

SMITHSONIAN MISCELLANEOUS COLLECTIONS.

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DIRECTIONS

FOR

COLLECTING, PRESERVING, AND TRANSPORTING

SPECIMENS OF NATURAL HISTORY.

PREPARED FOR THE USE OF

THE SMITHSONIAN INSTITUTION.



[Third Edition.]

WASHINGTON:  
SMITHSONIAN INSTITUTION.  
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## INTRODUCTION.

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IN the present pamphlet (prepared under the direction of Professor Baird with the co-operation of several naturalists) will be found brief directions for collecting and preserving objects of Natural History, drawn up for the use of travellers and others who may desire elementary instruction on this subject. The general principles involved are so simple as to enable any one, with but little practice, to preserve specimens sufficiently well for the ordinary purposes of science.

In transmitting specimens to the Smithsonian Institution, recourse may be had, when practicable, to the facilities kindly authorized by the War, Navy, and Treasury Departments, in the annexed letters. Parcels collected in the vicinity of military posts in the interior, may usually be sent down to the coast or the frontier in returning trains of the Quartermaster's Department. While waiting for opportunities of shipment, packages can generally be deposited in custom-houses, or public stores.

Where it is not convenient or practicable to make use of government facilities, the ordinary lines of transportation may be employed. When there is time enough to communicate with the Institution, instructions will be supplied as to the most eligible route; if not, then the cheapest but most reliable channel should be selected. In every case the parcels should be addressed to "the Smithsonian Institution, Washington," with the name of sender and locality marked on the outside. Full directions for packing specimens will be found in the pamphlet.

Collections in Natural History, as complete as possible, including the commonest species, are requested from any part of the country; as also lists and descriptions of species, notes of habits, &c.

For all assistance which may be rendered either in gathering specimens, or in aiding in their transportation, full credit will be given by the Institution in the annual reports to Congress, catalogues and labels of collections, and in other ways.

JOSEPH HENRY,  
*Secretary Smithsonian Institution.*

WAR DEPARTMENT,  
Washington, January 17, 1852.

SIR: In reply to your letter of the 7th inst., asking whether authority can be given to the officers of the Quartermaster Department to receive and transmit specimens of Natural History for the use of the Smithsonian Institution, I have the honor to inform you that directions have been given through the Quartermaster-General to furnish the facilities you ask for, whenever it can be done without expense to the United States.

Very respectfully, your obedient servant,  
C. M. CONRAD,  
*Secretary of War.*

Prof. JOS. HENRY,  
*Secretary Smithsonian Institution.*

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NAVY DEPARTMENT,  
February 21, 1853.

SIR: Authority is hereby given to you, to apply to the commanding officer of any vessel of war, or to any naval storekeeper of the United States, for facilities in transporting packages and specimens of Natural History intended for the Smithsonian Institution, and such officers are hereby required to furnish such facilities when asked for, provided they can be afforded without inconvenience to the public service and without expense to the United States.

I am, very respectfully, your obedient servant,  
JOHN P. KENNEDY,  
*Secretary of the Navy.*

Prof. J. HENRY,  
*Secretary Smithsonian Institution.*

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TREASURY DEPARTMENT,  
January 25, 1854.

SIR: In reply to your communication of 13th inst., I have the honor to state that collectors of the customs, commanders of cutters, and other officers of this Department, are hereby authorized and required to receive into buildings or vessels under their control, any packages intended for the Smithsonian Institution, and to transport or transmit the same towards their destination, whenever this can be done without inconvenience to the public service and without expense to the United States.

I am, very respectfully, your obedient servant,  
JAMES GUTHRIE,  
*Secretary of the Treasury.*

Prof. JOSEPH HENRY,  
*Secretary Smithsonian Institution.*

### § I. GENERAL REMARKS.\*

THE general principle to be observed in making collections of Natural History, especially in a country but little explored, is to gather all the species which may present themselves, subject to the convenience or practicability of transportation. The number of specimens to be secured will, of course, depend upon their size, and the variety of form or condition caused by the different features of age, sex, or season.

As the object of the Institution in making its collections is not merely to possess the different species, but also to determine their geographical distribution, it becomes important to have as full series as practicable from each locality. And in commencing such collections, the commonest species should be secured first, as being most characteristic, and least likely to be found elsewhere. It is a fact well known in the history of museums, that the species which from their abundance would be first expected, are the last to be received.

In every little known region the species which are the commonest, are rarest elsewhere, and many an unscientific collector in Texas, Mexico, the Rocky Mts., and elsewhere, has been surprised to find what he considered the least valuable species in his collection (owing to the ease with which they had been obtained in numbers), more prized by the naturalist than the rarities, which were in fact only well known stragglers from more accessible localities.

The first specimen procured of any animal, however imperfect, should be preserved, at least until a better can be obtained.

Where a small proportion only of the specimens collected can be transported, such species should be selected as are least likely to be procured in other localities or on other occasions. Among these may be mentioned reptiles, fishes, soft insects, &c.; in short, all such as require alcohol for their preservation. Dried objects, as

\* This chapter is intended especially for the guidance of travelling parties by land, and embraces many points referred to subsequently at greater length.

skins, can be procured with less difficulty, and are frequently collected by persons not specially interested in scientific pursuits.

In gathering specimens of any kind, it is important to fix with the utmost precision the localities where found. This is especially desirable in reference to fishes and other aquatic animals, as they occupy a very intimate relation to the waters in which they live.

The surest way of procuring the smaller mammals, as rats, mice, &c., is by setting traps in places where such animals may be expected to resort. A common mouse trap placed near the runs of meadow mice and baited with corn, potato, cheese, or other attractive substances, will often reveal the existence in numbers, of species whose presence was previously unknown. Corn shocks, stacks of hay, piles of rails, wood or stones, old stumps or logs, when overturned or removed, will often exhibit these mammals in greater or less number. They are also often turned up by the plough, spade, or pick.

Wolves, foxes, bears, and in fact most mammals can be obtained by placing strychnine on their favorite food.

There are two principal methods of preserving mammals; one by skinning, the other by throwing entire into alcohol. The skin, when removed from the body, as directed hereafter, may be prepared dry with arsenic, or placed in spirits; or if the animal be of small size, it may be thrown entire into alcohol, but an incision should *always* be made into the abdomen to facilitate the entrance of the liquid. The skin of the belly should also be separated from the subjacent walls of the abdomen. For purposes of examination it will be more convenient to have the skull removed entirely from the skin, when this is to be prepared dry; but care should be taken to attach corresponding marks to the two, so that they may be readily referred one to the other. The skull may then be preserved by boiling, or by cutting away the muscle, and drying, or by immersion in alcohol; in any case great care should be taken not to cut or mutilate any part of the bone, as its value would thereby be impaired. Separate skulls in any number, are always desirable. Where several specimens of a species are collected, the skulls of some may be left attached to the skin.

It will be well to preserve specimens of the smaller species, both as dry skins, and in alcohol.

It is very important to have the locality of specimens carefully noted and transmitted; and if possible, the date of capture,

and notes of habits and peculiarities. The sex, and color of the iris may likewise be indicated, and if not too much trouble, the following measurements in the case of skins of mammals: 1st, Length of head to the occiput; 2d, Length of head and body to the root of the tail; 3d, Length of tail from root to end of vertebræ, and 4th, Length of tail from root to the end of the hairs.

In many cases it is very difficult to preserve skins of the larger mammals, owing to the amount of arsenic required, the length of time needed for drying the specimens, or the inconveniently large bulk they occupy. All these objections may be readily obviated by the use of a fine powder composed of two parts of alum and one of saltpetre, intimately mixed.\* Every portion of the fresh skin should be well covered with this mixture, to which some arsenic may be added, the powder being forced into every corner. It may be most readily applied by means of a tin dredging box and afterwards rubbed in. If the skin be perfectly fresh, it may be folded up, without any stuffing, shortly after application of the powder, and packed away; it will be better, however, to allow it to dry partially, although it should be folded up before losing its flexibility. The skin should always be taken, when possible, from a recently killed animal, and the preservative applied at once. Skins prepared in this way will relax sufficiently for mounting by soaking a few hours in cold water.

Any fat, blood or muscle, which may be attached to the skin, should be carefully removed before the preservative is applied, the surface being kept at the same time moist and fresh, in order that the powder may more readily adhere. The first coat may be applied when the skin is inverted, and the hair inside; it should, after a little while, be returned to its natural condition, and a second quantity of the powder added.

The skin should be folded up something like a coat, the hair side outward; the head, feet and tail, properly adjusted. In small specimens, the folding may be omitted, and the skin kept in a flattened state. In animals less than a fox, a little stuffing may be used to fill out the head, and a small portion placed in the skin and legs. As little, however, should be used as possible, as it is an important object to diminish in every way the bulk of the prepara-

\* The use of this mixture was first suggested to the Smithsonian Institution by Mr. John G. Bell, of New York.

tion. No wrinkles, however, or unnecessary folds should be left in the skin.

