchonycteris*)	Robin 1881.
*+*Balantiopteryx plicata* (*Saccopteryx*)	Robin 1881.
*+*Taphozus melanopogon*	Robin 1881.
+*Coleura afra* (*Emballonura*)	Peters 1852.
Noctilionidae	
+*Noctilio leporinus*	Robin 1881.
+*Noctilio albiventer*	Cuvier 1835.
Nycteridae	
*+*Nycteris thebaica*	Robin 1881.
*+*Nycteris revolii*	Robin 1881.
+*Nycteris hispida* (*N. villosa*)	Peters 1852.

* The absence of the gall bladder was not noted.

TABLE 8—*Continued*

Chiroptera (*continued*)	
Megadermidae	
*+*Megaderma spasma*	
Rhinolophidae	
*+*Rhinolophus ferrum-equinum*	Robin 1881.
+*Rhinolophus hipposideros*	
*+*Rhinolophus euryale*	
+*Rhinolophus lobatus*	Peters 1852.
Hipposideridae	
+*Hipposideros diadema* (*Phyllorhina*)	Robin 1881.
*+*Hipposideros commersoni* (*Phyllorhina*)	
+*Hipposideros commersoni* (*Phyllorrhina vittata*)	Peters 1852.
*+*Hipposideros armiger* (*Phyllorhina*)	
Phyllostomidae	
*+*Phyllostomus hastatus*	
*+*Macrotus waterhousii*	Robin 1881.
*+*Glossophaga soricina*	
*+*Carollia perspicillata* (*C. brevicauda*)	
*+*Artibeus jamaicensis* (*A. perspicillatus*)	
+*Vampyrus spectrum*	Cuvier 1835.
Desmodontidae	
+*Desmodus rotundus* (*D. rufus*)	Flower 1872.
Vestertiliolidae	
+*Vespertilio murinus*	Robin 1881. Cuvier 1835.
+*Myotis myotis* (*Vespertilio*)	Kuhl 1820.
+*Myotis mystocinus* (*Vespertilio*)	
*+*Scotophilus temminckii*	Robin 1881.
*+*Pipistrellus kuhlii* (*Vesperugo*)	
+*Pipistrellus pipistrellus* (*Vespertilio*)	Cuvier 1835.
+*Nyctalus noctula* (*Vesperugo*)	Flower 1872. Hill 1926. Cuvier 1835.
*+*Lasiurus borealis* (*Atalapha noveboracensis*)	
*+*Barbastella barbastella* (*Synotus*)	Robin 1881.
*+*Plecotus auritus*	
+*Plecotus auritus*	Cuvier 1835.
+*Eptesicus serotinus* ("Vespertillion")	
+*Eptesicus serotinus* (*Vespertilio*)	Kuhl 1820.
+*Scotophilus nigrita* (*Nycticejus planirostris*)	Peters 1852.
*+*Miniopterus schreibersii*	
*+*Kerivoula hardwickii*	
Molossidae	
*+*Molossus obscurus*	
*+*Chaerephon plicatus* (*Nyctinomus*)	Robin 1881.
+*Cheiromeles torquatus*	
*+*Tadarida brasiliensis* (*Nyctinomus*)	
*+*Mormopterus acetabulosus* (*Nyctinomus*)	
+*Nyctinomous limbatus* (*Dysopes*)	Peters 1852.
+*Nyctinomus taeniotus* (*Dinops cestoni*)	Cuvier 1835.

TABLE 9

Primates	
Lemuridae	
+*Lemur mayottensis*	Beddard 1884a.
+*Lemur mongoz*	Hunter 1861. Ruge 1902.
+*Lemur macaco*	Martin 1831.

* The absence of the gall bladder was not noted.

TABLE 9—*Continued*

Primates (*continued*)	
Lemuridae (*continued*)	
+*Lemur catta*	Hunter 1861.
+*Lemur fulvus*	Flower 1872.
+*Lemur fulvus* (*L. albifrons*)	Hunter 1861.
+*Lemur variegatus* (*L. varius*)	Flower 1872. Grandidier and Milne-Edwards 1875.
+*Microcebus murinus*	Flower 1872.
+*Microcebus murinus* (*M. smithi*)	Ruge 1902.
+*Propithecus diadema*	Grandidier and Milne-Edwards 1875.
+*Hapalemur griseus*	Beddard 1884a.
+*Hapalemur simus*	Beddard 1901.
Indrisidae	
+*Indris indris* (*Avahi laniger*)	Ruge 1902. Grandidier and Milne-Edwards 1875.
Daubentoniidae	
+*Daubentonia madagascarensis* (*Chiromys*)	Ruge 1902. Mivart and Murie 1865.
+*Daubentonia madagascarensis* ("aye-aye")	Owen 1866.
Lorisidae	
+*Loris tardigradus* (*Nycticebus*)	Ruge 1902.
+*Loris tardigradus*	Hunter 1861. Flower 1872.
+*Loris tardigradus* (*Nycticebus*)	Mivart and Murie 1865.
+*Loris tardigradus* (*Stenops gracilis*)	Kuhl 1820.
+*Nycticebus javanicus* +*Arctocebus calabarensis*	Flower 1872.
+*Perodicticus potto*	Ruge 1902. Flower 1872.
+*Galago madagascarensis*	Kuhl 1820.
+*Galago crassicaudatus*	Flower 1852.
+*Galago mohali*	Smith 1849.
+*Myoxicebus griseus* (*Hapalemur*)	Beddard 1901. Grandidier and Milne-Edwards 1875.
Tarsiidae	
+*Tarsius fuscus* (*T. spectrum*)	Ruge 1902. Sonntag 1924. Woollard 1925.
Callitrichidae	
+*Oedipomidas oedipus* (*Midas*)	Flower 1872.
+*Callithrix jacchus* (*Hapale*)	Hunter 1861. Beattie 1927. Flower 1872.
Cebidae	
+*Cebus capucinus*	Sonntag 1924. Crisp 1862. Ruge 1902a. Flower 1872.
+*Cebus apella*	Hunter 1861.
+*Ateles geoffroyi*	Flower 1872.
+*Ateles cucullatus*	Murie 1865.
+*Ateles ater*	Ruge 1902a.
+*Ateles belzebuth*	Kuhl 1820.
+*Pithecia pithecia*	Sonntag 1924.
+*Pithecia monacha*	Flower 1862.
+*Cacajao rubicundus* (*Brachyurus*)	Forbes 1880.
+*Alouatta senicula*	Flower 1872.
+*Saimiri sciurea* (*Callithrix sciureus*)	Martin 1833.

TABLE 9—*Continued*

Primates (*continued*)	
Cercopithecidae	
+*Cercopithecus albogularis*	Mentzer 1929. Owen 1832a.
+*Cercopithecus erythrogaster*	Murie 1866.
+*Cercopithecus cynosurus*	
+*Cercopithecus talapoin*	
+*Cercopithecus cephna* (*C. cephus*)	Ruge 1906.
+*Cercopithecus nictitans*	
+*Cercopithecus callithricus* (*C. sabaena*)	Hunter 1861.
+*Cercopithecus petaurista*	Ruge 1906.
+*Cercopithecus sinicus*	Kuhl 1820.
+*Cercopithecus aethiops*	
+*Cercocebus fuliginosus*	Bradley 1903.
+*Erythrocebus patas* (*Cercopithecus*)	Ruge 1906.
+*Colobus vellerosus*	Flower 1872.
+*Theropithecus rueppelli* (*Gelada*)	Garrod 1879a.
+*Papio lestes*	Mentzer 1929.
+*Papio sphinx*	Ruge 1906.
+*Papio maimon*	Ruge 1906. Hunter 1861.
+*Papio anubis*	Ruge 1906. Hunter 1861. Flower 1872.
+*Papio porcarius*	Hunter 1861.
+*Papio leucophaeus* (*Mandrillus*)	Sonntag 1922.
+*Papio hamadryas*	Schrieber 1932.
+*Macaca maura*	Murie 1872.
+*Macaca brunnea*	Anderson 1872.
+*Macaca albibarbata* (*M. silenus*)	Hunter 1861.
+*Macaca mulatta* (*M. rhesus*)	
+*Macaca mulatta* (*M. rhesus*)	Linback 1933.
+*Macaca cynomolga*	
+*Macaca sinica*	Ruge 1906.
+*Macaca nemestrina*	
Pongidae	
+*Hylobates lar*	Ruge 1906a. Hunter 1861. Flower 1872.
+*Hylobates lar* (*H. leuciscus*)	Chapman 1900.
+*Pongo pygmaeus* ("orang")	Owen 1830. Sonntag 1924a. Ruge 1906a.
+*Pan satyrus* ("chimpanzee")	Ruge 1906a. Fox 1929.
+*Pan satyrus* (*Anthropopithecus troglodytes*)	Sonntag 1923.
+*Gorilla gorilla*	Flower 1872. Fox 1930. Ruge 1906a.
Hominidae	
+*Homo sapiens*	*A. U. C.*

TABLE 10

Carnivora	
Canidae	
+*Canis familiaris*	Gorham 1936.
+*Canis aureus*	Mentzer 1929.
+*Canis lupus*	Macalister 1867.
+*Speothos venaticus* (*Icticyon*)	Flower 1880.
+*Lycaon pictus*	Crisp 1855. Garrod 1878a.

