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FOR THE PEOPLE

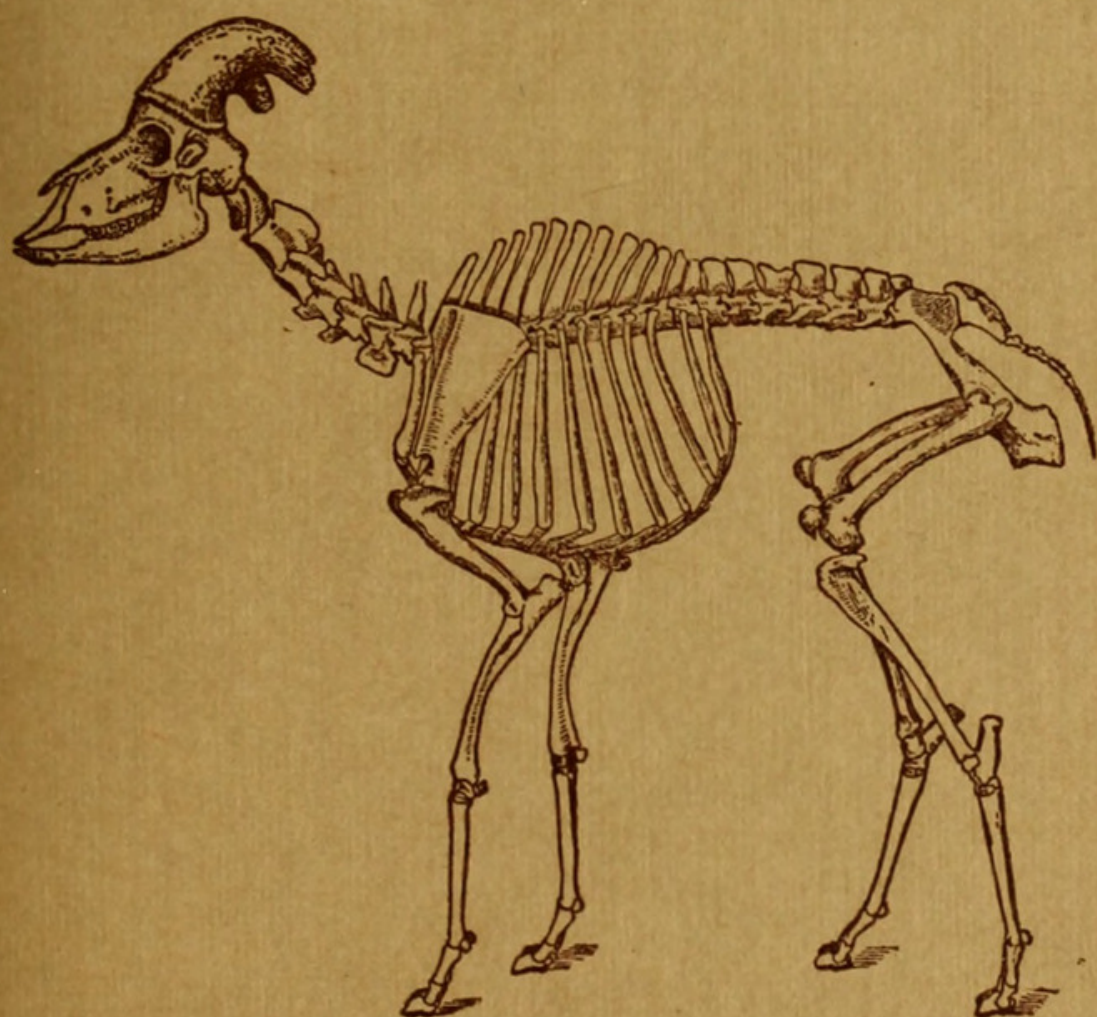
FOR EDUCATION

FOR SCIENCE



THE AMERICAN MUSEUM OF NATURAL HISTORY

# THE PREPARATION OF ROUGH SKELETONS



By FREDERIC A. LUCAS

GUIDE LEAFLET SERIES, No. 59



## NOTE

These leaflets are intended to furnish accurate information in regard to the preparation of specimens of various kinds for Museum purposes.

The following have been issued and may be purchased at the sales booth or from the Librarian; others are in the course of preparation;

**The Capture and Preservation of  
Small Mammals for Study**

By H. E. Anthony. Price 15 cents

**The Preparation of Birds for Study**

By James P. Chapin. Price 15 cents

**How to Collect and Preserve Insects**

By Frank E. Lutz. Price 16 cents

**The Preparation of Rough Skeletons**

By Frederic A. Lucas. Price 10 cents

**Suggestions to Collectors of  
Reptiles and Amphibians**

May be had on application to the Curator,  
Department of Herpetology

**Brief Directions for Preparing Skins  
of Large Mammals**

May be had on application to the Curator of Mammals



# THE PREPARATION OF ROUGH SKELETONS

BY FREDERIC A. LUCAS

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## INTRODUCTORY

### Why Skeletons are Needed

The skeleton is the best, and most enduring evidence we have, of any animal's place in nature and its relationships with other animals: it is also the solution of a problem in mechanics, that of carrying a given weight and of adaptation to some particular mode of life. So the skeleton not only indicates the group of animals to which its owner belongs, but also tells of his mode of life, for it varies, or is modified, according as a creature dwells on land, lives underground, or in the water, walks, swims or flies; feeds on grass, catches insects, or preys upon its fellows. Skeletons, therefore, are not only necessary for the student of the life of to-day, but to the palæontologist, for the life of the past can only be interpreted by comparison with that of the present; also the modern taxidermist needs the skeleton to aid him in the proper mounting of animals, especially mammals.

It is not always convenient or even practicable to collect skeletons, especially of large animals, and in such cases skulls are always welcome; this is particularly true of such large reptiles as crocodiles and turtles.