In skinning the larger animals, the skull may generally be removed entirely, and thus the labor of preparation greatly reduced. In this case the skull can be cleaned separately, by boiling until the flesh becomes soft and easily removed, or the raw flesh may be cut away, the brain extracted, and the skull dried rapidly by exposure to the air and sun. It can at any time afterwards be cleaned more perfectly. The preservation of the skull is a matter of the highest importance.

Skins of large animals may readily be converted into pliable leather, by rubbing on salt, alum and soft soap, continuing the operation for a considerable length of time. When the skin becomes nearly dry, it should then be pounded or rubbed all over, until the desired softness is obtained.

The skeletons of all kinds of mammals, even of the commonest species, should be collected. These may be roughly prepared by cutting away the meat, and allowing the bones to dry in the air. The skeleton may be dismembered, and the ribs separated from the vertebræ. The bones of each leg should, however, be left attached to each other, if possible. The skull may be cleaned by boiling. Where there is an opportunity, it will be well to soak the bones in water for a few hours to remove the blood.

A perfectly dry skin will keep very well without any application of preservative material, provided the insects are excluded. To this end each specimen may be separately enveloped in paper. Tobacco leaves in layers between skins, and covering them, will be a sure protection against most adult insects; and in the absence of tobacco, any highly pungent or odoriferous substance, as the artemisia or sage, and larrea of the western plains, may be employed.

In preparing skins of any kind, it is a matter of prime importance not to use any animal substance, as wool, hair, or feathers, for stuffing.

Skins of mammals and birds, especially if at all greasy and not thoroughly freed from muscle, are very liable to the attacks of small beetles, as *Dermestes*, &c., when boxed up for any length of time, especially in the field, and valuable collections have frequently been entirely destroyed by them in less than a month. An occasional examination should therefore be made of such collections. Whenever possible, it will be well to envelop each speci-

men completely in paper or cotton-cloth. The greatest care should always be taken to keep from such collections any uncleaned skulls or bones, wool, hair, loose feathers, or unpreserved animal matter of any kind. If necessarily kept in the same boxes with skins, skulls, even if apparently quite clean, should be separately and closely wrapped up so as to prevent the access of insects to them. It must be borne in mind that it is the larvæ of these insects that do the mischief, and that a single female gaining access to a specimen may lay eggs enough to do a vast amount of injury when developed.

Where danger is apprehended to large skins, or where they have been already attacked, a quantity of arsenic may be boiled for a time in water, and after the free arsenic is strained out by means of a cloth, the liquid may be applied to the fur or wool by means of a watering-pot. The ears, lips, orbital region, and nose may be well moistened by an alcoholic solution of corrosive sublimate. A tincture of strychnine is said, however, to keep off insects much better than anything else. (See also page 22.)

In passing through the breeding grounds of birds, attention should be paid to securing abundant specimens of nests and eggs. When possible, the skin of the bird to which each set of eggs may belong should be secured. Further directions in regard to nests and eggs will be found hereafter. Skins of all the species of birds in each locality should be collected. A series of birds in alcohol will also be very desirable.

A great obstacle in the way of making alcoholic collections while on a march has been found in the escape of the spirits and the friction of the specimens, as well as in the mixing up of these from different localities. All such difficulties have been successfully obviated by means of the following arrangement: Instead of using glass jars, so liable to break, or even wooden kegs, so difficult of stowage, a square copper can should be procured, having a large mouth with a cap fitting tightly over it, either by a screw or otherwise. The can should be inclosed in a wooden box, or may be made to fit into a division of a leather pannier, to be slung across the back of a mule. Several small cans, in capacity of from a half to one-third of a cubic foot, or even less, will be better than one large one. Small bags of musquito netting, lino, crinoline, or other porous material, should be provided, made in shape like a pillow-case, and open at one end; these may be from six to fifteen inches

long. When small fishes, reptiles, or other specimens, are procured in any locality, they may be placed indiscriminately in one or more of these bags (the mouths of which are to be tied up like a sack or pinned over), and then thrown into the alcohol. Previously, however, a label of parchment, or stout writing paper should be placed inside the bag, containing the name of the locality or other mark, and written in ordinary ink or pencil. The label, if dry before being placed in the bag, will retain its writing unchanged for a long time. The locality, or its number, should also be coarsely marked with a red pencil, on the outside of the bag, or a second piece of numbered parchment pinned on. This, if dry when pinned, will swell so as to be in no danger of being lost off. In this way, the specimens, besides being readily identified, are preserved from rubbing against each other, and consequent injury. Still farther to facilitate this object, an India-rubber gas-bag may be employed to great advantage, by introducing it into the vessel, and inflating until all vacant space is filled up by the bag, and the consequent displacement of the spirit. When additional specimens are to be added, a portion of the air may be let out, and the bag afterwards again inflated. In the absence of these arrangements a quantity of tow, cotton, or rags, kept over the specimens, will be found useful in preventing their friction against each other or the sides of the vessel.

The tin cans with screw caps for preserving meats and vegetables from the atmosphere, and now so universally used, may be employed as a substitute for the copper tanks, as being cheaper and more easily obtained. The most useful sizes are a quart and half gallon. Care must, however, be taken not to crowd too many specimens in the cans, to have them full of alcohol, and to change the spirit at least once.

The larger snakes should be skinned, as indicated hereafter, and the skins thrown into alcohol. Much space will in this way be saved. Smaller specimens may be preserved entire, together with lizards, salamanders, and small frogs. All of these that can be caught should be secured and preserved. The head, the legs with the feet, the tail, in fact, the entire skin of turtles may be preserved in alcohol; the soft parts then extracted from the shell, which is to be washed and dried.

Reptiles are to be sought for in different localities: those covered with scales can generally be readily observed: the naked skinned

ones are generally more or less concealed. Tree frogs will be found in early spring by the side of small streams or ponds in the woods or meadows. Salamanders are found under logs or bark in damp woods, or under flat stones near or in the water.

Every stream, and, indeed, when possible, many localities in each stream, should be explored for fishes, which are to be preserved as directed. For these, as well as the other alcoholic collections, the lino bags are very useful.

The stomachs of fishes and other vertebrates will often be found to contain rare animals not otherwise procurable, and should be carefully examined.

Great attention should be paid to procuring many specimens of the different kinds of small fishes, usually known as minnows, shiners, chubs, &c. Among these will always be found the greatest variety of species, some never exceeding an inch in length. These fish are generally neglected under the idea that they are merely the young of larger kinds; even if they should prove to be such, however, they will be none the less interesting. Different forms will be found in different localities. Thus the *Etheostomata*, or Darters, and the *Cotti*, live under stones or among gravel, in shallow, clear streams, lying flat on the ground. Others will be dislodged by stirring under roots or shelving banks along the water's edge. The *Melanuræ*, or mud-fish (a few inches in length), dwell *in* the mud of ditches, and are secured by stirring up this mud into a thin paste with the feet, and then drawing a net through it. The sticklebacks and cyprinodonts live along the edges of fresh and salt water. The *Zygonectes* swim in pairs slowly along the surface of the water, the tip of the nose generally exposed. They generally have a broad black stripe on the side. By a careful attention to these hints, many localities supposed to be deficient in species of fishes will be found to yield a large number.

After the death of a mammal or bird, or after the skin has been prepared a short time, lice will be seen on the surface, generally near the head. These should be carefully preserved on small papers and marked, separately, with the name or number of the specimen to which they belong.

The alcohol used on a march may be supplied with tartar emetic. This, besides adding to its preservative power, will remove any temptation to drink it on the part of unscrupulous persons.

Insects, excepting the *Lepidoptera*, and those covered with hairs

or scales, can be readily preserved in alcohol. Small bottles should be used for the purpose. Crabs and small shells, and aquatic animals generally, may likewise be treated in the same manner.

It is not usually possible to collect minerals, fossils, and geological specimens in very great mass while travelling. The fossils selected should be as perfect as possible; and especial care should be paid to procuring the bones and teeth of vertebrate animals. Of minerals and rocks, specimens as large as a hickory-nut will, in many cases, be sufficient for identification.

Where collections cannot be made in any region, it will be very desirable to procure lists of all the known species, giving the names by which they are generally recognized, as well as the scientific name, when this is practicable. The common names of specimens procured should also be carefully recorded.

All facts relating to the habits and characteristics of the various species of animals, however trivial and commonplace they may seem, should be carefully recorded in the note book, especially those having relation to the peculiarities of the season of reproduction, &c. The accounts of hunters and others should also be collected, as much valuable information may thus be secured. The colors of the reptiles and fishes when alive should always be given, when practicable, or, still better, painted on a rough sketch of the object.