TABLE 10—*Continued*

Carnivora (*continued*)	
Canidae (*continued*)	
+*Otocyon virgatus* (*Canis otocyon virgatus*)	Mentzer 1929.
+*Urocyon cinereoargenteus* (*Canis*)	Hunter 1861.
+*Cuon dukhunensis*	Murie 1872c.
+*Fennecus zerda* (*Canis*)	Hunter 1861.
+*Nyctereutes procyonoides*	Garrod 1878a.
Procyonidae	
+*Procyon lotor*	Crisp 1862. Macalister 1867.
+*Potos flavus* (*P. caudivolvulus*)	Hunter 1861. Macalister 1867.
+*Nasua rufa* or *narica*	Hunter 1861.
+*Bassaricyon gabbi* (*B. alleni*)	Beddard 1900a.
+*Ailurus fulgens*	Flower 1870.
+*Aeluropoda melanoleuca*	47432.
Ursidae	
+*Ursus arctos*	Hunter 1861. Macalister 1867.
+*Ursus maritimus*	Crisp 1862.
+*Ursus malayanus*	Rex 1888.
+*Melursus ursinus* (*Ursus labiatus*)	Flower 1872.
Mustelidae	
+*Mustela putorius* (*Putorius furo*)	Macalister 1867.
+*Mustela erminea* (*Putorius*)	Macalister 1867.
+*Mustela vison*	Gorham 1936.
+*Mellivora sagulata*	Hunter 1861.
+*Taxidea taxus* (*Meles labradoria*)	Hunter 1861.
+*Meles meles* (*M. taxus*)	Hunter 1861.
+*Martes martes* (*Mustela*)	Hunter 1861.
+*Martes pennanti* (*Mustela canadensis*)	Martin 1833b.
+*Mydaus marchei* (*M. meliceps*)	Hunter 1861.
+*Grison vittata* (*Mustela grison vittatus*)	Hunter 1861.
+*Tayra barbara* (*Galera*)	Crisp 1862.
+*Helictis subaurantiaca*	Garrod 1879c.
+*Helictis personata*	Beddard 1905a.
+*Lutra lutra* (*L. vulgaris*)	Hunter 1861. Crisp 1862.
+*Gulo* sp. (*Ursus gulo*)	Crisp 1862.
Viverridae	
+*Viverra zibetha*	Hunter 1861.
+*Viverra civetta*	Mivart 1882.
+*Suricata suricata* (*S. tetradactyla*)	Hunter 1861. Owen 1831b.
+*Paguma larvata* (*Paradoxurus*)	Mivart 1882.
+*Nandinia binotata*	Carlsson 1900.
−*Nandinia binotata*	Mivart 1882.
+*Crossarchus obscurus*	Martin 1834.
+*Arctictis binturong*	Garrod 1873a.
+*Hemigalus derbyanus*	Mivart 1882.
+*Galidea elegans*	Beddard 1909a.
+*Herpestes* sp.	Mivart 1882.
+*Prionodon* sp.	Mivart 1882.
+*Cryptoprocta ferox*	Beddard 1895.
Hyaenidae	
+*Hyaena brunnea*	Murie 1867.
+*Hyaena vulgaris*	Hunter 1861.
+*Crocuta crocuta* (*Hyaena*)	Watson and Young 1879a.
+*Proteles cristata*	Flower 1869.

Table 10—*Continued*

Carnivora (*continued*)	
Felidae	
+*Felis domestica*	Mivart 1881.
+*Felis pardalis* +*Felis nebulosa* (*F. macrocelus*)	Crisp 1862.
+*Panthera leo* (*Felis leo*)	Hunter 1861. Mentzer 1929.
+*Panthera pardus* (*Felis leopardus*)	Hunter 1861.
+*Panthera pardus* (*Felis pardus*)	Mentzer 1929.
+*Panthera onca* (*Felis*)	Martin 1832.
+*Lynx caracal* (*Felis*)	Hunter 1861.
+*Acinonyx jubata*	Mentzer 1929.
+*Felis concolor*	Martin 1833a.
Otariidae	
+*Eumetopias jubata* (*Otaria*)	Murie 1868.
+*Arctocephalus hookeri* (*Otaria*)	Murie 1867a.
Odobaenidae	
+*Odobaenus rosmarus* (*Trichechus*)	Murie 1870a.
Phocidae	
+*Phoca vitulina*	Hunter 1861. Flower 1872.
+*Phoca groenlandica*	Macalister 1867. Crisp 1862. Murie 1870b.

Table 11

Xenarthra	
Bradypodidae	
−*Bradypus tridactylus*	Hunter 1861. Burlet 1911.
−*Bradypus cuculliger* (*B. cuculli*)	Burlet 1911.
−*Bradypus griseus*	Wislocki 1928. Sonntag 1921a.
Choloepodidae	
+*Choloepus didactylus* (*Bradypus*)	Hunter 1861. Rapp 1852. Burlet 1911. Sonntag 1921a.
+*Choloepus hoffmani*	Wislocki 1928.
Myrmecophagidae	
+*Myrmecophaga jubata*	Owen 1854.
+*Cyclopes didactylus* (*Cyclothurus*)	Burlet 1911. Flower 1872. Wislocki 1928.
+*Tamandua* sp.	Wislocki 1928.
+*Tamandua tetradactyla*	Beddard 1909.
Dasypodidae	
+*Dasypus novemcinctus*	Hunter 1861. Crisp 1862. Rapp 1852.
+*Dasypus novemcinctus* (*D. peba*)	Owen 1831a.
+*Euphractus sexcinctus* (*Dasypus*)	Owen 1831c. Crisp 1862.
+*Tolypeutes tricinctus*	Garrod 1878.
+*Tolypeutes* sp.	Murie 1872a.
+*Chlamydophorus truncatus*	Macalister 1873.
Pholidota	
Manidae	
+*Manis pentadactyla*	Hunter 1861. Flower 1872.
+*Smutsia temminckii* (*Manis*)	Peters 1852.
+*Manis javanica*	Adams 1859.

TABLE 11—*Continued*

Tubulidentata	
Orycteropidae	
+*Orycteropus afer* (*O. capensis*)	Jaeger 1837. Sonntag 1925.
+*Orycteropus afer* (*O. afra*)	Fox 1930.

TABLE 12

Artiodactyla	
Tayassuidae	
−*Pecari torquatus* (*Dicotyles*)	Hunter 1861. Macalister 1867.
Suidae	
+*Babirussa alfurus* (*B. babirus*)	Flower 1872.
+*Phacochoerus africanus*	Mentzer 1929.
+*Phacochoerus aethiopicus* (*P. pallasii*)	Owen 1851.
Hippopotamiidae	
+*Hippopotamus amphibius*	Garrod 1879b. Weissberg 1932. Chapman 1881.
−*Hippopotamus amphibius*	Chapman 1881.
Camelidae	
−*Camelus bactrianus*	Flower 1872.
−*Lama guanicoe* (*L. pacos*)	Crisp 1862.
−*Lama vicugna* (*Auchenia* sp.)	Crisp 1862.
Tragulidae	
+*Tragulus kanchil*	Hunter 1861.
+*Tragulus javanicus* (*T. napu*)	Macalister 1867.
+*Dorcatherium aquaticum* (*Hyomoschus aquaticus*)	Flower 1867.
Cervidae	
+*Cervus axis*	Crisp 1862.
−*Cervus axis*	Hunter 1861. Raven 1936.
−*Cervus unicolor unicolor* (*C. hippelaphus*)	Crisp 1862.
−*Cervus unicolor moluccensis* (*C. moluccensis*)	Crisp 1862.
−*Cervus unicolor swinhoii* (*C. swinhoii*)	Garrod 1877.
−*Cervus unicolor marianus* (*C. mariannus*)	Garrod 1877.
−*Cervus elaphus*	Garrod 1877.
−*Cervus kukulii*	Garrod 1877.
−*Cervus timoriensis* (*C. molucensis*)	Garrod 1877.
−*Cervus duvauceli*	Garrod 1877.
−*Cervus alfredi*	Garrod 1877.
−*Cervus porcinus*	Garrod 1877.
+*Mazama superciliaris* (*Cervus*)	Crisp 1862.
−*Mazama rufus* (*Cervus*)	Garrod 1877.
−*Odocoileus hemionus* (*Cervus auritus*)	Crisp 1862. Gorham 1936.
−*Odocoileus mexicanus* (*Cervus*)	Crisp 1862.
−*Alces alces* (*Cervus*)	Crisp 1862.
−*Alces alces* (*A. machlis*)	Watson and Young 1879.
−*Muntiacus muntjac* (*Cervulus*)	Garrod 1877.
−*Muntiacus reevesi* (*Cervulus reevesi*)	Garrod 1877.
−*Hydropotes inermes*	Garrod 1877a.
−*Pudu pudu* (*Cervus*)	Garrod 1877.
−*Pudu pudu*	Flower 1875.
−*Elaphodus cephalophus*	Garrod 1877.
−*Elaphodus cephalophus* (*Lophotragus michianus*)	Garrod 1877.
−*Blastoceros bezoarticus* (*Cervus campestris*)	Garrod 1877.
+*Moschus moschiferus*	Garrod 1877. Crisp 1862. Flower 1875.