These directions for preparing rough skeletons, based on twenty years experience, were drawn up some thirty years ago and printed as one of a series of instructions for collectors issued by the U. S. National Museum. They are now, by permission, reprinted here with a few trifling changes. They have been divided into sections, in order that the collector might turn at once to the portion bearing directly on the



subject in hand. The general directions for mammals, however, apply with more or less force to all skeletons.

The extent to which these instructions can be followed will of necessity depend largely on circumstances. It is not to be expected that a collector working in the field would use the same time and care as one residing on the spot or located for some time at one place, but as one well prepared, *perfect* skeleton is worth more than half a dozen mutilated specimens, a little time spent in the work of roughing out and packing will be well repaid.

### Identification of Specimens

It is, of course, extremely important to know the correct name of every skeleton, and whenever possible this should be attached to the specimen, but it is a mere waste of valuable time to endeavor to identify specimens in the field.

When the animal is unknown, its skin, roughly taken off, should be kept, or the skin of another specimen should be prepared in the usual manner, in order that it may serve as a means of identifying the skeleton.

### Labeling

The best method is to have a series of numbers, stamped on pure sheet tin, and provided with a string for tying them to specimens, the numbers being recorded in a notebook.

Unfortunately these tin numbers are not always to be had, and a very good substitute may be made by cutting Roman numbers on a block of wood, or even notches on a stick.

If labels are used let them be of good stout manila, as thin paper is apt to be torn or defaced.

Do not use wire of any kind to fasten tin or lead numbers to specimens that are to go in alcohol or brine, for this sets up a galvanic action which results disastrously.



### **Selection of Specimens—Fractures**

Where time allows, select a series of skeletons of different ages; but where only one skeleton can be prepared, choose a fully grown, adult animal, as free as possible from fractures. If an animal is shot or trapped it is impossible to avoid breaking some bones, and such must be allowed to pass, but where it has been beaten to death, fracturing the skull and limb bones generally, the animal had better be thrown away at once.

If the skull alone is broken, select if possible another of the same size and send *both* with the body. When convenient send with a broken leg or wing another of the same size, but on no account throw away the fractured limb.

Do not neglect any animal simply because it is common, for a common species may be anatomically important.

### **Tools**

A knife and a pair of scissors are all that are absolutely necessary, but if these can be supplemented by one or two steel scrapers, the work will be greatly facilitated.

### **“Roughing Out”—Mammals**

If an animal is rare, the skin should be very carefully taken off and preserved; otherwise, remove the skin roughly and disembowel the specimen, taking care not to cut into the breastbone, especially the disk-shaped piece of cartilage in which it ends. Animals destined for skeletons should *on no account* be split up the breast as though they were being dressed for market.

Detach the legs from the body and remove the flesh, taking care in so doing not to remove the collar bone or kneecap with the meat. In the cat family the collar bone is very small, and lies loose in flesh between the shoulder blade and front end of the breastbone. The collar bone of weasels is



very minute and difficult to find, while, on the other hand, climbing and burrowing animals usually have this bone well developed, uniting the shoulder blade with the breastbone.

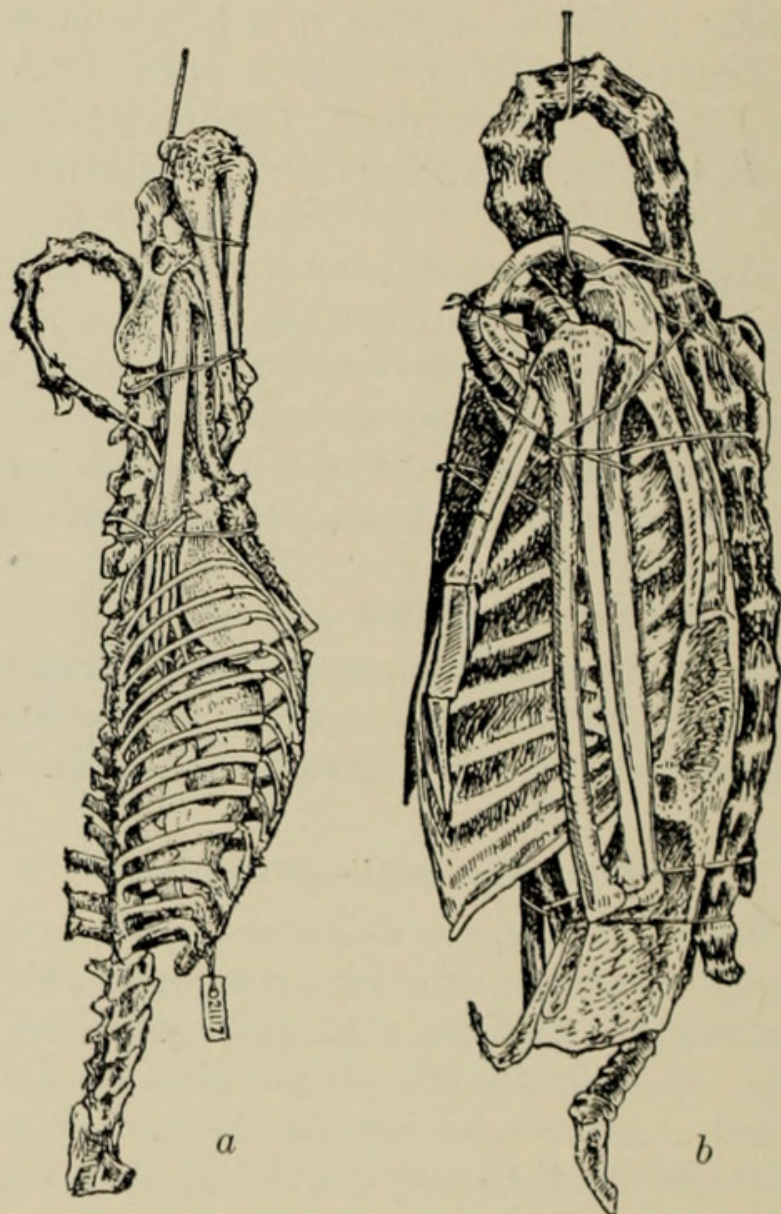


Fig. 1.—*a*, Skeleton of Fox ready for packing.  
*b*, Skeleton of a bird ready for packing.