#### LIST OF APPARATUS USEFUL FOR TRAVELLING PARTIES.

1. TWO WOODEN CHESTS; OR TWO LEATHER PANNIERS supplied with back strap for throwing across a mule, when the transportation is entirely by pack animals. One of these is intended to contain the copper kettles, and their included alcohol, together with the nets and other apparatus; the other to hold the botanical apparatus, skins of animals, minerals, &c. These, when full, should not weigh more than one hundred and fifty pounds the pair. Where the transportation is by wagons, the kettles may be carried in stout wooden chests, about two feet long, one foot wide, and one foot high outside, made of inch stuff. Two half-inch partitions inside may cut off spaces at each end large enough to receive kettles six inches broad, leaving an intermediate space of nine inches for the accommodation of nets, etc. It will be found very convenient to have a chest fitted with trays dropping in from

above, to carry more readily and securely skins of birds, small mammals, eggs, etc.

2. TWO COPPER KETTLES in one of the panniers or chests, to contain the alcohol for such specimens as require this mode of preservation, viz: Reptiles, fishes, sometimes birds, small quadrupeds, most insects, crabs, and all-soft invertebrates.

3. HALF A DOZEN OR MORE TIN PRESERVING CANS, of different sizes, from pint to gallon. These may replace the copper cans, though they are not so durable. Many of the ordinary stores of the expedition may be carried in these cans, which, when emptied, can then be used for preserving specimens.

4. AN IRON WRENCH to loosen the screw-caps of the copper kettles when too tight to be managed by hand.

5. TWO INDIA-RUBBER BAGS, one for each kettle. These are intended to be inflated inside of the kettles, and by displacing the alcohol cause it to rise to the edge of the brass cap, and thus fill the kettle. Unless this is done, and any unoccupied space thus filled up, the specimens will be washed against the sides of the vessel, and much injured.

6. SMALL BAGS MADE OF LINO, MUSQUITO-NETTING, OR COTTON, of different sizes, and open at one end. These are intended, in the first place, to separate the specimens of different localities from each other; and, in the second place, to secure them from mutual friction or other injury. These bags may be respectively  $7 \times 3$  inches,  $11 \times 5$ , and  $15 \times 7$ : of the latter size one-third as many as of each of the others will be sufficient: about 100 may be taken in all. The number or name corresponding to the locality is to be marked on the outside with red chalk, or written with ink on a slip of parchment, and dropped inside. The specimens are then to be placed in the bag, a string tied round the open end, or the end pinned up, and the bag thrown into alcohol. A piece of parchment may also be pinned on the outside, so as at the same time to close the mouth of the bag by folding over once or twice. The ink of the parchment must be dry before the slip is moistened in any way.

N. B. All mammals, and fishes and reptiles over five or six inches in length should have a small incision made in the abdomen, to facilitate the introduction of the alcohol. Larger snakes and small quadrupeds, too large to preserve entire, may be skinned, and the skins placed in alcohol. The skin covering the belly in the mammals should always be loosened from its adhesion to the walls of the abdomen, to prevent the hair from coming out.

7. PENCILS for marking the bags.

8. PARCHMENT to serve as labels for the bags. This may also be cut up into strips, and fastened by strings to such specimens as are not suited for the bags. Leather, kid, buckskin, &c., will also answer as substitutes.

9. FISHING-LINE AND HOOKS.

10. SMALL SEINES for catching fishes in small streams. The two ends should be fastened to brails or sticks (hoe-handles answer well), which are taken in the hands of two persons, and the net drawn both up and down stream. Fishes may often be caught by stirring up the gravel or small stones in a stream, and drawing the net rapidly down the current. Bushes or holes along the banks may be inclosed by the nets, and stirred so as to drive out the fishes, which usually lurk in such localities. These nets may be six or eight feet long.

11. POCKET SCOOP-NET; AND CASTING-NET.

12. ALCOHOL. About five gallons to each travelling party. This should be about 95 per cent. in strength, and medicated by the addition of one ounce of tartar emetic to one gallon of alcohol, to prevent persons from drinking it.

13. ARSENIC in pound tin canisters. This may be applied to the moist skins of birds and quadrupeds, either dry or mixed with alcohol. Arsenical soap may also be used.

14. ALUM AND SALTPETRE, finely powdered and intimately mixed in the proportion of two parts of the former, and one of the latter. Ten or fifteen pounds may be taken, to be used in the preparation of large skins. It can best be carried in the tin preserving cans, with screw caps, and applied from a small tin dredging box.

15. TARTAR EMETIC for medicating the alcohol as above.

16. Some DRACHM BOTTLES OF STRYCHNINE for poisoning carnivorous animals—wolves, foxes, bears, etc.—and for protecting certain parts of skins from insects.

17. Some CAMPHOR.

18. COTTON OR TOW for stuffing out the heads of birds and mammals. To economize space, but little should be put into the bodies of the animals. The skulls of the quadrupeds, except very small ones, may be removed from the skins, but carefully preserved with a common mark.

19. PAPER for wrapping up the skins of birds and small quadrupeds, each separately. The paper supplied for botanical purposes will answer for this.

20. A BALL OF STOUT COTTON TWINE.
21. A SHEET OF PARCHMENT.
22. BUTCHER KNIFE, SCISSORS, NEEDLES, AND THREAD, for skinning and sewing up animals: also, some papers of COMMON PINS.
23. BLANK LABELS of paper with strings attached for marking localities, sex, &c., and tying to the legs of the dried skins, or to the stems of plants. The name of the expedition and of its commander may be printed on the upper margin, and of the collector at the right end of the lower.
24. PORTFOLIO for collecting plants.
25. PRESS for drying plants between the blotting-paper. Pressure is applied by straps.
26. VERY ABSORBENT PAPER for drying plants.
27. STIFFER PAPER for collecting plants in the field. The same paper may be used for wrapping up skins of birds and quadrupeds, as well as minerals and fossils.
28. SMALL BOTTLES with wide mouths for collecting and preserving insects, etc. They should always be properly corked beforehand; 2 and 4 oz. are convenient sizes. Homœopathic bottles may also be added to advantage.
29. GEOLOGICAL HAMMER.
30. DOUBLE-BARRELLED GUN AND RIFLE; also shot-belt, powder-flask, powder, shot, percussion caps, and wadding.
31. FINE SHOT for small birds and mammals. Numbers 3, 6, and 9, or 10, are proper sizes; the latter should always be taken.
32. A POCKET CASE of dissecting instruments will be very convenient.
33. BLOWPIPE APPARATUS for mineralogical examinations.
34. POCKET VIAL for insects.
35. BOTTLE OF ETHER for killing insects.
36. INSECT PINS, and apparatus for capturing insects.
37. CORK-LINED BOXES.
38. POCKET NOTE-BOOK. The kind made of what is called metallic paper, with which a pewter pencil is used, is much the best, as not liable to being defaced. Every specimen should have its number, beginning with 1, marked on the label or object itself, and entered in the record, and but a single series for those dried and in alcohol. The different parts of the same object should have a single, common number, as a skin and its skull or skeleton; a bird and its nest or eggs, etc. Where several specimens of one locality are

enclosed in bags, however, a single number will suffice, unless some particular reference is to be made to any one of them. All notes of habits, etc., are to be made in the note-book; but the date, locality, and sex should be marked in addition on the label of the specimen.

## ‡ II. INSTRUMENTS, PRESERVATIVE MATERIALS, &c.

### 1. IMPLEMENTS FOR SKINNING.

The implements generally required in skinning vertebrated animals are: 1. A sharp knife or a scalpel. 2. A pair of sharp-pointed scissors, and one with strong short blades. 3. Needles and thread for sewing up the incisions in the skin. 4. A pair of spring forceps, rather sharp pointed, for adjusting the skin and feathers of birds, especially about the head, and for other purposes. 5. A pair of long forceps for introducing cotton into the neck of animals, etc. 6. A hook by which to suspend the carcass of the animal during the operation of skinning. To prepare the hook, take a string, of from one to three feet in length, and fasten one end of it to a stout fish-hook which has had the barb broken off. By means of a loop at the other end, the string may be suspended to a nail or awl, which, when the hook is inserted into the body of an animal, will give free use of both hands in the operation of skinning.

### 2. PRESERVATIVES.

The best material for the preservation of skins of animals consists of powdered arsenious acid, or the common arsenic of the shops. This may be used in two ways, either applied in dry powder to the moist skin, or still better mixed with alcohol or water to the consistency of molasses, and put on with a brush. Some camphor may be added to the alcoholic solution, and a little strychnine will undoubtedly increase its efficacy. There are no satisfactory substitutes for arsenic; but, in its entire absence, corrosive sublimate, camphor, alum, &c., may be employed. Many persons prefer the arsenical soap to the pure arsenic. This is composed of the following ingredients: arsenic 1 oz.; white soap 1 oz.; carbonate of potash 1 drachm; water 6 drachms; camphor 2 drachms. Cut the soap into thin slices, and melt over a slow fire with the water, stirring it continually: when dissolved, remove from the fire

and add the potash and arsenic by degrees: dissolve the camphor in a little alcohol, and when the mixture is nearly cold stir it in.