TABLE 12—*Continued*

Artiodactyla (*continued*)	
Giraffidae	
†+*Giraffa camelopardalis*	Owen 1838b. Gardon 1787.
−*Giraffa camelopardalis*	Owen 1838b. Crisp 1862. Neuville 1914. Murie 1872c. Chapman 1875a. Joly and Lavocet 1845.
−*Giraffa camelopardalis* (*Camelopardalis giraffa*)	Garrod 1877. Fox 1929.
−*Giraffa reticulata*	Lönnberg 1912.
Antilocapridae	
+*Antilocapra americana*	Murie 1870b. Lönnberg 1909.
Bovidae	
Bovinae	
+*Bos taurus* +*Bison bison* (*B. americanus*)	Hunter 1861.
+*Syncerus caffer* (*Buffelus c. radcliffei*)	Mentzer 1929.
Caprinae	
+*Ovis musimon*	Crisp 1862.
+*Capra hircus* (*C. picta*)	Garrod 1877.
*−*Capra angoriensis* (3 specimens)	Crisp 1862.
+*Hemitragus jemlahicus* (*Capra jemlaica*)	Garrod 1877.
Rupicaprinae	
+*Rupicapra rupicapra*	Rex 1888.
+*Budorcas taxicolor*	Lander 1919.
Ovibovinae	
+*Ovibos moschatus*	Lönnberg 1900.
Bubalinae	
−*Bubalis buselaphus* (*Antelope*) −*Damaliscus pygargus* (*Antelope*)	Crisp 1862.
+*Damaliscus pygargus* (*Damalis*)	Garrod 1877.
+*Connochaetes albojubatus*	Mentzer 1929.
+*Connochaetes gnu* (*Catoblepas*)	Garrod 1877.
Cephalophinae	
−*Cephalophus maxwelli* (*Antelope*)	Crisp 1862. Garrod 1877.
−*Cephalophus monticola* (*C. pygmaeus*)	Garrod 1877.
−*Cephalophus harveyi keniae*	Lönnberg 1900.
−*Cephalophus melanorrhaeus*	Lönnberg 1909.
−*Cephalophus natalensis* −*Cephalophus abyssinicus hindei*	Lönnberg 1900.
−*Cephalophus grimmia* (*Antelope mergens*)	Crisp 1862.
−*Cephalophus ogilbyi*	Lönnberg 1900. Lönnberg 1909.
Oreotraginae	
+*Ourebia nigricaudatus* (*Nanotragus*)	Garrod 1877.
+*Raphicerus campestris* (*R. neumanni*)	Lönnberg 1909. Mentzer 1929.
+*Neotragus pygmaeus*	Pocock 1918.
+*Rhyncotragus cavendishi* (*R. kirkii*)	Mentzer 1929.

† Six males, three females, others unsexed.

* Communication with breeders of Angora goats, in this country and abroad, failed to reveal any breed in which the gall bladder was absent. The number of specimens indicates that Dr. Crisp probably was guilty of mis-statement, rather than dissection of anomalous specimens.

TABLE 12—*Continued*

Artiodactyla (*continued*)	
Bovidae (*continued*)	
Reduncinae	
+*Redunca arundinum* (*Antelope isabelliana*)	Crisp 1862.
+*Kobus defassa*	Mentzer 1929.
+*Kobus ellypsiprymnus*	Smith 1849.
Saiginae	
+*Saiga tartarica*	Murie 1870c.
Antelopinae	
+*Antelope cervicapra* (*A. bezoartica*)	Crisp 1862.
+*Gazella dorcas* (*Antelope*)	Crisp 1862. Garrod 1877.
+*Gazella bennetti* (*Antelope*)	Crisp 1862.
+*Gazella granti*	Mentzer 1929. Garrod 1877.
+*Gazella subgutturosa*	Garrod 1877.
+*Gazella muscatensis*	Garrod 1877.
+*Gazella rufifrons*	Garrod 1877.
+*Gazella arabica*	Garrod 1877.
+*Antidorca marsupialis* (*Antelope euchore*)	Crisp 1862.
+*Lithocranius walleri*	Lönnberg 1900.
Oryginae	
+*Oryx leucoryx* (*Antelope*)	Crisp 1862.
+*Addax naso-maculatus*	Crisp 1862. Garrod 1877.
Tragelaphinae	
+*Tragelaphus scriptus* (*Antelope*)	Crisp 1862. Garrod 1877.
+*Strepsicerus strepsicerus* (*S. Kudu*)	Garrod 1877.
+*Taurotragus oryx*	Mentzer 1929.
+*Taurotragus oryx* (*Antelope oreas*)	Crisp 1862.
+*Taurotragus oryx* (*Oreas caana*)	Garrod 1877.
+*Boselaphus tragocamelus* (*Antelope picta*)	Hunter 1861.
+*Boselaphus tragocamelus* (*Portax picta*)	Garrod 1877.
+*Limnotragus gratus* (*Tragelaphus gratus*)	Neuville 1897.
+*Tetracerus quadricornis* (*T. subquadricornatus*)	Garrod 1877.

TABLE 13

Sirenia	
Trichecidae	
+*Trichecus manatus* (*Manatee americanus*)	Murie 1870.
+*Trichecus manatus* (*Manatus inunguis*)	Beddard 1897.
+*Trichecus manatus* ("Manatee")	Chapman 1875.
Dugongidae	
+*Dugong australis* (*Halicore* sp.)	Owen 1838a.
Rhytinidae	
−*Rhytina stelleri*	Steller 1749.
Hyracoidea	
Procariidae	
+*Procavia capensis*	Owen 1832. Macalister 1867. Mentzer* 1929.
−*Procavia capensis*	Raven 1936. Crisp 1862. Flower** 1872. Huxley 1872. Martin 1835.

* Mentzer examined two specimens, one with a gall bladder filled with liver flukes. He notes that the gall bladder, with a central and two lateral sacs, as reported by Owen and Macalister, may be found only as a dilation or a lateral pouch of the common duct, at the point where the four hepatic ducts join it.

** Flower says that this animal has no gall bladder, but in some specimens the common duct is dilated to great size.

TABLE 13—*Continued*

Proboscidea	
Elephantidae	
—*Elephas maximus* (*E. indicus*)	Hunter 1861. Crisp 1862. Forbes 1879.
—*Loxodonta africana* (*Elephas africanus*)	Forbes 1879.
—"Elephant"	Eales 1929. Chapman 1875b.

TABLE 14

Perissodactyla	
Tapiridae	
—*Tapirus terrestris* (*T. americanus*)	Crisp 1862.
—*Tapirus indicus*	Parker 1882.
—*Tapirus indicus*	Murie 1871b.
Rhinocerotidae	
—*Rhinoceros unicornis*	Beddard 1887. Owen 1850.
—*Rhinoceros sumatrensis* (*Ceratorhinus*)	Garrod 1873.
Equidae	
—*Equus caballus*	Hunter 1861.
—*Equus asinus*	Hunter 1861.
—*Equus zebra*	Hunter 1861.
—*Equus burchelli*	44391.
—*Equus quagga*	Mentzer 1929.

TABLE 15

Cetacea	
Mysticeti	
Balaenidae	
—*Balaena mysticetus*	Hunter 1840.
Balaenopteridae	
—*Balaenoptera acutirostrata* (*B. rostrata*)	Hunter 1861. Eschricht 1849.
—*Megaptera longimana* (*M. boops*)	Carte and Macalister 1868. Eschricht 1849.
Odontoceti	
Platanistidae	
—*Platanista gangetica*	Anderson 1879.
Physeteridae	
—*Physeter catodon* (*P. macrocephalus*)	Hunter 1840.
Ziphiidae	
—*Ziphiorrhynchus cryptodon*(?)	Burmeister 1866.
—*Hyperoodon ampullatus* (*Delphinus bidens*)	Hunter 1861.
Delphinapteridae	
—*Delphinapterus leucas* (*Belugia catodon*)	Hepburn and Waterson 1901.
—*Monodon monoceros*	Hunter 1840. Turner 1899.
Delphinidae	
—*Neophocaena phocaenoides* (*Neomeris*)	Chi Ping 1926.
—*Phocaena phocaena* (*Delphinus*)	Hunter 1840.
—*Phocaena phocaena* (*P. communis*)	Huxley 1872. Hepburn and Waterson 1901.
—*Orca gladiator* (*Delphinus orca*)	Turner 1899.
—*Orcella brevirostris* (*Orcella*)	Anderson 1879.
—*Globiocephalus melaena* (*G. melas*)	Gulliver 1853. Turner 1868. Murie 1873. Weissberg 1932a.

