

DAVIES'
NATURALIST'S
GUIDE

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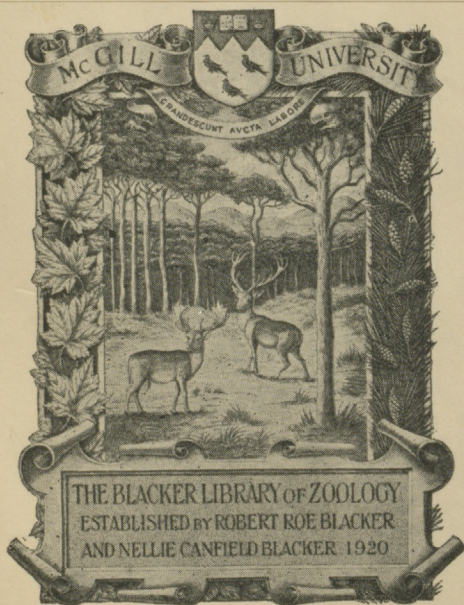
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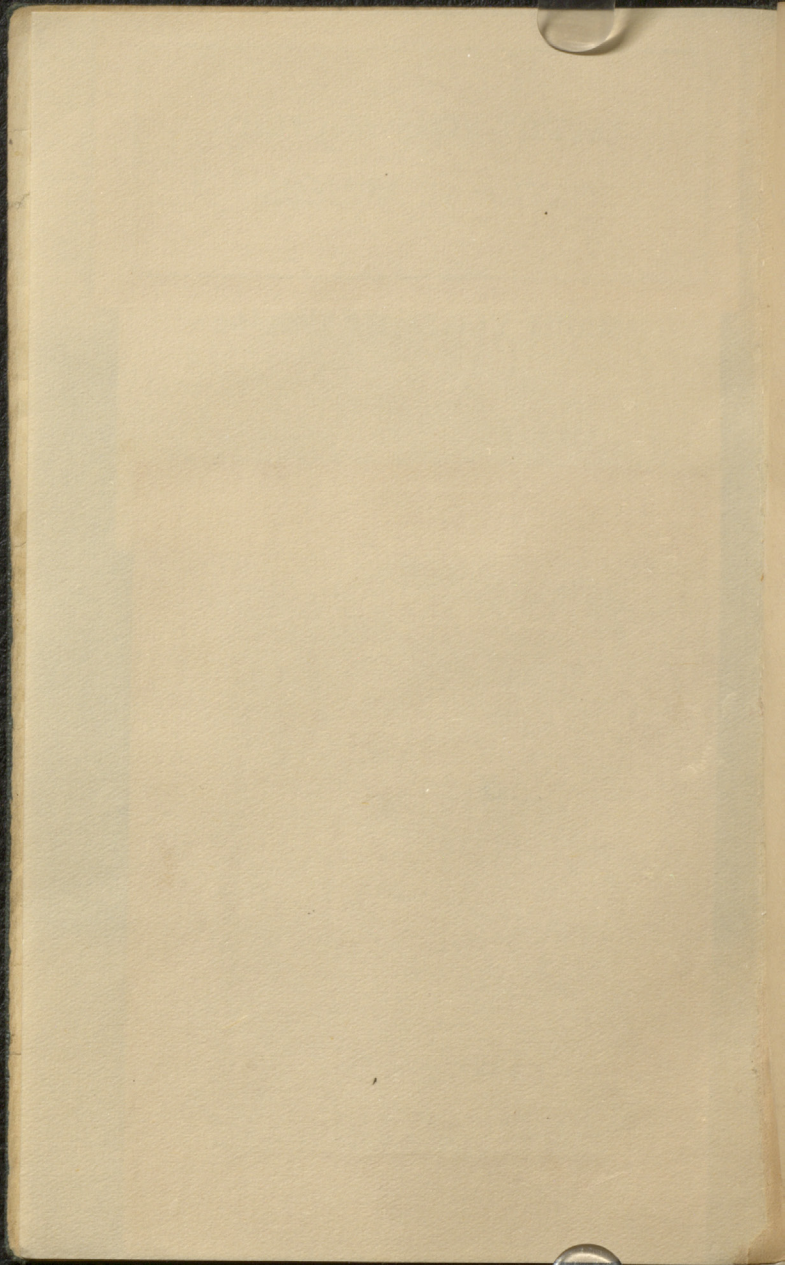
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some one qualified to teach it. Yet it must be insisted on, that birds, however well suited for ornament,—and certainly few objects are better adapted for that purpose,—are, when stuffed, not one whit more valuable as zoological specimens, than when simply prepared for the drawer of the cabinet. In collections for educational purposes, as in public museums, it is necessary to exhibit stuffed specimens, owing to the large number of persons who inspect them in the course of even a single day; but it is not to be argued therefrom, that every student who wishes to study the birds or quadrupeds of his country ought to spend his otherwise valuable time in performing a task which, if not better left alone, would at least be better performed by another. In short, while it is on every account advisable that the stuffer should have an extensive knowledge of the anatomy, habits, and general characteristics of quadrupeds and birds,—in fact, be a good naturalist,—it by no means follows that the student of zoology ought to be a stuffer.

In forming a private collection, it is of the first importance that it should be illustrative, *i.e.*, that the specimens should be fair types of the species, not monstrosities, either of size, colour, or form; that, however few, they should be grouped with regard to their affinities, and not huddled together without order or regularity, like the contents of the Chinese cabinets we sometimes see in curiosity shops; that the specimens be perfect, so far as possible, and illustrate the differences of colour and form depending on sex, age, and season; and that every specimen should be labelled with the name and sex, if known, the locality whence procured, and the date of capture.

In collecting species not of unfrequent occurrence, it is not advisable to accumulate crowds of examples. In most cases, a pair, or at the utmost four or five specimens, will be found to illustrate the characters of a species as well as a score, with this advantage, that space in the cabinet is economized, not to mention the wantonness evinced by the unnecessary destruction of life. Duplicates, however, of rare species may with advantage

be collected, provided they be intended for exchange with other naturalists, for by that means much may be done to promote science.

In killing animals, the shortest way is always the best. To the humane naturalist, and it is to be hoped that all who pursue the science are really humanized by it, nothing can be more distressing than to see a creature writhing under pain. It must not be supposed, however, that—

“The poor beetle that we tread upon,
In corporeal sufferance, finds a pang as great
As when a giant dies.”

On the contrary, it is a pretty well recognised fact, that the lower the development of the nervous system, the less intense is the creature's sense of pain. Yet it is well in all cases to lean to the side of mercy; to kill only where a decided object is in view, and then in the quickest manner.

Unfortunately for science, many exquisitely beautiful animals, particularly marine, either cannot be preserved at all, or become so changed in the hands of the manipulator, that form, colour, and substance are but mockeries of the living organism; and the only way of recording its very existence is to make a good drawing of it. A naturalist with a good eye to form and colour, and possessing the power to render these on paper, is so much more a naturalist than he who cannot use his pencil. To the collector who anticipates travelling in foreign countries, the importance of cultivating the arts of pencil-drawing and water-colour painting is too great to require argument to enforce it.

Even for the purpose of recording the colours of the eyes of vertebrate animals, the use of the brush may be with propriety recommended, on account of the difficulty of enforcing any certain standard for the nomenclature of colours.

In preparing this little treatise for the press, the writer has relied chiefly on his own experience in preserving animals; yet many of the directions are necessarily the offspring of hints received at times, either

written or orally, from others, though now so blended with his own daily practice, that he cannot, in many instances, point out the discoverers. Under these circumstances, it would be vain specially to enumerate any; and he therefore contents himself with thanking all.

Sub-Kingdom VERTEBRATA.

Animals possessed of an articulate internal skeleton present, in many respects, greater attractions to the young collector than any other of the zoological subkingdoms. Often of considerable size, and in many instances brilliant in colour, they are more readily procured, and easily mounted to look well, than the humbler members of the invertebrate groups; while our earliest associations being in some respects connected with quadrupeds, birds, and fishes, either as playfellows or pets, naturally predispose us to give them the precedence. To this may be added, that they alone of all animals afford the exciting pleasures of the chase, and the not less pleasurable recreations of shooting and angling.

MAMMALIA.

This, the highest division of the animal kingdom, including even man himself, generally occupies a large space in all zoological collections. The familiar designation of quadrupeds, or even "beasts," though enough to distinguish the class in a popular view, requires to be altogether rejected in order to have a clear understanding of the real ranges of the group, otherwise we would necessarily, on the one hand, exclude man, who has but two feet, and monkeys, which have no feet at all, but in reality four hands; and, on the other, reject whales, porpoises, and other cetaceous animals, which

are often, by the uneducated, confounded with fishes; as well as the whole group of the seals. The necessarily distinguishing characters of Mammals may be briefly summed up thus: they are vertebrate animals, breathing air by true lungs, bringing forth their young alive, and suckling them by means of teats.

To Procure Mammalia.—It is unnecessary to inform the student how he must set about to procure the larger Mammals of our country, such as foxes, wild cats, hares, &c. The gun or the fox-trap at once suggest themselves; while the traveller in foreign countries soon learns by experience the readiest method of reducing to submission such opponents as lions, elephants, and bears. It is the smaller Mammals that require more special attention. Should the student be in the good graces of a gamekeeper, he may easily procure these; but this not being the case, he must to the woods himself. He should, towards twilight, proceed to the outskirts of the wood, taking care to select a spot with a plentiful stock of hazel or beech, and there await the appearance of the squirrel and the dormouse, who come to collect their store. The ermine, weasel, and martens, are also now abroad, and will occasionally afford a mark for the gun. Traps, either of the kind usually employed for catching rats, or merely wire-gins, may be placed in frequented localities, and visited at daybreak to ascertain the result.

Cetacea are often cast ashore, stranded in shallows, or entangled in the nets of the fishermen. Seals must be shot; a task of some difficulty, owing to the rapidity with which they regain the water.

Bimana, the highest order of Mammals, includes man alone. Although every attempt to preserve specimens of the human species in their entirety must end in signal failure, yet it is of importance to the development of ethnological science that travellers should seize every opportunity to throw light on the natural history of man as a variable species. This may be done in various

ways: 1st, By bringing into request philological knowledge, in carefully recording, so far as possible, the peculiarities, whether of derivation, construction, or pronunciation, of the language spoken by the race under study; * 2d, By examination of their manners, customs, traditions, and even superstitions; 3d, By collecting illustrative examples of their costumes, arms, and manufactures; 4th, By procuring, where practicable, typical examples of skulls; and, 5th, By accurate drawings of average examples of the race. In all cases extreme examples should be avoided as worse than useless, tending as they do to thwart the objects of science. Missionaries and others residing permanently in little known regions may, if used to photographic manipulation, confer a boon on ethnological science by employing the camera as a means of obtaining faithful representations of the natives, and their modes of life.

When skulls are procured, they merely require cleaning, which may be done by steeping for a few days in fresh water, which should, however, be frequently changed. The brain can be removed by the occipital orifice without injuring any of the bones of which the skull is composed; a casualty to be in all cases carefully avoided. When dry, the name of the race, and, if known, the name, age, and sex of the individual, as well as the lo-

* "A vocabulary should be taken down from the mouths of intelligent natives. Care should be taken to compare the words given by one person with the testimony of others, in order to correct any defect or peculiarity of pronunciation.

"It is important to select properly the classes of words. The following should be chosen:—

"1. Numerals up to a hundred or more. Ascertain how far the people of each tribe can reckon.

"2. Words denoting family relations, such as father, mother, brother, sister, &c.

"3. Names of the different parts of the body,—head, arm, foot, &c.

"4. Names of visible natural objects, elements, &c.,—sun, moon, fire, water, &c.

"5. Names of animals, especially domestic animals.

"6. Verbs expressive of universal bodily acts, such as eat, drink, sleep, see, hear, &c.

"7. Personal pronouns,—I, thou, he, &c.

"8. Prepositions,—in, from, to, &c.—if they can be obtained."—Dr PRICHARD, in his "Admiralty Manual of Scientific Enquiry."

cality, should be written with ink on the top of the skull. A little hay, dry leaves, sawdust, or paper, will answer for packing.

The weapons will require very little attention, though it is of importance to ascertain whether any of them are poisoned, and use precautions accordingly. The dresses should be thoroughly dried, and packed in close-fitting boxes, with a quantity of any strong-smelling plant the locality may afford, to keep insects at a distance. A piece of tow or sponge saturated with naphtha or turpentine will answer better. They should be frequently examined, and if tending to mould, again thoroughly dried.

Mammalia in General.—For the sake of illustration, suppose that we have just procured a monkey or fox, or indeed any other moderately-sized quadruped, and means being at hand for the preservation of its skin, we proceed as follows:—The mouth, nostrils, and anus, are filled with tow or cotton, to prevent the blood or feculent matter from oozing out and so injuring the fur. The animal is laid on its back on a clean dry board or table, the legs pressed out, and having turned back the hair from a line exactly in the middle of the body, an incision is made through the skin at the posterior end of the abdomen, taking care to cut the skin only, and not the underlying muscles as well. This incision is to be carried up the line indicated by the turned hair till near the union of the neck with the body. With the left hand the skin is raised first on the one side and then on the other; at the same time the right hand is employed to loosen it by means of the handle of a scalpel or any flat piece of wood. The portion of the skin thus disengaged is kept from the flesh of the body by the insertion of quantities of tow or rags, or by sprinkling it with plaster of Paris or fine sand. The anus is next cut through, and immediately after, the tail at its junction with the body. The hind legs are then cut off at the upper thigh-joint, and the posterior portion of the body turned out of the skin. A hook suspended

from the wall or roof having been provided before commencing operations, the carcass is now suspended by the pelvis, and the skin gently pulled down from the back, the handle of the scalpel or flattened stick being employed as before to facilitate its removal. The neck is then uncovered, and the head proceeded with. In skinning the latter great care must be taken to cut off the ears as close to the skull as possible, and to preserve uninjured the eyelids, nostrils, and lips. The trunk is now removed from the hook and laid aside, and the legs successively hung on it by their fleshy parts, and the skin drawn down as far as the toes. The flesh is then removed with the aid of the scalpel, leaving, however, the tendons which unite the joints. Should the creature be rather large, and the bones in consequence of considerable size, it would be well to drill a hole in each end, and with a wire or thin metal rod force out the marrow. In order to skin the tail, the first and second vertebræ are laid bare, and attached to the hook or a strong cord. A cleft stick is then made to embrace the portion already skinned, and gradually forced down towards the extremity, carrying before it the freed skin. The skin being separated, it is now carefully examined, and any fatty or fleshy matter still adhering is removed with the knife. The bones of the legs are to be rubbed over with powdered burnt alum, which speedily dries them, or, if preferred, with arsenical soap (A.). The inner side of the skin is to be completely annointed with the latter preservative; and the bones of the legs being wrapt round with tow, are returned to their proper envelopes. The skull next requires attention. It should be separated from the neck, and the brain removed by the opening behind. This may not be very easily effected in some instances, and a portion of the bone will require to be removed in order to enlarge the orifice. In all cases, however, this should be avoided if possible, as the skulls of many foreign animals are of as much real value as the stuffed animal; and thus, when from any cause the skin gets destroyed (an occurrence by no means uncommon), the specimen still retains a scientific value.

Where time will permit, it is well to macerate the skull in water until it is completely divested of flesh, and the brain so decomposed as to be easily shaken out. Cleaned, by whatever means, the skull must be treated with preservative, and, the place of the flesh on it being supplied by tow, put back into the skin of the head. The tail may have a wire wrapt round with tow forced into it. A quantity of tow or thoroughly dried grass supplies the place of the body by distending the skin into something like its natural shape.