The proper materials for stuffing out skins will depend much upon the size of the animal. For small birds and quadrupeds, cotton will be found most convenient; for the larger, tow. For those still larger, dry grass, straw, sawdust, bran, or other vegetable substances, may be used. Whatever substance be used, care must be taken to have it perfectly dry. Under no circumstances should animal matter, as hair, wool, or feathers, be employed.

The bills and loral region, as well as the legs and feet of birds, and the ears, lips, and toes of mammals, may, as most exposed to the ravages of insects, be washed with an alcoholic solution of strychnine applied with a brush to the dried skin; this will be an almost certain safeguard against injury.

### § III. SKINNING AND STUFFING.

#### 1. BIRDS.

Whenever convenient, the following notes should be made previous to commencing the operation of skinning, as they will add much to the value of the specimens:—

1. The length, in inches, from tip of bill to the end of the tail; the distance between the two extremities of the outstretched wings; and the length of the wing from the carpal or first joint. The numbers may be recorded as follows: 44, 66, 12 (as for a swan), without any explanation; it being well understood that the above measurements follow each other in a fixed succession. These numbers may be written on the back of the label attached to each specimen.

2. The color of the eyes, that of the feet, bill, gums, membranes, caruncles, &c.

3. The date, the locality, and the name of the collector.

4. The sex. All these points should be recorded on the label.

Immediately after a bird is killed, the holes made by the shot, together with the mouth and internal or posterior nostrils, should be plugged up with cotton, to prevent the escape of blood and the juices of the stomach. A long narrow paper cone should be made; the bird, if small enough, thrust in, head foremost, and the open

end folded down, taking care not to bend or break or bend the tail feathers in the operation.\*

When ready to proceed to skinning, remove the old cotton from the throat, mouth, and nostrils, and replace it by fresh. Then take the dimensions from the point of the bill to the end of the tail, from the tip of one wing to that of the other, when both are extended, and from the tip of the wing to the first or carpal-joint, as already indicated.

A recent author recommends† that the girth of the bird be taken before skinning, by means of a band of stiff paper passed round the middle of the body over the wings, and pinned in the form of a ring. It is then slipped off towards the feet, and after the skin is prepared, is replaced, the stuffing inserted being enough to keep it from falling off. The exact circumference of the original bird can thus be readily maintained. In fact, the ring may be slipped on before the stuffing is commenced, and enough cotton inserted to fill out the shoulders within the paper.

After these preliminaries, make an incision through the skin only, from the lower end of the breast bone to the anus. Should the intestines protrude in small specimens, they had better be extracted, great care being taken not to soil the feathers. Now proceed carefully to separate the skin on each side from the subjacent parts, until you reach the knee, and expose the thigh when, taking the leg in one hand, push or thrust the knee up on the abdomen, and loosen the skin around it until you can place the scissors or knife underneath, and separate the joint with the accompanying muscles. Place a little cotton between the skin and body to prevent adhesion. Loosen the skin about the base of the tail, and cut through the vertebræ at the last joint, taking care not to sever the basis of the quills. Suspend the body by inserting the hook into the lower part of the back or rump, and invert the skin, loosening it carefully from the body. On reaching the wings, which had better be relaxed previously by stretching and pulling, loosen the skin from around the first bone, and cut through the middle of it, or, if the bird be small enough, separate it from the next at the elbow. Continue the inversion of the skin by drawing

\* Crumpled or bent feathers may have much of their elasticity and original shape restored by dipping in hot water.

† Davies' Naturalist's Guide. Edinburgh, 1858, page 19.

it over the neck, until the skull is exposed. Arrived at this point, detach the delicate membrane of the ear from its cavity in the skull, if possible, without cutting or tearing it; then, by means of the thumb-nails, loosen the adhesion of the skin to the other parts of the head, until you come to the very base of the mandibles, taking care to cut through the white nictitating membrane of the eye, when exposed, without lacerating the ball. Scoop out the eyes, and, by making one cut on each side of the head, through the small bone connecting the base of the lower jaw with the skull, another through the roof of the mouth at the base of the upper mandible, and between the jaws of the lower, and a fourth through the skull behind the orbits, and parallel to the roof of the mouth, you will have freed the skull from all the accompanying brain and muscle. Should anything still adhere, it may be removed separately. In making the first two cuts, care must be taken not to injure or sever the zygoma, a small bone extending from the base of the upper mandible to the base of the lower jaw-bone. Clean off every particle of muscle and fat from the head and neck, and, applying the preservative abundantly to the skull, inside and out, as well as to the skin, restore these parts to their natural position. In all the preceding operations, the skin should be handled as near the point of adhesion as possible, especial care being taken not to stretch it.

Finely powdered plaster of Paris, chalk, or whiting, may be used to great advantage by sprinkling on the exposed surface of the carcass, and inside of skin, to absorb the grease and blood.

An excellent suggestion of Mr. Davies, the author just quoted, in the case of greasy, fatty, or bloody specimens, is to have strips of calico or cotton cloth, and to baste them on the inside of the skin along the edges of the incision, so that they may project a little beyond the feathers. This will be exceedingly effectual in keeping the feathers clean. The cloth should be applied as soon as the edges of the first incision are raised enough to admit of it. This will answer the additional purpose of preventing the stretching of the skin.

The next operation is to connect the two wings inside of the skin by means of a string, which should be passed between the lower ends of the two bones forming the forearm, previously, however, cutting off the stump of the arm, if still adhering at the elbow. Tie the two ends of the strings so that the wings shall be kept at

the same distance apart as when attached to the body. Skin the leg down to the scaly part, or tarsus, and remove all the muscle. Apply the arsenic to the bone and skin, and, wrapping cotton round the boue, pull it back to its place. Remove all the muscle and fat which may adhere to the base of the tail or the skin, and put on plenty of the preservative wherever this can be done. Lift up the wing, and remove the muscle from the forearm by making an incision along it. In many cases, the two joints may be exposed by carefully slipping down the skin towards the wrist-joint, the adhesion of the quills to the bone being loosened: this is, however, scarcely an advisable method. It is perhaps generally better to clean the forearm from the inside before tying the wings.

The bird is now to be restored to something like its natural shape by means of a filling of cotton or tow. Begin by opening the mouth and putting cotton into the orbits and upper part of the throat, until these parts have their natural shape. Next take tow or cotton, and after making a roll rather less in thickness than the original neck, put it into the skin, and push firmly into the base of the skull. This can best be done by means of long forceps. By means of this, you can reduce or contract the neck if too much stretched. Fill the body with cotton, not quite to its original dimensions, and sew up the incision in the skin, commencing at the upper end, and passing the needle from the inside outwards; tie the legs and mandibles together, adjust the feathers, and, after preparing a cylinder of paper the size of the bird, or using one previously prepared as suggested on page 18, push the skin into it so as to bind the wings closely to the sides. The cotton may be put in loosely, or a body the size of the original made by wrapping with threads. If the bird have long legs and neck, these had better be folded down over the body, and allowed to dry in that position. Economy of space is a great object in keeping skins, and such birds as herons, geese, swans, &c., occupy too much room when outstretched.

In some instances, as among the ducks, woodpeckers, &c., the head is so large that the skin of the neck cannot be drawn over it. In such cases, skin the neck down to the base of the skull, and cut it off there. Then draw the head out again, and, making an incision on the outside, down the back of the skull, skin the head. Be careful not to make too long a cut, and to sew up the incision again.

The sex of the specimen may be ascertained after skinning, by making an incision in the side near the vertebræ, and exposing the inside surface of the "small of the back." The generative organs will be found tightly bound to this region (nearly opposite to the last ribs), and separating it from the intestines. The testicles of the male will be observed as two spheroidal or ellipsoidal whitish bodies, varying with the season and species, from the size of a pin's head to that of a hazel-nut. The ovaries of the female, consisting of a flattened mass of spheres, variable in size with the season, will be found in the same region.

Some writers advise a very careful cleaning out of the skull, without cutting away any of the bones, so that the skin, if otherwise useless, will at any time furnish a skull for the osteological series. This, however, requires so much more time, that it can scarcely be done on a journey, and a skull can generally be better obtained from another specimen, too much shot, perhaps, to be skinned.

The breast bone with its attachments, of at least one specimen of each species, should be cleaned and preserved.

For transportation, each skin of mammals as well as of birds should, when possible, be wrapped in paper, or else arranged in trays lined with cotton, and the interstices filled with the same material.

## 2. MAMMALS.

The mode of preparing mammals is precisely the same as for birds, in all its general features. Care should be taken not to make too large an incision along the abdomen. The principal difficulty will be experienced in skinning the tail. To effect this, pass the slipknot of a piece of strong twine over the severed end of the tail, and, fastening the vertebræ firmly to some support, pull the twine towards the tip until the skin is forced off. Should the animal be large, and an abundance of preservative not at hand, the skin may remain inverted. In all cases, it should be thoroughly and rapidly dried. Further remarks on this subject will be found in the introductory chapter.