Deer, antelopes, bears, and seals have no collar bone.

In small quadrupeds it will be unnecessary to detach the legs, but, whenever convenience in roughing out or packing



renders this needful, cut the collar bone loose from the breastbone and leave it fastened to the shoulder blade.

The legs being finished, disjoint and clean the skull. Be careful in removing the eyes not to thrust the point of the knife through the thin portion of the skull back of them and in deer, antelopes, or other ruminants, take care not to break through the thin bone back of the upper teeth. Also be careful not to cut off any projections of bone.

Remove as much of the brain as possible with a scraper, bent wire, or small stick.

In cleaning the ribs take care not to cut the cartilages joining them to the breastbone, and, when the tail is reached, look for a few little bones projecting downwards from the first few vertebræ.

Fold the legs snugly along the body, or, if they have been detached, tie them together with the skull on the under side, as much as possible within the chest cavity; also turn down the tail and tie it upon itself. See cut on page 4.

Roll up in a bit of rag and fasten *securely* to one of the long bones any bones which may have been detached or any splinters from a broken bone.

Hang the skeleton to dry in the shade, where it will escape dogs, cats, and rats. In this as in many other particulars the collector will necessarily be governed by circumstances, for in moist climates, or on shipboard, it may be needful to dry specimens in the sun, or even by the aid of a fire.

Lastly, in case a small skeleton is likely to be some time on the road, give it a very thin coat of arsenical soap to preserve it from the attacks of *Dermestes* and other insects.

On *short* collecting trips the poisoning may be omitted and the specimens treated when they reach their destination, but where small skeletons are to lie for some time uncared for, they should be poisoned, otherwise they may arrive in a very much mixed and dilapidated condition.



The breastbones of large animals should also be well poisoned.

The *best* method of poisoning small specimens is to dissolve arsenic in hot water, and when the solution is cold soak the skeletons in it for an hour or so. All the small rough skeletons stored in museum collections, as well as those in the stock of dealers in natural history material, are or should be thus

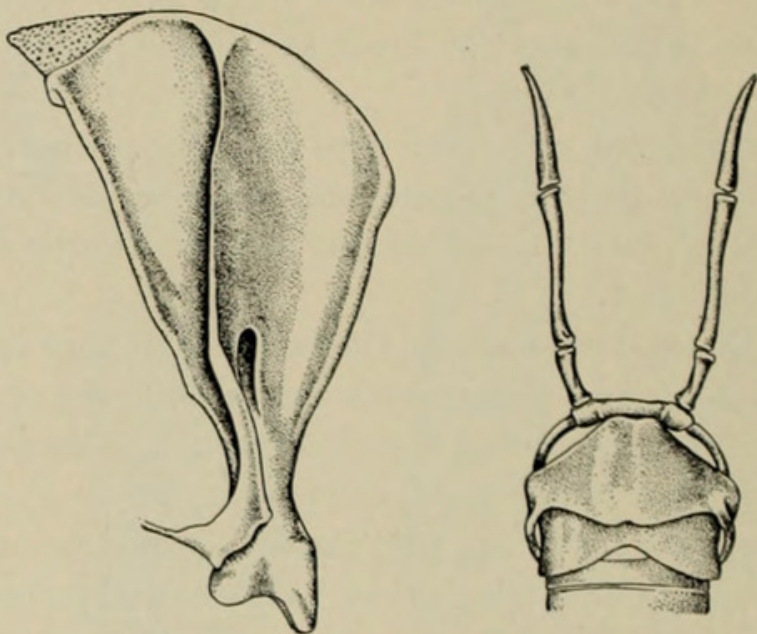


Fig. 2. — **Tongue bones or hyoid of a Dog.**

Fig. 3. — **Right shoulder blade of a Rabbit.**

Showing the backwardly projecting process.

treated. The addition of a little washing soda will cause water to take up much more arsenic than it otherwise would.

Should any of these small specimens be needed for disarticulated skeletons the arsenic can be extracted by soaking in a hot solution of washing soda.

### Special Points

Embracing the upper part of the windpipe and connecting it with the base of the skull is a series of bones known as the hyoid apparatus. This should be carefully saved. See cut.