The larger Mammals, as the elephant, rhinoceros, zebra, and deer, do not admit of such easy manipulation as the illustration chosen, and consequently should not be attempted unless really required for a special purpose, or in the event of their appearing to present some specific difference from those already known. A skull, with the antlers or horns attached in the case of deer and wild oxen, is often of as great value as a skin preserved for stuffing, and may be readily prepared by first removing the skin and the flesh from the cheeks and under part of the jaws, and then macerating in water until the remaining flesh parts easily from the bone, and the brain, in a softened state, may be shaken out by the occipital opening. When the skull is prepared without the skin, it is of the highest importance that it should be perfectly free from damages, and on no account whatever should the hole be enlarged to admit of the more easy removal of the brain. Where practicable, a suite of skulls should be obtained from the earliest age up to the matured adult. A number or mark should be written on the upper part of the skull, and any particulars of the size, sex, habits, &c., of the creature, together with the exact locality, must be written in a journal or list, with a corresponding mark or number at the head of the paragraph, after the following fashion:—

“ 2 A. MALE.—Native name *Muntjak*; height to shoulder, about 2 ft. 2 in.; colour, reddish-brown, inclining to yellow; female darker than male; face with two course folds of skin

like the letter V; pedestals of horns covered with skin; in elevated regions; motions swift, and, when pursued, returns by circuitous route to place from which it started; Java.

“2 B. FEMALE of 2 A.”

The skull being macerated, dried, and marked, it may be packed in straw, dry grass, or indeed any material at hand, and no further trouble taken with it. Even in the event of sending home a skin for stuffing, it is well to send also a good illustration of the skull, as much real scientific value attaches to the conformation of the bones of the head.

In skinning the larger Mammalia, especially the Pachyderms, it will be necessary to make three cuts on the under surface like the sign †. The longitudinal incision is passed from the mouth on to the anus, and the cross cuts from the right legs to the left. The operation is then proceeded with in the same way as for smaller quadrupeds, with the exception, that it is more troublesome, and must often be done under great disadvantages, on account of the difficulty of obtaining the means of suspending such weighty subjects. To prepare a skin of an elephant, a yak, or a large stag, with arsenical soap, would, under most circumstances, be extremely injudicious; and fortunately it is found that steeping in a saturated solution of alum answers the purpose equally well. In many instances, even alum cannot be procured in sufficient quantity, and then salting has been tried, but with bad results. In the absence of alum or other preservatives, a large skin should be spread, with the hairy side on the ground, and dried in the sun. If cleanly prepared in this way, and rapidly dried, it will, in all probability, reach this country in a state of perfect preservation. When dry, the skin is folded horizontally, with the hair inside, and keeping the head on the outside of the bundle, in order that the lips, &c., may be frequently inspected.

Kangaroos, and other allied animals, require to have the marsupial sac well annointed with the preservative, —whether arsenical soap or alum,—and distended by means of a piece of card. Should the pouch contain young at the time of death, these must be removed, with

the portion of the skin bearing the teats to which they are attached, and preserved in fluid.

Bats may be opened either before or behind, and the body removed. The wings must be well washed with preservative, and the creature laid on its back on a board, and the membranes spread out in a flying position, and secured by pins, one at each finger-point, until dry. The ears afford important zoological characters, and should therefore be kept from shrinking. The smaller species, such as those of this country, may be, when dry, prepared for the cabinet by simply glueing them by the wings to suitable pieces of card-board.

The armadillo and manis require no stuffing, on account of the hardness of their skins. It is, however, quite necessary to apply the preservative.

Seals are more easily stuffed than the majority of Mammals; and, if prepared in the way indicated for Mammalia generally, will have an appearance as natural as that of most animals in a museum. Much information is yet wanting on the subject of the seals of the Arctic and Antarctic Seas, and even of those of our own shores. In every instance, where practicable, an extra skull should be obtained.

Whales, porpoises, and dolphins, are often ranked among the "great fishes of the sea," yet, being true Mammals, come in appropriately in this place. Great care is necessary in skinning, and still more in removing from the skin the fat which adheres to it. To accomplish this latter, it will sometimes be well to steep the skin in water until it approaches a state of putrescence, when the fat may be easily drawn away. The skull must be preserved, as also the baleen, when it occurs. A note should be made of the number and direction of wrinkles, and the colour of the skin; and, if possible, a water-colour drawing should be made exhibiting both. Parasites, external as well as internal, should be sought for.

USEFUL MEMORANDA.

Always skin the creature, especially if covered with

hair, as soon after death as possible, taking care not to allow it to get wet. Wipe off the blood with a sponge before it dries.

Never use corrosive sublimate for the preservation of any skin which may be intended to be ultimately stuffed, as this substance renders it brittle, and effectually prevents the softening necessary for that operation.

Make particular note of the colour of the eyes, as also of their prominence and diameter.

Note the colour of any bare portions of skin, as on the cheeks and hips of some monkeys.

Note the character of the hair on the recent animal, *i.e.*, whether naturally sleek, or rough; also the attitudes of the animal in sitting, running, and leaping.

Take careful measurements from the recently killed specimen:—*1st*, From the nose to the insertion of the tail; *2d*, From the nose to the shoulders; *3d*, The length of the tail; *4th*, The girth of the chest; *5th*, The girth anterior to the hind legs; *6th*, The length from the shoulder to the fore paw, and from the upper part of the hip to the hind paw.

Skeletons of Mammals are, in a purely scientific point of view, even more valuable than stuffed specimens; hence the acquisition of the necessary materials for their formation is of the highest importance. Yet it must be distinctly understood that, however good the intentions, and careful the manipulation, the operator will, in the majority of cases, completely fail in his object, unless he have some knowledge of the anatomy of the vertebrate animal.

Skeletons are generally divided into *natural* and *artificial*, *i.e.*, those in which the ligaments are not removed from the bones, but are left for the purpose of connecting them, and those in which, by maceration or other means, the bones are entirely freed from the ligaments and artificially articulated. *Natural skeletons* can only be successfully made when the animals are of a small size, in no case exceeding that of the fox. The first part of

the process is to remove the skin as far as the points of the claws, and completely off the head and tail. The head is then separated, and the viscera being extracted, the body is put to macerate. In this country, except in the summer months, it may be well to accelerate the decomposition of the flesh, either by heat or by the addition to the water of a little caustic, soda, or potash. For the first few days it will be necessary to change the water every day, and, when the flesh has become bleached and partially decomposed, it may then be time to remove it with a knife, taking care not to injure any of the ligaments which serve to unite the bones. The greater part of the flesh being removed, the skeleton is again put into the macerating basin with fresh water, and on the succeeding days subjected to the operation of cleaning until all the flesh is removed. Great care must be taken not to injure the bones during the manipulation, as a scratched bone is really worth less than nothing. The brain being previously broken up and removed with a flattened piece of wood, the head is treated in a similar way to the body. Some operators *boil* the head and trunk for a greater or less time, according to the size of the animal, and then proceed to remove the flesh. This plan, though it may be necessary in very cold weather, should be avoided whenever maceration in cold water is practicable. When finally removed from the macerating basin the skeleton must be kept in a suitable position, by means of wires or threads attached to any frame-work which may be easily procurable, and left to dry; a wire, however, is previously passed down the spinal canal, and the end left projecting. When dry, the skull is attached by passing the wire which projects from the vertebræ of the neck into it by the opening in the base, and then binding the skull and vertebræ together by means of a piece of copper or brass wire, passed through the thick part of the latter and the occipital lobes of the skull, and tightly twisted.

It has been proposed to employ ants and wasps in the dissection of small animals, but I doubt whether the process is quite so successful as some of its advocates

would make it appear. The animal, being skinned, is smeared over with honey or treacle, put in a pasteboard box well perforated with holes, and inserted in an ant-hill, or placed in a situation much frequented by wasps. The former will, it is said, clean a mouse in a week, and the latter in a few hours.*

The traveller who intends to forward materials for skeletons to this country had better, in the case of small animals, send them in the flesh preserved in spirit; and, in the case of the larger mammals, disarticulated and cleaned by maceration. In order effectually to macerate larger animals, the following particulars should be attended to:—

1st. They should be disarticulated at the neck, shoulders, and hip-joints, before being placed in the water.

2d. The water should be changed every day for a week, or even more in the case of large animals.

3d. The flesh being quite putrid, the water must be removed by a syphon or stop-cock, and passed through a sieve, to prevent the escape of small bones.

4th. The larger bones being picked out, the residue of decomposed flesh must be examined in small quantities for minute bones, &c.

5th. The bones are next to be thoroughly washed, and dried in an airy situation.

6th. Great care must be taken not to mix the bones of two animals together in packing.

7th. The same particulars as to the living animals should be recorded, as in the case of preserving a skull (p. 10).

BIRDS.

From the comparative ease with which they are procured, as well as on account of their graceful forms and splendid plumage, birds are more general favourites among collectors than any other class in the animal

* Pole, "Anatomical Instructor."

kingdom, molluscous shells and insects only excepted ; and as a consequence ever occupy a large space in every public museum. Perhaps no more striking proof of the favour with which birds are viewed could be adduced than the number of valuable and expensive works on Ornithology which have from time to time issued from the press ; and the host of illustrations by naturalists who have specially devoted themselves to this subject. It will be sufficient to mention the names of Alexander Wilson, the precursor of ornithological science in America, Bonaparte, Audubon, the late C. J. Temminck of Leyden, Gould, Selby, the late William Yarrell, M'Gillivray, and lastly, Sir William Jardine, Bart., who, by the publication of his "Naturalist's Library," has brought the study of birds, as well as many other departments of Zoology, within the means of almost every one.

To Procure Birds.—No one who is in the habit of using a gun need be told how to procure birds, as that instrument is, at least in this country, more frequently employed in dealing death among the feathered tribe than on any other game. Of the manner of handling the gun it is not necessary here to speak, because it can only be learned by practice, under a competent teacher. Even the size of the shot cannot be dogmatically prescribed, as that must be in a great measure regulated by circumstances ; however, as a general rule, No. 8 will be found large enough for birds under the size of a pigeon, and No. 5 for those of greater bulk. It must be insisted on, however, that the sportsman fire at any other part of the bird rather than the head, as that part, once seriously injured, can never be successfully repaired. A bird being merely wounded is to be killed by strangulation. This may be effected by tying a running knot on a pocket-handkerchief, and passing the noose thus formed over the neck and tightening it. Some birds, when wounded, require to be very cautiously approached. The heron is particularly dangerous, on account of the length and sharpness of his bill, as well as the rapidity of his motions. A firm knock on the

head from a walking-stick may have the effect of subduing him.

In the absence of a gun, a trap or traps of various kinds may be used. The sieve, or the brick trap so often used by school-boys, will frequently be found serviceable. In other instances, a cage, with a decoy-bird, may be judiciously employed. Bird-lime is frequently used in catching birds for caging, and might occasionally be used by the naturalist, as it can be easily removed from the feathers with the aid of a little spirit of wine. It may be purchased from bird-dealers.

Another source from whence the British zoologist may replenish his cabinet is the poultry market, or shops. Many of the most valuable additions made to the British Fauna within the last quarter of a century have been derived from this source. Here, however, it is necessary to offer a word of caution. The purchaser must see that the birds are fresh in appearance, and not cold, moist, and icy; otherwise the valued additions to the cabinet may after all turn out to be frozen Norwegian or Canadian specimens, imported by an enterprising poulterer to satisfy the British appetite. Capercailzie, grouse, ducks, geese, and waders, are thus imported every season in immense quantities.

Suppose that the collector be his own caterer, it will be necessary for him to carry to the field, in addition to his gun and bag, a quantity of cotton wadding, some squares of paper, and a memorandum-book. With the cotton he stuffs the mouth, anus, and wounds,—the latter to prevent further bleeding;—after which he ties the beak close. Any spots of blood which may have escaped are to be carefully wiped from the plumage with the corner of a pocket-handkerchief dipped in water. A piece of paper of convenient size is twisted into a conical bag, such as are used by grocers, and the bird is put head-foremost into it. The mouth of the bag is then closed, taking especial care not to injure the feathers of the tail. The bird thus wrapped is placed in the game-bag, and others similarly treated added to the stock while the day's shooting lasts. The memorandum-book, how-

ever, must first be put into use, especially if the bird be a rare one, and the following particulars stated.* They are copied from a very useful tract published by order of the Smithsonian Institution of Washington in 1852, and comprise almost all the observations required to be made on the recent bird:—

“ 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 the tip of the 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-joint. The numbers may be recorded as follows,—44, 66, 12 (as for the 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 appended to each specimen.

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

“ 3. Are the heels covered or uncovered by the feathers of the belly?

“ 4. Attitude of the body while at rest, whether vertical, oblique, or horizontal. Does the bird perch or not?

“ 5. Position of the wings, whether supported or hanging, crossing on the tail or not. Are they continuous and covered by the feathers of the mantle (back) and breast for the upper third, half, or the two-thirds of their length? Their extremity; does it reach the end of the tail, the half, or the fourth of its length? The three last points will be of great use in mounting the specimens.”

To the above may be afterwards added the following particulars worthy of note—*i.e.*, sex of the bird; food, determined by examination of the contents of crop and gizzard; the date of capture; and precise information as to the locality. The native name, in case of a foreign specimen, is also of importance.

Birds require to be skinned almost so soon as cold, as they spoil sooner than Mammals. Where this is not practicable, and any considerable delay is anticipated,

* The beginner should practice noting the characteristics even of common birds, in order to acquire the habit of doing so with accuracy.

the intestines may be removed and abdominal cavity well sprinkled with powdered charcoal, chalk, pepper, or even fresh-ground coffee.

To Skin Birds well requires a considerable amount of patience, neat-handedness, and practice; nevertheless, it may be taught in a very short lesson. The adjuncts necessary are a scalpel or knife, a hook suspended from the ceiling by means of a cord, a quantity of chalk or plaster of Paris, some calico or linen rags, a needle and thread, and a supply of tow, flax, hemp, or cotton, for stuffing.

Before commencing to skin it is necessary to take a slip of cartridge or other strong paper, and bring it round the middle of the body over the wings so as to take the girth. This is pinned in the form of a ring, and slipped off in the direction of the feet. The plugs are to be removed from the mouth, anus, and wounds, and their places supplied with fresh pieces of stuffing. A string or strong thread is passed through the nostrils by means of a needle, and tied under the mandibles, leaving a long end loose.

The bird being laid on its back on a table, with the head pointing obliquely towards the left hand of the operator, the feathers along the middle line of the abdomen are gently pushed on either side with the fingers and thumb of the left hand, and a slit is made in the skin thus exposed, care being taken not to penetrate through the muscles into the intestines. The extent of this slit will vary with the expertness of the operator. The beginner will, in all probability, find it necessary to cut from the upper angle of the ridge of the sternum to the anus; though with practice he will in the end succeed in skinning without carrying the incision so high. The slit being made, the fingers are inserted between the skin and the flesh, and a little of the chalk or plaster dusted over the part thus exposed, in order to prevent the adhesion of the feathers to it. Strips of linen or calico, of proper width,* are now taken and

* The width for a goose will be about three to four inches, and

carefully sewed on the cut edges of the skin, after the manner of binding, in order not only to keep the exposed rows of feathers clean, but to prevent stretching of the skin in subsequent operations. The legs are now successively pushed forward and divided at the knee-joints, after which the vertebral column is also divided, leaving the last joint in the skin as a support to the tail-feathers. The body is then suspended on the hook by the rump end, and, with the fingers or the handle of the scalpel, the skin is separated from the back and sides until the shoulder-joints appear. Should the bird in hand be a gull, or, indeed, any of the order of waterfowl, it will be necessary to separate the wings at the shoulder-joints; but in all others it will be as well to make the division at the elbow-joint. The neck is next to be skinned, and then the head so far as the bill. The tongue and muscles of the head being removed, the head is separated from the neck, and, enlarging the opening behind (*foramen magnum*), the brain is scooped out with a flat piece of wood or a cut quill, according to the size of the bird. In skinning the head great care must be taken not to injure the external ears and the part surrounding the eyes. The bone (*tibia*) left in each leg is next to be well cleaned and anointed with preservative (A.) A little tow or flax is to be wrapt round it, and the skin of the leg itself being rubbed with preservative, the bone is to be restored to its original position by gently pushing it in. Where the upper bone of the arm (*humerus*) is retained, it also must be treated in a similar way. Except in large birds it is not necessary to do anything to the fore-arm (*radius* and *ulna*). In these, however, the muscles must be removed by cutting a slit in the skin along the inside of the arm. The next operation—the fatty matter, of course, having been previously removed—is to anoint the whole of the inside of the skin, as well as the skull, with preservative.

may be increased or diminished according to the size of the bird. This admirable plan, for which I am indebted to the suggestion of Mr Small, taxidermist, George Street, Edinburgh, is especially useful in skinning water-fowl with fat bodies and light-coloured plumage.