TABLE 15—*Continued*

Cetacea (*continued*)	
Odontoceti (*continued*)	
Delphinidae (*continued*)	
−*Lagenorhynchus albirostris*	Weissberg 1932a.
−*Delphinus delphis*	Weissberg 1932a.
−*Tursiops truncatus* (*Delphinus tursio*)	Hunter 1861.
−*Tursiops truncatus* (*T. tursio*)	Weissberg 1932a.
−*Grampus griseus*	Weissberg 1932a.
+*Gramphidelphis risii* (*Globiocephalus risii*)	Williams 1838.
−*Gramphidelphis risii* (*Grampus rissoanus*)	Murie 1871b.

TABLE 16

Rodentia	
Aplodontiidae	
−*Aplodontia rufa*	Hall, MVZ 22623.
Sciuridae	
+*Sciurus vulgaris*	Crisp 1862. Rex 1888. Cuvier 1835.
−*Sciurus carolinensis*	Crisp 1862.
+*Sciurus carolinensis* (*S. cinereus*)	Hunter 1861.
−*Sciurus indicus* (*S. maximus*)	Cuvier 1835. Crisp 1862.
+*Tamias striatus*	15440. 15442.
+*Marmota marmota* (*Arctomys*)	Hunter 1861.
+*Marmota marmota* (*Arctomys alpinus*)	Crisp 1862. Macalister 1867.
+*Marmota monax* ("Marmottes de canada")	Cuvier 1835.
+*Citellus tridecemlineatus*	Higgins 1928.
+*Citellus suslicka* ("Spermophile souslick")	Cuvier 1835.
+*Glaucomys volans* (*Pteromys volucella*)	Yarrell 1831a.
+*Glaucomys volans* (*Sciuropterus volucella*)	Hunter 1861.
+*Glaucomys volans* (*Sciurus volucella*)	Crisp 1862.
+*Glaucomys volans* ("Hassapan")	Cuvier 1835.
−*Petaurista petaurista* ("Le grand ecruil volant de Java")	Cuvier 1835.
Castoridae	
+*Castor fiber*	Macalister 1867. Crisp 1862.
+*Castor canadensis*	Hunter 1861.
Heteromyidae	
−*Perognathus fallax*	16190.
Geomyidae	
−*Thomomys bottae*	Gorham 1936.
−*Geomys bursarius*	Gorham 1936.
Anomaluridae	
+*Anomalurus pelii*	Alston 1875.
+*Anomalurus fraseri*	Alston 1875.
Pedetidae	
−*Pedetes caffer*	Parsons 1898.
−*Pedetes caffer* (*Helamys capensis*)	Hunter 1861.
−*Pedetes caffer* (Forster's jerboa)	Cuvier 1835.
Myoxidae	
+*Muscardinus avellenarius*	Cuvier 1835. Macalister 1867.
+*Glis glis* ("loir")	Cuvier 1835.
+*Glis nitedula* (?) ("lerot")	Cuvier 1835.
Dipodidae	
+*Dipus saggita*	Hunter 1861. Macalister 1867. Duvernoy and Lereboullet 1840.

TABLE 16—*Continued*

Rodentia (*continued*)	
Dipodidae (*continued*)	
+*Dipus gerboa* (*D. mauritanicus*)	Duvernoy and Lereboullet 1840.
+*Jaculus loftusi*	42459.
+*Zapus hudsonius*	18804.
+*Zapus hudsonius* (*Dipus americanus*)	Cuvier 1835.
Spalacidae	
+*Myotalpa aspalax* (*Siphneus myospalax*)	Milne-Edwards 1874.
+*Spalax* sp.	Macalister 1867.
+*Spalax typhlus* (*Mus*)	Cuvier 1835.
+*Rhizomys badius*	Anderson 1879.
+*Rhizomys pruinosus*	
Muridae	
Cricetinae	
−*Cricetus cricetus*	Macalister 1867.
−*Cricetus cricetus* ("Hamster")	Cuvier 1835.
−*Cricetulus migratorius* (*Mus atticus*)	
−*Cricetulus migratorius* (*Mus accedula*)	
−*Cricetulus migratorius* (*Mus phaeus*)	
−*Cricetiscus sungarus* (*Mus*)	
*−*Reithrodontomys longicauda*	16173.
+*Peromyscus leucopus*	15484.
Lophiomyinae	
−*Lophiomys* sp.	Flower 1872.
Microtinae	
+*Arvicola amphibia*	Macalister 1867. Hunter 1861.
+*Dicrostonyx richardsonii* ("Lemming de la baie d'Hudson")	Cuvier 1835.
+*Ellobius talpinus* (*Mus*)	
+*Ondatra zibethicus* ("Ondatra")	
+*Ondatra zibethicus* ("Desman")	Hunter 1861.
+*Microtus ochrogaster*	15486.
Murinae	
−*Rattus norvegicus* (*Mus decumanus*)	Hunter 1861.
+*Pelomys fallax*	Peters 1852.
+*Mus musculus*	Crisp 1862. Hunter 1861.
+*Leggada bellus* (*Mus minimus*)	Peters 1852.
−*Apodemus agrarius* (*Mus*)	Cuvier 1835.
−*Micromys minutus* (*Mus*)	
+*Steatomys pratensis* (*S. edulis*)	Peters 1852.
+*Arvicanthis abyssinicus*	21302.
+*Arvicanthis barbarus* (*Mus*)	Duvernoy and Lereboullet 1840.
−*Otomys nyikae*	21274.
+*Otomys brantsii* (*Euryotis*)	Smith 1849.
Gerbillinae	
+*Meriones shawi* ("Gerbille de Shaw")	Cuvier 1835.
+*Meriones shawi* (*Gerbillus shawii*)	Duvernoy and Lereboullet 1840.
+*Gerbillus pygargus* ("Gerbille du Senegal")	Cuvier 1835.
+*Tatera leucogaster* (*Meriones*)	Peters 1852.
Hydromyinae	
−*Hydromys chrysogaster*	Windle 1887.
Bathyergidae	
+*Myoscalops argenteo-cinereus*	Peters 1852.
+*Bathyergus* sp.	Hunter 1861.
+*Georychus capensis* (*Orycterus*)	

* In one of four individuals the organ was present.

TABLE 16—*Continued*

Rodentia (*continued*)	
Hystricidae	
−*Hystrix cristata*	Parsons 1894.
+*Hystrix cristata*	Macalister 1867. Hunter 1861. Lesbre 1907.
+*Hystrix cristata* ("*Porc-epic*")	Cuvier 1835.
−*Hystrix africaeaustralis*	Peters 1852.
+*Acanthion javanicum* (*Hystrix javanica*)	Parsons 1894. Mivart 1882a.
Erethizontidae	
−*Erethizon dorsalis*	Mivart 1882a.
−*Coendou prehensilis* (*Hystrix*)	Macalister 1867. Cuvier 1835.
Dasyproctidae	
+*Dasyprocta aguti*	Macalister 1867. Crisp 1862. Jones 1834.
+*Dasyprocta antillensis* or *albida* (*D. cristata*)	Mivart and Murie 1866.
+*Myoprocta acouchy* (*Dasyprocta*)	Owen 1831. Hunter 1861.
Caviidae	
+*Cavia porcellus*	Hunter 1861. Macalister 1867. Higgins 1927.
+*Hydrochoerus hydrochaeris* (*H. capybara*)	Stark 1934. Macalister 1867. Hunter 1861. Crisp 1862.
+*Cuniculus paca* (*Coelogenys*)	Hunter 1861.
+*Cuniculus subniger* (*Coelogenys*)	Martin 1838a.
+*Dolichotis patagonica*	Beddard 1891.
Chinchillidae	
+*Chinchilla laniger* +*Lagidium viscaccia* (*Lagotis cuvieri*)	Bennet 1833.
+*Lagidium viscaccia* (*Lagostomus trichodactylus*)	Owen 1839.
Capromyidae	
+*Capromys pilorides* (*Isodon*)	Say 1822.
+*Capromys pilorides* (*C. fournieri*)	Owen 1832b. Cuvier 1835.
+*Capromys melanurus*	Kuhl 1820. Dobson 1884.
Octodontidae	
+*Octodon degus* (*O. cumingii*)	Martin 1836b.
−*Echimys* sp.	Cuvier 1835.
+*Pectinator spekii*	Peters 1871.
+*Ctenomys torquatus*	44813.
+*Myocastor coypus* (*Myopotomus*)	Martin 1835c.
Ctenodactylidae	
+*Ctenodactylus gundi* (*C. massonii*)	Yarrell 1831.
Petromyidae	
*−*Petromys typicus*	Smith 1849.
Thryonomyidae	
+*Thryonomys swinderianus* (*Aulacodus*)	Garrod 1873b.
Leporidae	
+*Lepus timidus*	Crisp 1862. Hunter 1861.
+*Lepus californicus*	Gorham 1936.
+*Oryctolagus cuniculus* (*Lepus*)	Hunter 1861.
Ochotonidae	
+*Ochotona princeps*	MVZ 22913.

* Smith figures the liver. No gall bladder is shown. He offers no discussion.

REFERENCES

Adams, A.

1859. Notes on the Scaly Ant-Eater Taken during Life and after Death. Proc. Zool. Soc. Lond., p. 133.

Allen, G. M.