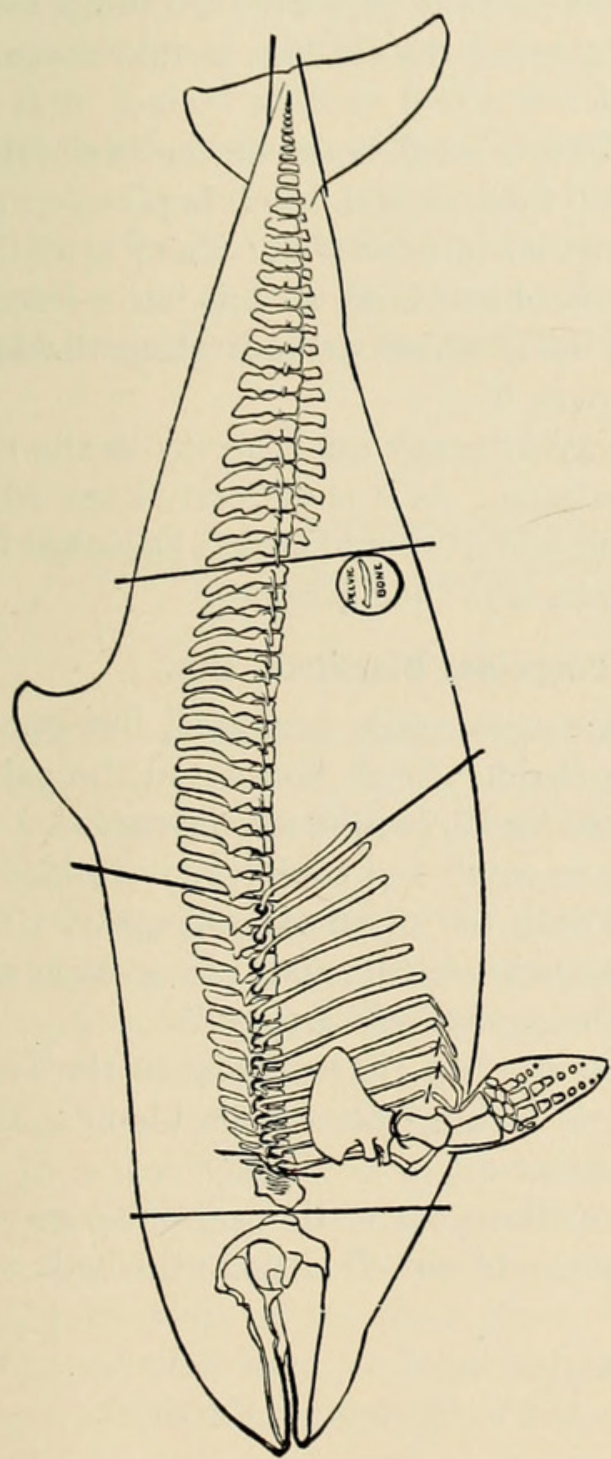


Fig. 4. — **Skeleton of a Porpoise.**

The lines show where the cuts should be made in dividing the skeleton

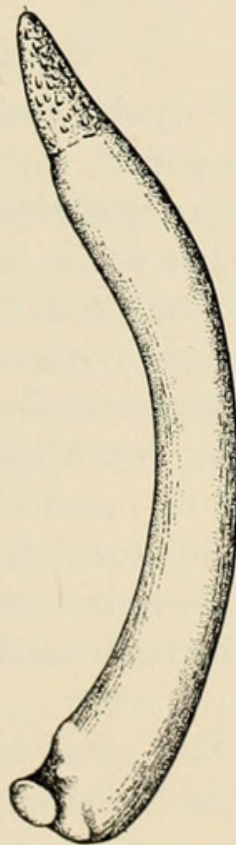


Fig. 5. — **Pelvic bone, natural size of a Porpoise (Tursiops).**



There are usually small bones, termed sesamoids, embedded in the tendons, where they play over the under sides of the toes, and on this account the tendons should never be cut off close to the bone.

There are often one or two small bones on the back lower portion of the thigh bone; these should be left in place.

In preparing the skeletons of rabbits particular attention should be given to the shoulder blade, as this has a slender projection at the lower end, which extends some distance backward. See cut on page 6.

The male organ of a great many quadrupeds, as the raccoon, is provided with a bone. As it is difficult to say when this may or may not be present, it should always be looked for, and when found left attached to the hip bones.

#### **Cetaceans: Porpoises Blackfish, Etc.**

Porpoise skeletons are very easily prepared, but one or two points, such as the slender cheek bones and the pelvic bones or rudimentary hind limbs, require special care.

The pelvic bones are so small and so deeply imbedded in the flesh that they are only too often thrown away. The accompanying cuts show their location and their average size in a specimen 7 or 8 feet long. See cut on page 7.

It often happens that the last rib lies loose in the flesh, with its upper end several inches from the backbone. This should always be looked for.

There are no bones in the *sides* of the tail or flukes nor in the back fin, and they can be cut off close to the body and thrown away.

The hyoid is largely developed in most cetaceans, and will be found firmly attached to the base of the skull.

#### **Birds**

In preparing a bird for a skeleton a little more care must be used than is necessary with a quadruped, the bones being lighter and more easily cut or broken.



The wings terminate in very small, pointed bones, and there is a similar bone—corresponding to the thumb of mammals—hidden in a tuft of feathers on the bend of the wing.

It is a good plan to leave this tuft untouched, as well as the outermost two or three wing feathers, so as to lessen the risk of removing any of these little bones with the skin.

Other parts requiring special attention are the slender points on the under side of the neck vertebræ, those projecting backward from the ribs, and the last bone of the tail.

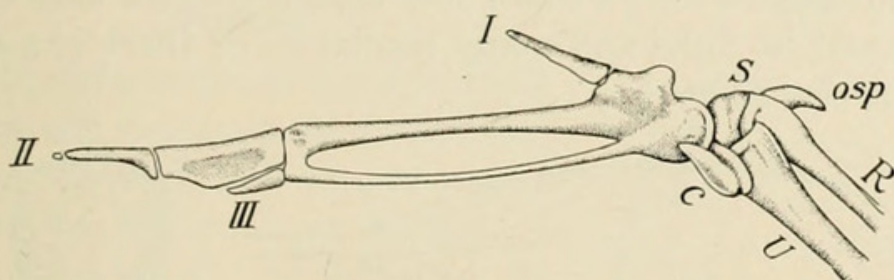


Fig. 6. — **Portion of right wing of Great Horned Owl.**

Seen from below. *R.* Radius; *U*, Ulna; *I, II, III*, First, second, and third fingers; *s*, Radiale; *c*, Ulnare; *osp.* Os prominens.

It frequently occurs in birds that many of the tendons become ossified, as they do in the leg of a turkey. Look out for such on the under side of the neck, in the legs and wings, and along the sides of the back, and do not tear off the muscles as you would if preparing a skin.