A wire, of about the length of the neck when skinned, is taken, and one end being fastened into the base of the skull, a little cotton, tow, or flax, impregnated with preservative, is wrapped round it, and then, by means of the string attached to the bill, the head is pulled out of the skin of the neck. If the specimen be intended for stuffing, the calico may be left on it; but if for a cabinet, this should now be removed, and a quantity of stuffing put in so as to distend the body. The wings being properly disposed on each side, the paper ring is now put round the body, and the stuffing continued until the whole fits tightly. It is then only necessary to sew up the slit, arrange any displaced feathers, and label, when the skin is ready for the cabinet.

Should the sex of the bird not be sufficiently obvious from the plumage, it will be necessary to remove the viscera from the abdomen, and the presence of ovæ or testis will at once decide the question.

The sternum may be preserved as an accompaniment to the skin. In order to do this, it is necessary to remove so much as can be conveniently done of the pectoral muscles, pass the knife under the shoulder-blades to separate them from the muscles of the back, and cut through the ribs at a little distance from the sternum, when the whole may be easily removed. Steeping from a few days to a fortnight or three weeks in water, with a little soda or potash, will render the flesh soft enough to be removed with the thumb-nail. The bones are then to be cleaned with a nail or tooth-brush. The water must be changed every second day.

Specimens prepared in this way, consisting, as they do, of the sternum, the coracoid bones, the furcula, and the scapulæ, are not only beautiful objects, but of great interest, as illustrating the power of flight of the birds.

The foregoing directions, though *generally* applicable, yet admit of some modifications to suit individual cases.

Several birds—as the vultures—have a considerable space of the skin destitute of feathers. This part must be skinned with more than ordinary care, as its nakedness exposes even the slightest rupture. It is some-

times recommended that these parts, when dry, should be painted with varnishes, in imitation of the colours in the living bird. Though this adds to the beauty of the specimen as a mere *show-thing*, it should never be tolerated by the naturalist; because, however well done, it has always an unnatural appearance.

The feet of most of the larger birds of prey are thick and fleshy. In these cases it will be necessary to cut a slit along the under side of each toe, and perhaps up the back of the tarsi, to remove the tendons. A little stuffing, well saturated with arsenical soap, must be used to supply the place of the parts removed; and a few stitches will close the openings. In no case should corrosive sublimate be employed, as it hardens the feet too much, and effectually prevents their subsequent softening, in the event of the skin being stuffed for a public collection. The same remark applies to herons, bitterns, ducks, and to all birds having fleshy feet and legs.

The webs on the feet of swimming-birds had better be skinned below, and must in all cases be well anointed with arsenical soap.

Grebes, and other water-fowl with white silky bellies, may be skinned from a slit in the back instead of the abdomen.

In some birds, as the creepers, humming-birds, and toucans, the tongue is horny, resembling either a folded strap or a feather. In these cases it may be judicious to leave it in the skull, provided the muscles at its root are entirely removed, and the whole well anointed with the preservative. *x better to remove it altogether -*

When the head of a bird is of such a size, as in the flamingo and the majority of web-footed birds, that the skin of the neck cannot be brought over it, it will be necessary to make an incision in the neck close to the head, and thence remove the brain, &c. This operation is one of considerable nicety, as the feathers are very apt to get daubed.

Humming-birds, from their diminutive size, are by no means easily skinned. Should the operator fear to risk a valuable specimen, he may have recourse to one of two

following methods of preservation suggested by Mr George Loddiges :—

“1st, Make an incision as if for skinning, and with a small pair of scissors remove so much of the soft parts as practicable, and supply the vacancy with cotton.

“2d, Merely dry the specimen, but as rapidly as possible, over a stove or oven, and pack with plenty of camphor.”

It is needless to say that the only really satisfactory way of preserving a bird is to skin it; and this should, in all cases where practicable, be attempted.

When a valuable skin is so completely broken up that it is impossible to make a specimen of it by the ordinary methods, it is recommended that it should be set up, feather by feather, on a model of the bird's body previously prepared. This, however, is by no means a satisfactory method, and is more the work of an artist or a taxidermist than a naturalist.

The same may be said of a method of mounting much in vogue on the Continent, and termed by the French *en demi-bosse*. Very pretty relieved pictures are produced; but they are fitter for the nursery or school-room than the zoological cabinet.

Skeletons of foreign birds are always acceptable in public museums. The method of preparing them is not sufficiently different from that adopted with Mammals to require explanation. As a general rule, birds of the size of a goose, or, under, should not be disarticulated, but prepared as natural skeletons.

The Nests and Eggs of Birds, apart from their mere beauty, are objects of sufficient scientific interest to warrant their preservation: indeed, it would be well, if practicable, to place beside the male and female of every species of bird, in a public collection, a nest, with the usual complement of eggs. So highly is the study of eggs esteemed, that instances are known of L.21 being

paid for a single specimen;* while L.5 is by no means an unusual price for the egg of the golden eagle.

To be a good collector of eggs and nests implies a thorough knowledge of the haunts and habits of birds; and this can only be acquired by out-door study.

It is not always practicable to preserve the nests of birds. Some, as the eagles, merely gather a quantity of dry sticks and leaves, and form loose, untransportable nests of such dimensions that few naturalist's cabinets could accommodate them. Others form no nest at all, but deposit their eggs in the sand. The great majority of nests, however, may be preserved. With the exception of thoroughly drying them, very little aid is necessary for their preservation. A little corrosive sublimate (B.) may be gently brushed over them; and in the event of their being composed of earthy matter, and becoming very friable, they may be treated with gum tragacanth (C.). Each nest should be packed in a box, as nearly its own size as possible, and the eggs deposited in it as nearly as may be the positions originally occupied by them. The whole may be covered with cotton in sufficient quantity to prevent shaking, but not so much as to endanger the safety of the eggs when the lid is applied.

The eggs require to be emptied of their contents, which should be done by making a suitable hole in the *side*, by means of a counter-sink in the case of large eggs, or an angular pricker in the case of small ones. Should the egg contain a young bird, the hole must be of larger dimensions, and the foetus cut out piecemeal. The inside may then be washed with corrosive sublimate (B.), and a piece of oiled silk, goldbeater's skin, or thin paper, pasted over the opening.

It is often recommended to pierce the egg at each end; but while this method presents no advantages over the one described above, it has the serious disadvantage that it is apt to destroy one of the chief characteristics of the specimen, *i.e.*, the contour of the ends.

* The egg of the great auk, in the collection of the late William Yarrell, Esq., fetched that price in London at an auction sale.

REPTILIA AND AMPHIBIA.

Though, to the popular mind, the word reptile conveys the idea of an animal mean and loathsome to a degree, yet the naturalist thinks far otherwise. To him the Reptilia, and the associated class Amphibia, present some of the most interesting genera in the whole sub-kingdom Vertebrata. Until of late years it was customary to include both of these classes under the comprehensive term Reptilia. They have, however, been very properly divided, chiefly on the ground that the Amphibia breathe in the early stage (when they are known as tadpoles) by gills; while in the true Reptilia, respiration is always, even in the youngest condition, carried on by means of lungs. Perhaps the readiest way of distinguishing the two classes is by the skin, which, in reptiles, as tortoises, lizards, and serpents, is covered with scales of greater or less dimensions; while in Amphibia, as newts or salamanders, syrens, frogs, and toads, the skin is quite destitute of scales, and is either perfectly smooth or warty.

Chelonians or Tortoises, including the turtle, so highly esteemed at aldermanic feasts, are defended by two strong plates; one on the back (*carapace*), and the other on the under side (*plastrum*), which are generally united at the sides, forming a compact boney shell, with an opening in the anterior end for the extrusion of the head and fore-feet, and another at the posterior end for the hind feet and tail.

Two methods of preservation present themselves:—

1st, To remove the head and limbs, and cut out so much of the flesh as can conveniently be done by passing the knife and scissors in at either opening; then macerate the remainder out, and dry. In this case, the skull should also be cleaned and preserved along with the shell.

2d, By means of a chisel or strong short knife, and a mallet or hammer, the under shell or plastrum is removed, leaving the head and limbs attached to the cara-

pace. These are then to be skinned as in Mammals; well anointed with preservative; and stuffed out with tow. The inner surfaces of the shields are also to be rubbed with arsenical soap; after which they may be united by means of wire.

If dirty externally, the shields should be washed with arsenical soap, and then rubbed with a woollen cloth or wash-leather till thoroughly dry.

The writer does not approve of oiling—far less varnishing—the shields, as is often done for the sake of effect.

Saurians or Lizards, Crocodiles, and Chamæleons, unless of very small size—in which case they require to be put up as wet preparations—* can be readily skinned much in the same way as Mammals; removing, however, the bones of the legs down to the foot. After being rubbed internally with arsenical soap, they are generally filled with sand during the process of sewing, and put in appropriate positions to dry; after which the sand is let out, and the strength and thickness of the skin retain them in their proper shapes. Some species, from the comparative softness of their skins, cannot be so treated, and require to be stuffed with flax or cotton. When the specimen—as is frequently the case—is too large to be easily transportable, the skull should be preserved. This will often be the case with a collector in India, especially if he have limited assistance; the species of crocodile and gavial being often of great size.

In collecting *Saurians*, whether in the skin, or merely as skulls, it is of importance to note the character of the tongue, whether extensible and bifid; thick, fleshy, and non-extensible; or fleshy, cylindrical, and capable of being protruded to a great distance. On these characters very important sub-divisions are founded.

The three native lizards—of which two are pretty generally distributed over Britain, and one is confined to the Channel Islands—are found in dry, sandy places.

* See chapter on "Wet Preparations."

They are too small to be successfully stuffed, and do not suffer much change of colour in spirit.

Ophidians or Serpents are the third order of true reptiles. Unlike the two former, they are always destitute of feet, and have along the under surface a row of plates considerably larger than the scales of the general surface of the body. Only two species are found in Britain: the viper, a native of dry heaths, and the innocuous snake, which frequents damp woods, and frequently forms its nest in a dung-heap, much to the terror of the simple rustic. The latter is often exposed for sale in Covent Garden Market; and when properly tended becomes, as the writer can vouch from personal experience, an amusing pet. It may be fed on young frogs. As a general rule, serpents should be put up as wet preparations. If judged too large for this purpose, they may be slit along the under side and skinned; the space being filled up with tow wrapt round a wire proportioned in size to the bulk of the specimen. To economise space, as well as for the purpose of effect, serpents are usually coiled or arranged in fanciful attitudes. Two mistakes, of very frequent occurrence, should be guarded against:—

1st, In giving the serpent the form of a flat coil the tail is often made to assume the outside instead of the inside whorl. This is a mistake, which no one who has ever seen a serpent coil itself should make.

2d, Serpents are often represented *bending back*; an attitude which the dorsal spinous processes render impossible in the living creature.

Many foreign serpents being venomous, great caution must be exercised both in their capture and in subsequent manipulations. All such should, if possible, be preserved in spirit.

Skulls of serpents, particularly if the fangs and teeth be perfect, are always valuable.

In collecting any of the Reptilia for the purpose of stuffing, it is of importance to make a note of the colour of the eyes; and also of the nature of the food, which

may be ascertained by an examination of the contents of the stomach.

Amphibians are all more valuable as wet preparations, than when stuffed: indeed, with the exception of frogs and toads, none of the class can be successfully set up dry. It is of importance to procure male and female, and, if possible, the tadpole condition of each species. The male newts in this country are distinguished during the spawning season by a beautiful crest running along the back. This occurs in spring.

There are seven species of Amphibians, natives of Britain,—one frog, two toads, and four water-newts. The latter, as well as frogs, are not uncommon in little pools and ditches. The common toad is easily procured on road-sides on damp summer evenings. The Natterjack toad is more local in its distribution, being confined to the marshes on the Solway Frith, and a locality in the county Kerry, Ireland.

Frogs and toads are very easily skinned and stuffed. First the mouth is opened, and with a pair of scissors the skull is cut, so as to remove from the inside the eyes and brain. Then the vertebral column is separated from the neck, and the arm bones at the shoulder; with a pair of forceps, the arms, as far as the fingers, are drawn out and cut off. The vertebral column is then laid hold of, and the whole body drawn out at the mouth. The legs being separated at the toes, the skin is returned into its natural position, and filled to a proper bulk with the following stuffing:—

A quantity of fine sawdust or bran, moistened with hot glue, and a few drops of the dissolved corrosive sublimite (B.)

Eyes are to be put in from the inside before the filling is completed; afterwards the mouth is to be secured with a single stitch, and the toad or frog modelled with the fingers into a proper shape. When dry the skin is washed with spirit of wine, to remove any of the stuffing which may have adhered to it.

The female of the pipa or Surinam toad, bears on her

back in little cells the eggs and young while in their tadpole condition. In this state it forms a highly-interesting specimen.

FISHES.

The student of Ichthyology will find a valuable coadjutor in the fishmonger. In attempting to form a collection of the fishes of any country the fish-shops and stalls should be inspected daily. Even in this country many rare specimens may thus be occasionally picked up. A still better plan is to win the good graces of the fishermen, and either accompany them to sea, or inspect the result of their labour on return to land: and seeing that many specimens are by them thrown away as unmarketable, they should be induced to bring everything to shore by a promise of purchase. On the sea-shore many specimens may be picked up from the pools left by the retiring tide, whence they may be taken with a small hand-net. The fresh-water species are caught with the rod, with trimmers, or nets. Those who have devoted themselves to this art will care for no hints as to procedure, while the novice will require either to study some of the books specially devoted to the subject,—as the “Rod and Gun,” by the late James Wilson, Esq.; or the “Practical Angler,” by Stewart; or, what is still better, receive practical instruction from some adept in the art.

Fishes are preserved in two ways: either skinned and stuffed in whole or in half, or put up as wet preparations.

To Stuff Fishes.—When practicable, the fish, so soon as taken out of water, should be wrapped in fine silk paper. In all cases it should be skinned while perfectly fresh, because the colours are very evanescent.