1910. *Solenodon paradoxus.* Mem. Mus. Comp. Zool., **40**, No. 1, p. 46.

Alston, E. R.

1875. On *Anomalurus*, Its Structure and Position. Proc. Zool. Soc. Lond., p. 94.

1880. On *Antechinomys* and Its Allies. Proc. Zool. Soc. Lond., p. 457.

Anderson, J.

1872. Further Remarks on the Anatomy and External Characters of *Macacus brunneus.* Proc. Zool. Soc. Lond., p. 208.

1879. Anatomical and Zoological Researches; comprising an Account of the Two Expeditions to Western Yunnan in 1868 and 1875. London.

Arnback-Christie-Linde, R.

1907. Der Bau der Soricidae and ihre Beziehungen zu Andern Säugetieren. Morph. Jahrb., **36**, p. 509.

Beattie, J.

1927. The Anatomy of the Common Marmoset. Proc. Zool. Soc. Lond., p. 593.

Beddard, F. E.

1884. A Contribution to the Anatomy of *Scopus umbretta.* Proc. Zool. Soc. Lond., p. 543.

1884a. On Some Points in the Structure of *Hapalemur griseus.* Proc. Zool. Soc. Lond., p. 391.

1886. On Some Points in the Visceral Anatomy of *Chauna chavaria.* Proc. Zool. Soc. Lond., p. 178.

1886a. Note on the Syrinx and Other Points in the Anatomy of the Caprimulgidae. Proc. Zool. Soc. Lond., pp. 147–153.

1887. On the Anatomy of the Sondaic Rhinoceros. Trans. Zool. Soc. Lond., **12**, p. 183.

1888. On Some Points in the Visceral Anatomy of *Balaeniceps rex*, Bearing upon Its Affinities. Proc. Zool. Soc. Lond., p. 284.

1890. On *Photodilus badius*, with Remarks on Its Systemic Position. Ibis, p. 293.

1890a. On the Anatomy of *Podica senegalensis.* Proc. Zool. Soc. Lond., p. 425.

1891. Notes on the Anatomy of *Dolichotis patagonica.* Proc. Zool. Soc. Lond., p. 238.

1894. On the Anatomy of *Palamedea cornuta.* Proc. Zool. Soc. Lond., p. 536.

1895. On the Visceral and Structural Anatomy of *Cryptoprocta ferox.* Proc. Zool. Soc. Lond., p. 432.

1895a. On Some Points in the Anatomy of *Pipa americana.* Proc. Zool. Soc. Lond., p. 827.

1897. Notes on the Anatomy of a Manatee Lately Living in the Society's Gardens. Proc. Zool. Soc. Lond., p. 58.

1897a. Notes on the Anatomy of the Phaëthon. Proc. Zool. Soc. Lond., p. 288.

1898. The Structure and Classification of Birds. London.

1898a. On the Anatomy of the Australian Cuckoo, *Scythrops novae-hollandiae.* Proc. Zool. Soc. Lond., p. 44.

1900. Book of Whales. London.

1900a. On the Anatomy of *Bassaricyon alleni.* Proc. Zool. Soc. Lond., p. 665.

1901. Notes on the Broad-Nosed Lemur. Proc. Zool. Soc. Lond., pt. 1, p. 125.

1901a. On the Anatomy of the Radiated Fruit-Cuckoo, *Carpococcyx radiatus*. Ibis, pp. 200–214.

1903. On Some Points in the Anatomy, Chiefly of the Heart and Vascular System, of the Japanese Salamander. Proc. Zool. Soc. Lond., pt. 2, p. 298.

1903a. On the Trachea, Lungs, and Other Points in the Anatomy of the Hamadryad Snake, *Ophiophagus bungarus*. Proc. Zool. Soc. Lond., pt. 2, p. 319.

1904. Preliminary Note on Certain Points in the Anatomy of *Eryx*, and Other Boidae, Partly Indicative of Their Basal Position among the Ophidia. Ann. Mag. Nat. Hist., (7), **13**, p. 233.

1905. A Contribution to the Anatomy of the Frilled Lizard (*Chlamydosaurus kingi*) and Some Other Agamidae. Proc. Zool. Soc. Lond., pt. 1, p. 9.

1905a. Some Notes on the Anatomy of the Ferret-Badger. Proc. Zool. Soc. Lond., pt. 2, p. 24.

1906. Contributions to the Anatomy of the Ophidia. Proc. Zool. Soc. Lond., p. 32.

1906a. Contributions to the Knowledge of the Vascular and Respiratory Systems in the Ophidia. Proc. Zool. Soc. Lond., pt. 2, p. 518.

1907. Notes on the Anatomy of a Species of Frog of the Genus *Megalophrys*. Proc. Zool. Soc. Lond., pt. 1, p. 324.

1907a. Contributions to the Knowledge of the Anatomy of the Batrachian Family, Pelobatidae. Proc. Zool. Soc. Lond., pt. 2, p. 871.

1907b. Contributions to the Knowledge of the Systematic Arrangement and Anatomy of Certain Genera and Species of the Squamata. Proc. Zool. Soc. Lond., pt. 1, pp. 35–68.

1908. On the Musculature, and Other Points in the Anatomy of the Engystomatid Frog, *Breviceps verrucosus*. Proc. Zool. Soc. Lond., p. 11.

1908a. Some Notes on the Muscular and Visceral Anatomy of the Batrachian Genus, *Hemisus*. Proc. Zool. Soc. Lond., p. 894.

1908b. On the Anatomy of *Antechinomys*. Proc. Zool. Soc. Lond., p. 563.

1909. On Some Points in the Structure of the Lesser Ant-Eater. Proc. Zool. Soc. Lond., p. 691.

1909a. On Some Points in the Structure of *Galidea elegans*. Proc. Zool. Soc. Lond., p. 483.

BENHAM, W. B.

1899. Notes on the Internal Anatomy of *Notornis*. Proc. Zool. Soc. Lond., p. 88.

BENNETT, E. T.

1833. On the Chinchillidae. Trans. Zool. Soc. Lond., **1**, p. 51.

BLYTH, E.

1866. Anatomical Notes on *Batrachostomus*. Ibis, p. 357.

BOULART, M. R.

1900. Note sur les canaux biliares de l'emeu. Bul. Mus. d'Hist. Nat., **6**, p. 419.

BRADLEY, O. C.

1903. On the Abdominal Viscera of *Cercocebus fuliginosus* and *Lagothrix humboldti*. Proc. Roy. Soc. Edinburgh, **24**, p. 517.

BURLET, H. M. DE

1911. Uber die Aussern en Formverhaltnisse der Lëber der Faultiere. Morph. Jahrb., **43**, p. 477.

BURMEISTER, H.

1866. Preliminary Account of a New Cetacean Captured on the Shores of Buenos Aires. Ann. Mag. Nat. Hist., (3), **18**, p. 94.

BURNE, R. H.

1905. Notes on the Muscular and Visceral Anatomy of the Leathery Turtle. Proc. Zool. Soc. Lond., pt. 1, p. 291.

CARLSSON, A.

1900. Uber die systematische Stellung der *Nandinia binotata*. Zool. Jahrb., **13**, p. 521, Syst. Abt.

1904. Zur Anatomie des *Notoryctes typhlops*. Zool. Jahrb., **20**, p. 81, Anat. Abt.

CARTE, A. and MACALISTER, A.

1868. On the Anatomy of *Balaenoptera rostrata*. Phil. Trans. Roy. Soc., **158**, p. 251.

CHAPMAN, H. C.

1875. Observations on the Structure of a Manatee. Proc. Acad. Nat. Sci. Phila., p. 456.

1875a. On the Anatomy of the Giraffe. Proc. Acad. Nat. Sci. Phila., p. 401.

1875b. Post-Mortem Examination of an Elephant. Proc. Acad. Nat. Sci. Phila., p. 401.

1881. Observations upon the Hippopotamus. Proc. Acad. Nat. Sci. Phila., p. 126.

1887. Notes on the Anatomy of *Echidna histrix*. Proc. Acad. Nat. Sci. Phila., p. 334.

1900. Observations on *Hylobates leuciscus* and *Chiromys madagascariensis*. Proc. Acad. Nat. Sci. Phila., p. 414.

1902. Observations upon *Galeopithecus volans*. Proc. Acad. Nat. Sci. Phila., p. 241.

CHI PING

1926. On Some Parts of the Visceral Anatomy of the Porpoise, *Neomeris phocaenoides*. Anat. Rec., **33**, p. 24.

CLARK, W. E. LE GROS

1926. On the Anatomy of the Pen-tailed Tree-shrew (*Ptilocercus lowii*). Proc. Zool. Soc. Lond., 1926, pp. 1179–1309.

CLELAND, J.

1869. The Peritoneum of the Human Subject Compared to That of the Wombat. Journ. Anat. Physiol., p. 197, pl. 8.

COE, W. R. and KUNKEL, B. W.

1906. Studies on the California Limbless Lizard, *Anniella*. Trans. Conn. Acad., **12**, No. 3, p. 10.

COPE, E. D.