In many, possibly most birds, the neck and back can be left untouched, as the muscles will dry up and a thin coat of arsenical soap will serve to keep out the *Dermestes* which would otherwise attack these places.

The hyoid bones, which support the tongue and are attached to the windpipe, should be saved, as should also the windpipe itself whenever, as in many duck's it has bony structures developed in part of its length. See page 10.

In many birds, and especially in birds of prey, there is a ring of bones surrounding the pupil of the eye. It is there-



fore best—unless you are an expert—not to remove the eyeball, but to simply puncture it to allow the escape of its fluid contents.

Remove the brain carefully.

In making the skeleton into a bundle for packing, bend the neck backward, detaching the skull if necessary, and fold the legs and wings closely alongside of the body. See page 4.

### Special Points

Cormorants have a small bone attached to the back of the skull, and in Auks and many similar birds there is a small bone at the elbow.

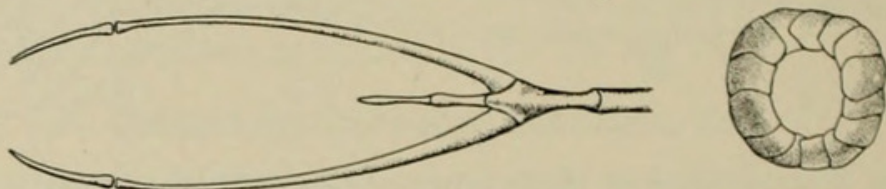


Fig. 7. — **Tongue bones or hyoid of a Great Blue Heron.**

Fig. 8. — **Eye-bones, sclerotals, of a Great Blue Heron.**

Sometimes there is a little bone at the hinder angle of the lower jaw, so that it is a good rule not to trim up a bird's skull too closely.

The easiest, and in many ways best, way to collect small birds is to place them entire in alcohol first making an incision in the lower part of the abdomen to allow the alcohol to reach the viscera.

Alcohol should not be used of full strength (95°), the proper proportion being one-quarter water and three-quarters alcohol. Not only birds, but small mammals and reptiles, may be preserved entire in alcohol, but now-a-days this cannot always be procured. Aside from the cost it is becoming increasingly difficult to obtain alcohol, even methylated spirit, and the demand for rum has rendered its use almost prohibitive.



Formalin was not in use when these instructions were written; it is a convenient medium for the preservation of small animals, especially where the soft parts are desired, but if animals are left in a solution of formalin for any length of time the bones are decalcified, lose their mineral matter, and become more or less useless. Unfortunately it often happens that nothing else is available, but if you must use formalin use it weak, in the proportion of one part of formalin to twelve of water.

### Turtles

In order to rough out a turtle it is usually necessary to remove the under shell or plastron, although some species, such as certain of the large land tortoises, can be roughed out without doing this.

In sea turtles, and a few others the plastron can be cut loose by taking a little time to the operation, but in the more solidly built tortoises and most fresh-water turtles it is necessary to saw through the bone, following the line indicated in the accompanying diagram.

The interior of the body being exposed, it is a comparatively easy matter to cut away the flesh.

Usually this can be done without disjointing any of the legs, and it is better, especially in small specimens, to leave them attached to the body. Beware, however, of cutting into any bones, as they are frequently soft in texture and easily damaged.

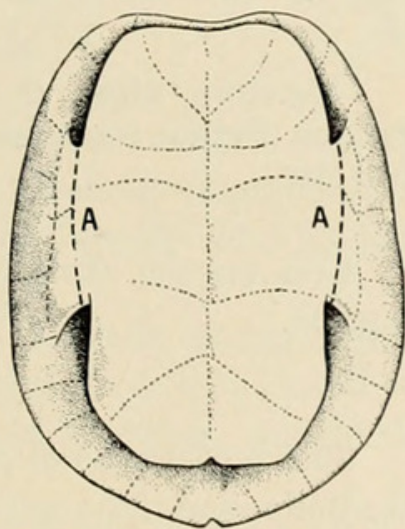


Fig. 9. — Shell of a turtle (*Chrysemys marginata*).

A, A, where cuts should be made to remove the lower shell or plastron.



### Snakes

Snakes require very little care in their preparation after the skin has been removed, but in the larger serpents, such as boas and pythons, vestiges of hind legs are present and should be carefully preserved.

Externally the legs appear as two little claws situated on either side of the vent; internally they are slender bones, about an inch and a half in length, loosely attached to the ribs.

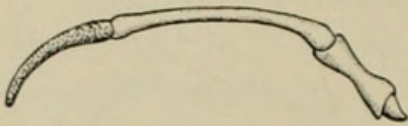


Fig. 10. — **Limb of a Python (*Python molurus*) full size.**

It is a comparatively easy matter to preserve both the skin and skeleton of any good-sized snake by exercising a little patience.

Do not try to skin through the mouth, but make a long cut on the under side and skin either way from it.

Coil up the skeleton and it will make a very compact bundle.

### Crocodiles

The breastbone of crocodiles extends the entire length of the body, and although the hinder portion of it is not attached to the backbone, yet great care is necessary in disemboweling not to cut away any of the slender bones of which it is formed.

There are also cartilaginous projections on the ribs which should not be sliced off in roughing them out.

### Fishes

Fishes vary so much in their structure that it is a difficult matter to give any directions for preparing their skeletons that would be of much service. As a rule species of small or moderate size are preserved entire in alcohol or formalin and only the larger species "roughed out." Almost invariably there are two rows of ribs present, and these extend backward for some distance.



Proceed slowly and carefully, as the edge of the scalpel will often give notice of some unsuspected bone.

Be especially careful about the head. There is a chain of bones encircling the eye, and the eyeball itself is often a bony cup.

Occasionally there are two or three bones attached to the back part of the hinder portion of the head, and the patch of flesh on the cheek is about all that can safely be removed.