The plan adopted by the writer for stuffing such fishes as the pike, perch, the salmonidæ, breams, haddocks, &c.,

is as follows: *— A clean soft deal-board of convenient size, a quantity of pins, a knife or scalpel, a pair of scissors, some corrosive sublimate in spirit (B.), a shallow basin of water, and a quantity of fine tow or flax, must be first provided. Having determined by previous examination which side is to be preserved, the fish is laid on the clean board, with that side uppermost, and the dorsal, anal, and caudal fins distended, and with a black-lead pencil its outline is accurately traced on the board, indicating by diverging lines the anterior angles of the fins. Placing the fish in the shallow basin, and, beginning at the head, an incision is made in the skin down the middle of the back to the tail, and a similar one down the belly. The dorsal, anal, and caudal fins must of course be left attached to the side to be preserved. The head is next split in two, and the half to be preserved detached from the vertebræ. The skinning is now proceeded with, commencing at the head. The interspinal bones which support the dorsal, anal, and caudal fins, are cut through with the scissors close to the skin. Having removed the half desired, so much as possible of internal bones and muscle of the head are cleared away with the scissors. The eyes are removed from *within*, so as to leave entire the integument which, in many fishes, as the *Gadidæ*, covers them. The skin and skull are now to be brushed internally with the preservative (B.), and any superfluous fluid remaining is to be carefully wiped off. On no account must the solution be allowed to touch the scales, as it immediately dims them. While the skin is yet moist and pliable, the back edge of it is pinned to the dorsal line on board. In doing this, it is necessary to commence with the head; having fixed it, a pin is put in at the base of the anterior margin of the dorsal fin, and another at the upper edge of the tail fin, distending them thereby: the remainder of the back is then pinned down. A quantity of tow is taken, and rolled

* The writer understands that to Dr Richard Parnell is due the credit of proposing the outlines of this plan.

into a shape somewhat resembling that of the fish, but considerably more slender, and pressed well back between the skin and the board. A pin is fixed in the front under-edge of the skin; and we continue to pin down to the pencil line on the board until the tail is reached, all the while stuffing in tow so as to give the fish a proper rotundity. Should the anal fin be dry before this part of the operation is completed, a damp sponge will immediately restore its pliability. The pectoral and abdominal fins are now to be moistened and distended by means of pins on pieces of cork. When dry, which will be in the course of a single day, or at most two, the pins are removed, the eyes are put in, and the skin fastened to a strong card-board by means of glue, and coated with turpentine varnish.

The eye of a fish being generally flat on the surface, is easily imitated by cutting a disc of silver paper of the same diameter as the eye, and another of black paper, to correspond with the pupil. These being gummed together, are placed behind the membranous integument, where such exists, and secured with gum.

The advantage of having an outline on the board, to which to pin the edges of the skin, will be very apparent to any one who attempts to stuff, say a pike, without this guide. Fishes' skins have a tendency to stretch longitudinally, and the result is, that it is by no means an easy matter to preserve the proper contour.

An easier plan, though one by no means so satisfactory, is to press the skin between blotting-paper (like a plant) till dry, and then glue it on cardboard. With some fishes it is almost quite necessary to adopt this plan, if they are to be skinned at all, on account of the softness of the scales and tenderness of the skin.

Larger species, such as sharks, sturgeons, sun-fish, and the tunny, are skinned in a way similar to that described as applicable to Mammals and birds, and the cavity being filled with tow, the sides of the opening are sewed together. For sharks, arsenical soap is better than corrosive sublimate. They should not be varnished.

Lampreys may be treated as described for frogs.

Fishes preserved in fluid are far more valuable for purely scientific purposes than if prepared by either of the above processes. At a subsequent page will be found instructions for putting up fluid, or, as they are technically termed, *wet* preparations.

In cases where the entire fish cannot be conveniently preserved, the head should at all events be secured. Heads or macerated skulls of sturgeons, sharks, skate, &c., are desiderata in most public collections.

The naturalist, especially if residing abroad, may do much for economic science, as well as for pure Zoology, by recording particulars regarding the season of spawning, the particular habitats, especially as to depth in the sea, and general statistics as to the abundance or scarcity of such species as afford food to man.

Sub-Kingdom ANNULOSA.

Until very recently this sub-kingdom was styled *Articulata*, a term which has now been very judiciously restricted to an important section in it. The members of the whole group are characterized by the annulated or ringed appearance of the body, as in the lobster, in insects, in centipeds, and worms.

Section ARTICULATA.

The members of this section are distinguished by having, in addition to an annulate body, truly jointed or articulate limbs. They comprise the four classes of *Crustacea*, or crabs, lobsters, woodlice, &c.; *Arachnida*, or spiders; *Myriapoda*, or centipeds; and *Insecta*.

CRUSTACEA.

The habitats of Crustaceans are as diverse as their forms. The great majority of them live in salt water,

and may be picked up on the shore, or in pools among rocks, or caught in crab cages. Many forms may be found among the refuse of the oyster dredge; while the stomachs of the larger fishes, as the cod, and even the mantels of bivalves, yield a fair supply. One genus, *Pinnotheres*, is only found in bivalves, as *Modiola* and *Pinna*. The larger masses of sea-weeds, as *Laminaria*, and the Gulf-weed, often afford a home to small species. Many Crustaceans are truly parasitic, and attach themselves to the eyes and gills of fishes; or even the abdomens of higher forms, as in the case of parasites on the hermit crab and on the common shore crab. Woodlice are terrestrial in their habits, and frequent damp places; they are more familiarly known in Scotland as *sclaters*. A large group of this class, the *Entomostraca*, are microscopic, or nearly so, and inhabit both salt and fresh water.

To Prepare Crustaceans.—They should be allowed to die in cold fresh water. On no account whatever should hot water be employed, as it immediately changes the colour. In the case of a crab the carapace or large shell should first be removed, leaving the limbs attached to the under portion. So much as possible of the flesh of the body and claws is then to be taken out, in the latter case employing a hooked wire. Except in large crabs it is not advisable to disarticulate the claws in order to clean them; but, when necessary, it may be done without materially injuring the specimen. Sometimes a piece is removed from the shell of the claw to facilitate the extraction of the muscle, and afterwards replaced and fastened in with cement. The whole of the inside is washed with corrosive sublimate, by means of a camel's hair brush, the limbs put in the desired position, and the shell is laid aside to dry, after which the parts are united with cement (I.) Should the specimen be a female, the false limbs on which the eggs are borne require to be preserved. Lobsters should have the carapace removed, and the limbs treated in the same way as crabs; the abdomen is then removed, and the contents

of it extracted by means of a hooked wire. Preservative (A. or B.) may then be applied, and a little cotton pushed into the abdomen. In drying, care must be taken to give a proper set to the small limbs on the abdomen, and the tail; this will best be accomplished by laying it upside down on a board, and propping such of the limbs as require it with pieces of cork.

Hermit crabs should have the soft abdomen slit open, the contents extracted, and the space filled with cotton. A little gum on the cotton will secure the edges of the slit. When dry they may be replaced in the shells in which they were found.

All Crustaceans, but especially the smaller species, are better preserved in fluid than in any other way. Nevertheless, it may be thought desirable to dry the smaller crabs, shrimps, sand-hoppers, and wood-lice. When the carapace is not too hard, a pin is passed through it into a flat piece of cork, and the Crustacean is set in the same way as an insect, with this exception, that slips of paper are not required, the limbs and feelers being kept in their places by pins bent obliquely over them. The chief thing to be attended to in setting is symmetry of parts. Nothing looks worse than a shrimp or crab with its limbs twisted about in every direction but the right one. Cirripeds or barnacles may be either dried or put up as wet preparations. They should be kept attached to the piece of stone or wood on which they are found.

Crustaceans should be dried in the shade, without artificial heat, and, if possible, in a place where there is a good current of air.

Parasitic Crustaceans and Entomostraca, the former on account of their softness, and the latter from their minute size, can only be preserved in fluid. The latter may, however, be put up as dry preparations for the microscope, though not very successfully.

Many parties apply varnishes of various kinds to the shells of Crustaceans when dry, but this had as well be dispensed with.

When covered with barnacles, or bivalve Mollusca,

the point of a knife should be passed under the shell when dry ; but if this does not remove it, on no account should acid be employed. A crab or lobster covered with these shells is not so uncouth an object as one blotched and corroded with acid.

Where opportunities occur, much good may be done to science by the study of the metamorphoses of Crustaceans ; but as a considerable amount of physiological knowledge is necessary for the task, the reader is recommended to consult works specially devoted to such subjects.

ARACHNIDA AND MYRIAPODA.

Spiders, scorpions, and centipedes, as, indeed, all members of the above classes, are better preserved in fluid than dry. They are, however, frequently dried, and set up in the same manner as insects or small Crustaceans. The abdomens of spiders almost invariably shrink in drying ; and to obviate this a small opening is made in their under surface, through which the viscera is pressed out, and fine cotton is introduced with the aid of the head of a pin. Mr Donovan found that by making the hole very small, and after having pressed out the contents, inflating with a blow-pipe, and drying, he preserved the colours better than by any other method. Mr Samouelle filled the abdomens with fine sand, instead of cotton. Hahn* recommends that centipeds should be steeped for a month in strong spirit of wine, in order that the soft parts may be hardened. They are then dried on blotting-paper, and the larger species fastened with pins ; the smaller being glued to strips of paper or card-board.

INSECTA.

Insects, not less from the facility with which they may be collected in almost any locality, and their convenient size for the cabinet, than the taste and neat-handedness called into play in setting them, have always been fa-

* Gründliche Anweisung, Krustenthier, &c. Zu sammeln, zu präpariren, &c. Von C. W. Hahn, Nürnberg, 1854.

yourites with collecting naturalists. The almost incalculable number of species contained in the class, and the very minute characters by which even genera are often distinguished, make the study of *Entomology* one of the best fitted of all departments of Zoology for training the faculties of observation and generalization.

To Procure Insects.—It would be more difficult to point out a locality where insects are not to be procured, than to tell where they may. As a general rule, however, it may be stated that places with a southern exposure and a dry soil are more favourable to the production of insects, particularly Lepidoptera, than those otherwise situated.

Lepidoptera abound in gardens, on heaths and commons, in woods, and on hill-sides. Many of them are extremely local in their distribution, while others are found almost everywhere. The early part of the day is the time best suited for their capture, with the exception of the moths, which are generally taken in the dusk or even towards midnight. In the latter case the collector proceeds to the known habitat with a lantern, round which the moths soon gather. Should the fruit-bearing trees not be in full blossom, the collector may have recourse to sugaring, *i.e.*, brushing a sweet compound (**D.** or **E.**) over the trunks of trees, and on stones and posts. This attracts moths.

By beating the branches and twigs of trees, great numbers of Lepidopterous and other insects, especially in the larval state, are dislodged, and may be caught in a net, an inverted umbrella, or a sheet spread underneath. Nearly every plant may be found at one period or another with some of its leaves curled up or folded together, and containing grubs. By collecting these, and rearing them, many Micro-Lepidoptera, which would otherwise escape detection, may be obtained. Beetles are seldom seen on the wing, except at night, but may be easily obtained in the day-time by those who know their haunts. Some are aquatic in their habits; others lurk beneath stones, in the bark and at the roots of

plants, and even in their blossoms; while not a few prefer less inviting places, and may be found among the droppings of oxen and other quadrupeds.

Nearly all the Mammalia, man himself not excepted, are the prey of wingless parasitic insects—as lice (*Pediculi*) and mites. Three species of *Pediculi* infest man; and in the disease called phthiriasis are found mites.

The larval state of many insects is passed in water, and these have to be searched for in shallow pools.

Seeing that insects are to be found everywhere, the only general direction to be given to the searcher is to *search everywhere*, until by experience, or the study of works specially devoted to the order he pursues, he attains sufficient knowledge of habitats to guide him.

A collection of insects of any order, which merely contains the perfect or imago condition, is to a certain extent imperfect. Whenever practicable, the grub and chrysalis should also be preserved. It might not be amiss for the young collector, when he obtains a number of grubs of a species of which he cannot fix the name, to dry, as directed hereafter, say one or two grubs, place the remainder in the breeding-cage, and, when the nymph state has been attained, dry one or two more. By this means he will, in the course of time, be possessed of the insect in its three stages, forming together a most interesting suite. The writer is not aware of any successful attempts to rear the caddis worm and its allies, nor yet to dry the larva well; but the case in which it lives, composed as it often is of beautiful fresh water-shells (*Cyclas* and *Planorbis*), may be easily preserved. Nests of social insects are also objects of scientific interest, as well as leaves, wood, and nuts pierced by them.

Apparatus for Collecting, &c.—These depend very much on the circumstances in which the collector is placed. In many instances insects may be knocked down with a hat or pocket-handkerchief, and, in the absence of a collecting box, placed in a twisted paper, or pinned inside the hat.

A Net is of importance to the proper pursuit of insects. This may be made according to the taste of the collector, but in the absence of any *pet* form, either, or both of those here figured will be found serviceable. Fig. 1 consists simply of two rods of wood of convenient dimensions (five feet will be about the maximum length), united at about two-fifths the length from the end by means of a screw-nail, so as to open and shut like a pair of scissors. The bag is made of gauze, crape, or strong muslin. It may be either white, green, or black. The latter is by many preferred. The rods may be, and frequently are, left unattached to each other.

Fig. 2 is simply a ring of brass wire, a foot or more

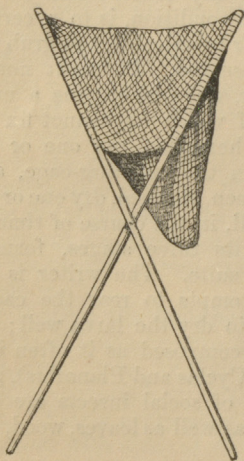


Fig. 1.

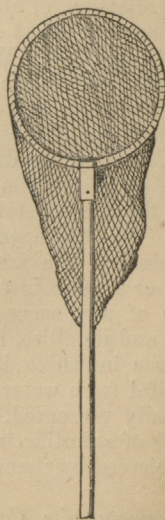


Fig. 2.

in diameter, with a ferule soldered to it, in which may be inserted the end of a walking-stick. The bag is of the same material as the former. This net is useful in

gathering aquatic insects, or in sweeping along the grass or plants growing by the wayside.

A *Collecting-box*, about two inches deep, by whatever length and breadth best suits the size of the collector's pocket, with the bottom and lid lined with cork, should also be carried. It may be made of tin, wood, or pasteboard. Pill-boxes, and small glass tubes or phials are also useful.

Bottles with wide mouths, and fitted with corks, for grubs; and stoppered bottles, with bruised laurel or other poisonous leaves, or spirit, for beetles, must also be carried. In addition to this, the collector should be provided with a botanical spud, or a garden trowel, to dig for grubs, &c., at the roots of plants and beneath the bark of decayed trees; a pair of forceps; a quantity of entomological pins of different sizes, ranging from No. 7 to 12; and some slips of cartridge or writing paper.

To Kill Insects.—The great majority of Lepidopterous insects may be killed by pinching the thorax on either side with the nail of the thumb and forefinger; or even by piercing it with the setting pin. When this fails, as in some species of *Bombyx*, it has been recommended to insert "a strong, red-hot needle into their thickest parts, beginning at the front of the thorax." In justification of this plan, its originator adds,* "If this be properly done, instead of lingering through several days, they are dead in a moment."

Chloroform, prussic acid, and sulphurous acid gas—produced by burning a brimstone match—are also employed with success.

In using chloroform, the experimenter is apt to take the insect out of the vapour too soon, and will perhaps find it revive under his hands when in the act of setting it.

Beetles and dragon-flies are also killed with difficulty. Hot water is often employed, after which they are dried with blotting-paper, and set. They may be with advantage immersed in the corrosive sublimate

* Haworth's "*Lepidoptera Britannica*."

solution (B.); which, besides killing them rapidly, effectually preserves their bodies from the pests of the cabinet.

In killing, by whatever method, the point to be kept in mind is the preservation of the specimen free from mutilation of any of its parts. This is a matter of difficulty, especially with Lepidoptera, and can only be properly taught by experience. One caution, however, may be given to the beginner;—never lay hold of a butterfly or moth by the wings; the proper place is the thorax or chest.

To Set Insects.—This is as easily done well as ill, provided it be properly gone about; and, as nothing looks so bad as a cabinet filled with twisted and unsymmetrical specimens, it is obviously a subject deserving the special attention of the young collector. Among the variety of plans suggested for this purpose, it is difficult to say which is the most deserving of preference. It may be safely stated, however, that as very much depends on the neat-handedness and taste of the manipulator, any plan in itself good will be found to answer the purpose.