1898. Crocodilians, Lizards and Snakes of North America. Rep. U. S. Nat. Mus., p. 153.

CRISP, E.

1855. Some Points Relating to the Anatomy of the Tasmanian Wolf, and the Cape Hunting Dog. Proc. Zool. Soc. Lond., p. 189.

1862. On the Situation, Form, and Capacity of the Gall Bladder in the Vertebrata. Proc. Zool. Soc. Lond., p. 132.

1862a. On Some Points Relating to the Anatomy of the Humming Bird. Proc. Zool. Soc. Lond., p. 209.

CUVIER, G.

1835. De la vesicule du fiel et ses conduits. Lecons d'anatomie comparee. Vingtieme lecon. Tome 4, 2e partie, art. 3, p. 548.

DOBSON, G. E.

1881. Notes on the Anatomy of the Erinaceidae. Proc. Zool. Soc. Lond., p. 398.

1882. Monograph on the Insectivora. London.

1884. On the Myology and Viscera of *Capromys melanurus*. Proc. Zool. Soc. Lond., p. 233.

DUVERNOY, G. L. and LEREBOULLET, A.

1840. Notes et renseignements sur les animaux vertebres de l'Algerie.

EALES, N. B.

1929. The Anatomy of a Fetal African Elephant. Trans. Roy. Soc. Edinburgh, **66**, p. 216.

ESCHRICHT, D. F.

1849. Untersuchungen über die nordischen Wallthiere. Leipzig.

FLOWER, W. H.

1852. Notes on the Dissection of a Species of *Galago*. Proc. Zool. Soc. Lond., p. 74.

1862. Notes on the Anatomy of *Pithecia monachus*. Proc. Zool. Soc. Lond., p. 332.

1867. Notes on the Visceral Anatomy of *Hyomoschus aquaticus*. Proc. Zool. Soc. Lond., p. 958.

1869. On the Anatomy of *Proteles*. Proc. Zool. Soc. Lond., p. 489.

1870. On the Anatomy of *Ailurus fulgens*. Proc. Zool. Soc. Lond., p. 764.

1872. Lectures on the Comparative Anatomy of the Organs of Digestion. Medical Times and Gazette, Feb. 24–Dec. 11.

1875. On the Structure and Affinities of the Musk Deer. Proc. Zool. Soc. Lond., p. 172.

1880. On the Bush-Dog, *Icticyon venaticus*. Proc. Zool. Soc. Lond., p. 70.

FORBES, W. A.

1879. On the Anatomy of the African Elephant. Proc. Zool. Soc. Lond., p. 429.

1880. On the External Characters and Anatomy of the Red Uakari Monkey, *Brachyurus rubicundus*. Proc. Zool. Soc. Lond., p. 627.

1880a. On the Anatomy of *Leptosoma discolor*. Proc. Zool. Soc. Lond., p. 465.

1880b. Contributions to the Anatomy of the Passerine Birds—III. Proc. Zool. Soc. Lond., p. 389.

1881. On Some Points on the Anatomy of the Koala. Proc. Zool. Soc. Lond., p. 181.

1881a. Notes on the Anatomy and Systemic Position of the Jacanas. Proc. Zool. Soc. Lond., p. 639.

1882. Notes on the Gall Bladder, and Some Points in the Anatomy of the Toucans and Barbets. Proc. Zool. Soc. Lond., p. 94.

1882a. Report on the Anatomy of Petrels. Voyage H.M.S. *Challenger*. London, 1882.

FOX, H.

1923. Diseases in Captive Wild Animals and Birds. Philadelphia, p. 238.

1927. Autopsy Reports. Report of the Laboratory and Museum of Comparative Pathology of the Zoological Society of Philadelphia.

1929. Idem.

1930. Idem.

FUHRMANN, O.

1914. Le genre *Typhlonectes*. Neuchâtel Mém. Soc. Sci. Nat., **5**, p. 112.

GADOW, H.

1882. On Some Points in the Anatomy of *Pterocles*, with Remarks on Its Systematic Position. Proc. Zool. Soc. Lond., p. 312.

GARDON (GORDON?)

1787. In Buffon: Histoire naturelle de mammifères. Suppl., 7, p. 398.

GARROD, A. H.

1873. On the Visceral Anatomy of the Sumatran Rhinoceros, *Ceratorhinus sumatrensis*. Proc. Zool. Soc. Lond., p. 101.

1873a. Notes on the Anatomy of the Binturong. Proc. Zool. Soc. Lond., p. 199.

1873b. Notes on the Anatomy of the Ground-Rat, *Aulacodus swinderianus*. Proc. Zool. Soc. Lond., p. 786.

1874. On Some Points in the Anatomy of the Columbae. Proc. Zool. Soc. Lond., p. 249.

1875. On the Kangaroo Called *Halmaturus luctuosus*, by d'Albertis, and Its Affinities. Proc. Zool. Soc. Lond., p. 57.

1875a. Note on Two Pigeons, *Ianthaenas leucolaema*, and *Erythraenas pulcherrima*. Proc. Zool. Soc. Lond., pp. 367–368.

1876. On a Peculiarity in the Carotid Artery, and Other Points in the Anatomy of the Ground-Hornbill. Proc. Zool. Soc. Lond., p. 60.

1876a. On the Anatomy of *Aramus scolopaceus*. Proc. Zool. Soc. Lond., p. 275.

1876b. Notes on the Anatomy of *Plotus anhinga*. Proc. Zool. Soc. Lond., p. 335.

1877. Notes on the Visceral Anatomy and Osteology of Ruminants. Proc. Zool. Soc. Lond., p. 4.

1877a. Notes on the Anatomy of the Chinese Water-Deer, *Hydropotes inermis*. Proc. Zool. Soc. Lond., p. 793.

1877b. Notes on the Presence or Absence of the Gall Bladder in the Family of Parrots. Proc. Zool. Soc. Lond., p. 793.

1878. Notes on the Anatomy of *Tolypeutes tricinctus*. Proc. Zool. Soc. Lond., p. 228.

1878a. Notes on the Visceral Anatomy of *Lycaon pictus*, and of *Nyctereutes procyonides*. Proc. Zool. Soc. Lond., p. 374.

1879. Notes on the Visceral Anatomy of the Tupaia of Burma. Proc. Zool. Soc. Lond., p. 301.

1879a. Notes on the Anatomy of *Gelada rueppelli*. Proc. Zool. Soc. Lond., p. 455.

1879b. On the Brain and Other Parts of the Hippopotamus. Trans. Zool. Soc. Lond., 9, pt. 1, No. 3, p. 17.

1879c. Notes on the Anatomy of *Helictis subaurantiaca*. Proc. Zool. Soc. Lond., p. 305.

GARROD, A. H. and DARWIN, F.

1872. Notes on an Ostrich Lately Living in the Society's Gardens. Proc. Zool. Soc. Lond., p. 356.

GEOFFROY, C.

1803. Observations anatomique sur le crocodile du Nile. Ann. Mus. d'Hist. Nat., Paris, 2.

GRANDIDIER, A. and MILNE-EDWARDS, A.

1875. Histoire de Madagascar. Mammifères. Oiseaux.

GREGORY, W. K.

1910. The Orders of Mammals. Bull. Amer. Mus. Nat. Hist., 27, p. 403.

GULLIVER, G.

1853. Notes on a Cetaceous Animal Stranded on the North-East Coast of Ireland. Proc. Zool. Soc. Lond., p. 63.

GÜNTHER, A.
1858. On the Structure of *Rhinophrynus dorsalis*. Proc. Zool. Soc. Lond., p. 339.
1867. Contribution to the Anatomy of *Hatteria*. Phil. Trans. Roy. Soc., **157**, p. 622.

HALL, E. R.
1936. Personal Communication. Specimen in the Mus. Vert. Zool., Univ. Calif., Berkeley.

HASWELL, W. A.
1882. Notes on the Anatomy of Two Rare Genera of Pigeons. Proc. Linn. Soc., N. S. W., **7**, p. 115.

HEIN, S. A. A.
1915. Contributions to the Anatomy of *Monodon monoceros*. Verh. Kon. Akad. van Weten., Amsterdam, sec. 2, No. 4, pp. 17–27.

HEPBURN, D. and WATERSON, D.
1901. The Alimentary Viscera of the Porpoise. Trans. Roy. Soc. Edinburgh, **40**, p. 313.

HIGGINS, G. M.
1927. On the Extra-Hepatic Biliary Tract in the Guinea Pig. Anat. Rec., **36**, p. 129.
1928. The Extra-Hepatic Biliary Tract of the Striped Gopher. Anat. Rec., **37**, p. 287.

HILL, W. C. O.
1926. A Comparative Study of the Pancreas. Proc. Zool. Soc. Lond., p. 591.

HUNTER, J.
1840. Observations on Certain Parts of Animal Oeconomy, with Notes by Richard Owen. Philadelphia, p. 334.
1861. John Hunter's Essays and Observations. Compiled by Sir Richard Owen. London.

HUXLEY, J.
1872. The Anatomy of Vertebrated Animals. London.

JAEGER, H. F.
1837. Anatomische Untersuchung des *Orycteropus capensis*, p. 19.