When the skeleton is hung up to dry place bits of wood or other material between the gills so that the air may circulate freely and dry them rapidly.

Fishes, small reptiles, and toads and frogs can be best collected by placing them in alcohol.

### Packing

First be sure that a skeleton, and especially a small one, is thoroughly dry. Otherwise it is apt to "sweat" and rot the ligaments.

In the case of a large skeleton this would do no harm, but as the bones of small animals are left attached to one another by their ligaments and are not wired together, any such separation causes serious injury.

If the specimen is the size of a deer, it will be necessary to disjoint the backbone just behind the ribs in order to make a compact bundle.

A moose or buffalo can be cut up still more by separating the leg-bones at each joint and making several sections of the backbone.

Occasionally it is necessary to reduce a skeleton to its smallest possible dimensions, and then, in addition to the above measures, the breast-bone must be separated from the ribs by cutting through the cartilage *just below the end of each rib*. The ribs can then be detached from the backbone, and thus dismantled a good-sized skeleton can be packed in a flour barrel. Barrels, it may be remarked, are very useful for pack-



ing purposes. It is a good plan to wrap a rag, a little tow or something around the front teeth of deer and similar animals to prevent the incisors from chipping while in transit and if

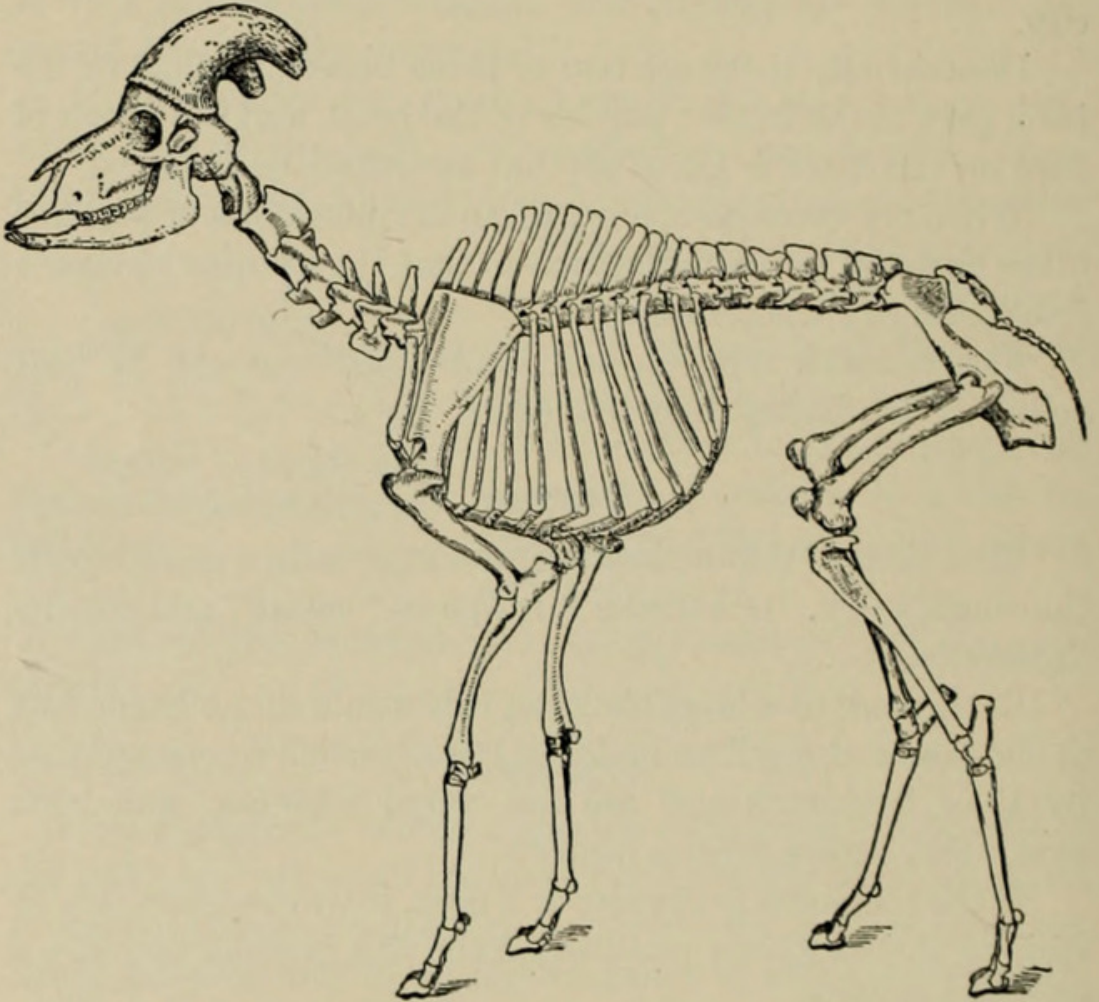


Fig. 11. — **Skeleton of Mountain Sheep.**

AA, places where backbone may be disjuncted; E, place where cut should be made to separate rib from breast-bone; S, sesamoids.

you are very careful you will put something between the grinding teeth for the same purpose.

Boxes should be tight, so as to shut out hungry dogs and prevent entirely the attacks of rats and mice. I have frequently seen valuable skeletons that were ruined in a single night by ravages of one or two rats.



Care should also be taken not to leave boxes open over night while being packed, lest mice should make a nest in the packing material and be shut up with the specimens.

Straw or hay is the best packing material, but Spanish moss, shavings, "excelsior," or cocoa fiber will serve the purpose. Usually but little is needed, the main point being to prevent the skeletons or loose bones from rattling about.