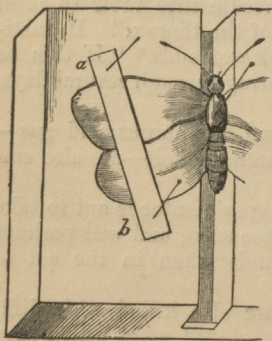


Fig. 3.

middle of the thorax. The pin is then fixed in the

The following method of setting Lepidoptera is, with slight modifications, founded on that most generally pursued on the Continent:—

Pieces of soft deal, about three inches square, have grooves cut in them, from a quarter to three-eighths of an inch deep. A thin piece of cork may be glued in the bottom of the groove if desired. The insect is laid hold of by the thorax, its wings forced a little up, and a pin passed through the

bottom of the groove, so that the body lies free of the sides, and with ample space below for the legs, as in fig. 3. A strip of card must be pinned to the board at *a*, the other end being raised so that the wings may be moved with freedom under it. The upper wing is then laid hold of at its anterior edge with the forceps, and moved forward to the requisite position, in which it is retained by gently pressing the upper end of the card on it until the under wing is also brought into position, when the pin *b* may be inserted. The same has now to be done with the wings on the other side, taking care that they exactly correspond in height. The antennæ are also to be arranged symmetrically, and, if necessary, kept in their places by having pins inserted obliquely over them. The insect is then put away to dry, which will usually take from one to three weeks, depending on the size of the specimen, and also on the state of the weather.

Some collectors have the sides of the wooden blocks bevelled or curved downwards from the groove to the edge, as in figs. 4 and 5; and there can be no doubt

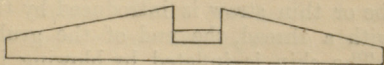


Fig. 4.

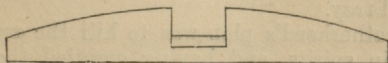


Fig. 5.

that either of these arrangements have their advantages in many cases. In France, and also in this country, slips of glass, or of sheet lead, are sometimes employed instead of card-board or paper.

The foregoing plan will be found suitable, with such

modifications as circumstances may suggest to the great majority of insects.

Beetles and Orthopterous insects are better set on flat boards without any groove. Unless the under wings are to be distended, beetles ought to be pierced through the right clytron. Minute insects of all orders require to be fastened by means of gum on small pieces of card, either round or wedge-shaped, through which a pin is passed to fasten them in the cabinet.

When the abdomen is of such a nature, as in the larger moths, the dragon flies, and many others, that it shrivels in drying, it must be emptied and stuffed as directed for spiders.

Larvæ, from their destructibility, generally require to have their contents removed, and the space either filled with cotton as in spiders, or they are preserved in either of the following ways. M. Dupont's plan is to procure a vessel of sheet-iron in the form of a funnel, and place its apex downwards in a charcoal fire. In the caterpillar, previously killed, a small incision is made at the vent through which the vicera are pressed out. A glass tube or thin straw is introduced by this opening, and with a thread, the end of the grub is tied round it. The skin is inflated by blowing in at the open end of the tube; and placing it within the cone, inflation is continued as often as the slightest collapse makes its appearance, until the specimen is perfectly dry, when it may be fastened with a little gum on a card or in a small tray.

Mr Weatherhead's plan was to kill the grub by immersion in spirits, and having emptied the skin as above, he filled it with fine sand, which he afterwards shook out when the specimen was dry.

It may be suggested that the solution of corrosive sublimate (B.) should be employed in killing, as it not only gives hardness to the skin when dried, but effectually keeps off mites.

The Chrysalis, or nymph, may be preserved either by

making an incision in the side, steeping in the corrosive sublimate solution, and simply drying; or the slit may be made to extend so far as to allow of the body being altogether removed from the case. The cases cast off by insects on their entering the perfect or imago condition, are better suited for the cabinet than any which we can prepare, and therefore should be carefully collected.

Breeding Cages may be varied in form and size according to the taste and means of the student. The following particulars, however, must in all cases be studied:—The larvæ must be regularly supplied with the food of which they partake most freely in a natural state; a plentiful supply of air must be admitted; moisture must also be secured; and in the case of such as burrow in ground, some moist earth must be put in the bottom of the cage. The form of cage usually recommended is a box of oak a few inches deep, and a framework, with wire-gauze sides rising above it. The writer has reared many insects, and among others, the swallow-tail butterfly, in a flower-pot covered with an inverted tumbler. There can be no doubt, however, that the more complete the apparatus, the more certain is success; and a well-made breeding-cage may be made an ornamental, as well as a useful piece of furniture.

It is of importance that only one species should be admitted to each breeding-cage, as they are apt to forsake vegetable for animal food.

Section VERMES.

The section Vermes, including worms and rotiferous animalcules, is distinguished from the Articulata by the absence of truly articulated limbs. They are chiefly aquatic in their habits, living in the sea, in fresh water, or in the juices of higher animals. A few, as the common earth worm, are terrestrial.

To Procure Worms.—The marine species may be ob-

tained by dredging, or gathered on the beach. They either lurk under stones or burrow in mud or sand. In the latter case, they are frequently furnished with a sheath, composed of minute fragments of sand and shells, held together with a transparent cement and fine threads. Some genera (*Serpula* and *Spirorbis*, &c.) form dense calcareous tubes, which are found attached to shells of Mollusca and Crustacea, or to sea-weeds. The parasitic worms were formerly classed under the order Entozoa; they are generally colourless, thread-like, or flat, as in the tape-worm. In an early stage the tape-worm consists merely of a head and an inflated sac. They inhabit the soft tissues of many vertebrate animals. Measles in pork is caused by one of them.

Rotiferous Vermes are all microscopic. They are found in stagnant water and vegetable infusions.

To Preserve Worms.—The first thing to be attended to is killing. This is an easy matter with moderately-sized marine worms, but with the more elongated genera, as *Nemertis* and *Phyllodoce*, it requires some nicety. The plan which the writer pursues is as follows:—The worm is allowed to remain in a jar with sea-water, until, by the vitiation of the latter, the creature begins to lose its irritability. This can be easily put to the test by touching it, and watching the effect. The water is then to be nearly all poured off, and weak spirit slowly added. The *Nemertis* will endeavour to throw itself in pieces by producing sudden bends in its body. When these are observed, the finger is gently pressed against the outside of the curve to reduce it until the worm dies. By adopting this plan, any worm may be preserved without a single break. There is another advantage gained by allowing the worm to become enfeebled in the sea-water, *i.e.*, that it generally throws out its proboscis, an organ of much value in distinguishing genera. *Serpulæ* and other shell-inhabiting worms should be preserved with the shell attached, and, if possible, another specimen removed from the shell should be placed in the same jar. Flat marine

worms (Planariidæ) can scarcely with safety be allowed to linger in the water, owing to their extreme liability to decay, but should be at once plunged into the preserving fluid.

Fresh-water worms, as well as tape-worms, may be placed in spirits immediately after being caught.

No successful attempt has been made to preserve worms dry. The sea-mouse (Aphrodite) has been sometimes stuffed, but not satisfactorily.

Rotatoria, being microscopic objects, do not come within the compass of this work.

Sub-Kingdom MOLLUSCA.

Owing to the presence of two very well marked types of organization in this sub-kingdom, it has been divided up into two great sections, the Mollusca Proper and the Molluscoïda.

Section MOLLUSCA (Proper.)

To this group belong all the shell-bearing mollusks known under the various names of snails, periwinkles, whelks, buckiés, cowries, conchs, ear-shells, limpets, clams, oysters, mussels, cockles, &c., as well as the sepias or cuttle-fishes. Their habits are extremely varied. By far the greater number breathe by means of branchia or gills, and inhabit the water, either salt or fresh; while another group—in this case all univalved—breathe by means of true lungs, and are terrestrial in their habits. As a general rule, they are provided with shells, though, in many instances, comparatively small and internal; yet a large group, the Nudibranchiata, are quite destitute of even the internal rudiment of a shell.

To Procure Mollusca.—Marine species are chiefly obtained by dredging; by examining masses of floating

algæ; by carefully observing the contents of pools of the sea-shore, or the beach itself; and by dissecting the stomach of the larger fishes, such as the cod. During the low tides large quantities of Mollusca may be obtained by turning over the stones, and looking narrowly into the crevices of rocks. Ear-shells, limpets, and other allied genera, adhere to the rocks between tides, and may be removed by applying a little warm water, or by giving the shell a sudden jerk with the foot. Naked Mollusca lurk under stones or among sea-weed at low-water mark. Many bivalves bury themselves in the sand, or in holes excavated in submerged shale or wood. When in sand, they may be dug up with a large fork; but they can only be successfully got out of the rock by employing the hammer and chisel. Cuttle-fishes are often cast on shore; they are also caught occasionally on the lines set by fishermèn for cod; and may also be obtained by trawling. Floating Mollusca occur in every sea, but more especially in those enjoying a high temperature: the towing-net is the only effective instrument for their capture.

Fresh-water Mollusca may be gathered with a net similar to that described at page 38 (fig. 2), or, still better, by using the shell-spoon (fig. 6). This consists of

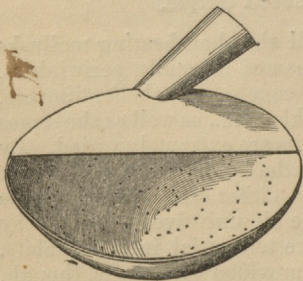


Fig. 6.

a hemispherical cup of white iron, about four inches in diameter, with a half lid soldered on the top, and an oblique socket for the insertion of the point of a walking-stick. The whole cup is perforated with holes. When, say a *Limnæus*, is obtained from the pool, the cup is raised until the stick is nearly horizontal, and slightly turned over on the side on which the covering is, so that the creature lodges securely between the side of the

cup and the partial lid. Bivalves seldom float; therefore they must be sought for either by lifting some of the mud in the spoon, and washing, or by pulling up the reeds and other plants, and examining the roots. Fresh-water mussels stick in the mud at the bottom of ponds and rivers: an iron rake is very useful in capturing them.

Land Mollusca must be hand-picked among leaves, roots, or the decaying stones of old walls. Their abundance in limestone and chalk districts has often been the subject of remark.* The following notes on these creatures are taken from Mr Woodward's admirable "Treatise on Recent and Fossil Shells," published in Mr Weale's elementary series:—

"Land-shells are most abundant on calcareous soils, and in warm and moist climates. The British species are collected with advantage in autumn, when full-grown, and showing themselves freely in the dews of morning and evening. Some species, like *Bulimus acutus*, are found only near the sea; *Bulimus Lackhamensis* ascends beech-trees on the chalk downs and cotteswoldes; *Pupa juniperi* and *Helix umbilicata* occur chiefly on rocks and stone walls. The moss-frequenting *Clausilia* may be obtained, even in mild winter weather, at the roots of trees; the small species of *Pupa* (or *Vertigo*) are sometimes taken abundantly when sweeping wet grass with an insect net; *Acicula fusca* lives at the roots of grass; *Cionella acicula* is found in old bones (such as occur in Danish burial grounds!), and occasionally in moving garden-bulbs; *Helix aculeata* has been met with on the undersides of leaves (e.g., the sycamore) a few feet from the earth."

For collecting land-shells, a few wide-mouthed bottles or pill-boxes should be carried.

To Preserve Mollusca.—By far the greater number of

* On one occasion, on a fell side in Westmorland, the writer found the common garden snail (*Helix hortensis*) so plentiful, that it was scarcely possible to put down the foot without treading on them.

collectors content themselves with the cleaned and dried shells of Mollusca, without attempting to preserve their softer parts. Indeed, a moderately-sized private cabinet will not admit of anything more. It is extremely desirable, however, that not only should the soft parts inhabiting shells be preserved, but more especially the mollusks which either are destitute of a shell altogether, or have only a small rudimentary one inside the mantle. This, though applicable to the well-known species of our own country, applies with far greater force to those of little-known regions.

Cephalopods or cuttle-fishes should always be preserved in fluid. Two genera—*Spirula* and *Nautilus*, inhabiting the southern seas—are much wanted in a perfect condition in all public museums. In the case of the latter, it will be well to make a small perforation in the first chamber of the shell to allow the preservative fluid to enter.

Naked Mollusca should be allowed to die in sea-water before being placed in the spirit or other fluid. The same remark applies to shell-bearing Mollusca, especially the univalved. Shells may be cleaned out either by pouring hot water over the living creatures, or allowing them to die in the water. A bent pin will be found useful in extracting the animal from the smaller shells. The chief thing to be attended to is to have the shells well cleaned and dried before being packed.

The operculum, which covers the opening in many spiral shells, must be preserved, and if of a hard, calcareous substance, simply placed within the mouth of the shell; but if thin and horny, a little cotton should be put into the shell, and the operculum fastened to this with gum.

In cleaning bivalve shells care must be taken not to break the hinge, as otherwise the valves are apt to be separated and lost. They should be tied together while yet the hinge is soft.

No attempt should be made to remove the adherent shells of other Mollusca or Crustacea. It ought especially to be kept in mind that the application of acids

will injure the specimen far more than the presence of scores of serpulæ and barnacles.

The epidermis which covers the shell is, so far as colour is concerned, the most characteristic feature in all species; therefore it follows that this must be carefully preserved. An application of oil has been often recommended; and, more recently, Gen. Totten has proposed the use of *chloride of calcium* for the purpose of keeping the epidermis moist and clear. In the majority of instances no such application will be necessary, provided the shells are carefully dried and preserved.

Section MOLLUSCOIDA.

The animals included in this section are entirely destitute of a proper calcareous shell, and require to be preserved in fluid.

The Tunicata, the highest group, are simply gelatinous-like sacs, generally colourless, though occasionally red or tawny. They are sometimes so very transparent that the functions of digestion and respiration may be seen through their external tunics. Some are solitary, and others are aggregated like a bunch of fruit; while more minute forms resemble a layer of gelatinous matter spread over the frond of a sea-weed, and dotted with various colours. They are all marine, and chiefly obtained by dredging, though they are frequently cast on shore by a heavy sea, and may be found attached to the stalks of Algæ, to shells, or stones.

The Polyzoa, or *Bryozoa*, are a group of plant-like animals, inhabiting alike salt and fresh water, long confounded with Polyyps, and with them associated under the class Zoophyta. The Flustra, common on the sea-shore all round this country, and often preserved among collections of Algæ, is one of the most familiar examples of this class. The marine species may be gathered on the shore after a high tide, or obtained by dredging. The fresh-water species are found in streams, ponds, and

canals, adhering to stones and plants. Like the true Polypi, many of the Polyzoa may be preserved dry by washing in fresh water, and pressing between sheets of absorbent paper; but in this state they are far less valuable than as wet preparations.

Sub-Kingdom RADIATA.

The members of this group of animals are generally characterized by the ray-like arrangement of their parts. In general form they are either cup-shaped, with tentacles fringing the lip; star-shaped, spherical, or hemispherical; though in one group they bear a considerable resemblance to melons or cucumbers. They are entirely aquatic in their habits, and, with very few exceptions (only two in Britain), live in salt water.

Well-marked characteristics lead to the natural division of this group into three classes,—*Echinodermata*, *Actinozoa*, and *Hydrozoa*; and each class demands special treatment, on account of the differences of texture which they severally present.

ECHINODERMATA.

This, the highest class of radiate animals, includes what are familiarly known as sea-urchins, star-fishes, and sea-cucumbers.

They are all best obtained by dredging, though many star-fishes may be seen at low-water creeping over the rocks and sea-weeds, or lying outstretched in little pools left by the retiring tide. Sea-urchins, or Echini, are also to be met with on the shore, and even occasionally a sea-cucumber.

Echini and star-fishes may be preserved dry. With the former it is necessary to cut a slit in the membrane which surrounds the dental apparatus (where such exists), on the lower part of the sphere, and thence remove the viscera. In drying it is well to suspend in a place where

there is a thorough draught of air. Some collectors, with a view to keeping the spines erect, fasten a hook in the soft skin at the mouth, and, without removing the viscera, hang the Echinus to dry, either exposed to the heat of the sun or to artificial heat.