The tails of some mammals cannot be skinned as directed above. This is particularly the case with beavers, opossums, and those species which use their tail for prehension or locomotion. Here the tail is usually supplied with numerous tendinous muscles, which

require it to be skinned by making a cut along the lower surface or right side, nearly from one end to the other, and removing the bone and flesh. It should then be sewed up again, after a previous stuffing.

For the continued preservation of hair or fur of animals against the attacks of moths and other destructive insects, it may be saturated with a solution of arsenic in water to be strained and applied rather warm. A little strychnine added will be of much service.

A free use of tobacco scraps among skins, though no security against the attacks of insects, will be of use. Kreosote is also an excellent remedy, though a disagreeable one. The Persian Insect powder (made from the leaves and stems of *Pyrethrum*, and forming the basis of the so-called magnetic powders of Lyon and others), when fresh, will also keep off insects. Perhaps none of these remedies, including ether, chloroform and turpentine, will kill larvæ; they may repel the perfect insect, but when the eggs are laid, there is scarcely any remedy except exposing the skins to a temperature a little below that of boiling water for ten or twelve hours, and thus drying up the egg or grub. The best plan therefore will be to keep the skins clean, and not packed too tightly, and in close fitting drawers or trays. (See also page 8.)

### 3. REPTILES.

The larger *lizards*, such as those exceeding twelve or eighteen inches in length, may be skinned according to the principles above mentioned, and then dried, although preservation in spirit, when possible, is preferable for all reptiles.

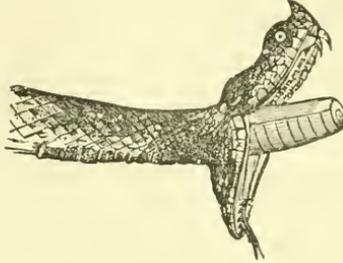
Large *frogs* and *salamanders* may likewise be skinned, although cases where this will be advisable are very rare.

*Turtles* and *large snakes* will require this operation.

To one accustomed to the skinning of birds, the skinning of frogs or other reptiles will present no difficulties.

The skinning of a snake is still easier. Open the mouth and separate the skull from the vertebral column, detaching all surrounding muscles adherent to the skin. Next, tie a string around the stump of the neck thus exposed (see figure), and, holding on by this, strip the skin down to the extremity of the tail. The skin thus inverted should be restored to its proper state, and then put in spirit or stuffed, as convenient. Skins of reptiles may be stuffed

with either sand or sawdust, by the use of which their shape is more easily restored, or they may be simply flattened out.



Turtles and tortoises are more difficult to prepare in this way, although their skinning can be done quite rapidly. "The breastplate must be separated by a knife or saw from the back, and, when the viscera and fleshy parts have been removed, restored to its position. The skin of the head and neck must be turned inside out, as far as the head, and the vertebræ and flesh of the neck should be detached from the head, which, after being freed from the flesh, the brain, and the tongue, may be preserved with the skin of the neck. In skinning the legs and the tail, the skin must be turned inside out, and, the flesh having been removed from the bones, they are to be returned to their places by redrawing the skin over them, first winding a little cotton or tow around the bones to prevent the skin adhering to them when it dries."—RICHARD OWEN.

Another way of preparing these reptiles is as follows: Make two incisions, one from the anterior end of the breastplate to the symphysis of the lower jaw, and another from the posterior end of the breastplate to the vent or tip of the tail; skin off these regions and remove all fleshy parts and viscera without touching the breastplate itself. Apply the preservative, stuff, and sew up again both incisions.

"When turtles, tortoises, crocodiles, or alligators, are too large to be preserved whole in liquor, some parts, as the head, the whole viscera stripped down from the neck to the vent, and the cloaca, should be put into spirit or solution."—R. OWEN.

#### 4. FISHES.

As a general rule, fishes, when not too large, are best preserved entire in spirits.

Nevertheless, they may be usefully skinned and form collections, the value of which is not generally appreciated. In many cases, too, when spirit or solutions cannot be procured, a fish may be preserved which would otherwise be lost.

There are two modes of taking the skin of a fish: 1. The whole animal can be skinned and stuffed like a bird, mammal, or reptile. 2. One-half of the fish can be skinned, and nevertheless its natural form preserved.

*Sharks, skates, sturgeons, garpikes or garfishes, mudfishes*, and all those belonging to the natural orders of *Placoids* and *Ganooids*, should undergo the same process as given above for birds, mammals, and reptiles. An incision should be made along the right side, the left always remaining intact, or along the belly. The skin is next removed from the flesh, the fins cut at their bases under the skin, and the latter inverted until the base of the skull is exposed. The inner cavity of the head should be cleaned, an application of preservative made, and the whole, after being stuffed in the ordinary way, sewed up again. Fins may be expanded when wet, on a piece of stiff paper, which will keep them sufficiently stretched for the purpose. A varnish may be passed over the whole body and fins, to preserve somewhat the color.

In the case of *Ctenoids*, *perches*, and allied genera; and *Cycloids* trouts, suckers, and allied genera; one-half of the fish may be skinned and preserved. To effect this, lay the fish on a table with the left side up; the one it is intended to preserve. Spread out the fins by putting underneath each a piece of paper, to which it will adhere on drying. When the fins are dried, turn the fish over, cut with scissors or a knife all around the body, a little within the dorsal and ventral lines, from the upper and posterior part of the head, along the back to the tail, across the base of the caudal fin down, and thence along the belly to the lower part of the head again. The dorsal, caudal, and anal fins, cut below their articulations. This done, separate the whole of the body from the left side of the skin, commencing at the tail. When near the head, cut off the body, with the right ventral and pectoral fins, and proceed by making a section of the head and removing nearly the half of it. Clean the inside, and pull out the left eye, leaving only the cornea and pupil. Cut a circular piece of black paper of the size of the orbit and place it close to the pupil. Apply the preservative, fill the head with cotton as well as the body. Turn over the

skin and fix it on a board prepared for that purpose. Pin or tack it down at the base of the fins. Have several narrow bands of paper to place across the body in order to give it a natural form, and let it dry. The skins may be taken off the board or remain fixed to it, when sent to their destination, where they should be placed on suitable boards of proper size, for permanent preservation.

Such a collection of well-prepared fishes will be useful to the practical naturalist, and illustrate, in a more complete manner, to the public the diversified forms and characters of the class of fishes which specimens preserved in alcohol do not so readily show.

These skins may also be preserved in alcohol.

#### § IV. PRESERVING IN LIQUIDS, AND BY OTHER MODES BESIDES SKINNING.

##### I. GENERAL REMARKS.

The best material for preserving animals of moderate size is alcohol. When spirits cannot be obtained, the following substitutes may be used :—

I. GOADBY'S SOLUTION.—A. *The aluminous fluid*, composed of rock salt, 4 ounces; alum, 2 ounces; corrosive sublimate, 4 grains; boiling water, 2 quarts. B. *The saline solution*, composed of rock-salt, 8 ounces; corrosive sublimate, 2 grains; boiling water, 1 quart. To be well stirred, strained, and cooled.

II. A strong brine, to be used as hereafter indicated for Goadby's Solution.

III. In extreme cases, dry salt may be used, and the specimens salted down like herring, &c.

The alcohol, when of the ordinary strength, may be diluted with one-fifth of water, unless it is necessary to crowd the specimens very much. The fourth proof whiskey of the distillery, or the high wines, constituting an alcohol of about 60 per cent., will be found best suited for collections made at permanent stations and for the museum. Lower proofs of rum or whiskey will also answer, but the specimen must not be crowded at all.

To use Goadby's Solution, the animal should first be macerated for a few hours in fresh water, to which about half its volume of

the concentrated solution may then be added. After soaking thus for some days, the specimens may be transferred to fresh concentrated solution. When the aluminous fluid is used to preserve vertebrate animals, these should not remain in it for more than a few days; after this, they are to be soaked in fresh water, and transferred to the saline solution. An immersion of some weeks in the aluminous fluid will cause a destruction of the bones. Specimens must be kept submerged in these fluids. The success of the operation will depend very much upon the use of a weak solution in the first instance, and a change to the saturated fluid by one or two intermediate steps.

The collector should have a small keg, jar, tin box, or other suitable vessel, partially filled with liquor, into which specimens may be thrown (alive if possible) as collected. The entrance of the spirit into the cavities of the body should be facilitated by opening the mouth, making a small incision in the abdomen a half or one inch long, or by injecting the liquor into the intestines through the anus, by means of a small syringe. After the animal has soaked for some weeks in this liquor, it should be transferred to fresh. Care should be taken not to crowd the specimens too much. When it is impossible to transfer specimens to fresh spirits from time to time, the strongest alcohol should be originally used.