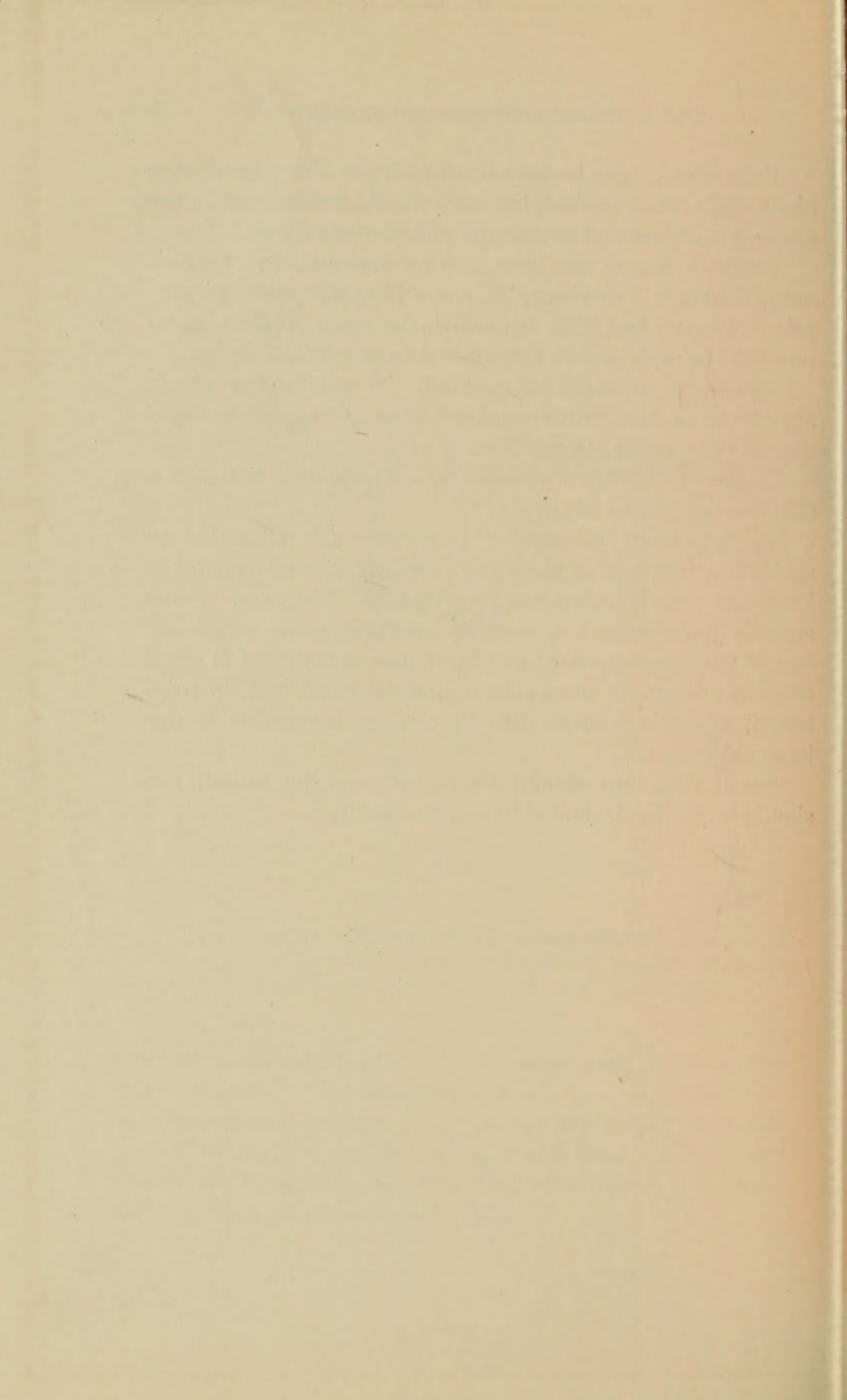
Beware of sea weed for packing. No matter how dry it appears to be, it contains so much salt as to become wet when exposed to a moist atmosphere.

Never put alum on a skeleton, nor soak any bones in a solution containing alum.

In hot, moist climates it is occasionally allowable to sprinkle a little salt on the bones of a large animal in order to keep the flesh from putrefying instead of drying. Some aquatic animals, such as seals and porpoises, can be packed in salt without detriment to their bones, a fact that is often of great advantage when such animals are collected on ship-board, where it is often difficult or even impossible to dry large skeletons.

Small skeletons should on no account be salted, nor should large ones be boiled to remove the flesh.





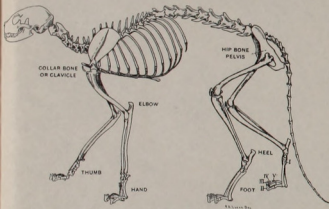


## MODIFICATIONS FOR LOCOMOTION

Shows the variations in the skeleton, and especially in the limbs, by which animals are adapted for walking, jumping, flying or swimming. The snake is introduced to show that it is possible for an animal to run, climb or swim with no limbs at all.

The series of limbs in a nearby case shows details of structure, the bones being colored so that the same bone in the various feet may be readily distinguished.

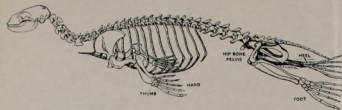
See also Relation between Form and Habits.



### THE CAT

*Felis domestica*

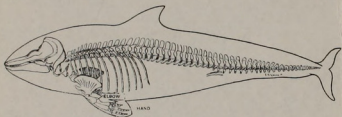
An example of a skeleton slightly modified for free and rapid movements and for jumping—this last point is indicated by the length of the foot bones and the size of the heel and elbow. The skeleton of the cat may serve as a convenient term of comparison with the skeletons of other animals.



### HARBOR SEAL

*Phoca vitulina*

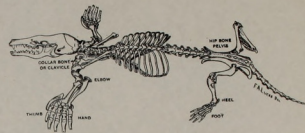
Like other seals this species passes some time on land, coming out to bask in the sun, but the legs are of little use for locomotion on land. All four limbs are changed into paddles for swimming, though the hair seals swim mainly with their hind feet and the eared seals with their front feet.