The larger star-fishes (*Solaster*, *Uraster*, &c.), may be either plunged in hot water, and laid out to dry, or may be first cleaned in the following manner:—A hooked wire is passed in at the mouth, on the under surface, and into each limb, from which so much as possible of the soft matter is removed; the mouth is then held close to a water-pipe, and the force of water carries out what cannot be extracted with the wire. A little of the corrosive sublimate solution (B.) may be poured in at the mouth with advantage.

Slender-armed star-fishes (*Ophiocoma*, *Ophiura*, &c.), merely require to be steeped for a short time, say twenty-four hours, in spirit, and laid in a situation where they will dry rapidly. The same treatment will answer equally well for the Medusa-head star-fish. These forms are all extremely brittle, but with tolerable care need not be injured either in capturing or preparing. The beautiful Comatula is equally tender, and certainly more difficult to preserve well. Like all other marine animals, it is better preserved in fluid than dry. To those who wish to dry it, the following plan, pursued by a lady with great success during several seasons at Lamash, will be acceptable. The great merit of the plan is its simplicity:—The Comatula, so soon as possible after its capture, is placed in a shallow basin of fresh water, and, when flaccid, floated out on a piece of strong white paper, in the same manner as a sea-weed. Any pinnules that may appear to be distorted are moved into a proper position by means of a camel's hair brush, and the paper with the Comatula spread on it, immediately subjected to pressure between absorbing paper.

Sea-cucumbers (*Holothuroida*) being destitute of the dense bony plates which cover the other orders of Echinoderms, cannot be successfully dried. The

chief thing to be attended to in putting up as wet preparations is to let them die in sea-water, so as to preserve their branched tentacles in an extended condition.

ACTINOZOA.

The members of this class, though agreeing in anatomical details, vary much in external appearance. It includes the precious coral, the island building corals, the Actiniæ or sea-anemones of our shores, sea-fans, the Alcyonium, or dead men's fingers, Neptune's cup, the phosphorescent sea-pens, and other equally varied forms.

With the exception of Actinia, and one or two allied genera, they are all compound animals, consisting of a large number of zooids, or individuals aggregated together.

Actiniæ may be procured among rocks on the sea-shore during low-water. The Alcyonium is sometimes cast on shore, as also the Pennatula (sea-pen). In gathering the other Actinozoa, the dredge is the only efficient assistant.

Only one species of true coral (*Caryophyllia Smithii*) is a native of the British seas, though some other forms, as the sea-fan, have occasionally been procured.

Corals, if wanted to be preserved dry, merely require to have the animal washed out with fresh water, and the calcareous skeleton dried. Specimens in fluid are great desiderata, and should be sent home whenever opportunity permits.

Sea-pens, Alcyoniums, and other allied animals, must be put up as wet preparations. This remark also applies to Actiniæ, though the means usually adopted, —*i.e.*, spirit or saline solutions,—so destroy the colour and appearance of the specimens, that it is hardly possible to distinguish one species from another when preserved. The writer, as the result of his own experiments,*

* It is necessary to state that these experiments, commenced in July 1856, are not yet completed; but, as the results already obtained

proposes the following method of preserving something of the natural form and colour of these animals:—The Actinia is allowed to remain in sea-water until nearly dead. While the tentacles are completely distended with sea-water, the animal is gently lifted into a smaller vessel, and the end of a glass tube of suitable size, and previously filled with glycerine, is pushed in at the mouth, and the contents forced into the body by blowing. The tube is again and again filled and applied, until the fluid which exudes at the points of the tentacles has lost its saline taste: the surrounding fluid is then removed, and replaced with glycerine. Large specimens will require to have the glycerine again changed before fastening up the preparation, which may be done in a month.

HYDROZOA.

The lowest class of Radiata contains the Polyps and Jelly-fishes.

The Polyps may all, with the exception of the Hydra, be easily preserved. In general form they very much resemble the Polyzoa (page 49), as also in their habits, with this exception, that only two genera are found in fresh water. They are preserved in exactly the same manner as Polyzoa, with which they are often confounded.*

Jelly-fishes (*Acalepha*) are variable in form; but the most conspicuous kinds in this country resemble a flattened hemisphere, and are familiarly known as sea-blubbers or sea-nettles, the latter name being conferred on them from the stinging properties which some of them possess. The term Medusæ is also applied to them. The more minute species occur plentifully in sheltered places, and have either the form of the larger kinds, or are spherical or cylindrical.

The larger species are frequently cast on shore, or seem satisfactory, it is thought judicious to publish them so far as they go.

* It is worthy of remark, as showing the difficulty of deciding many zoological questions, that even Professor Owen retains together the Polyzoa or Bryozoa and Polypi under one class—Zoophyta.

may be caught with a sieve held over the edge of a small boat. The smaller kinds are caught in a towing-net. Being extremely fragile, they all require to be handled with the greatest care.

Medusæ are preserved with difficulty. Spirit, diluted vinegar, and other preparations have been tried, but with very little success; until Mr Goadby proposed a modification of his solution (F. 3), which certainly surpasses anything previously in use, although it is open to the same objections as all other saline solutions. Where these objections are not deemed important, the collector cannot do better than use his method.

After a series of experiments conducted last year, the writer obtained a solution which he thinks possesses fully all the advantages of Mr Goadby's, without any of its disadvantages. (See G.) The largest specimens may be preserved in it.

Small Medusæ (*Beroë*, *Thaumantia*, &c.), can be very well preserved in glycerine in tubes.

Before being put into the solution, they may be set aside for a short time to drain. To insure the thorough preservation of fleshy Medusæ, they should be injected with the solution at the oral and ovarian orifices.

Vellela and Physalia may be preserved in solution G, or in weak spirit.

Sub-Kingdom PROTOZOA.

The members of this group, though extensive numerically, are very partially represented in all collections, on account of their minute size. They are the lowest of all animals in organization; hence the least capable of preservation. Sponges and infusorial animalcules, the latter of which were by Ehrenberg erroneously termed polygastric animals, are the most characteristic of the group.

Sponges are readily procurable, during low tides, under the projecting ledges of rocks. They are also

abundantly yielded by the dredge in most places. One genus (*Clione*) attacks the shells of oysters and other bivalves, in which it pierces numerous minute holes. In rivers and canals the fresh-water sponge (*Spongilla fluviatilis*) may be found by examining piers, and more especially such as are of wood-work, under water.

In order to preserve sponges dry, it is only necessary to wash them well in fresh water, and dry them thoroughly. Many of them are very brittle, however, and require delicate handling. They are occasionally pressed between paper, in the same manner as botanical specimens.

Infusoria can only be employed as microscopical specimens, if we except, perhaps, one genus (*Ophrydium*), a globular, jelly-like mass, of a greenish colour, growing attached to the stems of plants in ponds. Even this never looks well in spirit, and it is doubtful whether it repays the trouble spent on it.

DREDGING, AND COLLECTING MARINE ANIMALS.

The apparatus necessary for a successful dredging excursion are, a good dredge, of a size suited to the boat and capabilities of the rowers,* a dredging-basket fitted with glass jars of various sizes, sieves, a tub, a bucket, a dredging-board, some thin tinfoil, a quantity of preserving fluid, and a pocket lens. To these may be added, where practicable, a trawl-net, and in all cases a towing-net, for floating animals of small size, and a grapnel, to secure masses of *Laminaria*.

Dredges are simply iron frames so constructed that they shall scrape the bed of the sea, with a net or bag attached, in which the specimens are retained. Any form, then, which will secure this end may be adopted, though the judicious collector will do well to profit by

* Convenient size of boat for a two-feet dredge is about 20 feet long, by 5 feet in breadth of beam.

the experience of those who have travelled the field before him; and if he does not fully approve of the forms of dredge now in use, he should at least make them the groundwork of his own improvements. To the late lamented Dr Ball of Dublin is due, more than to any other naturalist, the thanks of all dredgers for the many improvements on that useful instrument which not inappropriately bears his name.

The dredge about to be described contains all the latest improvements made by Dr Ball, and may be fairly termed the best dredge now in use (fig. 7). It consists of two plates of iron

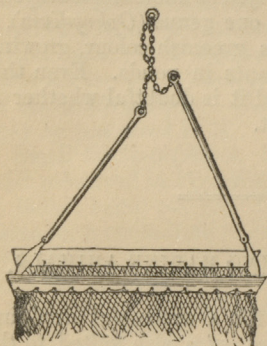


Fig. 7.

placed at a slightly outward angle, and connected at their lower edge by transverse rods. On each of these rods is placed a triangular plate, which moves outwards and inwards like a hinge. To the upper angle of each plate is jointed a rod of iron, so as to move at right angles with the movement of the plate itself. Each rod has at its upper extremity a chain, and these are united by a strong ring, which is itself succeeded by a broad

pulley-like ring for the reception of the rope. The upper edges of the scraper-plates are made considerably thinner than the under edges, and in the latter are drilled a number of holes to permit of the bag being attached. The object sought by adding the chain to the rods, as well as the extra number of joints, is to afford greater freedom of action.

The size of the dredge will depend on the ground to be worked, the dimensions of the boat, and the propelling force. For a common row-boat, with two men or lads pulling at the oars, it will be as follows:—Scrapers, two feet by two inches, five and-a-half inches apart at

connecting rods, and six and a-half inches apart at scraping edges; arms, including triangular plate, one foot two inches, with nine inches of chain to each. Larger sizes may be employed where circumstances warrant; and, in the case of dredging in shallow water in a very small boat, or in ponds and canals, a miniature dredge, capable of being stowed away in a small carpet-bag, will be found useful.

The dredge above described is not yet generally known, but is likely soon to supersede that now in use, and commonly styled "Ball's Dredge." This resembles the former, except in the arms, which each consists of two rods united into one at the upper extremity, and made to hinge directly on the connecting cross-rods of the frame, without the intervention of a triangular plate. These rods are either united at the top by means of a bolt passing through them, and at the same time through the ends of an overlapping horse-shoe-like ring for the rope; or they are each provided with a swivel-ring.

Oyster dredges may be employed where better are not to be had; but the meshes are too wide for the retention of a great many valuable specimens, and the unwieldy nature of the framework renders it an unpleasant instrument in the hands of any other than professed fishermen.

Bags for dredges should seldom, except in very small sizes, exceed in depth one half the length of the scrapers. They may be nets made of good strong string, with the meshes as small as it is possible to work them; or, in some instances, of canvas, with a window of wire-gauze in each side for the egress of the water. So far as the writer's own experience goes, the nets are far preferable to the canvas bags, except for the collection of Diatomaceæ and other very minute objects. Thick copper wire, or thongs of undressed hides, should be employed in lacing the bags on the frames. Bag-nets of undressed hide are used with advantage on very stony ground, on account of their tenacity.

The strength of the rope will depend on circumstances.

It is better to err on the safe side, so as to prevent the mortification of leaving the dredge fast at the bottom of the water. In length the rope should be at least double the depth of the water, to allow the dredge to scrape properly; besides which a quantity of *slack* should be at command, to be let out on event of fouling.

Trawl-nets, such as are used by fishermen, may be advantageously employed where the bottom is either clay or sand. They are of a larger size than dredges, and differ from them chiefly in simply passing *over* the surface of the ground, instead of sinking into it. The framework, which is proportionably stronger than that of a dredge, is partly of wood and partly of iron. Of the latter material are two side frames, somewhat triangular in shape, united at the upper angles by a long beam of wood, and having attached to the posterior inferior angles a strong chain. The beam is about eight inches square, by forty or more feet in length; and the iron frames are from two to three feet across. To the general frame is attached a net thirty yards in depth, bearing inside of it another funnel-shaped net, like that represented in the towing-net (fig. 8). Fishes, Crustaceæ, Mollusca, and Radiata, are taken in abundance by means of this net. "They are used (at Scarbro') by boats of thirty-five to sixty tons, by crews of from four to six men, and two to three boys."* The collector may easily extemporize a trawl-net with such materials as he has at hand, provided he can secure sufficient weight to sink it. The size may vary according to circumstances.

Towing-nets are invaluable in the pursuit of minute floating Crustacea, Mollusca, and Medusæ. The simplest form is a bag, which may be made of *bunting*, the material used for flags; of thin canvas, technically called *scrim*; or indeed any fabric which combines a moderate degree of strength with closeness of texture and ready

* See Supplement to Woodward's Shells, page 426.

porosity. The bag may be sewn round a hoop, say a foot in diameter; or it may have a stick fastened across the mouth, and a few leaden weights attached to one side, and pieces of cork to the other.

A more perfect and satisfactory instrument, the invention of the late Dr Ball, is that represented in fig. 8. There are two nets attached to the ring, one of which opens as a funnel, about half-way down the inside of the other, to prevent the escape of objects after they have once got in. A glass jar, with a strong bead-rim (a cupping-glass answers very well), is fastened about half-way through a thick bung by means of string, and the open end of the outer bag is passed over the rim, and temporarily retained, either by a cord or a strong India-rubber band. For greater security a string passes from the cork to the ring at the mouth of the net. Either three or four strings are placed at equal distances on the hoop, and united by a common knot to the line. The advantage of the glass vessel is, that the collector can tell at once what has been captured, and can remove the specimens without the slightest injury, by undoing the string or taking off the elastic band. A wide-mouthed bottle will be found to be a capital substitute for the cupping-glass.

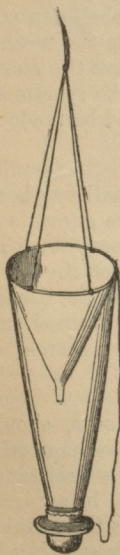


Fig. 8.

A *Dredging-basket* ought to contain a number of glass jars,—one of which, for the reception of the contents of the towing-net, should be at least six inches in diameter by a foot in depth,—so fitted that they may be easily removed with the hand, but not liable to break from shaking. A quantity of glass bottles, with wide mouths and corks, and a few tubes, also fitted with corks, will be found useful. Should the collector desire to preserve fishes, or the larger Crustacea and Mollusca, it will

be advisable to add to the above a few wide-mouthed earthenware jars, of sizes varying from three inches to nine inches in diameter. These should be well fitted with bungs.

Sieves are used for washing the contents of the dredge, and one of them should be so fine that no shell can possibly pass through it. The other may have the meshes half an inch wide. It is convenient to have the sieves attached, the finer being under to retain the specimens that pass through the other. They should be made of copper.

A Dredging-board is very useful in a small row-boat. It is made so as to lie right across from one gunwale of the boat to the other, and has a ledge of wood, about an inch high, along each side, to keep the water off the knees and feet of the searchers. The contents of the dredge are emptied on this board, and when examined, are either transferred to the sieves for further search, or simply swept overboard.

Dredging, if performed in the British seas, should always be done with the assistance of a fisherman who knows the nature of the ground. If this assistance cannot be commanded, a good chart should be secured. The most prolific ground is that known as the Laminarian Zone, from the quantity of *Laminaria* growing in part of it. It extends from the low-water mark to a depth of about fifteen fathoms, and includes the oyster-banks in Europe, and the pearl-fisheries of Asia.

Having everything in readiness, and the boat in good easy motion, the rope is coiled in the bottom of the boat so that it may be let out without knotting, and the end attached to the ring of the dredge by being passed *twice* through it and then tied. The dredge is then put over the stern of the boat, and the rope run out until the strain on it tells that the scraper is biting on the ground. A sudden strain will indicate that the dredge has caught on some ledge of rock, when the *slack* must be let out,

and the boat stopped as soon as possible, and made to pass back over the dredge, until freed. In hauling in the dredge, precaution must be taken to coil the rope as before. The contents being placed on a board or in the tub, the dredge is returned again to the water for a further supply. The bucket, as well as a number of the glass jars, should be full of water for the reception of the animals captured. Many creatures can never be seen to perfection save in the dredging-boat; and the naturalist who wishes to enjoy this treat will supply himself abundantly with glass jars, as the best means to that end. The branching Zoophytes, many Molluscous animals, Crustaceans, and even fishes, display themselves with great beauty, and some of them even with a certain amount of grotesqueness, when newly taken out of their ocean homes.