To pack the larger specimens for transportation, procure a small keg, which has been properly swelled, by allowing water to stand in it for a day or two, and from this extract the head by knocking off the upper hoops. Great care must be taken to make such marks on the hoops and head as will assist in their being replaced in precisely the same relative position to each other and the keg that they originally held. At the bottom of the keg place a layer of tow or rags, moistened in liquor, then one of specimens, then another of tow and another of specimens, and so on alternately until the keg is *entirely filled*, exclusive of the spirit. Replace the head, drive down the hoops, and fill completely with spirits by pouring through the bung-hole. Allow it to stand at least half an hour, and then, supplying the deficiency of the liquor, insert the bung and fasten it securely. An oyster-can or other tin vessel may be used to great advantage, in which case the aperture should be soldered up and the vessel inclosed in a box. A glass jar or bottle may also be employed, but there is always a risk of breaking and leaking. The specimens may also be transported in the copper

vessels referred to on pages 9 and 13, and also in the tin preserving cans. In the absence of tow or rags, chopped straw, fine shavings, or dry grass may be substituted.

It will conduce greatly to the perfect preservation of the specimens, during transportation, if each one is wrapped up in cotton cloth, or even paper. A number of smaller specimens may be rolled successively in the same wrapper. In this way, friction, and the consequent destruction of scales, fins, &c., will be prevented almost entirely. The travelling bags described on p. 13 will answer the same purpose.

Should the specimens to be packed vary in size, the largest should be placed at the bottom. If the disproportion be very great, the delicate objects at the top must be separated from those below by means of some immovable partition, which, in the event of the vessel being inverted, will prevent crushing. The most imperative rule, however, in packing, is to have the vessel perfectly full, any vacancy exposing the whole to the risk of loss.

It is sometimes necessary to guard against the theft of the spirit employed by individuals who will not be deterred from drinking it by the presence of reptiles, &c. This may be done by adding a small quantity of tartar emetic, ipecacuanha, quassia, or some other disagreeable substance. The addition of a little arsenic will add to the preservative power of the spirit. A small quantity of soap is said to have a remarkable effect in preserving the color; a little saltpetre appears to have also the same effect.

## 2. VERTEBRATES.

Mammals and birds should always have an incision made in the abdomen to admit the spirit. In the former the skin on each side of the cut should also be raised or separated from its attachment to the subjacent walls, to prevent the hair from coming off. Where several specimens of a kind are preserved it will be well to remove the intestines entirely from some of them, to insure their sound preservation.

Fishes over five or six inches in length should also have the abdominal incision. Specimens with the scales and fins perfect should be selected, and, if convenient, stitched, pinned, or wrapped in bits of muslin, &c., to preserve the scales; placing them in the lino bags will answer the latter object. In general, fishes under

twelve or fifteen inches in length should be chosen. The skins of larger ones may be put in liquor. It is important to collect even the smallest. The same principles apply to the other vertebrata.

The smallest and most delicate specimens may be placed in bottles or vials, and packed in the larger vessels with the other specimens.

### 3. INVERTEBRATES.\*

INSECTS, BUGS, &c.—The harder kinds may be put in liquor, as above, but the vessel or bottle should not be very large. Butterflies, wasps, flies, &c., should be pinned in boxes, or packed in layers with soft paper or cotton. Minute species should be carefully sought under stones, bark, dung, or flowers, or swept with a small net from grass or leaves. They may be put in quills, small cones of paper, or in glass vials. They can be readily killed by immersing the bottles, &c., in which they are collected, in hot water, or exposing them to the vapor of ether. Large beetles, however, can generally only be killed by piercing with some poisonous solution, as strychnine.

When possible, a number of oz. or 2 oz. vials, with very wide mouths, well stopped by corks, should be procured, in which to place the more delicate invertebrata, as small crustacea, worms, mollusca, &c.

It will frequently be found convenient to preserve or transport insects pinned down in boxes. The bottoms of these are best lined with cork or soft wood. The accompanying figures will explain, better than any description, the particular part of different kinds of insects through which the pin is to be thrust; beetles (Fig. 1) being pinned through the right wing-cover or elytra; all others through the middle of the thorax, as in Fig. 2.

The traveller will find it very convenient to carry about him a vial having a broad mouth, closed by a tight cork. In this should be contained a piece of camphor, or, still better, of sponge soaked in ether, to kill the insects collected. From this the specimens should be transferred to other bottles. They may, if not hairy, be killed by immersing directly in alcohol.

\* A separate pamphlet in reference to collecting insects will be published by the Institution, and a special chapter on marine invertebrates will be found at the end of the present work.

A lump of camphor may be placed in a piece of cotton cloth and pinned firmly in the corner of the box containing dried insects, for the purpose of preventing the ravages of larvæ. A few drops of kreosote occasionally introduced will also answer the same purpose.

Fig. 1.

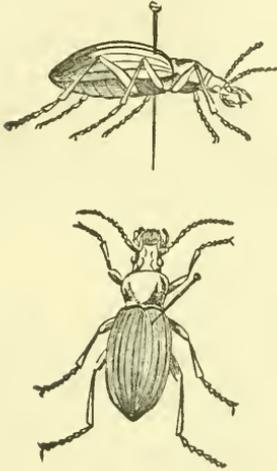


Fig. 2.



Sea-urchins and starfishes may be dried, after having been previously immersed for a minute or two in boiling water, and packed up in cotton, or any soft material which may be at hand.

The hard parts of coral, and shells of mollusca may also be preserved in a dried state. The soft parts are removed by immersing the animals for a minute or two in hot water, and washing clean afterwards. The valves of bivalve shells should be brought together by a string.

Wingless insects, such as spiders, scorpions, centipedes or thousand-legs, earth-worms, hair-worms, and generally all worm-like animals found in the water, should be preserved in alcoholic liquor, and in small bottles or vials.

#### § V. EMBRYOS.

Much of the future progress of zoology will depend upon the extent and variety of the collections which may be made of the embryos and fetuses of animals. No opportunity should be

omitted to procure these and preserve them in spirits. All stages of development are equally interesting, and complete series for the same species would be of the highest importance. Whenever any female mammal is killed, the uterus should be examined for embryos. When eggs of birds, reptiles, or fish are emptied of their young, these should be preserved. It will be sufficiently evident that great care is required to label the specimens, as in most cases it will be impossible to determine the species from the zoological characters.

Whenever the abundance of specimens will warrant it, as many as fifty eggs of the same kind of bird, in different degrees of development, may be collected, care being taken to crack the egg at the blunt end, to facilitate the entrance of the spirit.

#### § VI. NESTS AND EGGS.\*

Nothing forms a more attractive feature in a museum, or is more acceptable to amateurs, than the nests and eggs of birds. These should be collected whenever they are met with, and in any number procurable for each species, as they are always in demand for purposes of exchange. Hundreds of eggs of *any* species with their nests (or without, when not to be had) will be gladly received.

Nests require little preparation beyond packing so as to be secure from crumbling or injury. Each one should be placed in a box or ring of paper just large enough to hold it. The eggs of each nest, when emptied, may be replaced in it and the remaining space filled with cotton.

Eggs, when fresh, and before the chick has formed, may be emptied by making small pin-holes on opposite sides, and blowing or sucking out the contents. Should hatching have already commenced, an aperture may be made in one side by carefully pricking with a fine needle round a small circle or ellipse, and thus cutting out a piece. The larger kinds should be well washed inside, and all allowed to dry before packing away. If the egg be too small for the name, a number should be marked on it with ink corresponding to a memorandum list. Little precaution is required in packing, beyond arranging in layers with cotton and having the box entirely

\* A separate pamphlet has been published by the Institution in regard to the collecting of nests and eggs.

filled. It is always better to wrap each egg in a loose coat of cotton before arranging in layers, and they should be packed in small wooden boxes.

Cracked eggs should have strips of tissue paper pasted over the line of fracture; or the crack may be painted over with collodion while the sides are pressed together.

The parent bird should be secured, and either skinned entire or the head and wing kept to identify the species.

The eggs of reptiles, provided with a calcareous shell, can be prepared in a similar way.

The eggs of fishes, salamanders, and frogs may be preserved in spirits, and kept in small vials or bottles. A label should never be omitted.

## § VII. PREPARATION OF SKELETONS.

Skulls of animals may be rapidly prepared by boiling in water for a few hours. A little potash or lye added will facilitate the removal of the flesh.

Skeletons may be roughly prepared in the field by skinning the animal and removing all the viscera, together with as much of the flesh as possible. Whenever practicable, they should be allowed to soak a few hours in water to extract the blood. The bones should then be exposed to the sun or air until completely dried. Previously, however, the brain of large animals should be removed by separating the skull from the spine, and extracting the brain through the large hole in the back of the head. The head may be cleaned by boiling. In case it becomes necessary to disjoint a skeleton, care should be taken to attach a common mark to all the pieces, especially when more than one individual is packed in the same box.