### HARBOR PORPOISE

*Phocaena communis*

The porpoise is an example of a mammal fitted for living only in the water, and represents the extreme of modification among mammals. The hind limbs have been lost, their only vestiges being two little bones that represent the pelvis, or hip bone: the front limbs have been changed into rigid paddles, fit only for balancing or steering; locomotion is effected by what is really the tip of the tail, which has been developed into flukes for swimming. Note that unlike the tail of fishes the flukes of whales and porpoises contain no bones.



### MOLE

*Scalops aquaticus*

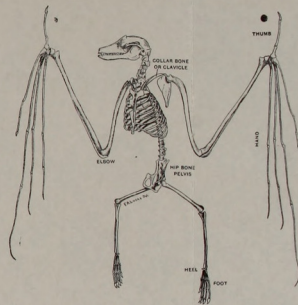
Modifications of the skeleton for an underground life are most evident in the fore limbs which perform the work of digging, being for this purpose short and stout, the hands large, and turned on edge. (In the figure the hand is turned down to show the bones).

The foot is also strengthened by the addition of a bone running along the edge of the foot, shown in the picture. This bone is not found in other mammals.

The skeleton of the mole illustrates the fact that a bone of little importance in one group of animals may be of great value in another.

In the cat and the seal, in which there is no particular strain on the fore feet and great freedom of movement is needed, the clavicle or collar bone is very small, or absent: it is also absent in the porpoise in which the fore limb is scarcely used.

In the bat and the mole in which flying or digging bring great strain on the fore limb, the collar bone is very strong to brace the shoulder. This is particularly evident in the mole.



### FRUIT BAT

*Pteropus species*

As in other bats the fore legs are modified, or changed, for flight, all the bones, but especially the fingers, being greatly lengthened to form supports for the membrane that serves as a wing. The fruit bats fly with rather slow wing beats and the outer part of the wing is proportionately larger and more rounded than in their smaller, more active relatives. The hind feet are little used, serving mainly as hooks by which the bat hangs itself up—head downwards—to sleep.

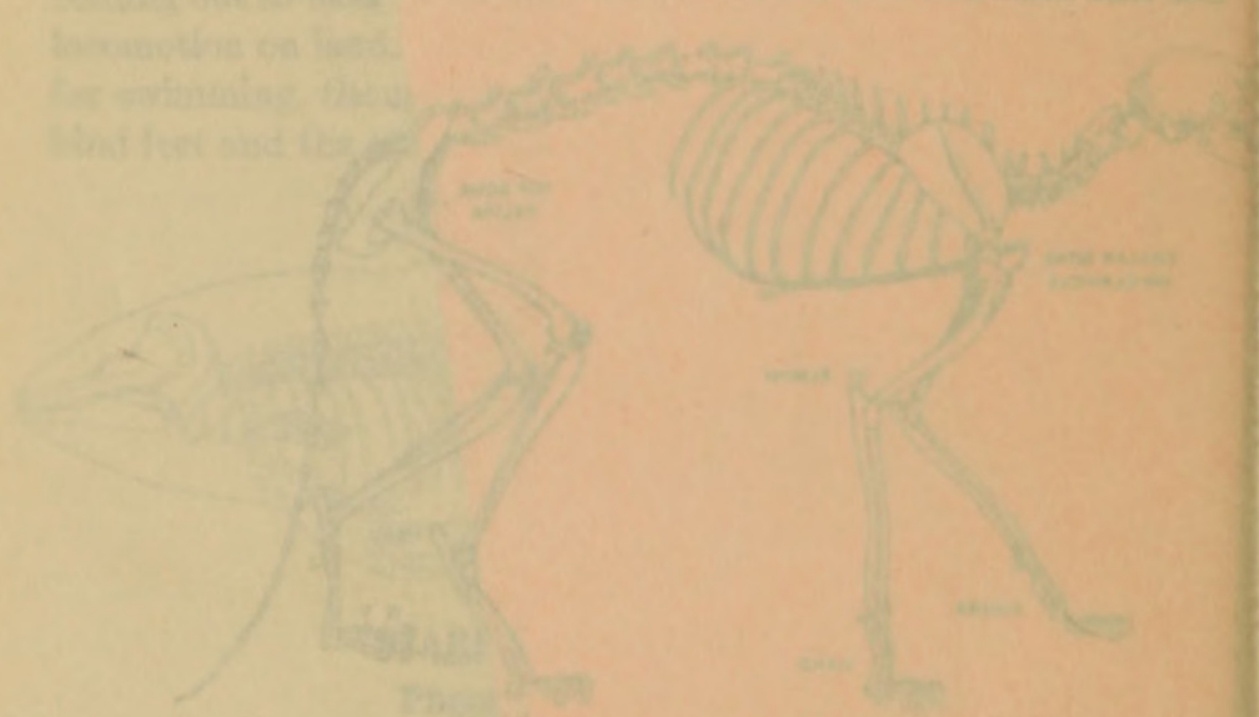


## MODIFICATIONS FOR LOCOMOTION

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See also Relation between Form and Habitat.



## THE CAT

*Felis domesticus*

The cat is a small, sleek, and agile animal, adapted for a life of hunting. Its skeleton is characterized by its long, flexible spine and its powerful hind limbs, which are adapted for jumping and pouncing. The cat's skull is large and rounded, with prominent eyes and a small, pointed ear. Its teeth are sharp and curved, and its claws are retractable. The cat's body is covered in a thick, soft coat of fur, and its tail is long and bushy. The cat is a carnivorous animal, and its diet consists of small mammals, birds, and insects. It is a solitary animal, and it spends most of its time alone, except when it is hunting or mating. The cat is a domesticated animal, and it is one of the most popular pets in the world.





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