The towing-net is kept constantly out, its contents from time to time being examined and secured. This is easily enough managed with the improved form, as it is only necessary to detach the cup, and pour its treasured contents into a larger glass jar; but with the bag-shaped nets it requires more care. In this latter case, provided a jar sufficiently large is at hand, it will be found most expedient simply to turn the net inside out, and shake it gently up and down for a time in the jar filled with sea-water. The Medusæ will readily forsake the bunting bag for their own free element, and swim away, sparkling in the sunbeams like little meteors. If any one group of natural objects more than another excites the admiration of the onlooker, and makes him even question at times the evidence of his own vision, it is these tiny little morsels of animality, contracting and expanding, glistening with rainbow hues, and then mysteriously vanishing from sight: things apparently so impalpable that their existence as living organized beings might almost be questioned; so slightly formed, that the pressure of a feather might annihilate them; yet living and certainly enjoying life in that same element which destroys fleets, and with its resistless force sets at nought alike the barriers raised by man and those

of Nature's forming. While in the Laminarian Zone the grapnel should be used, and the masses of sea-weed hauled up examined for small Mollusca, Crustacea, Sponges, &c.

Storing Specimens.—From time to time such of the captures as are wanted for preservation in fluid are laid aside and allowed to drain. Fishes, unless when very small, have a slit cut in the abdomen to allow the fluid to enter, and are wrapt separately in pieces of thin canvas (serim). Crabs are also wrapt in canvas. In packing the store-jars, it is of importance to keep the smaller specimens by themselves, to prevent breakage. A little cotton, wool, or fine tow, may be placed as an additional security between each layer. Labels, being little slips of thin block-tin with numbers punched or scratched on them, may be tied to specimens, and any particulars as to locality, depth in water, scarcity or abundance, and nature of the ground,—whether rocky, sandy, or muddy,—stated in a log kept for the purpose. When large univalve Mollusca are preserved in fluid, a small hole should be made in one of the whorls,—not at the point, as sometimes recommended,—to allow the spirit to enter. The smaller Crustacea and other shells may be wrapt loosely in thin tinfoil before being placed in the fluid.

The jars should be tightly corked, but must not be yet finally sealed up for transmission, as the fluid will require to be renewed, or at least strengthened, in about a week's time, to make up for the dilution caused by the water passing out of the animals. After this has been accomplished, they may be luted with Péron's composition (H.) Sealing-wax may be employed where the preservative is either glycerine or a saline solution, but should never be used where spirit is employed, on account of its solubility in that fluid.

The small Medusæ from the towing-net should be put separately in tubes of suitable size, and preserved either in glycerine or the creosote solution (G.) While yet floating in the large glass jar, the tube is inverted over the Medusa like a diving-bell, and suddenly reversed,

when it will be found that the animal is captured. The water is then carefully poured out of the tube, retaining the animal in the bottom of it. After standing a short time in this state, the preservative is added. Glycerine, although it has a tendency to render most bodies *too* transparent, answers very well for these diminutive creatures.

WET PREPARATIONS.

Where time, space, and, what is still more important, money, can be spared, a large portion of Invertebrate animals, and many of the Vertebrata as well, should be put up as wet preparations. Thousands of interesting specimens can neither be stuffed nor dried, and of those that can, not a few are more valuable wet than dry. The young of Mammals, as well as all the rarer species of moderate size,—the young of Birds, Fishes, Reptiles, and Amphibians; Crustacea, Arachnida, Myriapoda; many Insects, Molluscoïda, Echinoderms, and Polyps, are all more valuable in fluid than dry; while the Vermes, naked Mollusca, and Medusæ cannot be otherwise preserved than as wet preparations.

In the chapter on Dredging will be found instructions for placing the various specimens in fluid, with a view to immediate preservation.

FLUIDS.

It is quite obvious that the first desideratum is a good antiseptic solution,—*i.e.*, one which shall perfectly preserve the natural form and texture of the specimen. Could a liquid be obtained which, in addition to this, would preserve the colour as well, and at the same time be free from the objection of rapid evaporation or crystallization, it would be hailed as the greatest boon to

zoological science. Unfortunately, no such fluid has yet been obtained, nor is it at all likely ever to be.

The antiseptic fluids most successfully employed are saline solutions, turpentine, glycerine, and spirit of various degrees of strength, and in combination with other substances.

Saline solutions, of which the brine used in curing meat may be taken as the type, have long been in use. They consist of common salt, with various combinations of alum, nitre, cream of tartar, &c., with water. To Mr Goadby is due the credit of perfecting these solutions; and he has given three receipts for their preparation (F. 1, 2, and 3), the last being intended especially for *Medusæ*.

While thankfully acknowledging the service rendered to collectors by Mr Goadby's solutions, the writer cannot recommend their use in fitting up specimens for a public or a private collection, unless in the absence of proper supplies of strong and colourless spirit, on account of their extreme liability to crystallize on any portion of the specimen not quite covered, as well as on the lip and sides of the jar.

Turpentine has frequently been recommended for preserving wet specimens. The chief objection to its use is its non-solubility in water. The specimen, in order to be put up in it, requires to be first thoroughly dried; an operation impossible in many cases, and injurious in all.

Glycerine has of late obtained a large amount of attention as a preservative; but, unfortunately, its high price, combined with the difficulty of obtaining it pure, have hitherto prevented its extensive use by zoologists. Although glycerine communicates a somewhat unnatural degree of transparency to specimens preserved in it, and renders them, in the majority of cases, unfit for subsequent dissection, yet, when judiciously employed, its value as an antiseptic solution is very great, seeing

that by means of it alone can the colours of many animals be at all preserved. Fishes, Crustaceans, Starfishes, Sea-Anemones, and the smaller Medusæ, may be successfully preserved in this fluid. The larger Medusæ and worms have not as yet been found to succeed. As a general rule, the glycerine should not be diluted, and in any case not more than a fourth of its bulk of water should be added. A small piece of corrosive sublimate will prevent moulding.

Spirit is, after all, the best medium known for the preservation of wet preparations, whether zoological or anatomical. Its usually high price has been urged as an objection, but now that the Government liberally permits the use of methylated spirit for scientific purposes free of duty, all hindrance to its extensive use is removed.

The spirit in which specimens are finally put up should be perfectly transparent, and free from the slightest tint. To secure this, it should be kept, not in a cask, but in a glass carboy, and well corked up.

As a general rule, proof spirit will be found quite strong enough for the preservation of any zoological specimen; while many, as Zoophytes, do not require a greater strength than 20 under proof. In the absence of a hydrometer, the 60 over-proof spirit may be reduced to proof by adding three parts by measure of water to five of spirit; and to 20 under-proof, by mixing equal quantities of water and spirit.

If possible, distilled water should be employed, and in all cases the mixture must stand some hours before using, to allow the heat to escape.

For the preservation of the larger Medusæ, as also other gelatinous-like animals, the writer knows no fluid equal to that obtained by him in the summer of 1857 (G). The proper quantity of creosote is dissolved separately in a little spirit, and then added. If properly managed, the fluid will generally be just sufficiently dense to float the Medusæ near its surface.

GLASS JARS.

These may be made of any form, to suit the accommodation for them in the museum, or the fancy of the collector, always provided that the necks are of sufficient width to admit the specimens. Many valuable collections of small subjects, intended more for use than ornament, are merely put into wide-mouthed stoppered phials. When intended, however, for a museum, specimens require other treatment, and the selection of proper jars is a matter of some importance. One thing must in all cases be attended to,—*i.e.*, the clearness and freeness from flaw of the glass.

Oval jars were formerly much in use, on account of their economizing the spirit, but they are now seldom employed, owing to their great liability to break. The best form of jar is certainly the cylindrical, with a slightly projecting base, to insure stability, and a rim to secure the cover. This rim may be either a mere thin turned-over fold of the upper edge of the jar, as in phials used by apothecaries, or a solid bead brought round it; or, still better, it may be formed by forcing out the upper edge into the form of a shallow cup, about half an inch wider than the cylinder (in section fig. 9). The latter form is undoubtedly the best, as it affords a rest for a piece of whalebone from which to suspend the specimen.

Very beautiful wide-mouthed jars, with glass stoppers ground to them, are sometimes used, but they are expensive. They have the recommendation, however, that at any time the specimen can be removed for examination, and replaced without trouble.

A jar invented by Mr P. Stevenson, Lothian Street, Edinburgh (the upper part of which is represented in section in fig. 10), although, like the above, more expensive than the common form, deserves notice. It is a cylinder without any lip, but with two small notches placed opposite each other to receive the ends of a piece of whalebone. The mouth of the jar is ground smooth,

and fitted with a circular plate of glass, held in position by a metallic rim. The mouth of the jar, for further security, is anointed with a mixture of lard and white wax before the glass cover is put on. These jars, when made very shallow in proportion to their width, answer admirably for the larger Medusæ, as their glass covers permit of the specimen being seen from above.

In ordering glass jars it is well to fix a gradation of sizes. Twelve, nine, six, and three inches in height, by one and a-half, two, and three inches, or more, if required, will be found the most generally useful.

Glass tubes of various sizes are useful for serpents, worms, and some zoophites. They can be readily closed at the bottom, and may be fitted at the mouth like other jars, or brought together by means of the blow-pipe. In the latter case the tube must be longer than ultimately required for the size of the specimen. The snake being inserted in the dry tube, the portion to be closed is subjected to the flame of the blowpipe, and, when sufficiently softened, is drawn out to a point. When cold this point is broken off, so as to leave a small hole for the entrance of the spirit. The tube, slightly heated so as to expand the air, is placed, opening downwards, in a vessel containing spirit until cold. The tube is again heated slightly in the hand, to cause the vapour of the spirit to fill it and expel the air; it is then again inverted in a vessel of spirit, and this is repeated until there is sufficient fluid in the tube to cover the specimen. It is then only necessary to dry and apply the thin point to the blowpipe, and twist it round to close the opening.

MANIPULATION.

The preparation being well soaked, so as to remove any colour likely to affect the fluid, the next thing, after selecting the proper solution and jars, is to put up the specimen.

As a general rule, it is judicious to wait until subjects

for several jars are ready before commencing to put them up.

Each jar should contain but *one* species only.

To Display Specimens in Jars.—In all cases the specimen chosen for display should be as perfect in all its parts, and as free from distortion, as possible. If of such a weight and consistency that it will support itself in a proper attitude, it is merely required to slip the animal into the jar previously filled to the required height with the solution. This will be found to be the case with Sponges, Zoophytes, most Star-fishes, many Molluscs, and some of the larger Crustaceans.

By far the greater number of animals require support, and this may be supplied in several ways.

Specimens may be simply suspended by threads from pieces of whalebone, in such jars as afford a resting-place for them (figs. 9 and 10). The thread used is

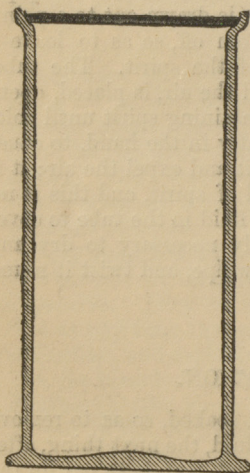


Fig. 9.

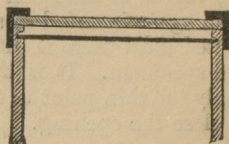


Fig. 10.

that known as "Barber's Twist," and should be of the

very thinnest kind. Where this is not to be obtained, very fine white sewing silk may be substituted.

Round and thin-edged jars are not suitable for suspending specimens in, as the thread carries over the fluid, and causes loss by evaporation. In these jars the specimens require to be displayed on tablets, and these may be used of three kinds,—*i.e.*, glass, mica, or bees' wax, coloured or white. The tablets should fit as nearly as possible the width and height of the jar.

When glass is used, the specimen is secured to it by simply tying both round with the strong twist.

Mica is better, as it is easily punctured, and the threads may be passed through the holes by means of a needle. In putting up thin intestinal worms, it will be sufficient to make two holes in a perpendicular line, and pass the specimen with care through each successively.

Waxen tablets are useful where parts dissected out are to be displayed, as they can be easily fixed in the required position by means of strong bristles, or small splinters of quill. Pins are sometimes used, but they are apt to corrode.

The chief objection to the use of wax is, that it only permits of one side being seen.

To Secure Preparation Jars.—The method of enclosing preparation jars most generally in use, and, all things considered, probably the best where expense is a consideration, is the following:—

A circular piece of block tin, rather wider than the mouth of the jar, is cut, and being laid on the rim, a hard substance, such as a knife handle, is rubbed round it, until the overlapping edges fit like a cap over the rim. This is then laid aside until wanted. Some ox bladder, steeped till *nearly* putrid,* is then stretched firmly over the mouth of the jar, and a thin but strong cord tightly wound round several times under the lip and tied.

* This will require about four days in summer, and two to three weeks in winter.

Before the bladder dries, the tin plate is applied over it, and over that again another layer of bladder, which is treated like the first. The surplus bladder is now cut off close to the string, and the preparation set aside until the covering is dry, when it should receive several—at least five—coats of paint. Some manipulators tie on the last layer of bladder by means of coarse string, which they remove before proceeding to paint. Common oil paint answers as well as, if not better, than coloured varnishes, since the spirit does not act on it. The last coating, however, should be what is technically called “flattening,” *i.e.*, paint thinned with turpentine instead of oil.

A very neat way of closing jars is by grinding the rim* smooth, and fitting to it a circular piece of glass. The glass is luted to the lip, and over all is tied a piece of bladder as above. When dry, the bladder is cut from the plate of glass, leaving only so much as will cover the lip. The bladder which is left may be painted, and then has the appearance of a clasp-rim. The luting first employed was simply a solution of gum arabic. Common glue, marine glue, or a lute proposed by M. Péron for another purpose, and by him termed *lithocolle* (H.), will be found to answer even better than gum.

CABINETS, CATALOGUES, AND LABELS.

The amateur living at home should endeavour by all means to have his collections systematically arranged, and for this purpose, it is of the first importance that his cabinets should be properly planned. While much will depend on the space which can be rendered available for museum purposes, as also on the condition of the naturalist's pecuniary means, there are certain lead-

* This can only be done with thin-lipped and beaded jars.

ing principles which can always be more or less attended to. Even the traveller abroad might, with advantage, imitate, so far as in his power, the conditions required in a home cabinet.

Cabinets may be of two kinds,—*i.e.*, frames with sliding drawers, or simply boxes into which are fitted a series of wooden trays for the reception of the specimens. The former, though more expensive, is without doubt the better form, as it admits of access being had to any drawer without disturbing the others. The drawers may be made of well-dried deal, though wainscot is superior, from its lesser tendency to warp. The sizes of the cabinets will of course vary with the space at disposal. It may be remarked, however, that, for British birds, the drawers or trays need in no instance exceed two and a-half feet in length by two in width and six inches in depth. In laying birds in the drawers, they should be placed, in a single tier, on their backs, with their feet towards the observer, so that they can be readily observed without the necessity of handling. A layer of cotton-wad may be placed with advantage in the bottom of the drawer. For the protection of the specimens from mildew and mites, the cabinets should be kept in a dry place, and each drawer should have placed in the corner of it a small vessel, containing either turpentine or naphtha; the latter is better than the former, because, if it should be upset on the specimens, it completely evaporates without leaving any mark,—but its smell is by no means pleasant.

Drawers for British Eggs or Shells need not be more than three inches deep inside. For some of the Crustaceans deeper drawers will be necessary.