JEPSON, G. L.
1932. *Tubulodon taylori*, a Wind River Eocene Tubulidentate from Wyoming. Proc. Amer. Phil. Soc., **71**, p. 255.

JOLY, N. and LAVOCAT, A.
1845. Recherches historiques, zoologiques, anatomiques, et paléontologiques, sur la girafe. Mém. Soc. Mus. d'Hist. Nat. Strasbourg, **3**.

JONES, R.
1834. Notes on the Dissection of an Agouti. Proc. Zool. Soc. Lond., p. 83.
1834a. Notes on the Dissection of Azara's Opossum. Proc. Zool. Soc. Lond., p. 101.

KOLLMAN, M.
1912. Anomalie des voies biliares chez un tortue, *Clemmys leprosa*. Bull. Soc. Zool. France, **37**, p. 103.

KUHL, H.
1820. Beitrage zur Zoologie und vergleichenden Anatomie. Abt. 2, pp. 3–126. Frankfurt-am-Main.

LANDER, K. F.

1919. Some Points on the Anatomy of the Takin. Proc. Zool. Soc. Lond., p. 211.

LESBRE, F. X.

1907. Contribution a l'anatomie du porc-epic commun (*Hystrix cristata*). Archiv. Mus. d'Hist. Nat. Lyon, Mém. 3, **9**, p. 43.

LINBACK, P.

1933. Chapter on Digestive System, in "Anatomy of the Rhesus Monkey," by Hartman and Strauss, p. 223. Baltimore.

LONNBERG, E.

1900. On the Soft Anatomy of the Musk-Ox. Proc. Zool. Soc. Lond., p. 154.

1909. Contributions to the Knowledge of the Anatomy of the Ruminants. Arkiv Zool., **5**, No. 10.

1912. Anatomical Notes on Mammals Obtained in B. E. A. by the Swedish Zoological Expedition of 1911. Sven. Vetenskap. Akad. Handl., **49**, No. 7.

MACALISTER, A.

1867. Contributions to the Comparative Anatomy and Physiology of the Gall Bladder. Medical Press, **4**, p. 129.

1873. A Monograph on the Anatomy of *Chlamydophorus truncatus*, with Notes on the Structure of Other Species of Edentata. Trans. Roy. Irish Acad., **25**, p. 274.

MACKENZIE, W. C.

1918. The Liver, Spleen, Pancreas, Peritoneal Relations, and Biliary System in Monotremes and Marsupials. Melbourne.

1936. Personal communication.

MARTIN, W. C. L.

1830. On the Anatomy of *Testudo indica*. Proc. Zool. Soc. Lond., p. 47.

1830a. On the Anatomy of *Testudo graeca*. Proc. Zool. Soc. Lond., p. 63.

1830b. On the Anatomy of the Alligator Tortoise. Proc. Zool. Soc. Lond., p. 129.

1831. On the Anatomy of the Ruffed-Lemur. Proc. Zool. Soc. Lond., p. 58.

1832. On the Anatomy of the Jaguar. Proc. Zool. Soc. Lond., p. 7.

1833. Notes on the Dissection of a Squirrel Monkey. Proc. Zool. Soc. Lond., p. 88.

1833a. Notes on the Dissection of a Puma. Proc. Zool. Soc. Lond., p. 120.

1833b. Notes on the Dissection of a Pekan. Proc. Zool. Soc. Lond., p. 97.

1834. Notes on the Dissection of a Mangue. Proc. Zool. Soc. Lond., p. 114.

1834a. Notes on the Dissection of Azara's Opossum. Proc. Zool. Soc. Lond., p. 101.

1835. Notes on the Dissection of a Cape Hyrax. Proc. Zool. Soc. Lond., p. 15.

1835a. Notes on the Dissection of a Red-Backed Pelican. Proc. Zool. Soc. Lond., p. 16.

1835b. Notes on the Dissection of *Crocodilus leptorhynchus*. Proc. Zool. Soc. Lond., p. 129.

1835c. Visceral and Osteological Anatomy of the Coypus. Proc. Zool. Soc. Lond., p. 174.

1836. Notes on the Visceral and Osteological Anatomy of the Cariama. Proc. Zool. Soc. Lond., p. 29.

1836a. Notes on the Anatomy of Buffon's Touraco. Proc. Zool. Soc. Lond., p. 32.

1836b. Notes on the Dissection of the Chilean Bush-Rat. Proc. Zool. Soc. Lond., p. 71.

1838. On a New Genus of Insectivorous Mammal. Trans. Zool. Soc. Lond., **2**, p. 249.

1838a. On the Visceral Anatomy of the Spotted Cavy. Proc. Zool. Soc. Lond., p. 54.

MATTHEW, W. D.

1909. The Carnivora and Insectivora of the Bridger Basin. Mem. Amer. Mus. Nat. Hist., **9**, p. 291.

MENTZER, S. H.

1929. Comparative Anatomy of the Biliary System. Calif. and Western Med., **30**, p. 315.

MILLER, G. S.

1923. List of North American Recent Mammals. Bull. U. S. Nat. Mus., No. 128, p. 500.

MILNE-EDWARDS, H. and A.

1874. Recherches des mammifères. Paris, p. 118.

MITCHELL, C.

1895. On the Anatomy of *Chauna chavaria*. Proc. Zool. Soc. Lond., p. 351.

1913. Observations on the Anatomy of the Shoebill, and Allied Birds. Proc. Zool. Soc. Lond., p. 644.

MIVART, ST. G.

1881. The Cat. London.

1882. Notes on Some Points in the Anatomy of the Aeluroidea. Proc. Zool. Soc. Lond., p. 459.

1882a. Notes on the Anatomy of *Erethizon dorsatus*. Proc. Zool. Soc. Lond., p. 271.

MIVART, ST. G. and MURIE, J.

1865. On the Anatomy of *Nycticebus*. Proc. Zool. Soc. Lond., p. 255.

1866. On the Anatomy of the Crested Agouti. Proc. Zool. Soc. Lond., p. 386.

MURIE, J.

1865. Notes on a Spider Monkey Lately Living in the Society's Menagerie. Proc. Zool. Soc. Lond., p. 740.

1866. Supplementary Notes on the Red Monkey. Proc. Zool. Soc. Lond., p. 382.

1867. On the Female Generative Organs, Viscera and Fleshy Parts of *Hyaena brunnea*. Trans. Zool. Soc. Lond., **7**, p. 507.

1867a. On the Dermal and Visceral Structures of the Kagu, Sun-Bittern, and Boatbill. Trans. Zool. Soc. Lond., **7**, p. 465.

1867b. On the Cause of Death of the Sea-Bear Lately Living in the Society's Gardens. Proc. Zool. Soc. Lond., p. 244.

1868. Researches on the Anatomy of the Pinnipedia. Trans. Zool. Soc. Lond., **7**, p. 528.

1870. On the Form and Structure of the Manatee. Trans. Zool. Soc. Lond., **8**, p. 129.

1870a. Researches on the Anatomy of the Pinnipedia. Pt. 2. Trans. Zool. Soc. Lond., **7**, p. 411.

1870b. On the Anatomy of the Prongbuck. Proc. Zool. Soc. Lond., p. 350.

1870c. On the Saiga Antelope. Proc. Zool. Soc. Lond., p. 451.

1871. On the Viscera and Sternum of Pell's Owl. Journ. Anat. Phys., **6**, p. 170.

1871a. On Risso's Grampus. Journ. Anat. Phys., **6**, p. 115.

1871b. On the Malayan Tapir. Journ. Anat. Phys., **6**, p. 131, pl. 9.

1872. Observations on the Macaques. Proc. Zool. Soc. Lond., pp. 727, 784.

1872a. On the Habits, Structure, and Relations of the Three-Banded Armadillo. Trans. Linn. Soc. Lond., **30**, p. 71.

1872b. On the Horns, Viscera, and Muscles of the Giraffe. Ann. Mag. Nat. Hist., (4), **9**, p. 177.

1872c. On the Anatomy of the Indian Wild Dog. Proc. Zool. Soc. Lond., p. 718.

1873. On the Organization of the Caaing Whale. Trans. Zool. Soc. Lond., **8**, p. 235.

NEUVILLE, M. H.

1897. Sur le fois des quelques antilopes. Bull. Mus. d'Hist. Nat., **2**, p. 22.

1914. Sur le fois des girafes. Bull. Mus. d'Hist. Nat., **20**, p. 208.

OSGOOD, W. H.

1921. A Monographic Study of the American Marsupial, *Caenolestes*. Field Mus. Nat. Hist., Zool. Ser., **14**, p. 73.

OWEN, R.

1830. On the Anatomy of the Orang-Utan. Proc. Zool. Soc. Lond., p. 4.

1831. On the Anatomy of the Acouchy. Proc. Zool. Soc. Lond., p. 75.

1831a. On the Anatomy of the Nine-Banded Armadillo. Proc. Zool. Soc. Lond., p. 141.

1831b. On the Anatomy of the Male Suricate. Proc. Zool. Soc. Lond., p. 51.