Skulls and skeletons may frequently be picked up, already cleaned by other animals or exposure to weather. By placing small animals near an ant's nest, or in water occupied by tadpoles or small crustacea, very beautiful skeletons may often be obtained. The sea-beach sometimes affords rich treasures in the remains of porpoises, whales, large fishes, as sharks, and other aquatic species.

Although, to save time and opportunities in the field, it is usually necessary to prepare skulls by boiling in water, as just explained, the process is sometimes apt to leave the bones colored, or even somewhat greasy. The best method of preparing skulls

and skeletons for a museum is undoubtedly, after cutting away the greater mass of flesh, that of macerating, or allowing them to remain in cold water until the decaying flesh separates from the bones. At first, the water, as it becomes charged with blood, is poured off and replaced by fresh; after this is repeated for a time, the flesh becomes bleached, and the bones may then be suffered to remain as long as necessary (sometimes for weeks), removing the specimen from time to time and scraping off the softening flesh. After this has been all removed and the bones well scrubbed under water with a stiff brush, they should be soaked a little longer to remove any remnant of infiltrated blood. During these operations, care must be taken not to injure or separate any of the ligaments. Shreds of tendon may be cut off with a sharp knife or pair of scissors. The ligaments may then, according to Eyton,\* be converted into a tough, leathery substance by immersion in a liquid prepared by making a saturated solution of common alum and, when cold, diluting it with an equal quantity of water, and adding half an ounce of common salt for every half pound of alum. If the bones are free from blood, twenty-four hours' immersion will be sufficient; large birds or other animals may require nearly a week. When removed from the solution, the bones must be washed under a current of water, or in a basin, and then allowed to dry in any desirable position.

It is important, in preparing skeletons, not to allow the flesh to dry too soon on the bones, or, at least, to allow them to soak in water for a time before drying, as the subsequent operations will be rendered much easier.

Greasy skulls or bones can be readily cleaned by immersion in ether for a length of time. The ether should be kept in a tight jar, and every precaution taken to prevent undue proximity to a light or the fire, the vapor being exceedingly explosive. A simpler method consists in boiling them in a large quantity of water, having a little potash added.

## ‡ VIII. PLANTS.

The collector of plants requires but little apparatus; a few quires or reams of unsized paper, of folio size, will furnish all that will be

\* *Ibis*, I, 1859, 55.

needed. The specimens as gathered may be placed in a tin box, or, still better, in a portfolio of paper, until reaching home. About forty or fifty sheets of the paper should be put into the portfolio on setting out on an excursion. Put the specimens of each species in a separate sheet as fast as gathered from the plant, taking a fresh sheet for each additional species. On returning to camp, place these sheets (without changing or disturbing the plants) between the absorbent drying papers in the press, and draw the straps tight enough to produce the requisite pressure. The next day the driers may be changed, and those previously used laid in the sun to dry; this to be continued until the plants are perfectly dry. If paper and opportunities of transportation be limited, several specimens from the same locality may be combined in the same sheet after they are dry.

Place in each sheet a slip of paper having a number or name of locality written on it corresponding with a list kept in a memorandum book. Record the day of the month, locality, size, and character of the plant, color of flower, fruit, &c.

If the stem is too long, double it or cut it into lengths. Collect, if possible, half a dozen specimens of each kind. In the small specimens, collect the entire plant, so as to show the root.

In many instances, old newspapers will be found to answer a good purpose both in drying and in keeping plants, although the unprinted paper is best—the more porous and absorbent the better.

When not travelling, pressure may be most conveniently applied to plants by placing them between two boards, with a weight of about 50 lbs. laid on the top.

While on a march, the following directions for collecting plants, drawn up by Major Rich, are recommended :—

Have thick cartridge or envelop paper, folded in *quarto* form, and kept close and even by binding with strong cord; newspapers will answer, but are liable to chafe and wear out; a few are very convenient to mix in with the hard paper as dryers. This herbarium may be rolled up in the blanket while travelling, and placed on a pack-animal. The specimens collected along the road may be kept in the crown of the hat when without a collecting-box, and placed in paper at noon or at night. Great care should be taken to keep the papers dry and free from mould. When there is not time at noon to dry the papers in the sun, they should be dried at night by the fire, when, also, the dried specimens are

placed at the bottom of the bundle, making room on top for the next day's collection. A tin collecting-box is very convenient; plants may be preserved for two or three days in one if kept damp and cool. It is also convenient in collecting *land-shells*, which is generally considered part of a botanist's duty. A collector should also always be provided with plenty of ready-made seed-papers, not only for preserving seeds, but mosses and minute plants. Many seeds and fruits cannot be put in the herbarium, particularly if of a succulent nature, causing mouldiness, and others form irregularities and inequalities in the papers, thus breaking specimens and causing small ones and seeds to drop out. Fruits of this kind should be numbered to correspond with the specimen, and kept in the saddle-bags, or some such place. It is necessary, in order to make good specimens, to avoid heavy pressure and keep the papers well dried, otherwise they get mouldy, turn black, or decay.

The seeds and fruits of plants should be procured whenever practicable, and slowly dried. These will often serve to reproduce a species otherwise not transportable or capable of preservation.

On board ship, it is all-important to keep the collections from getting wet with salt water. The papers can generally be dried at the galley. The whole herbarium should be exposed to the sun as often as possible, and frequently examined, and the mould brushed off with a feather or camel-hair pencil.

In collecting algæ, corallines, or the branched, horny, or calcareous corals, care should be taken to bring away the entire specimen with its base or root. The coarser kinds may be dried in the air (but not exposed to too powerful a sun), turning them from time to time. These should not be washed in fresh water, if to be sent any distance. The more delicate species should be brought home in salt water, and washed carefully in fresh, then transferred to a shallow basin of clean fresh water, and floated out. A piece of white paper of proper size is then slipped underneath, and raised gently out of the water with the specimen on its upper surface. After finally adjusting the branches with a sharp point or brush, the different sheets of specimens are to be arranged between blotters of bibulous paper and cotton cloth, and subjected to gentle pressure. These blotters must be frequently changed till the specimens are dry.

## § IX. MINERALS AND FOSSILS.

The collections in mineralogy and palæontology are, amongst all, those which are most easily made; whilst, on the other hand, their weight, especially when travelling, will prevent their being gathered on an extensive scale.

All the preparation usually needed for preserving minerals and fossils consists in wrapping the specimens separately in paper, with a label inside for the locality, and packing so as to prevent rubbing. Crumbling fossils may be soaked to advantage in a solution of glue. Melted wax also answers an admirable purpose in the case of bones.

Fossils of all kinds should be collected. Minerals and samples of rocks are also desirable. The latter should be properly selected, and cut to five by three inches of surface and one to two inches thick.

The vertebrate fossils of North America are of the highest interest to naturalists. These are found in great abundance in the regions known as "Mauvaises Terres," or "Bad Lands," and occurring along the Missouri and its tributaries, White River, Milk River, Platte, Eau qui Court, &c. The banks and beds of these and other streams likewise contain rich treasures of fossil bones. Similar remains are to be looked for in all caves, peat bogs, alluvial soil, marl-pits, fissures in rocks, and other localities throughout North America. Single teeth, when found, should be carefully preserved.

The floor of any cavern, if dug up and carefully examined, will generally be found to contain teeth, bones, &c. These, however similar in appearance to recent or domesticated species, should be carefully preserved.

Specimens ought to be tightly packed up in boxes, taking care that each one is wrapped up separately, in order that the angles or any crystalline surfaces should not be destroyed by transportation; their value depending upon their good condition. The same precautions will be required for corals. The interstices between the specimens, in the box or cask, may be occupied by sand, shavings, hay, cotton, or other soft substance. Sawdust is considered objectionable on account of its settling too much. It is absolutely essential that no cavity be left in the vessel or box.

### ‡ X. MINUTE MICROSCOPIC ORGANISMS.

It is very desirable to procure specimens, from many localities, of the various forms of microscopic animals and plants, not only on account of their intrinsic interest, but for their relation to important general questions in physical and natural science. These will almost always be found to occur in the following localities:—

1. In all light-colored clays or earths, as found in peat bogs, meadows, soils, &c., particularly when these are remarkably light.

2. In the mud from the bottom of lakes and pools. A small handful of this mud or of the confervoid vegetation on the bottom, if dried *without squeezing*, will retain the Diatomaceæ and Desmidiæ.

3. In the mud (dried) from the bottom and along the margins of streams in any locality. The muds from brackish and from fresh waters will differ in their contents.

4. In soil from the banks of streams. The surface and subsoils should both be collected.

5. In the soundings brought up from the bottom of the sea or lakes. These should be collected from the greatest possible depths. If an armature be used to the lead, it should be of soap rather than fatty matter, as being more readily removed from the organisms. The mud which adheres to anchors, to rocks, &c., below *high-water-mark*, as well as below *low-water*, should also be carefully gathered.