Cabinets for Insects may be made with sliding drawers two and a-half inches deep, and lined at the bottom with a layer of cork. A very neat plan is, to procure from dealers, book-shaped boxes, made in the same form as portable draught-boards. The collection may thus occupy a place on the book-shelves. Store boxes may be made to contain permanently the collection, and these

can be got up by any joiner. They are made thus: Two trays, say one foot square by two and a-half inches deep, are joined at one side with an iron hinge or a piece of leather tacked across the length, in such a way that either tray will represent the lid of the other. For further security the trays may be rabbeted. Each tray is fitted with a layer of cork, about a quarter to three-eighths of an inch in thickness. On the cork is to be pasted a sheet of white cartridge paper, which covers the blemishes, and affords a good background for the insects.

The plan generally adopted in arranging insects permanently in a cabinet is to place them in perpendicular columns, beginning at the left upper corner of the drawer or box. These columns should be marked off with lines in red or black ink, and must be regulated in width by the average size of the insects. If possible, spaces should be left for such species as are not yet in the collection, so that additions may be subsequently made without, on the one hand, destroying the serial order of the specimens, or on the other, necessitating the constant readjustment of the whole.

In labelling insects, the name of the genus or subgenus should precede the species belonging to it. In each drawer a small muslin bag filled with camphor should be fastened in some convenient position by means of a pin.

In sending insects home from abroad, store-boxes should be used in preference to either books or cabinets with drawers. Having taken precaution to make the specimens, as well as the boxes themselves, thoroughly dry, a supply of camphor bags is to be provided, and the junction of the two halves of the box rendered air and dust-tight by pasting a broad slip of strong calico round it.

In arranging Eggs, Crustacea, and Shells, in cabinets, provision must be made to keep the specimens from mixing. This may be done in two ways, either by using small card-board trays, or by mounting the specimens on tablets of various kinds.

Tablets may be made of various materials, *i.e.*, thick cardboard, thin wood (as that used in making cigar

boxes), or glass. When wood or cardboard is employed, it ought to be covered either with white or coloured paper, according to the fancy of the manipulator. Should coloured paper be preferred, it will be well to select a material which is *surface-coloured* and not dyed through, on account of the liability of the latter to fade. The glass tablets may be either ground on the edges, or, what is still better, bound with stripes of bookbinders' cloth or paper. A mixture of stiff flour paste with glue is the best substance for fastening the binding to the glass.

The tablets, of whatever material, should be cut to sizes varying in regular order according to the dimensions of the specimens. For British shells the tablets may be cut as follows:—Three and a-half inches diameter, by two, four, six, eight, and ten inches. The Pinna alone will require a larger tablet, which may be seven inches by ten. By following this rule the tablets will fit accurately into the drawer intended for their reception, without leaving irregular vacancies. For crustaceans and echinoderms another series will be required, the diameters of which will be eight inches, by four, six, or eight, liable, however, to be reduced exactly one-half for the accommodation of the smaller species.

In fastening specimens on the tablets, glue, a mixture of glue and paste, marine glue, liquid glue, or Péron's luting (**H.**), may be used. Minute or very delicate specimens should not be fastened directly on the tablets, but may be protected in various ways. Minute shells may be placed in a tube, either loose or on a slip of thin card-board, fastened to the cork by means of a slit in the latter, and a little luting. The tubes may be fixed with threads on the tablets in such a way as to be removable at pleasure.

The writer makes use of round glass-topped boxes for the protection of delicate Crustaceans. The bottom is first removed from the box, which is then fixed by means of marine glue to the glass tablet in such a way that the glass takes the place of the original bottom, and the box being thus rendered transparent on both sides, per-

mits of the examination of the inclosed specimen without injury. The lid being left in its original condition, can be removed when more minute examination is necessary.

In placing eggs on tablets, they should be fixed with the hole downwards.

Wet preparations require to be placed on shelves, in such a position that, while they have a sufficient supply of light, they are not exposed to the direct rays of the sun.

Catalogues are of such manifest value to all systematic collectors that their use need not be insisted on. They are of two sorts; *i.e.*, chronological—recording the additions from day to day made to the collection; and systematic. It may be safely left to the discretion of the collector whether or not to form a catalogue of the first kind, while the other must be looked upon as indispensable.

The plan followed by the writer in forming systematic catalogues, though in the first instance entailing a considerable amount of labour, is yet in the end so satisfactory that he confidently recommends its adoption. In the first instance, it is necessary to select a book which is to be taken as the authority for the classification of the group under study. Having done this, a complete catalogue of all the species described is written out on foolscap paper, the orders being written in a larger hand than the families, and these again larger than the genera. It should be so arranged that each page will contain from six to eight specific names, under each of which is left a clear space. As a species is obtained, the letter *a* is written under its name, and on the same line the locality from whence procured, and the date of its capture, when known. Should a second and third specimen of the same species be added to the collection, the letters *b* and *c* follow in the catalogue in the same way as the letter *a*, and the like particulars are stated. Each addition is thus catalogued in its systematic order, while the blanks under specific names indicate at a glance the extent of the desiderata. At page 80 is

printed the first page of a catalogue of British Echinodermata kept on this plan.

Labels.—Without exact records of the localities from whence specimens have been procured, it is not too much to say that they are all but worthless. Numbers referring to catalogues are sometimes affixed to specimens as a means of identification; but this plan should in most cases be avoided, as liable to lead to confusion. Labels should be affixed to all specimens, affording, as they do, a ready means of ascertaining what is known of their names and localities, without the trouble of turning up catalogues. The size of the label must be regulated by the bulk of the specimen, but need in no case exceed three inches by two. Printed or lithographed forms may be procured at a very trifling cost, and have always a neat appearance. The following form will be found to be very useful. It is represented as filled up with the name, &c., of the first specimen in the page of the printed form of catalogue, the small capitals indicating the words lithographed or printed on the label:—

FAMILY.—Comatulidæ.

GENUS.—Comatula, *Lam.*

SPECIES.—rosacea, *Link.*

The Rosy Feather-Star (*a*).

LOCALITY.—Lamlash Bay. 8, 1854.

The letter *a* serves to identify it with the specimen recorded in the catalogue, while the figures 8, 1854, show that it was collected in August of the year 1854. The first line may be left out, and the name of the family, if desired, placed before the species composing it.

Labels for insects require to be of a smaller size, and it is found convenient to have the titles of the family, genus, and species on separate slips, each being distin-

guished by the relative size of the letters. The slip bearing the specific name, however, should also have recorded on it the habitat and date.

RECIPES.

A. ARSENICAL SOAPS, &c.

1.—BECŒUR'S.

Camphor.....	5 oz.
White Arsenic, in powder.....	2 lbs.
White Soap.....	2 lbs.
Salts of Tartar.....	12 oz.
Powdered Chalk.....	4 oz.

The soap, cut in thin slices, is put in a vessel, with a little water, over a slow fire, and stirred till melted, when the chalk and salts of tartar are added. The pot is then removed from the fire, the arsenic added, and the whole thoroughly mixed and brought to the consistence of a thick paste. The camphor, being previously triturated in a mortar, with a little spirit of wine, is finally added, and the paste put into a jelly-pot and labelled.

2.—SWAINSON'S.

White Arsenic.....	1 oz.
White Soap.....	1 oz.
Carbonate of Potash.....	1 dr.
Distilled Water.....	6 drs.
Camphor.....	2 drs.

This composition is formed into cakes like ordinary soap.

3.—SIMON'S.

Scented Soap.....	1 $\frac{1}{4}$ lb.
Alum.....	8 oz.
Pearl Ash.....	4 oz.
Common Salt.....	4 oz.

SIMON'S—(continued).

Powdered Chalk.....	8 oz.
Powdered Camphor.....	2 oz.
Water.....	1½ lb.
Oil of Petroleum.....	2 oz.

The other ingredients being mixed, the oil of petroleum and camphor are last added.

4.—LAURENT'S.

Arsenate of Potash.....	2 drs.
Sulphate of Alumina.....	2 drs.
Powdered Camphor.....	2 drs.
White Soap.....	0½ oz.
Spirits of Wine.....	6 oz.
Essence of Thyme.....	3 drops.

The first two are to be placed in a bottle with the soap, and the spirit poured over them. When dissolved, the other ingredients are added. This composition requires to be carefully stoppered.

5.—BULLOCK'S ARSENICAL POWDER.

White Arsenic.....	1 lb.
Burnt Alum.....	1 lb.
Tanners' Bark.....	2 lbs.
Camphor.....	0½ lb.
Musk.....	0½ oz.

The three first are to be powdered, mixed, and passed through a sieve; after which the camphor and musk are to be added, and the whole thoroughly mixed.

B. CORROSIVE SUBLIMATE SOLUTION.

This is prepared by dissolving two drachms of corrosive sublimate in an ounce of spirit. It should be applied with a camel's hair brush.

C. GUM TRAGACANTH.

The gum is steeped in water until it swells into a firm paste. When required for use, it is to be heated

by placing the vessel among boiling water. A few drops of **B.** will keep it from moulding.

D. SHIELD'S "SUGAR" FOR MOTHS.

Ale	Half a pint (nearly).
Common Honey	Half lb.
Sugar	Quarter lb.
Rum	Half a wine glassful.
Essential Oil of Bitter Almonds	} Five Drops.

The ale is heated, and then the sugar and honey added, and, when cold, the rum and oil of almonds,—the latter being previously mixed together.

E. ANOTHER "SUGAR."

A thick syrup, made of brown sugar, with a small quantity of rum.

F. GOADBY'S SOLUTIONS.

1. Bay Salt..... 4 oz.
Alum..... 2 oz.
Corrosive Sublimate 2 grains.
Rain-Water 1 quart.
2. Bay Salt $\frac{1}{2}$ lb.
White Arsenic 20 grains.
Corrosive Sublimate 2 grains.
Boiling Rain-Water 1 quart.

3. For Medusæ a saturated solution of bay salt is reduced to the strength indicated by a *bead* marked 1148. To the quart of this is added two ounces of alum, and the whole diluted to half strength. The specimens are macerated in this for twenty-four hours, and, if small, are then transferred to the bay salt solution, of strength 1148. Larger specimens require to be steeped for two or three weeks before being placed in the full strength solution of bay salt. The aluminous fluid must be daily changed during the process of steeping.

G. FLUID FOR MEDUSÆ.

Methylated Spirit, reduced to 30 underproof... 1 quart.
 Creosote 40 drops.

H. PÉRON'S LUTING.

Common Resin.
 Red Ochre, finely pulverized.
 Yellow Wax.
 Oil of Turpentine.

The wax being melted in a vessel over the fire, the resin is next added, and then the ochre is gradually stirred in. Lastly, the turpentine is poured in, and the whole boiled for a short time.

In order to prevent the mixture taking fire, extreme caution must be used; and the vessel ought to be capable of containing at least three times the quantity made at a time. According as the ochre or other ingredients predominate, the substance will be brittle or elastic.

I. NICOLAS' GUM PASTE.*

Colocynth..... 1 oz.
 Gum Arabic, in powder..... 2 oz.
 Starch 3 oz.
 Cotton, finely cut..... 0½ oz.

The colocynth is cut into small fragments, and boiled in about a pint of water; the liquor is then strained, and the starch and gum added to it. The mixture is allowed to simmer on a slow fire for a short time. The cotton, being previously as finely reduced as possible by clipping with scissors, is added, and the whole well mixed.

A few drops of the corrosive sublimate solution will be an improvement.

The cement may be softened by placing it in boiling water.

* "Manuel du Naturaliste Préparateur," by M. Boitard. Paris, Roret, 1853

(SPECIMEN PAGE OF CATALOGUE IN PROGRESS.)

CLASS ECHINODERMATA.

Order I.—CRINOIDÆ.*Family 1.—COMATULIDÆ.**Comatula*, Lam.—*C. rosacea*, *Link.* Rosy Feather-Star.*a* Lamlash Bay. Dry. 8, 1854.*b* Do. In spirit. 1857.*c* Do. Stalked condition. In spirit. 1857.**Order II.—OPHIURIDÆ.***Family 2.—OPHIURÆ.**Ophiura*, Lam.—*O. texturata*, *Lam.* Common Sand-Star.*a* St Abb's Head. Dry. 1856.*O. albida*, *Forbes.* Lesser Sand-Star.*a* Lamlash Bay. Dry. 1856.*Ophiocoma*, Ag.—*O. neglecta*, *Johnston.* Gray Brittle-Star.*O. Ballii*, *Thomson.* Ball's Brittle-Star.*O. punctata*, *Forbes.* Dotted Brittle-Star.

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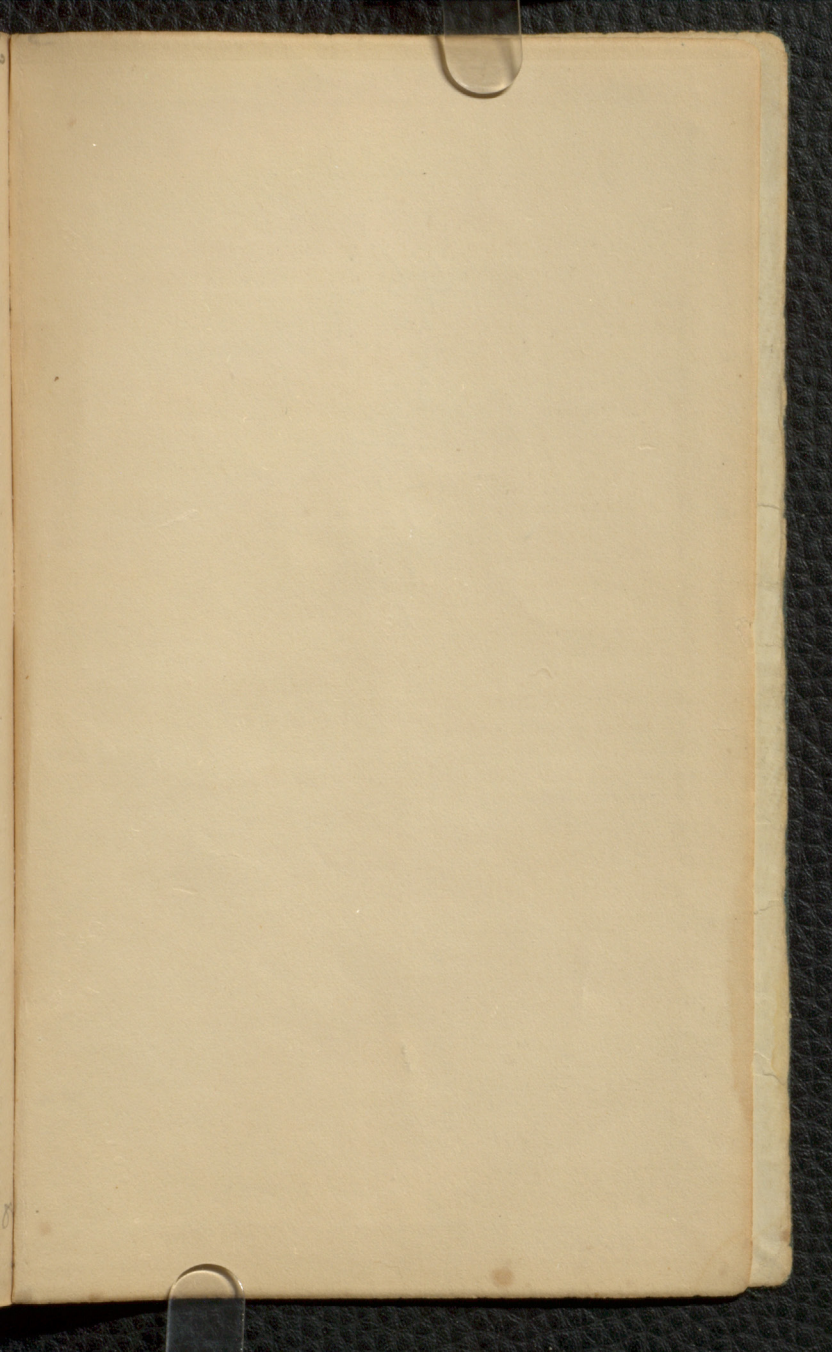
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