1831c. On the Anatomy of the Weasel-Headed Armadillo. Proc. Zool. Soc. Lond., p. 154.

1831d. On the Anatomy of the Crocodile. Proc. Zool. Soc. Lond., p. 169.

1832. On the Anatomy of the Cape Hyrax. Proc. Zool. Soc. Lond., p. 205.

1832a. On the Anatomy of *Cercopithecus albogularis*. Proc. Zool. Soc. Lond., p. 18.

1832b. On the Anatomy of *Capromys fournieri*. Proc. Zool. Soc. Lond., p. 69.

1833. On the Anatomy of the Concave Hornbill. Proc. Zool. Soc. Lond., p. 102.

1833a. Descriptive and Illustrated Catalogue of the Physiological Series of Comparative Anatomy Contained in the Museum of the Royal College of Surgeons in London.

1834. On the Anatomy of the Purple-Crested Touraco. Proc. Zool. Soc. Lond., p. 3.

1838. On the Anatomy of the Southern Apteryx. Trans. Zool. Soc. Lond., **2**, p. 270.

1838a. On the Anatomy of the Dugong. Proc. Zool. Soc. Lond., p. 29.

1838b. Notes on the Anatomy of the Nubian Giraffe. Trans. Zool. Soc. Lond., **2**, p. 217.

1839. On the Anatomy of the Bischacha. Proc. Zool. Soc. Lond., p. 175.

1846. Lectures on the Comparative Anatomy and Physiology of Vertebrate Animals. Pt. I, Fishes. London.

1850. On the Anatomy of the Indian Rhinoceros. Trans. Zool. Soc. Lond., **4**, p. 44.

1851. On the Anatomy of the Wart-Hog. Proc. Zool. Soc. Lond., p. 67.

1852. Notes on the Anatomy of the Tree Kangaroo. Proc. Zool. Soc. Lond., p. 102.

1854. On the Anatomy of the Great Ant-Eater. Proc. Zool. Soc. Lond., p. 155.

1866. Anatomy of Vertebrates. 3 vols. London.

1866a. On the Aye-Aye. Trans. Zool. Soc. Lond., **5**, p. 73.

PARKER, W. N.

1882. On Some Points in the Anatomy of the Indian Tapir. Proc. Zool. Soc. Lond., p. 771.

PARSONS, F. G.

1894. On the Anatomy of *Atherura africanus*, Compared with That of Other Porcupines. Proc. Zool. Soc. Lond., p. 684.

1898. On the Anatomy of the African Jumping-Hare, *Pedetes caffer.* Proc. Zool. Soc. Lond., p. 858.

1903. On the Anatomy of the Pig-Footed Bandicoot. Journ. Linn. Soc. Lond., **29**, p. 77.

PETERS, W.

1852. Reise nach Mossambique. Berlin.

1861. De serpentum familia Uropeltaceorum. Berlin.

1871. Contributions to the Knowledge of *Pectinator.* Trans. Zool. Soc. Lond., **7**, p. 397.

POCOCK, R. I.

1918. On Some of the External Characters of the Ruminant Artiodactyla. Ann. Mag. Nat. Hist., (9), **1**, p. 429.

RAPP, W. L.

1852. Anatomische Untersuchungen über die Edentaten. 2nd ed.

RAVEN, H. C.

1936. Personal communication. Specimens in the American Museum of Natural History.

REID, J.

1835. Anatomical Description of the Patagonian Penguin. Proc. Zool. Soc. Lond., p. 132.

REX, H.

1888. Beitrage zur Morphologie der Säugerleber. Morph. Jahrb., **14**, p. 566.

ROBIN, H. A.

1881. Recherches anatomiques sur des mammifères de l'ordre des Chiropteres. Ann. Sci. Nat., (6), **12**, art. 2.

ROMER, A. S.

1936. Vertebrate Paleontology, p. 366, 2nd ed. Chicago.

ROTHSCHILD, W.

1900. A Monograph of the Genus *Casuarius*, with a Dissertation on the Morphology and Phylogeny of the Paleognathae and Neognathae by W. P. Pycraft. Trans. Zool. Soc. Lond., **15**, p. 109.

RUGE, G.

1902. Die aussern Formverhaltnisse der Lëber bei den Primaten. Eine vergleichend-anatomische Untersuchung. II. Die Lëber der Halbaffen. Morph. Jahrb., **29**, pp. 450–552.

1902a. Idem, III. Die Lëber der platyrrhinen Westaffen. Morph. Jahrb., **30**, pp. 42–84.

1906. Idem, IV. Die Lëber der Ostaffen-Simiae Catarrhinae. A. Lëber der Cercopithecidae. Morph. Jahrb., **35**, pp. 75–239.

1906a. Idem, V. Die Lëber der Hylobatidae und Anthropomorphae. Morph. Jahrb., **36**, pp. 93–275.

SAY, T.

1822. On a Quadruped Belonging to the Order Rodentia. Journ. Phila. Acad., (1), **2**, p. 332.

SCHMIDT, C. R. and IVY, A. C.

1937. Journ. Cell. and Comp. Physiol., **10**, 365.

SCHRIEBER, H.

1932. Die Bauchorgane der Primaten. Morph. Jahrb., **69**, p. 221.

SEABRA, A. F.

1901. Algumas observacoes sobre a anatomia do *Potomogale velox.* Journ. Sci. Lisboa, (2a), **6**, pp. 145–149.

SHUFELDT, R. W.

1887. Notes on the Visceral Anatomy of Certain Auks. Proc. Zool. Soc. Lond., p. 43.

1890. Contributions to the Anatomy of *Heloderma suspectum.* Proc. Zool. Soc. Lond., p. 148.

SMITH, A.

1849. Illustrations of the Zoology of South Africa.

SONNTAG, C. F.

1921. The Comparative Anatomy of the Koala, and the Vulpine Phalanger. Proc. Zool. Soc. Lond., p. 567.

1921a. A Contribution to the Anatomy of the Three-Toed Sloth. Proc. Zool. Soc. Lond., p. 157.

1922. On the Anatomy of the Drill. Proc. Zool. Soc. Lond., p. 429.

1923. On the Anatomy, Physiology, and Pathology of the Chimpanzee. Proc. Zool. Soc. Lond., p. 376.

1924. The Morphology and Evolution of the Apes and Man. London.

1924a. On the Anatomy, Physiology, and Pathology of the Orang-Outan. Proc. Zool. Soc. Lond., p. 395.

1925. A Monograph on *Orycteropus afer.* Proc. Zool. Soc. Lond., p. 406.

STARK, D.

1934. Uber den feineren Bau der Lebervenen von *Hydrochoerus capybara.* Anat. Anz., **78**, p. 242.

STELLER, G. W.

1749. De Bestiis Marinis, etc. Novi Commetarii Academiae Scientiarum Imperialis Petropolitanae. Tome 2. (Translated by W. and J. C. Miller, in Jordan: Fur Seals and Fur Seal Islands of the North Pacific Ocean, Washington, pt. 3, p. 194, 1899.)

THOMPSON, J. C.

1913. Contributions to the Anatomy of the Ophidia. Proc. Zool. Soc. Lond., p. 14.

TURNER, W.

1868. A Contribution to the Anatomy of the Pilot Whale. Journ. Anat. Phys., **2**, p. 66.

1899. Additional Observations on the Stomach in the Ziphoid and Delphinoid Whales. Journ. Anat. Phys., **23**, pp. 470–492.

WATSON, M. and YOUNG, A.

1879. On the Anatomy of the Elk. Journ. Linn. Soc. Lond., **14**, p. 371.

1879a. On the Anatomy of *Hyaena crocuta.* Proc. Zool. Soc. Lond., p. 79.

WEBER, M. and BURLET, H. M. DE

1927. Die Säugetiere. 2nd ed., **1**. Jena.

WEISSBERG, H.

1932. Das Pankreas und die grossen Gallengange von *Hippopotamus amphibius.* Morph. Jahrb., **71**, p. 462.

1932a. Beitrage zur Anatomie einiger Cetaceen. Morph. Jahrb., **71**, pp. 97–157.

WILLIAMS, S. W.

1838. Notices of Some of the Specimens of Natural History Which Were Collected During the Voyage of the *Morrison* to Lewchew and Japan. The Chinese Repository, **6**, No. 9, pp. 411–414.

WINDLE, B. C. A.

1887. On the Anatomy of *Hydromys chrysogaster.* Proc. Zool. Soc. Lond., p. 63.

WISLOCKI, G. B.

1928. Observations on the Gross Microscopic Anatomy of the Sloths. Journ. Morph., **46**, p. 345.

WOOLLARD, H. H.
1925. The Anatomy of *Tarsius spectrum*. Proc. Zool. Soc. Lond., p. 1071.

YARRELL, W.
1831. Notes on *Ctenodactylus massonii*. Proc. Zool. Soc. Lond., p. 49.
1831a. On the Anatomy of the Lesser American Flying Squirrel. Proc. Zool. Soc. Lond., p. 38.

YOUNG, C. G.
1888. On the Habits and Anatomy of *Opisthocomus cristatus*. Notes from Leyden Mus., **10**, p. 170.