6. In bunches of damp moss from rocks, roofs of houses, trees, about pumps, &c.

7. In the deposits in the gutters and spouting of roofs of houses.

8. In the dust which at sea collects upon the sails or deck of vessels. When not in sufficient quantity to be scraped off, enough may be obtained for examination by rubbing a piece of soft clean paper over the surface affected.

Specimens of all these substances should be gathered, and, when moist, dried *without squeezing*. The quantity may vary from a few grains to an ounce, depending on the mode of transportation to be adopted. *Every specimen, as collected, should have the date, locality, depth below the surface, collector, &c., marked immediately upon the envelop.*

It is also desirable to collect filterings from river, brackish, and

sea-waters. To do this, take a circular piece of filtering-paper, six inches or thereabouts in diameter (blotting-paper will answer if the other cannot be procured). Pass a quantity of the water, varying with its turbidity from a pint to a gill, through the paper, and allow this to dry. Mark the paper or its envelop with the amount of water passed through, date, place, &c. It is desirable to have specimens thus prepared for every locality and for every month in the year. They may be sent, as well as light packages of dried muds, &c., by mail, and should be transmitted as speedily as possible. Unless the operation can be performed by an experienced hand, the weighing may be dispensed with.

When the water of lakes and ponds has been rendered turbid by minute green or brown specks, these should be gathered by filtration through paper or rag, which may then be dried, or, still better, this matter may be scraped off into a small vial of alcohol.

#### § XI. ON THE COLLECTION AND PRESERVATION OF MARINE INVERTEBRATES.\*

CLASSIFICATION.—The animals inhabiting the sea, excluding the fishes and other vertebrates, may be divided, for convenience, into groups, as follows: 1st. CRUSTACEANS, including crabs, hermits or soldier crabs, lobsters, *langoustes*, cray-fish, *camerones*, shrimps, prawns, sand-hoppers, beach-fleas, whale-lice, sea-creepers, pill-balls, fish-lice, sea-spiders, water-fleas, gill-suckers, and other parasites on fish, also barnacles. 2d. ANNELIDS, including all kinds of sea-worms, some of which hide among seaweed and pebbles, but most of which live in mud or sand, many having tubes. 3d. CEPHALOPODS, or cuttle-fishes and squids. 4th. NAKED MOLLUSCS, or sea-slugs. 5th. SHELLS, both bivalve and univalve. 6th. TUNICATES, vulgarly called “sea-squirts,” consisting simply of leathery balls or sacks of various shapes, with two apertures, often occurring in compound forms. 7th. BRYOZOANS, or those minute coral-like incrustations found on seaweeds, stones, and old shells. 8th. HOLOTHURIANS, those worm-like or slug-like echinoderms like the bichele-mer or trepang. 9th. ECHINI, sea-eggs or sea-urchins, most of which resemble chestnut burrs, being covered with spines. 10th. ASTERIAS and star-fishes of all kinds. 11th. POLYPS, including

\* Prepared by Mr. Wm. Stimpson.

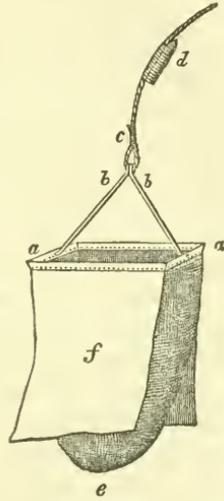
corals and corallines, and those minute animals from which the medusæ are developed. And 12th. SPONGES.

LOCALITIES AND STATIONS.—Where the retreat of the tide is sufficient, the sea-shore always affords the best field for the collector, and the specimens generally increase in number and interest in proportion as we approximate to low-water-mark. Nevertheless the whole area should be searched, as each species has its peculiar range, and many forms can live only where they are exposed to the air for a greater part of the time each day. The ground may be either muddy, sandy, weedy, gravelly, stony or rocky, and the animals inhabiting each kind of ground will be found to be more or less peculiar to it, and rarely to occur on the others. *Sand* and *mud* are, however, so similar in character that their denizens are nearly the same, though some prefer the clearer waters which flow over sand, to the turbid tide which deposits mud. But few specimens will be found on the surface of such ground, although the little pools lying upon it should be scooped with the dip net for shrimps, etc., but it is only by the spade that its true riches can be developed. By digging in spots indicated by small holes, a great number of worms, boring crustaceans, and bivalves may always be found. *Weedy ground* is so called from the abundance of eel-grass and sea-weed which covers it. These weeds should be examined carefully for small shells and crustaceans; perhaps the best method of doing this being to wash quantities of the weed in a bucket of water and examine the sediment. *Gravelly ground* is not generally very rich in animal life, but will repay an examination, as small crabs are fond of lurking among the pebbles. *Stony ground* is by far the richest of all. Wherever there are stones, particularly flat ones, about large enough to afford a moderate degree of exercise to a common sized man in turning them over, there the zoologist can never fail to fill his basket and bottles; for beneath these stones myriads of rare and beautiful species retire for moisture and protection during the retreat of the tide. *Rocky ground* should be searched chiefly in the pools and crevices.

Littoral or sea-shore investigations should be carried on not only in the bays, harbors, and creeks, but on the ocean beach, in each locality, to get at a true idea of its fauna, as the respective animals will be found different.

DREDGING.—A large proportion of the marine invertebrates never approach the shore closely enough to be left exposed by the tide,

and these can only be obtained with certainty and facility by means of the *dredge*. This consists of a rectangular frame of iron, the longer sides of which are sharpened in front and beveled outward a little. Along the back of the frame holes are perforated for the attachment of a fine meshed net, and to the short sides handles are hinged, which may be folded down in packing. There should be a ring at the end of each handle, and through these rings the rope may be passed when the handles are raised, which will be found a simple and sufficiently safe method of fastening the dredge for use. A weight should be attached to the rope two or three feet in front of the dredge, which is useful in sinking and keeping it in proper position when operating in deep water. On each of the longer sides of the frame there should be a leather flap, attached, for the protection of the net. The following are convenient dimensions for the apparatus: Frame, *a, a*, 20 inches long by 10 inches broad, of bar-iron,  $1\frac{1}{2}$  inches wide and one-fifth of an inch thick.



Handles, *b, b*, each 17 inches long, of half-inch rod-iron. Bag, *e*, three feet long, of mesh as fine as can be got, and strong twine; size of aperture rather larger than that of the frame. Rope, *c*, 20 to 200 fathoms to suit the depth of water. Weight, *d*, 5lbs.; an iron window-weight answers the purpose, and is much cheaper than lead.

The dredge should be carefully cast mouth-downward, that the tail of the net may not foul the handles or scythes. No precise directions can be given as to the amount of scope of warp to be let out;—about twice the depth of water is generally sufficient, but this should be diminished or increased in proportion as the dredge nips too hard or slides too easily over the ground, which may be readily determined by feeling the rope. The dredge is liable to be caught on rocky bottoms. When the check is felt, it is usually only necessary to heave in a portion of the warp, but sometimes the boat must be put about and run in an opposite direction.

All bottoms should be searched with the dredge, but gravelly and shelly ground will be found most productive. The boat may

be propelled by sails if sufficient care be taken to graduate the amount of canvas to the strength of the wind, in order that the dredge may move slowly over the bottom. Oars are safer, if the force is at command; and in a tide-way, the tide alone may move the boat with sufficient power, the rope being made fast amidships, or towards the bows, according to the strength of the current. Dredging may be carried on at all depths inside of 200 fathoms.

**INSTRUMENTS FOR COLLECTING.**—For shore collecting, a broad flat basket, with jars or tin-cans, of various sizes, for the smaller and more delicate animals, which should be brought home in sea-water. A spade, trowel, and a strong knife for detaching limpets and tunicates from the rocks. A small dip-net is quite indispensable. In dredging, besides the baskets and bottles, one or more buckets are necessary, as many of the larger animals, such as starfishes, are fragile, and can only be brought safely home in sea-water. And, above all, there should be wire-sieves for washing out the sand or mud brought up from soft bottoms.

**PRESERVATION OF SPECIMENS.**—Alcoholic fluid is the only medium in which marine invertebrates can be properly preserved, shells and corals alone being excepted. Dried specimens are always in danger from dampness and breakage, and when sent to the Museum, seldom reach their destination uninjured. In placing the specimens in kegs, cans, jars, or bottles, a few rules should be carefully observed: 1st. Never crowd them too much; a bottle should be not more than half filled with specimens, but must be always entirely filled with alcohol. 2d. Adapt the bottles to the size of the specimens, placing small ones in small bottles, or, if very minute, in homœopathic vials. 3d. Never put soft and delicate forms with hard or spinous ones, which would injure them in any agitation. Each jar or bottle should contain specimens from one locality and station, which should be indicated in full on the label—the nature of the ground, distance from low water mark, and, if dredged, the depth of water being noted. In the larger kegs or cans, if specimens from more than one locality are included, each should have a parchment label attached, with the notes written in ink.